GRAPHOLINGUISTICS AND ITS APPLICATIONS

Graphol inguistics in the 21st Century—2022

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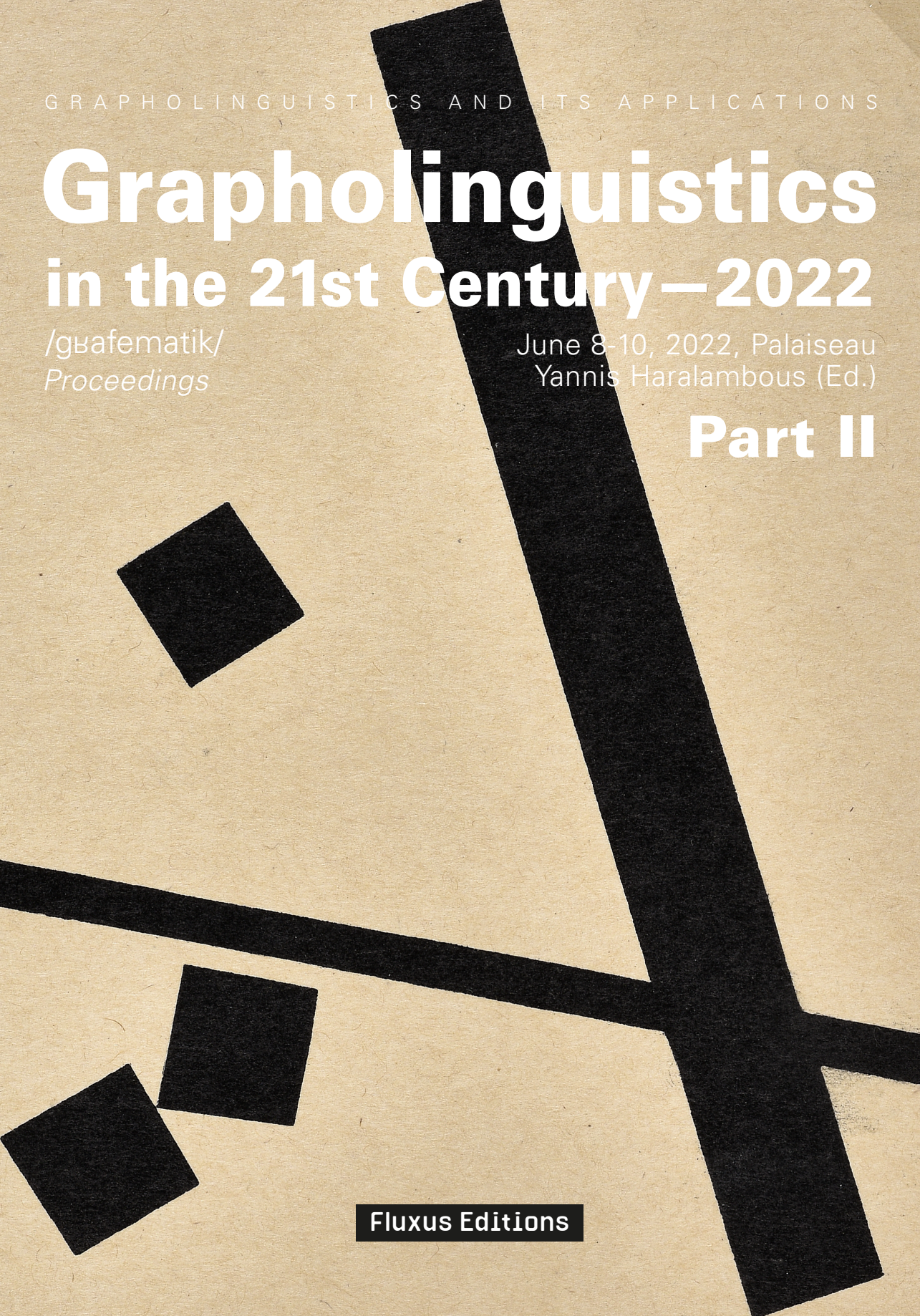
June 8-10, 2022, Palaiseau
Yannis Haralambous (Ed.)

Part II



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/gʁafematik/

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Introducing Multi-Gender Hebrew

Michal Shomer

Abstract. Multi-Gender Hebrew is a new set of Hebrew letters facilitating multi-gender reading and writing, to promote gender equality, created by designer Michal Shomer. These letters were first introduced to the public in 2019. In 2021, the creator released a full free version for download of the new letters including a digital keyboard allowing users to type them. The letters are added to the existing modern Hebrew alphabet to expand the gender categories of the Hebrew language, which, by default, has two grammatical genders: feminine or masculine. With the new letters, Hebrew speakers can express a gender-neutral and a multi-gender intention in the written language, and they are doing so: individuals as well as organizations are using the new letters in various ways, such as in signage, marketing and writing. Multi-Gender Hebrew receives a lot of reaction and recognition locally and globally, and has driven the debate about gender equality in the Israeli public.

1. Background

1.1. Sex & Gender

An *assigned sex*, or simply *sex*, is assigned to us at birth by the health care provider that treats us, who determines our sex based on biological or physiological factors, such as our genitals and body parts, our chromosomes, and our hormones. Most people would be assigned *female* or *male*, with a small percentage of the population being *intersex*. *Gender* is the range of characteristics, behavior, and social expectations that our society uses to distinguish women and men. Gender is a social concept and is pretty much what society attributes to our biology. It's important to note that our gender identity may not always be what is socially expected from us based on our assigned sex: a person's assigned sex may be female, but their gender identity might be man (i.e., *Transgender*). While sex is typically binarily divided to female and male, gender is binarily

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categorized into *woman* or *man*. *Non-binary gender identities* refer to gender identities that are outside of gender binaries, such as *Gender Fluid*, *Agender*, G*enderqueer*, and so on. The non-binary community usually considers itself a part of the LGBTQ+ community, when the *T* stands for *Transgender*, and the *Q* stands for *Queer*: these may represent non-binary and gender non-conforming people. (Webb et al. n.d.; Abrams and Ferguson 2024; Planned Parenthood Federation of America[1]; Wikipedia[2])

1.2. Gender in the Hebrew Language

Many languages have grammatical gender, for example, German, French, Spanish, and Arabic. One of these gendered languages is Hebrew; Hebrew is a highly grammatically gendered language (Almog 2002; Bershtling 2012; Muchnik 2012) with two grammatical genders: feminine and masculine. The following quote, by the famous Hebrew poet Yona Wallach, demonstrates this beautifully: in her poem titled "Hebrew", Wallach writes: "Hebrew is a sex maniac" (1985: 17). Hebrew speakers have to address the issue of gender when using the language; not only that almost all words in Hebrew are grammatically gendered—including most parts of speech like nouns, adjectives, verbs, pronouns, numerals, etc. (The Academy of the Hebrew Language 2021; Muchnik 2012)—but according to the "official" rules of the language as outlined by The Academy of the Hebrew Language (2010), as well as to what's being used by most speakers, the masculine form is considered the generic form, used to refer to an unknown individual or to include men, women, and (hopefully) non-binary people in the plural. This sets the focus on the masculine only, or the man; a challenge for Hebrew speakers, shared with speakers of other grammatically gendered languages, especially those who want to promote equality for women and non-binaries.

There is fascinating research about the relations between language and gender, looking into the impact of language on our perception and our minds, and dealing with the question of how language speakers perceive the feminine and the masculine. Among them are Guiora et al. 1982; Prewitt-Freilino et al. 2012; Konishi 1993; Boroditsky et al. 2003; Boroditsky 2009; and Wasserman and Weseley 2009. Two interesting studies specific to Hebrew are those of Vainapel et al. 2015 and Kricheli-Katz and Regev 2021.

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1. "Sex and Gender Identity" https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity, "What's Intersex?" https://www.plannedparenthood.org/learn/gender-identity/sex-gender-identity/whats-intersex.

2. 'Gender" https://en.wikipedia.org/wiki/Gender, "Non-Binary Gender." https://en.wikipedia.org/wiki/Non-binary_gender, "Sex Assignment" https://en.wikipedia.org/wiki/Sex_assignment, "Intersex" https://en.wikipedia.org/wiki/Intersex, "Transgender" https://en.wikipedia.org/wiki/Transgender.

The first examined the effect of the use of the masculine-generic vs. a gender-neutral inflection on survey responses and found that women reported lower task value when academic motivation questionnaires were written in the masculine-generic in comparison to a gender-neutral inflection, and women reported lower self-efficacy than men when the questionnaire was written in the masculine-generic. The researchers explain that their findings suggest that surveys written in gendered languages (or translated into gendered languages) "may contain construct-irrelevant variance that may undermine the validity of their scores' interpretations" (Vainapel et al. 2015), risking getting to false conclusions. The second study (Kricheli-Katz and Regev 2021) examined the effect of the masculine-generic on exam results and found that addressing women examinees in the masculine-generic had a negative impact on their achievements, compared with a feminine form: grades that women received were lower when the test was written in the masculine-generic than when the test was written in the feminine form. The researchers show that addressing women in the feminine, compared to addressing them in the masculine, reduces the gender gap in mathematics achievements by a third.

While the above research illustrates some of the challenges in the Hebrew language relating to gender, there are some ways and methods that Hebrew speakers are using to have a more fair and equal language (Eisenreich 2020; Yifrah n.d.; The Academy of the Hebrew Language 2021). Even though there's no single "perfect" approach that is acceptable by all speakers, some of these methods include using infinitive and plural imperative forms, using past or future tenses that are gender-neutral, using slang language combining the feminine and masculine endings in the same word, using both feminine and masculine forms one after the other or mixing up both forms randomly in the same sentence or paragraph/story; or using the feminine form only, as a way to challenge the patriarchal elements of the Hebrew language.

Written communication offers even more options for inclusivity, such as creating two variations of the text (or more), one in the feminine and one in the masculine; using words that end with the letter He (ה׳) or words of the second person which are written in the same way both for the feminine and masculine forms, while pronounced differently; using both forms in the same word with a slash ("/"), dot (".") or a dash (hyphen "-" or Hebrew *maqaf* "־" or em-dash "—") between the feminine and the masculine letters (or vice versa) to combine them. The slash usually represents two binary options, women or men, while the dot is considered more gender-diverse. Using the dot and mixing up both forms when speaking is very common among non-binary Hebrew speakers when there's a need to avoid referring to oneself in a binary way. Using both forms intertwined or alternately is called among speakers "לשון מעורבת," meaning "mixed- tongue" or "mixed-language".

2. Multi-Gender Hebrew

2.1. Intro

I'm excited to introduce another solution, or suggestion, which I developed to address the gender challenge in Hebrew: Multi-Gender Hebrew is a new set of innovative all-inclusive Hebrew letters facilitating multi-gender reading and writing (in Hebrew: עברית רב־מגדרית). The new Multi-Gender Hebrew letters offer a third option, adding a gender-neutral and a multi-gender expression to the written language. Through typographic hands-on exploration, done as part of my graduation project for a B.Design degree in Visual Communication Design at Holon Institute of Technology (HIT), advisor: Judith Asher (to whom I would like to extend my thanks), I created and designed these additional new letters to the Hebrew alphabet. While the Hebrew that most speakers are used to forces a binary choice between the feminine and masculine, focusing on the masculine and not leaving much room for non-binary identities, these letters are shifting the focus to women and non-binary genders, expanding the modern Hebrew writing system. The new letters do not remove or override existing words or forms in Hebrew; they simply offer a wider variety of choices.

A first example with the phrase "All People are Equal" (i.e., should have equal rights and opportunity) written in Multi-Gender Hebrew can be seen in Figure 1.

Multi-Gender Hebrew has two main goals:

- Make women seen in the Hebrew language; acknowledge and solidify women's presence and include women in the language, in conversation, and in society.
- Form a new all-inclusive seen and fair linguistic space for non-binary people and identities within the Hebrew language, using visibility as a tool towards acknowledgment, presence, and opportunity.

Multi-Gender Hebrew consists of 12 new characters: 11 new letters and one *nikud* sign (diacritic). Each new letter is composed of visual elements from one or two Hebrew letters in parallel, along with some additional typographic or stylistic alterations. In addition, a new digital keyboard was developed, which allows everyone to type the new signs. A free version of Multi-Gender Hebrew was released in February 2021, accessible to Hebrew speakers who wish to install and use the new type and who might want to promote gender equality by doing so. Many institutions and organizations in Israel have already adopted the new letters in signage, documents, educational materials, marketing and graphics, websites, media, and more. Many individuals are using the new letters in writing, in essays, poetry, prose, academia, personal use, and so on. Here's a link to Multi-Gender Hebrew's website (Hebrew),



FIGURE 1. An example of the new Multi-Gender Hebrew letters in the Frank-Rühl font

where users can explore the new letters and download the type & digital keyboard for free: `multigenderhebrew.com`.

Multi-Gender Hebrew serves as a tool to bring together all genders, visually and conceptually. Other visual solutions, such as using a slash or a dot between grammatical feminine and masculine endings or forms, are at times separating or dividing between the grammatical genders, or they include a hierarchy of genders. Multi-Gender Hebrew tries to hold an approach in which all genders are equally represented, all genders are part of one united form of the word, all genders are coming together.

Multi-Gender Hebrew is a solution or proposal for the written language only, and as such, it does not deal with a new pronunciation for these new letters. The new letters allow the writer to write and the reader to read the text in a multi-gender way: both in the feminine and masculine forms together, at the same time, which, of course, gives the text a new multi-gendered meaning. When readers read out loud texts using the new letters, they usually choose to use feminine forms, masculine forms, or a mix. They may often choose a gender based on the context of the text, based on their own gender, or based on other individual and social factors.

The Multi-Gender Hebrew letters are not unique to a specific font or typeface; they are new letters that can be designed for any Hebrew font (when the appropriate copyrights are granted). To date, I have introduced the new letters to the public with three main Hebrew

fonts: Frank-Rühl (Hagilda[3]), Narkiss Block (Fontef[4]) and Alef (Hagilda[5], Google Fonts[6]). A Multi-Gender Hebrew version of the latter, "Alef Multi-Gender" (technical name: `Alef MultiGndr`), was the one published in 2021 for free, together with a suitable digital keyboard, allowing the new letters to be typed with keyboard shortcuts. The entire Hebrew alphabet, including the new letters, with the serif font Frank-Rühl on the right and the sans-serif font Alef on the left, can be seen in the snapshot below (Figure 2). As can be gathered, I did not design a whole new font, but rather additional new letters that are added to the Hebrew alphabet.

In addition, as part of the release of the new type, a new website was launched that allows users to experiment with the new letters directly in the browser (link mentioned earlier). While I was in charge of all design aspects and the overall project management, this release owes tremendous gratitude to partners in the work: the digital keyboard was developed by Didi Kohen (software developer and activist), and the website's developer is Muli Dayan (developer and technology enthusiast). Both generously invested their time and effort to achieve a quality tool for users.

2.2. The Letters

Let's get to know all new letters with two example sentences.

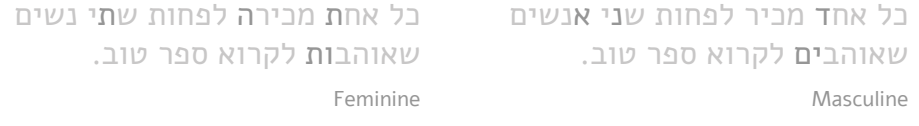
The first sentence translates to "Everyone knows at least two people who love to read a good book.". In Hebrew, the following words in this sentence are grammatically gendered: *(every)one*, *knows*, *two*, *people*, *love*. In Figure 3, the differences between the feminine and the masculine forms in these gendered words are visualized in grey, and below them, the example sentence is shown written in Multi-Gender Hebrew. This sentence includes six new Multi-Gender Hebrew letters: תָּד (Tad), הָה (Ha), נָת (Nat), אָן (Ann), יוִן (Yuv), and תִּם סופית (Final Tem). When the Multi-Gender Hebrew letters are in use in this sentence, all genders are explicitly represented in said words.

The second example sentence translates to "The instructor of their acting class is also a performer valued and loved by everyone.". In Hebrew, the following words in the sentence are grammatically gendered: *instructor*, *their*, *is* (*she/he* in this example), *performer*, *valued*, *loved*, *everyone*. The differences between the feminine and the masculine forms in these

3. פרנק־ריהל הגילדה [Frank-Rühl Hagilda] `https://hagilda.com/frankg/`
4. נרקיס בלוק [Narkiss Block] `https://fontef.com/narkiss-block`
5. `http://alef.hagilda.com/`
6. `https://fonts.google.com/specimen/Alef?subset=hebrew`



Figure 2. The Hebrew alphabet including the new characters of Multi-Gender Hebrew



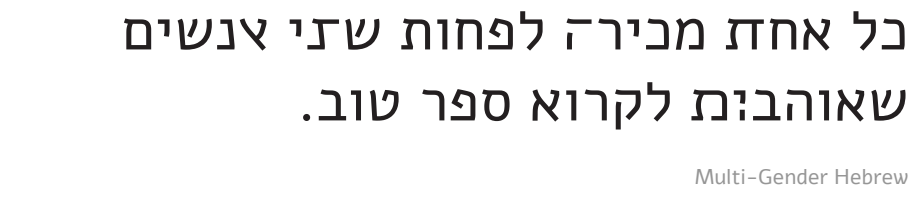


Figure 3. An example sentence written in Multi-Gender Hebrew

words are again visualized in grey in Figure 4. Right below, the sentence is written in Multi-Gender Hebrew, this time including seven new Multi-Gender Hebrew letters (two of which already seen in the previous example): הָת (Hatt), וָ (Va), יוִ (Yuv), יָת (Yat), תָה (Ta), הָה (Ha), and נֶם סופית (Final Nem). This example also shows the Multi-Gender Hebrew nikud sign, רֶב (Rev), a diacritic mark I designed along with the letters, used to express or stress a multi-gender intention. When the Multi-Gender Hebrew letters are being used in this sentence, it tells the

reader that the instructor and the person taking the acting class are non-binary (or are using non-gendered language to refer to themselves).

מרצה קורס המשחק שלו הוא גם
שחקן מוערך ואהוב על כולם.

Masculine

מרצת קורס המשחק שלה היא גם
שחקנית מוערכת ואהובה על כולן.

Feminine

מרצ״ת קורס המשחק שלו״ה הו״א גם
שחקנ״ת מוערכ״ת ואהוב״ה על כולם״.

Multi-Gender Hebrew

Figure 4. Another example sentence written in Multi-Gender Hebrew

Figure 5 displays all 12 new Multi-Gender Hebrew characters, along with their names and at least one word demonstrating each being used.

Ann	א	אָן (אנשים)	Yat	ת	יָת (תלמד, אזרחית)
Tad	ת	תָּד (אחת)	Final Nem	ם	נֵם סופית (אתם)
Ha	ה	הָה (אתה)	Final Tem	ת	תֵּם סופית (תלמידות)
Va	ו	וָה (שלו)	Nat	נ	נָת (שניים, בנאדם)
Hatt	ת	הָת (מורת הכיתה)	Ta	ת	תָּה (לומדת, תלמידות הכיתה)
Yuv	י	יוּו (הוא, רבות)	Rev	ַ	רֵב (Nikud) (אתם)

Figure 5. All new Multi-Gender Hebrew signs

Figure 6 shows a few more examples of the new letters in short text.

For more information on each new letter, an example of almost all its possible uses with different grammatical forms, and the relevant keyboard shortcut to type each new letter, you may download a publicly



Figure 6

available resource including a detailed table with all new signs from the website of Multi-Gender Hebrew[7].

2.3. Adoption and Outstanding Reaction

Multi-Gender Hebrew was first publicly published in July 2019, and since then started to get recognized and reach a large audience. . It quickly spread through social media pages and groups engaged in feminism or gender issues, one of them and the first to publish Multi-Gender Hebrew is "Dabru Eleynu" ("דברו אלינו," translates to "talk to us", by the inspiring feminist activist Dafna Eisenreich, Dabru Eleynu 2019). Multi-Gender Hebrew instantly received praises and positive feedback, filled with excitement on the groundbreaking innovation. In July 2020, after a few individual requests, I decided to prepare and publish on the Facebook page of Multi-Gender Hebrew free files for download with the phrase "Welcome" written in Multi-Gender Hebrew in the Alef font—while the work on its final version and implementation was still in

7. עברית רב־מגדרית [Multi-Gender Hebrew] https://multigenderhebrew.com/assets/Multi-Gender_Hebrew_Installation_Guide.pdf#page=4.

progress (Multi-Gender Hebrew 2020). Happily, not only those who initially requested, but many people and institutions downloaded the files and began to use Multi-Gender Hebrew in the public space.

Hundreds of signs in Multi-Gender Hebrew are placed all over Israel, and a few around the world, put up since the free "Welcome" files were published—a practice that went on also after the full version was out and carries on to this date. These include many local government and city entrances or city halls all over the country, universities, schools, kindergartens, youth movements, educational buildings, libraries, public gardens or parks, social organizations and non-profits, health care spaces, offices of private and public companies, shops and stores, conferences and events, sports venues, state offices, and of course, people's private spaces, like personal offices, private events, home or room entrances, and more (Multi-Gender Hebrew 2022a). There are also websites welcoming users in Multi-Gender Hebrew. The act of putting up a "Welcome" sign in Multi-Gender Hebrew spread quickly. These signs are typically proudly presented by the entity that is displaying them, to which testify the social media posts that usually publicly announce every new sign (for example: Ofira Yochanan Wolk 2020; 2021; Givatayim Youth 2021; Givatayim mayor Kunik 2021; Ramat-Gan mayor Carmel Shama-Hacohen 2021; Hefer Valley regional council 2021). A few of these signs are proudly shown in Figure 7.

After getting non-stop requests asking when it would be possible to use all the new letters and when a full version is expected to come out, and a few months after the free "Welcome" files were published, I completed a full version for download of Multi-Gender Hebrew. This version includes a technical implementation in which the new letters are implemented in a font file and in a digital keyboard, which everyone can download to their computer free of charge. February 28, 2021, marked the day on which a long-anticipated tool to use Multi-Gender Hebrew was released (a link to the exciting announcement can be found in the references list under Multi-Gender Hebrew 2021b). Once published, many people went ahead and started to use all new letters.

A few examples of interesting, exceptional, or typical uses of Multi-Gender Hebrew are as follows: learning materials; events and wedding invitations; official documents; a statement of principles by Kiryat Tivon regional council on gender equality; Ketubot, plural of Ketubah (in Hebrew: כתובה), a religious document that is considered a marriage "contract" in traditional Jewish weddings; "Privacy Policy" legal documents (Klinger n.d.); some unofficial use of Multi-Gender Hebrew within the Israeli army by individuals (Schneider 2021); academic texts: including works written by students in Amirim program, an interdisciplinary Honors program in the Humanities of The Hebrew University of Jerusalem (The Hebrew University of Jerusalem 2020; Zamir 2020),

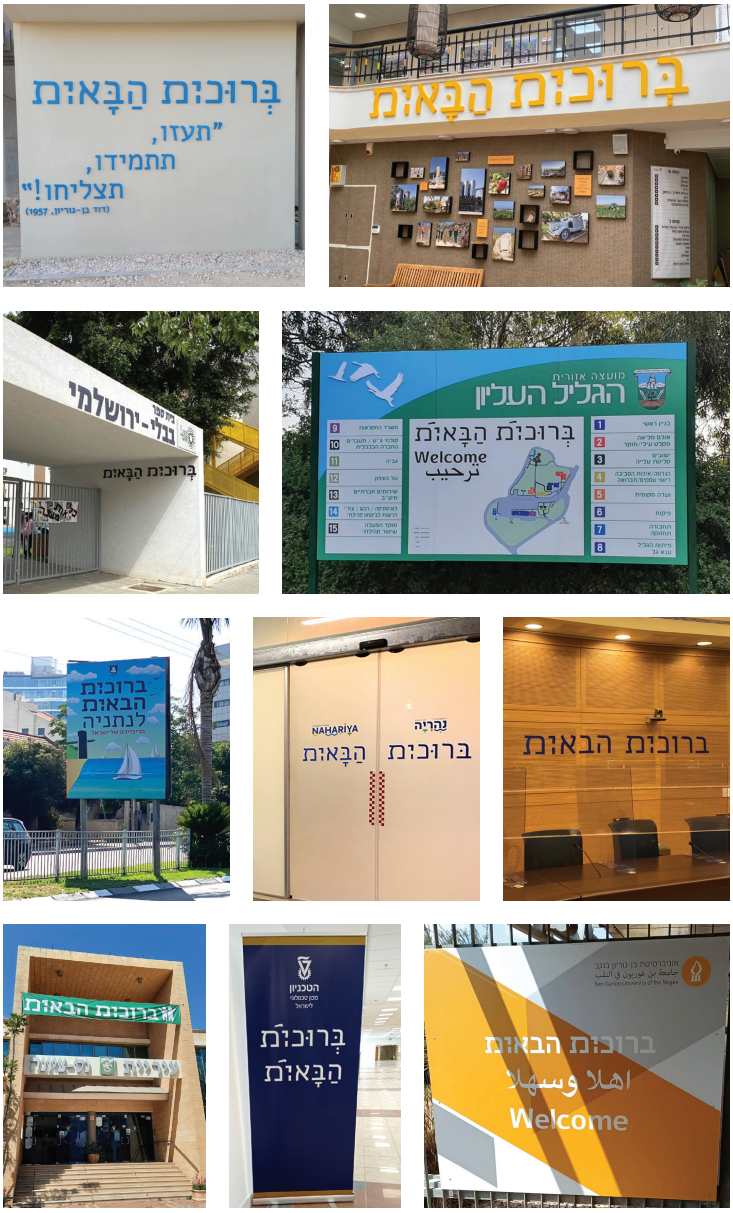


FIGURE 7. Photos of "Welcome" signage in Multi-Gender Hebrew. From left to right, top to bottom: Ben-Gurion Heritage Institute in the Negev; Gezer regional council, city hall (one of the first to proudly place a sign); Bavli-Yerushalmi school in Tel Aviv (in Tel Aviv-Jaffa, Ramat-Gan, Givatayim, Hod HaSharon and Hefer Valley regional council, all school entrances have been decorated with a Multi-Gender Hebrew "Welcome" sign, a step initiated by each of the local governments [Multi-Gender Hebrew 2021a; 2021d; 2021e; 2021g; 2022b; Ynet 2021]); Upper Galilee regional council; city of Natanya; city of Nahariya, city hall; Knesset, the Israeli parliament, the room of the Committee on the Status of Women and Gender Equality; city of Ness Ziona, city hall; Technion—Israel Institute of Technology in Haifa; Ben-Gurion University of the Negev, Be'er Sheva

as well as by students in other institutions and at least one doctoral dissertation (Nuphar 2024).

In addition, plenty of brands and companies, big or small, choose to use Multi-Gender Hebrew in marketing. Two examples of major advertisers who used Multi-Gender Hebrew are Colmobil (in Hebrew: כלמוביל) and Strauss (in Hebrew: שטראוס). The first is a company selling vehicles all over Israel that launched a re-brand with a tagline in Multi-Gender Hebrew (Ice team 2024), in a campaign that spun over various mediums like TV, social media, and huge billboard signs on major roads in Israel. The second is an international food & beverage enterprise, huge in Israel and known for its snacks and dairy products, with tens of thousands of employees in Israel and around the world (Strauss Group[8]), which released a campaign changing the logo of one of its famous products ("Gamadim," a children's fruit-flavored yogurt), to a new Multi-Gender Hebrew logo version, instead of just using the masculine form, trying to shift the focus to young girls to promote gender equality among parents and kids (Strauss Group[9]). The product packaging was updated to include the new Multi-Gender Hebrew logo, with the company estimated to distribute millions of units of the product all over the country, a massive exposure to Multi-Gender Hebrew. There are also a lot of ads calling for employees or open calls for contributors written in Multi-Gender Hebrew in an attempt to bring people of all genders on board, like "7-Eleven" in Israel calling for new employees or an open call for plays by the Cameri Theatre ("התאטרון הקאמרי," considered one of the leading and most important theatres in the country) for a festival dedicated to the trans and non-binary community (The Cameri Theatre 2021). Some politicians used Multi-Gender Hebrew in their campaigns, like Knesset member Merav Michaeli, leader of the Labor Party in 2021-2024 and previously Minister of Transport. Michaeli is a veteran, well-known feminist activist, most familiar in leading the public debate and advocating for the use of equal-language (and personally, a great inspiration to me and to Multi-Gender Hebrew, Michaeli 2021; 2013).

Multi-Gender Hebrew is also used in creative and academic writing. In the summer of 2021, there was a Multi-Gender Hebrew writing contest: Tali Bleicher, manager of an Israeli Facebook page called "Open Calls for Writing" came to know the new type and launched a prize-winning contest where writers were invited to submit poems or short stories written in Multi-Gender Hebrew (Kolot Korim Lichtiva 2021a; Multi-Gender Hebrew 2021c). More than 130 works were submitted for the contest—all written in Multi-Gender Hebrew—an amaz-

8. על החברה [About the Company] https://www.strauss-group.co.il/company/strauss_israel/

9. גם בנים וגם בנות יכולים ויכולות לעשות הכל! [Boys and Girls Alike Can Do Anything!] https://gamadim-gamadot.strauss-group.co.il/.

ing turnout (Kolot Korim Lichtiva 2021b; Multi-Gender Hebrew 2021f). Multi-Gender Hebrew can also be found in published books, like the children's book "הסיפור שלנו" ("Our Story") by Shani Friedman (Friedman 2021), the guidebook for parents on education and gender, "הורות מודעת מגדר" ("Gender Aware Parenting") by Tal Breier Ben Moha (Breier Ben Moha 2023), and "שסע" ("Between Our Tongues"), a poetry book by Yael Pilowsky Bankirer (Pilowsky Bankirer 2023) with four poems written with the new letters. Multi-Gender Hebrew is used in journals, magazines, and zines (like Amram et al. 2023 and Bush Collective[10]).

Multi-Gender Hebrew is also seen in the art world. In January 2024, Design Museum Holon in Israel opened a new international exhibition about gender in design in which Multi-Gender Hebrew took part and was presented for about six months (Design Museum Holon n.d.), with thousands of visitors attending the exposition. Multi-Gender Hebrew was also used in another exhibit in the museum and in other art shows and events.

Some of the previous examples are seen in Figures 8 and 9.

Other than being used by speakers, Multi-Gender Hebrew is receiving, gratefully, a lot of enthusiastic recognition and traction by the public and in media coverage, both locally and globally. Multi-Gender Hebrew attracts a lot of reaction, especially on social media. It has a Facebook page[11] with more than 12.5K followers to date, as well as Instagram and X (formerly Twitter) accounts (@multigenderhebrew and @MultiGenderHeb, respectively), all three receiving a lot of love from the public and engaged users. Media appearances of Multi-Gender Hebrew draw a lot of response and talk, and typically raise a lot of comments, discussions, and buzz online, and often a news story. In August 2022, The New York Times published an article about Hebrew and gender and included Multi-Gender Hebrew and an interview with me, the creator (Kershner 2022). Over and over again, Multi-Gender Hebrew is discussed in the Israeli press, with numerous items covering or simply mentioning Multi-Gender Hebrew, such as in major Israeli newspapers or media outlets, like Haaretz, YNET, Kan—Israeli Public Broadcast Corporation, Reshet 13, Keshet 12, The Times of Israel and others.

3. Conclusion

It is encouraging and beautiful to see the implementations of Multi-Gender Hebrew by speakers and the very positive response my creation receives. Further research will allow more insight into the wide variety of uses of the new type and the reaction to it by Hebrew speakers.

10. https://www.bushfanzine.com/

11. https://www.facebook.com/MultiGenderHebrew



FIGURE 8. Images of uses and implementations of Multi-Gender Hebrew. From left to right, top to bottom: a few of the Colmobil campaign's billboard signs in Ayalon Highway in Israel; the open call for submissions to the Multi-Gender Hebrew writing contest; an ad in Multi-Gender Hebrew of the former parliament member Gaby Lasky; one of the many ads calling for employees in Mutli-Gender Hebrew by "7-Eleven"

Like other gender-related issues, Multi-Gender Hebrew is debated, typically among those who reject the idea inequality in the Hebrew language exists, and that it needs to be addressed. The overall response that Multi-Gender Hebrew receives may be interesting to analyze in other opportunities. And, other than that, there is much more to discuss about Multi-Gender Hebrew, which will hopefully be covered in future papers.

Personally, I would like to continue the work and development of Multi-Gender Hebrew, as well as to further explore how users interact with the new letters and how they may affect their perspective on gender equality and on reality. Some of the future developments I'm planning



FIGURE 9. More images of uses and implementations of Multi-Gender Hebrew. From left to right, top to bottom: an ad calling for music teachers by Arad's Conservatory of Music; a tattoo of the word "equal" inked in Multi-Gender Hebrew; the open call for plays by the Cameri Theatre; a wedding invitation in Multi-Gender Hebrew

or working on for Multi-Gender Hebrew are technical solutions and applications to address accessibility needs, releasing the technical implementation for mobile devices, making it easier for users to use the new letters with tools that offer semi and full automation to convert text into Multi-Gender Hebrew or that allow control over the new letters through the browser or app, expanding Multi-Gender Hebrew by making the design available with more fonts, including hand-written Hebrew type (cursive or "Ktav"), and inventing more creative gender-equal solutions for the written as well as spoken Hebrew (including situations that are not fully covered with the 12 new characters). I can't wait to find out what the future holds for Multi-Gender Hebrew and how it will evolve and grow.

The wide adoption and reaction to Multi-Gender Hebrew suggest that people are eager for solutions or new alternatives and practical tools for gender equality in the language. I see language as a powerful tool to promote gender equality, and I believe that creative thinking is the X factor we ought to use to seek equality and justice.

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The Akshara as a Graphematic Unit

Arvind Iyengar

Abstract. The written unit called an akshara is emblematic of several South and South-East Asian writing systems. In its most basic form, an akshara comprises a combination of free and bound written elements, and typically denotes a phonological vowel or a consonant-vowel sequence. Yet, there remain several open questions on the definitional limits of an akshara, leaving the concept somewhat fuzzy. For instance, what phonological values could an akshara potentially have? Conversely, is the phonological value of a written entity sufficient grounds to determine its status as an akshara? Further, if a particular written sequence is pronounced differently in different languages written in the same script, does this impact on the aksharic status of the written entities? Finally, to what extent is the akshara an inherent characteristic of certain writing systems? Is its existence in any way determined by externally imposed orthographic norms and practices? This paper addresses these questions and more in attempting to constrain and define the akshara.

1. Introduction

1.1. Overview

Since the 1990s, the popularization of the terms *abugida* and *alphasyllabary* (Bright, 1999; Daniels and Bright, 1996) has coincided with an increase in scholarly interest on the unit of writing known as the *akshara*.[1] Originating as a phonological concept (Rimzhim, Katz, and Fowler, 2014), the akshara is now commonly understood as a written unit, often characterized as a graphic syllable (Salomon, 2007) or orthographic syllable (Sproat, 2000). The prototype of the akshara is a combination of 'free' and 'bound' written elements that corresponds to a phonological [V] or [CV] sequence (Gnanadesikan, 2017; Nag and Perfetti, 2014). The

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1. Sanskrit /ɐkʂɐrɐ/; English usu. /ˈʌkʃəɹə/.

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akshara is considered iconic of the Brahmic writing systems prevalent across South and South East Asia (Gnanadesikan, 2021), due to which they are sometimes termed *aksharic* systems.[2]

At the same time, much of the research thus far on aksharic writing has approached the subject matter from a cognitive, psycholinguistic and educational lens (Joshi and McBride, 2019; Winskel and Padakannaya, 2014). Critiques explicitly addressing the graphematic aspects of the akshara are rare. In the words of Joyce and Meletis (2021), existing research on aksharic writing has focused primarily on its processing fits, and less on its linguistic fits. As a result, the akshara is yet to be rigorously analyzed using contemporary grapholinguistic approaches. Moreover, and akin to the term *grapheme* (Daniels, 2018), authors over the years have differed in their interpretation of the akshara, in the process adversely impacting the term's semantic connotations and theoretical consistency.

In light of the above, there is a need to constrain, refine and define the conceptual scope of an akshara, in order to ensure terminological precision and epistemological robustness. With this aim in mind, I propose in this paper certain criteria for labelling a unit of writing an akshara, while also highlighting aspects requiring further scrutiny.

1.2. Terminology

Although the study of writing systems is currently a "hot" discipline (Sproat, 2018, p. 269), it is also a fairly recent development. As a result, it invariably grapples with issues of vacillating and often competing terminology for one and the same concept. Conversely, a given term may be used in a polysemous manner by different authors, in the process leading to inadvertent ambiguity. Against this background, I provide below a summary of the terms used in this paper and their definitional scope.

In the literature, the basic unit of a writing system has been variously designated as *sign*, *symbol* or *letter*. However, as Meletis (2020, p. 78) observes, these appellations "lead double lives as lay terms and quasi-technical terms". Equally ambiguous is the term *grapheme*, due to which it has been notably rejected by Daniels (2018). Consequently, I label the basic unit of writing a *graph*, and consider it to be the written counterpart to a phonological *segment*. Individual or sequences of

2. Sanskrit /ɐkʂɐɾikɐ/; English usu. /ˈɑːkʃəɹɪk/. The term serves as the adjectival counterpart of the noun *akshara*. The en-Latn spelling |aksharic| is modelled on |Sanskritic|, |Vedic|, |yogic|, |karmic| and the like, and is becoming increasingly prevalent in recent anglophone scholarship (Gnanadesikan and Judson, 2021; Vaid, 2022).

graphs are enclosed in pipes (| |) where needed. I define *script* as a superset or macro-inventory of graphs used to graphize or create a written form for a spoken language. When coupled with a particular language, the script-language pair constitutes a *writing system* (henceforth 'WS'). The conceptualization of script and language as two distinct but essential components of a WS follows the lead of Meletis (2020), Neef (2015), and Weingarten (2013). Accordingly, Latin (or Roman), Arabic, Devanagari and Canadian Syllabics are scripts, in that they represent inventories of graphs used to graphize one or more spoken languages. When paired with a spoken language, they form WSs such as German–Latin, Kashmiri–Arabic, Nepali–Devanagari or Inuktitut–Syllabics. It follows that the same script may be used by multiple languages, as in German–Latin and Swahili–Latin, while a particular language may be written in more than one script, as in Kashmiri–Arabic and Kashmiri–Devanagari. Each unique combination of script and language results in a distinct WS. To ensure compactness, I adopt the convention followed by the website *ScriptSource* and specify a WS using the ISO codes for its constituent language and script. Thus, German–Latin, Kashmiri–Arabic, Nepali–Devanagari or Inuktitut–Syllabics may be designated `de-Latn`, `ks-Arab`, `ne-Deva` and `iu-Cans`, respectively. Assigning WSs binomial monikers of this kind ensures componential transparency while also highlighting the subtle but crucial distinction between a script and WS on the one hand, and between a script and ISO tag for greater specificity (Raymond, 2020). For instance, `ne-Deva-IN` may be used to denote Nepali written in Devanagari in India, and `de-Latn-1996` to refer to German written according to the 1996 spelling reforms (Johnson, 2005).

From the above, it is evident that the *graphetic* properties of a WS, entailing matters of graph size, shape, position and other typological considerations (Altmann and Fengxiang, 2008; Meletis, 2020, p. 393), only concern the script component. This makes a graphetic analysis of a script or WS analogous to the phonetic analysis of a spoken language. In contrast, the *graphematics* or *graphematic system* of a WS refers to the underlying correspondences between the graphs of its script component on the one hand, and the phonological segments, morphemes or other units of its comparable to the phonological dimension of a spoken language. For convenience, I denote 'graphematic' and 'phonological' by |γ| and |ϕ|, respectively (Haralambous, 2019). *Orthography* denotes the explicit rules or implicit conventions that constrain graphematic possibilities and, in some cases, override them (Honda, 2021; Meletis, 2020; Neef, 2015). This makes orthography an optional component of a WS which, when present, may have graphematic as well as sociolinguistic ramifications (Bunčić, Lippert, and Rabus, 2016; Joyce and Meletis, 2021). Table 1 summarizes the scope of the terms described.

Other key terms appearing in this paper concern the various types and subtypes of WSs in question. All WSs discussed herein are *segmen-*

Table 1. Dimensions of writing systems

Term	*WS component(s) involved*	*Objects of analysis*
graphetic	script	typographic & calligraphic characteristics, design & material properties…
graphematic	script + language	γ-ϕ correspondences, allograph distribution…
orthographic	script + language	rules or conventions governing (allo)graphs, spelling, punctuation…
sociolinguistic	script + language	WS used by who, when, how, for what purpose…

taries, in that their minimum grain size is the ϕ-segment (Gnanadesikan, 2017). More precisely, all WSs mentioned in this paper are vowelled segmentaries, in that they generally denote individual consonant and vowel ϕ-segments (henceforth [C] and [V], respectively) using distinct graphs or graphetic elements. That said, these WSs may also comprise graphs corresponding to sequences or clusters of ϕ-segments, such as [CV] or [CCV]. Where required to describe graphs based on their phonological values, I refer to them as [C]-grams, [V]-grams, [CV]-grams and so on. Regardless of its phonological value, a graph or written element may be graphetically central, as in Latin-script |*e*|, or graphetically peripheral, as in the so-called acute accent |◌́|. In other words, written elements may be graphosegmental or graphosubsegmental (Meletis, 2020, 97ff; Osterkamp and Schreiber, 2021, 172 footn. 2).

In the grapholinguistic literature, reference is most often made to three subtypes of vowelled segmentary: *alphabet*, *alphasyllabary* and *abugida*. These terms are defined by Daniels (1996) thus:

> ALPHABET
>
> a type of writing system that denotes consonants and vowels
>
> ALPHASYLLABARY
>
> a writing system in which vowels are denoted by subsidiary symbols not all of which occur in a linear order (with relation to the consonant symbols) that is congruent with their temporal order in speech
>
> ABUGIDA
>
> a type of writing system whose basic characters denote consonants followed by a particular vowel […]
>
> (ibid., p. xxxix)

Of these, the terms *alphasyllabary* and *abugida* have often been used as near-synonyms by scholars and laypersons alike. However, both Daniels (ibid., 4, footnote) and Bright (1999) have clarified the conceptual dis-

creteness of the two terms. According to Bright (ibid., p. 45), an alphasyllabary denotes [V]s with distinct allographs in complementary distribution. Following a [C]-gram, an alphasyllabary indicates a [V] using a specific set of allographs, known variously as secondary, dependent or bound graphs. In most other positions, a [V] is indicated with another set of allographs, termed primary, independent or free graphs. It should be noted that the 'secondary', 'dependent' or 'bound' nature of a graph does not require it to be graphetically diminutive or subsegmental. With reference to Table 1, the dependent or bound nature of a graph is a graphematic-orthographic restriction on its occurrence, while its γ-(sub)segmentality is a graphetic aspect. It is entirely possible for a graph in a WS to satisfy one of these conditions but not the other. In the context of an alphasyllabary, bound [V]-grams may well be graphetically central.

In contrast to an alphasyllabary, Bright (ibid., p. 45) lays down the defining characteristic of an abugida as the presence of an identifiable subset of graphs with phonological value [CV₀], where [V₀] is a so-called inherent, default or unwritten vowel ϕ-segment. The label *inherent* stems from the fact that the graphs in question have no overt graphetic element corresponding specifically to [V₀]. The inherent vowel in a [CV₀]-gram may be overridden or suppressed by various graphematic and/or orthographic means, depending on the WS in question.

2. The Prototypical Akshara

The distinction between an alphasyllabary and an abugida has been further distilled by Gnanadesikan (2017) as follows:

> The definition of *alphasyllabary* focuses on the arrangement of the signs into syllable-like structures (the *akṣara*), while the definition of *abugida* includes the use of an 'inherent' or 'default' vowel. Thus, the Daniels and the Bright typologies disagree as to whether to give priority to *what* [phonological] segments are being represented or to how the representation of those segments is arranged.
>
> (ibid., 9–10, emphasis in original)

Gnanadesikan's observation underscores Bright's (1999) clarification on the labels alphasyllabary and abugida being indicative of distinct graphematic behaviors. Also present in her observation is a reference to the written unit known as the *akshara*.[3] The prototypical akshara has a

3. The Latin-script spelling |akṣara| used by Gnanadesikan (2017) is based on conventions of the International Alphabet for Sanskrit Transliteration (IAST). Per the terminology and conventions outlined in Section 1.2, the IAST may be considered an instantiation of the Sanskrit–Latn writing system (sa-Latn-iast).

phonological value of [V] or [CV]. Among the latter subtype, [C] is typically indicated by an independent or free written element and [V] by an element that is graphematically dependent on, or bound to, the free [C]-gram as its base. Thus, the prototypical akshara satisfies the conditions for alphasyllabic writing. Included in the prototype are graphs with a phonological value of [CV$_0$], where [V$_0$] is the inherent or default vowel ϕ-segment that has no distinct graphetic manifestation. Consequently, the prototypical akshara also qualifies as abugidic in nature. Table 2 presents a selection of aksharas with phonological values of [V] and [CV] from the Hindi–Devanagari, Tibetan–Tibetan and Sinhala–Sinhala WSs.

Table 2. Aksharas denoting [V] and [CV]

hi-Deva			bo-Tibt			si-Sinh		
ə	ɪ	ʊ	a	i	u	a	i	u
अ	इ	उ	ཨ	ཨི	ཨུ	අ	ඉ	උ
nə	nɪ	nʊ	na	ni	nu	na	ni	nu
न	नि	नु	ན	ནི	ནུ	න	නි	නු

In sum, the akshara is typical of WSs that are alphasyllabaries as well as abugidas, due to which such WSs—including the ones in Table 2—are known as *aksharic* systems (Gnanadesikan, 2021, p. 304; Iyengar, 2023).

3. Beyond the Prototype

Whereas the prototypical or *minimal* akshara is relatively straightforward to identify and narrow down on, there is as yet no scholarly consensus on what the definitional limits of an akshara should be. That is, the boundaries of the *maximal* akshara remain fuzzy. This prompts the question of how much a written unit can depart from the aksharic prototype before it is considered to no longer exhibit the essential properties of an akshara. To address this question, we first need to scrutinize the characteristics used to identify the minimum or lower limits of an akshara, and verify whether they prove adequate for identifying its maximum or upper limits. If not, how can we best plug any conceptual gaps that exist, in order to devise an epistemologically and theoretically robust definition of the akshara?

3.1. Written Elements and Their Phonological Values

The prototypical akshara is defined as a written unit that corresponds either to a vowel ϕ-segment [V] or a consonant-vowel sequence [CV]. However, several WSs commonly portrayed as aksharic also feature written units corresponding to a series or cluster of consonants followed by a vowel, such as [CCV], [CCCV] and so on. The question that emerges here is: how many [C]s can precede a [V] within the context of a single akshara? Put differently, is there an upper limit on the number of prevocalic [C]s that a single akshara can denote? Furthermore, are these upper limits WS-specific, or can they be applied to multiple WSs? In brief, can an akshara be plausibly and reliably defined as written unit denoting no more than a certain number of [C]s in sequence, followed by a single [V]? Or are there instances of putative aksharas terminating in a [C], or denoting only a [C]? If yes, is the prototype of the akshara—a written unit corresponding to [V] or [C*V]—theoretically tenable? Table 3 addresses some of these questions by providing examples of written sequences with phonological values of [CCCV] and [C] from various aksharic WSs.

Table 3. Written sequences from aksharic WSs denoting [CCCV] and [C]

Row 1	hi-Deva ʈsjə स्य	kn-Knda ʈsjɐ ತ್ಸ್ಯ	si-Sinh ʈsja ත්‍ස්‍ය ත්ස්‍ය
Row 2	ml-Mlym n ൻ	bn-Beng ʈ ৎ	mni-Mtei k ꯀ

From an emic perspective, each of the hi-Deva and Kannada–Kannada (kn-Knda) examples in Row 1 of Table 3 would usually—although not always—be identified as an individual akshara, in the process legitimizing the existence of aksharas with value [CCCV] in these WSs. Such aksharas are also attested in homoscriptal WSs, such as Marathi–Devanagari (mr-Deva) or Tulu–Kannada (tcy-Knda), unless explicitly proscribed by WS-specific orthographic rules or conventions. Unlike hi-Deva and kn-Knda, however, si-Sinh does not provide for [ʈsja] to be written in a manner generally identifiable as a single akshara. In fact, si-Sinh allows for [ʈsja] to be transcribed in two ways. Of these, |ත්‍ස්‍ය| may be emically interpreted as comprising two aksharas, while |ත්ස්‍ය| might well be described as having three aksharas. The issue of homophonous heterography will be examined further in Section 3.2. For now, the examples from Row 1 of Table 3 suggest that evidence is sparse for a univer-

sal upper limit on the number of pre-vocalic [C]s that a single akshara can denote. To the extent such limits can be identified, they are invariably WS-specific. Consequently, the phonological criterion of number of pre-vocalic [C]s appears unreliable for purposes of defining an akshara.

Row 2 of Table 3 provides examples of graphs denoting only [C] from Malayalam–Malayalam (ml-Mlym), Bengali–Bengali (bn-Beng) and Manipuri–Meetei Mayek (mni-Mtei). Evidence from the grapholinguistic and computational literature points to these graphs being considered independent units in their respective WSs (Constable, 2004; Everson, 2007; Mohanan, 1996; 2007). Based on this evidence, there appears to be a strong case for the graphs in question to be deemed aksharas in their own right, in the process establishing the existence of aksharas that are simple [C]-grams. Such a conclusion sits uneasily with the prototype of an akshara described in Section 2 as a written unit whose phonological value is [V]-final.

Among the properties of the prototypical akshara outlined in Section 2, the [CV] subtype was characterized by an independent or free written element corresponding to [C], optionally appended with a dependent or bound element denoting [V]. This begs the question: are there instances of prospective aksharas where the *bound* element denotes [C]? If yes, can the bound element in an akshara also have other phonological values, such as ɸ-suprasegmentals? Table 4 provides examples to this end.

Table 4. Bound elements in aksharic WSs denoting [C] and ɸ-suprasegmentals

Row 1a	kn-Knda		te-Telu		sa-Gran	
	ɾ		m		ɦ	
	◌ೄ		◌ం		◌ꣂ	
Row 1b	ɾjaː		(ʷ)oːm		t̪sjɐi̯ɦ(ⁱ)	
	ಯಾ		ಓಂ		꣆ꣀꣃꣂ	
Row 2a	or-Orya		my-Mymr		pa-Guru	
	◌ଁ		◌꧴		◌ਃ	
	vowel nasalisation		*creaky tone*		*consonant gemination*	
	◌ଁ		◌꧴		◌ੱ	
Row 2b	mũ		kɛ̰		ʋɔɖːi	
	ಮೆಁ		ಕೆ̰		ವೆಡ್ಡಿ	
Row 3a	ne-Deva	ta-Taml	si-Sinh	kn-Knda	te-Telu	my-Mymr
			Ø			
	◌्	◌்	◌්	◌್	◌్	◌္
Row 3b	kʌk	kɐk	kak	kɐk	kɐk	kɛʔ
	कक्	கக்	කක්	ಕಕ್	కక్	ကက်

Row 1a in Table 4 shows that kn-Knda, Telugu–Telugu (te-Telu) and Sanskrit–Grantha (sa-Gran) comprise certain bound graphs that effectively act as [C]-grams in themselves. This phenomenon is further detailed in Row 1b, which shows potential aksharas in these WSs with phonological values [CCV], [VC], and [CCCVC], wherein one of the [C]s is denoted by the bound [C]-gram in Row 1a. Rows 2a and 2b illustrate how bound aksharic elements in Odia–Odia (or-Orya), Burmese–Burmese (my-Mymr) and Punjabi–Gurmukhi (pa-Guru) may stand for ɸ-suprasegmentals such as nasalization, tone or even consonant gemination.[4] Of these, pa-Guru |ੱ| is particularly intriguing as it represents gemination of the phonological [C] represented by the following [C]-gram. With reference to the pa-Guru example in Row 2b, if |ਵੱਡੀ| [ʋəɖːi] is considered to comprise two aksharas, it would imply that |ੱ| is graphematically situated within the first akshara but manifests phonologically under the second. Rows 3a and 3b depict a set of graphematically analogous bound graphs from various aksharic WSs, collectively known by the generic name *virama*.[5] It is the viramas that pose perhaps the greatest challenge to a phonology-based definition of the akshara. As exemplified in Row 3b, the bound viramas are affixed to a free [CV₀]-gram to overtly indicate that [V₀] should not be pronounced.[6] Due to this function, viramas are also known as vowel killers (Gnanadesikan, 2021) or zero vowel markers (Bright, 1996, p. 387). Since the viramas effectively denote [∅], it is unclear what category they fall under in terms of phonological value.

The examples in Table 4 add to the body of evidence for aksharas that deviate from the [V]-final prototype described in Section 2. Rows 1a and 1b tell us that several WSs feature aksharic candidates that are phonologically [C]-final, denote a phonological [C] by a graphematically bound element, or both. Rows 2a and 2b implicitly reveal that the sound value of the prototypical akshara is typically conceived of in terms of [C]s and [V]s—namely, in terms of ɸ-segments. This is despite the vast majority of aksharic WSs having provisions for denoting ɸ-suprasegmentals such as nasalization and tone. The example of pa-Guru |ੱ| also drives home the point made by some authors (Gnanadesikan, 2017) that the graphematic boundaries of an akshara may not align with the boundaries of a phonological syllable. Finally, the existence of the bound graph known

4. The adjective [oɽia] is increasingly being rendered in en-Latn as |Odia| in place of the previously common |Oriya|. The adjective 'Burmese' remains common in anglophone linguistic circles, although the en-Latn form |Myanmar| is also encountered.

5. From Sanskrit /ʋiɾɐːmɐ/ 'stop, pause'; English usu. /vɪˈɹɑːmə/.

6. In certain WSs, the virama may have additional graphematic functions, such as forming part of complex bound graphs—as in si-Sinh |කේ| [keː]—or indicating specific phonological values depending on the graphematic environment—as in my-Mymr |ကက်| [kɛʔ].

as virama potentially results in aksharas that are [∅]-final. It remains to be seen how this aspect can be suitably captured in a phonology-based definition of the akshara. In all, the cases described and analyzed in this subsection strongly prompt us to revisit the prototype of an akshara described in Section 2, and reflect on whether it is at all possible to robustly and rigorously define an akshara in phonological terms alone.

3.2. Heterophonous Homography and Homophonous Heterography

In order to arrive at a holistic view of the situation, the WS-specific evidence provided in Section 3.1 needs to be complemented by a cross-WS or macro perspective. In this regard, Table 5 demonstrates how the same written sequence may be varying pronounced in different languages—or, more precisely, in different WSs.

TABLE 5. Heterophonous homography in WSs based on the Devanagari and Tibetan scripts

sa-Deva	ɐmɕɐ	अंश	bo-Tibt	kɛːལ	སྐད
ne-Deva	ʌŋsʌ		dz-Tibt	keːཀ	
hi-Deva	ənɕ		lbj-Tibt	skət	
mr-Deva	ə̃w̃ɕ		bft-Tibt	skʌt	

As seen in Table 5, the graph sequence |अंश| is a valid lexical item in Devanagari-script Sanskrit, Nepali, Hindi and Marathi. Similarly, the Tibetan-script |སྐད| is a well-formed string in the written forms of the Tibetan, Dzongkha, Ladakhi and Balti languages. This reveals that a homographic sequence of prospective aksharas may be heterophonously interpreted depending on the language—and, by extension, the WS—in question. As evident, the heterophonous interpretations implicate not just the target ϕ-segments but also the ϕ-syllables indicated. For instance, Devanagari-script |अंश| is interpreted as disyllabic [ɐmɕɐ] and [ʌŋsʌ] in the context of Sanskrit and Nepali, respectively, but as monosyllabic [ənɕ] and [ə̃w̃ɕ] in Hindi and Marathi, respectively. This phenomenon ties in with the observation in Section 3.1 that the graphematic boundaries of a written akshara may not align with the phonological boundaries of a spoken syllable.

A cross-WS analysis reveals that the converse—namely, homophonous heterography—is also attested. Table 6 provides examples of such occurrences.

In Table 6, each heterographic pair has the same phonological value, despite the members of each pair generally being viewed as differing in akshara count. Together with the examples from Table 5, it emerges

Table 6. Homophonous heterography in aksharic WSs

hi-Deva	əɖɖa	अड्डा अड्डा
ta-Taml	lɐkʃmi	ல க் ஷ் மி ல க்ஷ் மி
ml-Mlym	n̪ɐnmɐ	ന ൻ മ ന ന്മ

that there is a large degree of variation across aksharic WSs in the correspondence between their written and spoken forms. In such a scenario, it proves problematic to define one in terms of the other. This further strengthens the case against using a phonological yardstick to define a written unit such as the akshara.

3.3. Innate Property or Orthographic Convention?

Of the examples in Table 6, it emerges that the homographic sequences in Hindi–Devanagari and Tamil–Tamil are in free variation. In most contexts, users may opt for either form based on personal preference. However, selecting between the two Malayalam–Malayalam forms has orthographic implications. The ml-Mlym sequence |ന്മ| is characteristic of the pre-1970s "traditional" orthography, whereas |ൻമ| follows the simplified or "modern" orthography (Mohanan, 1996, p. 424).

The Lao-Lao (lao-Laoo) presents perhaps the strongest argument against the use of a phonological metric to define an akshara. Traditionally, lao-Laoo was an alphasyllabary-cum-abugida, much like the neighboring WS of Thai–Thai (th-Thai) (Diller, 1996). However, following the 1975 revolution in Laos, a new official orthography for lao-Laoo was promulgated, which required all phonological [V]s to be overtly represented in writing (Gnanadesikan, 2021). The new rules effectively resulted in the elimination of [CV$_0$]-grams from the lao-Laoo inventory, since the former [V$_0$] would now be written just like every other [V]—with a bound [V]-gram in postconsonantal position. The discarding of the inherent [V$_0$] feature meant that lao-Laoo in the reformed orthography no longer qualified as an abugida. Gnanadesikan (ibid., p. 314) observes that lao-Laoo's loss of the inherent [V$_0$] was in no way the result of natural evolution, but was entirely attributable to government-imposed orthographic reform.

The examples of ml-Mlym and lao-Laoo testify to orthographic conventions having the ability to alter or impact the phonological value of a written sequence and, consequently, its akshara count. This finding refutes any assumption that the akshara is an innate property of a WS.

Rather, it shows that aksharic WSs are impacted by top-down orthographic conventions just as WSs of other typological categories are.

Therefore, if an akshara's boundaries may vary independently of its phonological values, and its very existence impacted by external orthographic norms, there seems to be scant justification for using a phonological point of departure for defining this unit of writing. Rather, a robust, generalizable and expandable definition of the akshara appears more likely to emerge from a holistic approach, centered primarily on graphematic criteria.

4. Constraining the Akshara

Some of the conclusions in Section 3 have already been alluded to in the scholarly literature, albeit in disparate contexts. For instance, Nag (2017) notes that certain aksharic WSs may indicate specific consonant ϕ-segments by bound graphs, which is corroborated by the examples in Table 4. Conversely, Padakannaya, Pandey, Saligram, and Ranga Rao (2016) state that an akshara may have a variety of phonological values, be it a ϕ-segment, a ϕ-syllable or part of a syllable. This observation aligns with the examples of Table 5, which highlight the inherently variable overlap of an akshara with a ϕ-syllable. Tying together the above claims, Gnanadesikan (2021, p. 327) writes that "[t]he syllable-akshara mapping breaks down with [graphetically] more complex aksharas". Gnanadesikan's observation that an akshara's phonological value becomes harder to predict with increasing graphetic complexity drives home the core argument in this paper—namely, that phonological value proves increasingly less reliable as a defining criterion for the akshara as we move away from the simple prototype.

My argument, therefore, is essentially to pivot from a phonology-dependent or dependentialist definition of the akshara towards one that is more phonology-independent or autonomistic (Haralambous and Dürst, 2019; Meletis, 2020). To wit, the akshara will always be *associated* with phonology, but should not be *decided* by it. This distinction is a subtle but crucial one. Accordingly, I propose that, across writing systems, an akshara is best conceived of in graphe(ma)tic terms, comprising one mandatory free graph and zero or more optional bound graphs. Table 7 details this conception using the examples from Table 6. Individual aksharas are shown separated by a γ-segmental space, while bound graphs are denoted in red.

In the proposed conception of an akshara, the notion of a free graph includes so-called conjuncts, ligatures and stacked-graphs compressed into one γ-segmental space, exemplified in Table 7 by |ക്ഷ|, |ന്മ| and |ᩈ᩠ᩅ|, respectively. Such a stance is based on the graphematic properties of the complex graphs in question being akin to the properties of simple

TABLE 7. Homophonous heterography with varying aksharic counts

hi-Deva	əɖɖa	अ ड ड ा	3 aksharas
		अ ड्ढ ा	2 aksharas
ta-Taml	lʁkʃmi	ல க் ஷ் ம ி	4 aksharas
		ல க்ஷ் ம ி	3 aksharas
ml-Mlym	n̪ʌnmʌ	ന ൻ മ	3 aksharas
		ന ന്മ	2 aksharas

free graphs. For instance, |க்ஷ|, |ന്മ| and |ड्ढ| each occupies a distinct ɣ-segmental space, possesses an identifiable phonological value, and is able to take on bound graphs, among other things. Hence, it makes sense to consider such complex graphs graphematically equivalent to simple free graphs in the aksharic context.

In theory, the number of optional bound graphs appendable to a free graph within the bounds of a single akshara could be infinite. In practice, however, the number of bound graphs one can affix to or juxtapose with the free aksharic nucleus would depend on WS-specific factors. These include the number of bound graphs available in that WS's graph inventory, any WS-specific graphematic-orthographic restrictions on the co-occurrence of certain bound graphs, and so on.

As evident, the above conceptualization of an akshara is intertwined with, but not reliant on, the phonological values of its constituent elements. Since an akshara is now being defined on graphematic terms, it could have any sound value. Thus, the free and bound elements of an akshara may denote a ɸ-segment, a ɸ-suprasegmental or a null ɸ-segment. Aksharic elements of the last type include viramas (Table 4, Rows 3a and 3b) and the shared graphetic bases used to construct independent [V]-grams in certain aksharic WSs, such as bo-Tibt |ཨ| and my-Mymr |အ|.[7] Besides, if an akshara is conceived of as a written unit centered around one free graph, it follows that one can add or remove as many bound

7. Such phonologically empty elements used as graphetic bases to construct independent [V]-grams are known by a variety of names: *vowel carriers*, *vowel bearers*, *vowel holders* or *vowel support letters*, among several others (Gill, 1996; Gnanadesikan, 2009; 2017; Iyengar, 2018; Salomon, 2007). In the context of Korean–Hangeul (kr-Hang), the terms *zero consonant* (King, 1996) and *dummy consonant* (Pae, 2011) have also been used. However, the last two terms have connotations of the graphetic elements in question being associated with a phonological [C], when, in reality, they simply occur in a paradigmatic relationship with graphematic [C]-grams or [CV₀]-grams. Iyengar (2023) labels the phonologically empty elements in question *kenograms*, from Greek |κενός| 'empty'.

elements as graphematically permissible without impacting the akshara count. However, if one adds or removes a free graph, the akshara count would increase or decrease accordingly. This idea is reflected in the examples in Table 7.

5. Open Questions and Further Refinement

The robustness of the definition of an akshara proposed in this paper will only be vindicated by testing it on as many purportedly aksharic WSs as possible—namely, on WSs that are alphasyllabaries as well as abugidas. Doing so will bring to light WS-specific phenomena and how well the proposed definition of an akshara accounts for them. In fact, there are already several questions at this stage worth exploring further.

At the granular level, if an akshara should not be defined in terms of its phonological value, how far can a putative akshara depart from being fundamentally phonographic in nature? Put differently, can a logogram—comprising graphetic elements that cannot be compartmentalized and individually associated with specific phonological values—qualify as an akshara? For instance, ta-Taml |ஸ்ரீ| [sɾiː ~ ɕɾiː] is commonly described as a 'ligature', but is effectively logographic in nature (Amalia Gnanadesikan, personal communication, 10 June 2022). Its sound value is invariant, and it cannot take on additional bound graphs. Consequently, one may argue that ta-Taml |ஸ்ரீ| does not entirely satisfy the aksharic criteria proposed in this paper. Along similar lines, there exist homophonous-heterographic pairs such as sa-Deva |ओम्| and |ॐ|, both pronounced [oːm], and ta-Taml |ஓம்| and |ஓ|, both realized as [(ʷ)oːm]. Whereas the graphematic sequences |ओम्| and |ஓம்| are clearly phonographic and, therefore, aksharic in nature, |ॐ| and |ஓ| are evidently logograms whose aksharic status is contestable. Hence, more research is required into the question of an akshara's compositional transparency (Meletis, 2020) and on setting out criteria thereunder for a graph to qualify as aksharic in nature.

At a macro or WS level, there remains room for the phonological associations of an akshara to be scrutinized further. In Section 2, the prototypical akshara was portrayed as a written unit displaying alphasyllabic as well as abugidic properties. Should this be a hard criterion for a graph—and, by extension, its source WS—to qualify as aksharic? Can a WS that is either an alphasyllabary or an abugida, but not both, be legitimately considered aksharic in nature? For instance, Divehi–Thaana (dv-Thaa) and Sindhi–Arabic (sd-Arab) both write postconsonantal [V]s using bound allographs, in the process qualifying as alphasyllabaries (Bright, 1999; Gnanadesikan, 2017; Iyengar, 2023). However, dv-Thaa and sd-Arab do not feature [CV$_0$]-grams and are, therefore, not abugidas. Conversely,

various South Asian languages when written in Braille—known collectively as Bharati Braille—do not feature bound [V]-grams, but do contain [CV$_0$]-grams (IIT Madras, 2020; Sproat, 2010). Hence, the Bharati Braille systems are not alphasyllabaries, but they are abugidas.[8] Against this background, to what extent can dv-Thaa, sd-Arab and Bharati Braille be considered aksharic in nature, and their written units subject to the definition of akshara proposed in this paper? The question also applies to Korean–Hangeul (kr-Hang), which appears to satisfy the conditions for an alphasyllabary but not for an abugida (Iyengar, 2023; King, 1996). WSs based on Canadian Aboriginal Syllabics, such as those for Cree (cr-Cans), Inuktitut (iu-Cans) and Carrier (crx-Cans), present a particularly intriguing test case for the definition of akshara. These WSs denote a [C] by a specific graph shape and the subsequent [V] by the orientation of the graph, as in cr-Cans and iu-Cans |ᑕ| [ta] and |ᑎ| [ti] (Harvey, 2003; Nichols, 1996). A sole [V] is indicated by a phonologically empty graph or kenogram (see footnote 7) appropriately oriented, as in cr-Cans and iu-Cans |ᐊ| [a] and |ᐃ| [i]. If one likens graph orientation to a bound [V]-gram in postconsonantal position, there are grounds to argue that cr-Cans, iu-Cans and crx-Cans are alphasyllabic and, hence, typologically similar to dv-Thaa and sd-Arab. Consequently, these WSs need to be considered collectively when making decisions on their aksharic status.

Aside from its graphematic implications, the question of whether non-abugidic or non-alphasyllabic WSs can be considered aksharic is also relevant from a sociolinguistic perspective. In several South Asian 'letter' is etymologically derived from the Sanskrit term /ɐkʂɐrɐ/ (Amalia Gnanadesikan, personal communication, 21 October 2021). Consequently, categorizing the South Asian WSs of dv-Thaa, sd-Arab and Bharati Braille as non-aksharic may prove dissonant with popular emic views on the basic graphematic unit of these WSs. At the same time, classifying sd-Arab as aksharic might sit uneasily with the pervasive portrayal in the literature of Arabic-script-based WSs as abjads, which persists despite scholarly evidence to the contrary (Bright, 1999; Gnanadesikan, 2017; Iyengar, 2023). Moreover, since the label *aksharic* remains semiotically associated with Brahmic WSs, it remains to be seen whether the Ethiopic WSs of Geʿez, Amharic and Tigrinya in the Geʿez script (gez-Ethi, am-Ethi and ti-Ethi, respectively) will be readily characterized as aksharic despite evidently satisfying the criteria proposed in this paper. For this reason, a definition of the akshara as a graphematic unit should, wherever possible, take into account and align with sociolinguistic perceptions of this unit of writing. To this end, I have attempted in this paper to address the graphematic aspect. A complementary sociolinguistic treatment of the subject matter is not only highly desirable but

8. For additional examples of WSs that are either alphasyllabaries or abugidas, but not both, see Gnanadesikan and Judson (2021) and Iyengar (2023).

imperative if we are to arrive at a comprehensive and epistemologically robust definition of the elusive unit of writing that is the akshara.

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Endangered Languages in the Digital Public Sphere: A Case Study of the Writing Systems of Boro and Manipuri

Rachel Garton, Merrion Dale, L. Somi Roy & Prafulla Basumatary

Abstract. Languages around the world are rapidly disappearing, with thousands of minority languages facing potential extinction. A key aspect of language documentation and revitalization is having a viable writing system, as the ability to read and write one's native language allows for the particularly relevant in the digital age, with the Internet allowing communication on a global scale. However, despite the benefits of a writing system, the development and adoption of a writing system and orthographic standards are not easy and can become a lengthy process. Due to the rapid loss of languages, many communities do not have the luxury to allow orthographic norms to evolve naturally and must make rushed decisions on writing system use. Parallel to these initiatives, many language communities have taken to sharing their language and culture online via social media. Social media is much more informal than many other modes of writing and allows writers to explore alternative writing styles, spellings, and even scripts. To explore this further, this paper presents case studies of two vulnerable languages—Boro and Manipuri—through interviews with native speakers and the personal experiences of its co-authors.

1. Introduction

A critical piece of language revitalization and documentation is the development of an orthography. The ability to read and write one's native language opens avenues for using the more. It is also crucial for efficient language documentation, since an orthography brings written language standards and allows community members to be active participants in the documentation process, helping prevent what is known as the "transcription bottleneck" (Cahill and Rice, 2014; Council, 2020).

However, the development and adoption of orthographic standards is no small feat and has many potential hurdles, some relating to the intricacies of the language, and some relating to community identity (Cahill

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and Rice, 2014; Devi and Choksi, 2022; Pappuswamy, 2017). Not only must communities decide on which writing system to adopt (e.g., Roman, Devanagari, a system with an indigenous script, etc.), but spelling conventions must also be agreed upon. Differing opinions on preferred scripts and orthographic norms can cause this process to be lengthy, which can then delay certain documentation and revitalization initiatives.

Due to the increasingly rapid global loss of many indigenous languages, many communities do not have the luxury of allowing orthographic norms to develop organically and must make rapid decisions on standards so that language documentation and revitalization can occur, some facing technological and infrastructural limitations along the way that can impede their progress. Additionally, speakers often find themselves operating in silos, each creating a variation of a potential orthography but unable to achieve a global consensus. Community input and collaboration is widely considered a critical facet of orthography development (Willis Oko, 2018) but it can be difficult to coordinate large workshops at a frequent cadence.

Social media has seen widespread adoption among indigenous communities for sharing their language and culture online (Buszard-Welcher, 2001; Carpenter et al., 2016; Cassels, 2019; Cru, 2018; Djomeni and Sadembouo, 2016; Emmanouilidou, 2014; B. D. Lillehaugen, 2016) and connecting individuals with other speakers of their language. This form of online written communication can be viewed as a way to gauge the state of a vulnerable stories and poems or religious texts, which may not accurately reflect spoken language and prove challenging for emerging readers to utilize.

Furthermore, standardized and regulated writing may have different lexical use and syntax patterns compared to spoken language (De Korne and Weinberg, 2021). Social media interactions are often much more informal and more accurately reflect daily conversion, meaning they may be a useful way to assess the organic use of a language's writing system and what patterns may emerge based on the types of written interactions that occur. This informal register can allow speakers to express themselves with a form of written language that best reflects their own linguistic realities, which can bolster language revival (ibid.).

To explore these ideas further, we present a case study of Boro (Bodo) (ISO 639-3: brx) and Manipuri (Meiteilon) (ISO 639-3: mni), two Sino-Tibetan languages spoken primarily in North-Eastern India. Both being scheduled languages per the Indian constitution and having available published literature (Pappuswamy, 2017). The writing systems of both languages have undergone notable transformations as speakers pursued scripts that were most representative of community identity and are still evolving today.

Section 2 will discuss the importance of written language for endangered orthographic standards. Section 3 will provide a cultural and sociolinguistic background of North Eastern India, the region in which both Boro and Manipuri are spoken. Section 4 and 5 will give in-depth information on the Boro and Manipuri writing systems, respectively. Section 6 will discuss the digital public sphere and the use of endangered and vulnerable languages online. Section 7 covers the current state of Boro and Manipuri use online, specifically on social media, and includes excerpts and observed trends from interviews conducted with native speakers of these languages as well as the third and fourth authors, who are native speakers of Manipuri and Boro, respectively.

As the authors discuss, the issue of orthography development for unwritten and endangered languages is often approached from a traditional linguistic perspective, though sociolinguists have recently applied critical theory to the topic (cf., De Korne and Weinberg 2021, Hernández, López-Gopar, and Sughrua 2017). Due to this perspective, written language is often viewed as secondary to spoken language and orthography development is seen as a "means to an end" for language documentation.

In an attempt to challenge some of these views and bring to light other facets of orthography development and use, the present paper seeks to include grapholinguistic theory (cf., Neef (2015) and Meletis (2020)) to the issue and connect the concerns of orthographic development to the larger grapholinguistic community. It is the authors' hope that this will bring greater awareness to the issue of orthography development for endangered the broader linguistics community how grapholinguistics can be applied to this critical topic.

2. Orthography Development

Having a corresponding writing system for one's language system provides opportunities to use the language in a wider variety of contexts. It allows not only for personal written communications (e.g., letters, dairies, etc.) but can also increase representation of the allows for the creation of educational materials and other publications. Also, if the script is available in Unicode, then it also allows for use of the language online (e.g., email, websites, social media), though there may still be hurdles to this, which is discussed in more detail in later sections.

Having a written language also helps to alleviate what is commonly referred to as the "transcription bottleneck" in language documentation. During documentation initiatives, there are typically hours upon hours of audio and video footage that is collected. The speech in these recordings must then be transcribed. Without a practical (i.e., non-academic) way to write the language, transcription falls on the shoulders of those



FIGURE 1. Photograph of sign in Meitei Mayek and Roman scripts, left (Bachaspatimayum, 2020)



FIGURE 2. Photograph of published Bodo Literature, right (Daimari, n.d.)

who are formally trained in linguistic transcription. A writing system allows community members to become active participants in the documentation process. However, development and adoption of a writing system and subsequent orthographic standards is a highly complex issue.

Before venturing into the larger discussion on orthography development, it is important to define the authors' use of terms such as "writing system," "orthography" and "script," as these terms are often used in a plethora of ways, often synonymously, among many linguists. We follow Neef (2015) and Meletis (2020), and others in our use of these terms.

A"writing system" is the combination of a script and how it is applied to a given language (i.e., graphematics). One may cite the "English writing system" which is a combination of the Roman script and the correspondences between the graphemes in the script and phonological units in the language. "Writing system" is very commonly conflated with "orthography," which will be addressed shortly.

A "script" is the physical implementation of a writing system, including its graphical features. For example, that the horizontal bar in <T> overhangs the vertical bar on both sides, as opposed to only one side as in <Γ>, is a feature of the Roman script and purely a graphetic concern, with no ties to a specific language.

An "orthography" is the prescriptive use of a writing system for a particular language, including spelling conventions and the correspondence of linguistic units to graphemes and grapheme clusters. Meletis (2020) describes three facets of an orthography—system, use, and norm. System is the actual writing system itself, as previously defined. This system is then put into use. Through more widespread and continued

use, certain norms begin to develop. This leads to the prescriptive use of the system, resulting in normative spellings. See Meletis (2022) for a more in-depth discussion on orthographic standardization.

Though many writing systems may have particular rules which allow for various spellings of a given word (e.g., "ryte" instead of "right," Meletis 2020, p. 156), orthographic norms dictate standardized spellings of written units. While there exist governing bodies to formally establish norms (cf., Académie française), historically many norms evolve organically over time. These norms are more enforced in certain domains, and variability is tolerated in some orthographic spaces better than others (ibid.). For example, published manuscripts are typically proofed for adherence to orthographic rules whereas written utterances shared on social media may be less standardized. This is of particular importance to the present study because the focus is on written language use on social media, where orthographic standards are typically relaxed and writers may feel more comfortable deviating from established norms or experimenting with alternative spelling conventions.

As previously mentioned, "orthography" is commonly conflated with "writing system," but the two are not synonymous. "Orthography" is strictly the prescriptive aspects of a writing system. This is an important distinction because if descriptive linguistics focuses on orthographies rather than writing systems then the descriptions become inherently prescriptive in nature (ibid.).

That is not to say that development/adoption of orthographic norms should not be prioritized, but they should be prioritized for the right reasons. If the end goal of developing orthographic standards is only so that it can be used to document spoken language, does that actually add any value to members of the language community beyond language preservation? Furthermore, critical theories have stressed the potential dangers of forcing a prescriptive orthography in a language community too early, as it can lead to literacy elitism and harmful social distinctions of "literate" and "illiterate" (De Korne and Weinberg, 2021; Hernández, López-Gopar, and Sughrua, 2017).

Grapholinguistic theory also stresses the fact that the orthographic module of writing systems (i.e., the prescriptive rules of writing system use) are not obligatory and written language can exist without strict conventions, as it has done so historically (Meletis, 2020). Rather than force prescriptive norms and rush decisions, the development of a written culture within a language community should reflect traditional communicative practices and evolve within the cultural context of the community as much as possible.

Cultural context is important. There are many non-linguistic factors that influence orthography development (Cahill, 2014), some of which will be explored in greater detail in later sections. These fall into what

is called "sociocultural fit"[1]. Writing and written language are deeply rooted in cultural identity and influenced by a myriad of sociopolitical factors, including religion, national identity, politics, etc. (Cahill, 2014; Meletis, 2020). Script, and even the typeface of said script, is strongly associated with particular groups and, thus, the choice to adapt an existing writing system can be seen as aligning culturally with those associated groups. This is seen to be the case in the North East Indian region, as will be discussed in the next section. No matter how good a linguistic fit a particular writing system may be, it will never be adopted by the writing community if it is a poor sociocultural fit (Cahill, 2014).

Technology is also a key factor in the modern, digital age. While a writing system is necessary for communicating online (Pappuswamy, 2017), the nature of the script and orthography also dictate how easy it is for individuals to engage in writing practices. Not all scripts are supported by Unicode and typing certain graphemes, including those with diacritics, on conventional keyboards can be cumbersome, leading to some writers using shorthand digraphs as an alternative to diacritic use (Chelliah and Garton, 2023).

Furthermore, prior exposure to majority language scripts and orthographic standards can influence the preferences of the language community. It is possible that an individual's native language (L1) is not the language they use in school, where they learn to read in a majority language and in another script. This native script (S1) (cf., Gnanadesikan 2020) may differ from the script used for the L1 writing system (L1WS) and features of the S1 may influence an individual's acquisition of their L1WS. This influence, or transference, may be positive or negative depending on the nature of the L1WS and the L2WS. If the L1WS, which would be S2, is a different script than S1 then the acquisition of S2 may be tedious and frustrating (ibid.). Adoption of a new writing system may go poorly for a language community if too many members have an S1 that differs from the script of the new system.

There are also linguistic factors of orthography development (Cahill and Rice, 2014), which determine "linguistic fit"[2]. In other words, how well does a writing system fit with the language system that it represents? When adopting a writing system, decisions must be made about how to represent certain linguistic features. These decisions are typically focused around how to represent the results of morphophonological processes (Chelliah and Garton, 2023). Should surface or underlying forms be represented? Or should a mix be proposed, as Snider (2014) recommends? Questions such as what constitutes an orthographic word and punctuation conventions must also be addressed. For an in-depth

1. See Meletis (2020), chapter 8 for an in-depth review of sociocultural fit.
2. See Meletis (ibid.), chapter 6 for an in-depth review of linguistic fit.

discussion and examples of these in a Tibeto-Burman context, see Chelliah and Garton (2023).

This plethora of factors means that the questions of writing system and orthography are different for every language and community of writers, though there are common threads and lessons to be learned from all stories. With that, the present paper focuses on the stories of two – focusing on the use of these languages' orthographies in digital public spheres.

3. Linguistic Landscape of North Eastern India

India is home to over 170 languages and 540 dialects, according to the Linguistic Survey of India (Grierson, 1921), and is a linguistically rich country. The North Eastern region of India alone is home to over 400 languages and dialects, 80 of which are considered endangered (Pappuswamy, 2017). These languages and dialects are spread across four language families—Tibeto-Burman, Indo-Aryan, Austria-Asiatic, and Tai-Kadai—the majority belonging to the Tibeto-Burman grouping (Haokip, 2021).

Language status in India is no less complex. While many countries merely classify languages as "official," the multilingual environment of India necessitates a more layered system. Special language status in India is determined by the Eighth Schedule of the Indian Constitution, resulting in some languages being referred to as "scheduled Hindi, though business and government work may also be conducted in English.

There are 22 scheduled languages[3], and these languages have special status in India. Scheduled languages are guaranteed cultural representation and the Indian government has a responsibility to promote them (Pappuswamy, 2017). Scheduled languages are also often the third language taught in schools per India's Three-Language Formula, which stipulates that schools teach Hindi, English, and a third Indian language (Eucation, 2020). The general purpose of scheduled languages is to preserve and promote linguistic diversity in India and protect indigenous languages of the region. However, this in no way guarantees the vitality of these considered vulnerable by UNESCO (Moseley and Nicholas, 2010; Pappuswamy, 2017). UNESCO cites the lack of a viable writing system and consistent script as a factor of this vulnerability (Moseley and Nicholas, 2010).

3. All 22 languages are: (1) Assamese, (2) Bengali, (3) Gujarati, (4) Hindi, (5) Kannada, (6) Kashmiri, (7) Konkani, (8) Malayalam, (9) Manipuri, (10) Marathi, (11) Nepali, (12) Oriya, (13) Punjabi, (14) Sanskrit, (15) Sindhi, (16) Tamil, (17) Telugu, (18) Urdu (19) Bodo, (20) Santhali, (21) Maithili and (22) Dogri (Governent of India, 2017).

Language and writing are deeply rooted in culture and, as such, are strongly tied to cultural identity. As previously discussed, the choice of writing system and script is often heavily influenced by socio-political and religious factors. This is absolutely the case in North Eastern India. The religious landscape of India is complex, with a spectrum of Buddhism, Hinduism, and Christianity. Writing systems are often heavily associated with religion (Lillis and McKinney, 2013; Pappuswamy, 2017), with Devanagari seen as Hindu, Latin seen as Christian, and Tibetan seen as Buddhist (Pappuswamy, 2017). Furthermore, deciding power over script choice is seen as a matter of local autonomy and can result in socio-political tension, as was the case with the Boro script shift in the 1970s (covered more in section 5).

The North Eastern region of India has dozens of tribal bodies, many of which have historically felt culturally repressed and economically exploited (Prabhakar, 1974). While great efforts have been made by the Indian government to weave these tribes into the larger tapestry of Indian culture, many individuals still feel closely tied to their tribal identities rather than a homogenous national identity. Script use and orthographic norms are a strong part of this identity and the use of a particular orthography can be seen as a way of expressing this identity (ibid.).

While historically the use of a preferred script was highly localized, the advent of the Internet, the increased accessibility of multilingual keyboards (e.g., Keyman, see Computational Resource for South Asian Languages (CoRSAL) (n.d.[c])) and the expansion of Unicode have given speakers of minority languages new, globally visible platforms upon which they can engage and express their linguistic identities.

4. Boro Writing System Shifts and Current Orthography

The Boro language, also known as Bodo, is spoken in Assam, particularly the autonomous Bodoland Territorial Region in North Eastern India (CoRSAL, n.d.). It is a member of the Sino-Tibetan language family and spoken by over 1.4 million people (India, 2011). Despite the large number of speakers, UNESCO still considers Boro a vulnerable language, with the writing system being a contributing factor (Moseley and Nicholas, 2010).

Originally, the language was written with a mixture of Roman, Assamese, and Bengali writing systems, with no orthographic conventions established (Sarmah, 2014). In the 1950s, the Assamese script was settled on, but this was short-lived. Since the 1950s, there have been continued discussions over which script would best represent the identity of the Bodo people. Assamese was not the preferred script for the Bodo



मोकथां जीउनि सावगारि बोग्रा : गुस्ताभ कुरबे

गुदि : बिकाश पराशर

राव सोलायगिरि : मुश्रीमा किरन बर'

जीउनि सुखु-दुखु, रंजा-बाजा, थैनायनि नुथाय, सोरजिनायनि बायदि बायदि महरखौ बेरखां होनाया सावगारि मुलुगनि मोनसे गोमोथाव आरो ओंथि गोनां बाथ्रा। थिक बिदिनो सावगारि मुलुकआव जीउनि गासै खौबो बेरखांहोग्रा गांसे सावगारिया जादों : "The Painters Studio" । बे गांसे ओरैबादि सावगारि जेराव गासिबो मोकथां जिउनि महरफोरा बेरखांजोबदों। सावगारि बोगिरि कुरबेआ गावनि लोगो सेम्पफ्लेउरी नो गांसे लाइजामजों फोरमाय हरदों : 142× 2353/4 इंचि गुवार गावगारियाव आगसिथि **थैनायनि फार्से आवगायलांनाय जीउ, आगदाथि जीउनि गोजोननाय** आरो गेजेरनि सावगारियाव गावखौनो **सोरजिलु खामानियाव मुखुब जानाय** फोरमायदों। बियो जानो हागौ थैनाय आरो थांनायनि जुजिनायनि सिन। बे सावगारिखौ लानानै गोबां सुबुंआ गोबां बाथ्रा बुंदों। गोबांआनो बिखौ फ्रान्सनि राजखान्थिनि सिन होननानै बुंनो नागिरो। World Exibhition नि सायख'गिरि फोराबो बे सावगारिखौ गोजौ थाखोनि होननानै बाख्नायदोंमोन। सावगारिखौ मोकथां (Realism) जों लोगोसे सावगारि बोरिगिनि साबसिन सावगारि होननानै फोथायदों।

बै मुंदांखा Painting खौ आखिदोंमोन फ्रान्सनि "जेन डेजार गुस्ताभ करबेया"। मोकथांबादि सावगारि बोगिरि होननानै सिनाय जानाय कुरबेआ 1819 माइथायनि 10 जुन दानाव सुइजारलेण्डनि सिमायाव थानाय सानजा फ्रान्सनि जुरा मुंनि मोनसे फिसा नोगोराव थानाय अरनानसआव जोनोम मोन्दोंमोन। उन्दै समाव गुस्ताभ कुरबेया अरनानसनि हाजो ओनसोलाव जीउ खांदोंमोन। अरनानसआ फैलाव जायगा, गुबुन फारसेथि अरणबारि आरो बेनि गेजेरावनो दङ'मोन अनथायजों बुंफबनाय

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FIGURE 3. Photo of an article about French painter Gustave Courbet (Boro, 2005)

people, who wanted autonomy and a way to express their cultural identity (George, 1994; Prabhakar, 1974).

In the 1960's the first Boro medium schools were introduced, where, as the name suggests, Boro was the medium for all classroom instruction. This prompted accelerated conversations about the need for a standardized Boro writing system to be used in textbooks (C. Basumatary, 2014; P. Basumatary, 2017; BC, 2019; Wary, 2017). Throughout the 1970s, the Bodo Sahitya Sabha (Bodo Literacy Society) became a major participant in the push for a new script for the Boro writing system. Originally, the Roman script was proposed and school materials began to be published in Roman script following proposed orthographic rules (Prabhakar, 1974). However, other parties pushed for Devanagari and eventually the Bodo Literacy Society, Bodo Sahitya Sabha, shifted their stance, formally agreeing to adopt Devanagari for Boro in 1975 (Sarmah, 2014). Despite this formal adoption, discussion about which writing sys-



FIGURE 4. Photograph from a Boro orthography workshop on December 12, 2010 (photo taken by co-author Prafulla Basumatary)

tem and script to adopt are ongoing. Co-author Prafulla Basumatary made an observation regarding personal preference for one script over another on Facebook. He noted that Bodos historically have used both scripts but that a section of the population still has a preference for using exclusively Roman script and he observes that this preference carries over into their script choice on Facebook.

Today, the Bodo Sahitya Sabha remains a critical organization which continues to work with the Boro community on orthographic standards for the language. Workshops are frequently held and the literacy society has been known to leverage social media to announce workshop decisions. This will be discussed in more detail in section 7. Boro is largely written in Devanagari (see Fig. 3), but some writers will use the Roman script in certain contexts. As the authors explore in section 7, there are numerous motivations for a Boro speaker to opt to write in either Roman or Devanagari script.

5. Manipuri Writing System History

The Manipuri language, also known as Meiteilon (also, Meithei, Meitei, Meitheiron, Meetei), is widely spoken in the Indian state of Manipur (CoRSAL, Manipur) as well as in Assam, Tripura, Bangladesh and Myanmar. The official Census of India 2011 recognized 1.7 million speakers, but other estimates are closer to 3 million due to the distribution of speakers beyond Manipur (Roy, 2017).



FIGURE 5. Digitized image of a Manipuri manuscript (Shobhana Lakshmi Chelliah, n.d.)



FIGURE 6. Photo of Manipuri speaker Chanam Hemchandra displaying a Manipuri manuscript (Roy, 2008)



FIGURE 7. Photograph of Manipuri manuscript collection (Molinaro, 2008b)

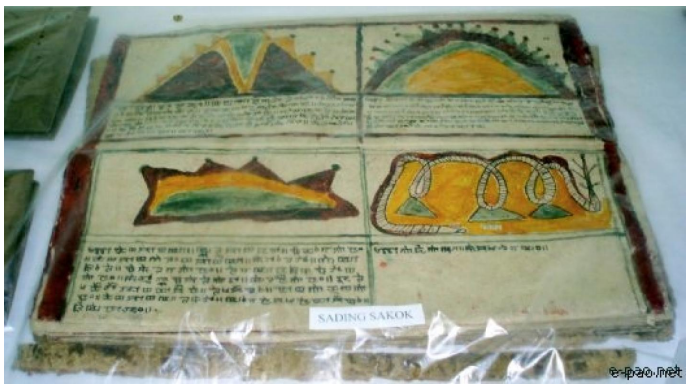

FIGURE 8. Photograph of a Manipuri manuscript: Sading Sakok (Molinaro, 2008a)

Despite these large numbers, UNESCO reports still consider the language vulnerable due to a number of factors, including lack of a unified writing system (Moseley and Nicholas, 2010). Like Boro, Manipuri has been written with more than one script and this flux has prevented a unified writing system to be accessible for all generations.

Prior to the 18th century, the Manipuri language was written using an abugida called Meitei Mayek (Laithangbam, 2017). The script is from a group of Tibetan scripts originating from the Gupta Brahmi script (Shobhana Lakshmi Chelliah, 2011). In the early 18th century, Hindu missionaries spread Hinduism amongst the region, prompting the converted King of Manipur (and, later, the British) to decree the use of the Bengali script (Bangla) instead (Laithangbam, 2017; Roy, 2017). Bangla initially coexisted with Meitei Mayek throughout the 18th, 19th, and

20th centuries but then gradually gained ascendance after the Anglo-Manipuri War of 1891. Today, roughly 40,000 manuscripts in Meitei Mayek remain, in part because Hindu missionaries torched many writings in Meitei Mayek (Roy, 2017). See Figs. 4 and 5 for a scan of a surviving manuscript and photo of a bound book.

While Meitei Mayek was originally replaced with Bangla, the script was officially reinstated as official for the Manipuri writing system in 2006. Now shop signs, newspapers, and other public written materials in Meitei Mayek can be found (Laithangbam, 2017). It was added to the Unicode Standard in 2009 (Roy, 2017) which has further spurred its adoption. The Supplementary Document by co-author L. Somi Roy details this history in his account of his attempt to bridge the gap in the usage of the two scripts.

6. Endangered Languages in the Digital Age

The 21st century has brought a new wave of technologies, some referring to society's current digital transformation as the "Fourth Industrial Revolution" (Schwab, 2018). The rapid advancement of information technologies, which allow users to easily engage with one another on a global scale, has given rise to new public spheres which exist only digitally.

The concept of "public sphere" (German: *Öffentlichkeit*) was originally coined by Jürgen Habermas, a German philosopher. Habermas defined a public sphere as a community "made up of private people gathered together as a public and articulating the needs of society with the state" (Soules, 2007). While Habermas' definition does include virtual communities which do not "necessarily exist in any identifiable space" (ibid.), the authors specify public spheres which exist online as "digital public spheres" to better differentiate the phenomenon from more traditional and analog public spheres.

Among these digital public spheres exist those comprised of speakers of endangered languages who are communicating and connecting online to share their language and culture. Before the digital age, speakers of endangered languages had much more siloed communities in which language use, especially written language use, might take place. The language might be written locally within a tight geographic space, but writings rarely spanned beyond that and, if they did, it was likely in private communications or formal (often religious) writings, not in a broader social capacity. As a result, languages used in such a confined environment were at a stronger risk of dying out, as speakers defaulted to the more wide-spread and accepted majority languages of their area. For details on the many factors which contribute to language endangerment, see Shobhana L. Chelliah (2021).

Enter the age of the Internet, digital communication, and social networking platforms. Suddenly, the reach of small language communities is expanded globally so not only can individuals communicate across the world in real time, but their writings can be easily diffused among others. Buszard-Welcher's 2001 publication *Can The Web Help Save My Language* explored the then-emerging phenomenon of websites dedicated to the use, preservation, and promotion of endangered languages, and the potential role these sites could play in the future of language revitalization. She analyzed these sites in terms of their creators, users, content, and appeal to young speakers. Since 2001, the arrival of social media has provided many significant platforms for endangered

Social media can serve as an access point for many individuals to other people who speak their language, or who are affiliated with the language through their heritage (Cassels, 2019; Scannell, 2012). Many of these platforms allow the creation of folksonomies, which ensure that the tagged content is searchable by others and can boost the content's visibility. This property alone has valuable implications for the promotion of minority and endangered languages as evidenced in examples of videos on TikTok using the hashtag #cajunfrench which, at the time of writing, have garnered a collective 30.7 million views. Selecting this tag brings up every video that has used it (often an individual sharing a recording of an older family member telling a story in Cajun French or teaching songs, stories, and new vocabulary). Similarly, separate digital language activism campaigns and case studies on the Gwitch'in, Sami, and Zapotec languages have resulted in the creation of Twitter hashtags to encourage use of these indigenous languages, and in the case of Zapotec, helped to establish a more active online "writing culture" (Billock, 2015; B. D. Lillehaugen, 2016).

The creation and utilization of Facebook groups for language learners/communities has served in some respects as a modern interpretation of endangered language websites. Group members are able to engage in discourse with one another and share questions, media from other platforms, and even archived materials related to the community's shared language and culture (Dale et al., n.d.; De Falco and Cesarano, 2016). For example, the University of North Texas' Computational Resource for South Asian Languages (CoRSAL) has worked with linguists and language collection depositors for the Boro, Lamkang, Azamgarhi, and Burushaski language collections to create such groups on Facebook as a means to connect members from each speaker community to their archived easily accessible for promotion and revitalization purposes for speaker communities who might otherwise face internet connectivity struggles, making it more feasible to access this data through Facebook on their mobile devices.

Community-based language and policy planning prioritizes the agency of representation and use (McCarty, 2018). The participatory

nature of the digital public sphere has allowed for certain areas to serve as grounds for grassroots language reclamation that can manifest through vernacular literacies, as well as language ideology and image planning discourse (Androutsopoulos, 2013; Barton and Lee, 2012; Cru, 2018). A 2018 case study examined the comments section for two videos of Yucatec Mayan and Mapuche rap music and found that the positive feedback left by members of each respective language community were expressed through multiple orthographic systems and representative of sentiments of prestige and image planning among the speakers of these indigenous languages (Cru, 2018). Cru noted that, in contrast to regulated environments like schools, "user-generated digital spaces are opening up opportunities for the production of meaningful writing practices in indigenous further noted that these spaces are more free from expectations of standardization. This is a sentiment that B. Lillehaugen (2019) and B. D. Lillehaugen (2016) supports in her work with the use of Zapotec on Twitter. She notes that it is not crucial for a language to have a standardized writing system for them to participate in writing their language on social media, and that such standardization can often arise out of the ongoing writing practices of the speaker population (p. 365).

6.1. Representation and Negotiation in the Digital Public Sphere

While the technology exists to facilitate online use, there are still developmental hurdles for many languages. If a language's orthography utilizes a script that is not yet available in Unicode, there is still work to be done. Harkening back to the early exploration of dedicated endangered language websites, Buszard-Welcher identified the issue of font (un)availability, noting that there was considerable discussion of this issue across these websites she studied:

> Of the sites in the sample, 28% had content on writing systems. This includes discussions of fonts (7 sites), offering fonts for free download (7 sites), and discussions of writing systems (7 sites). The latter are usually short descriptions of the development of particular writing systems accompanied by a chart of symbols. One site, Cherokee, has online lessons for learning to use the writing system (Buszard-Welcher, 2001, p. 334).

The need for bridging the digital language divide, and ensuring greater diversity in web/social media compatible scripts persists, but there have been notable efforts put forth by the speakers of affected Osage language (ISO-639-3: osa) is a Native American language spoken in modern day Oklahoma, United States and is written with a script that represents the movements in traditional dances. The project to incorporate the graphemes into the Unicode Standard was long and expensive,

requiring coordination with community leaders and Unicode developers (Martucci, 2014). Thankfully, this hard work paid off and today Osage speakers can write their language digitally (Nation, 2014).

Despite the inclusion of many scripts into the Unicode Standard, usability is still a major concern. Multilingual keyboard software and mobile applications have become fairly advanced, but the usability gap between more widespread scripts (e.g., Roman, Cyrillic) and specialized scripts (e.g., Meitei Mayek) is wide. These usability concerns add a layer of complexity to the already-complex issue of orthography development and script choice. In fact, as explored in Section 5, there have been proposals to "Romanize" Manipuri in order to facilitate easier digital use, particularly on mobile devices (Roy, 2017). Additionally, writers of some languages, such as Hakha Lai (ISO 639-3 code: cnh) and Mizo (ISO 639-3 code: lus), may also resort to shorthand representations of graphemes which are cumbersome to type. Both the Hakha Lai and Mizo orthographies utilize the grapheme <ṭ> but writers will often substitute this with <tt> and <tr>, respectively (Chelliah and Garton, 2023).

These examples raise an interesting question with respect to the case studies at hand: How are Boro and Manipuri orthographic standards negotiated in a digital space? What factors may dictate or motivate individual script choice/spelling conventions? As discussed, the use of endangered languages online has surged in recent years, resulting in far more written material than ever before. Could digital platforms, like social media, expedite more natural development of community orthographic norms? The following sections will explore written language use by Boro and Manipuri speakers online, specifically as it pertains to their use of social media, and will discuss potential implications for how social media might be leveraged by language communities continuing to develop orthographic rules for their chosen writing system.

7. Boro and Manipuri Online

In order to understand the lived experiences of Boro and Manipuri writers, the authors interviewed Boro and Manipuri speakers who use their respective language to engage online, either actively or passively. The focus of the interviews was on Facebook, as both aforementioned Bodo Literacy Society, have a Facebook presence, but interviews also touched on other social media and digital platforms, such as WhatsApp, YouTube, Instagram, and email. Themes from the interviews were then validated against the observations and experiences of the third and fourth authors as users of social media platforms such as Facebook and WhatsApp and native Manipuri and Boro speakers, respectively. The

following sections discuss the individual results for Boro and Manipuri before summarizing the findings and identifying key themes.

7.1. Boro Use Online

Although, unsurprisingly, every internet/social media user will have behaviors and tendencies that shape the varying observations of their user unique experiences, among the Boro speakers interviewed there were trends in their observations of the factors influencing digital Boro writing. Interviewees reported varying writing domains of original posts on Instagram and WhatsApp. They also reported active commenting on YouTube videos as well as both individual and group Facebook posts.

There was a unanimous consensus among interviewees that a primary motivating factor for the choice between using Roman or Devanagari script online was that of convenience. Perception of convenience was motivated in part by the assessment that Roman script could be employed with a greater speed. Additionally, co-author Prafulla Basumatary notes that the Roman keyboard may be regarded as easier to use and present fewer spelling challenges for users. Individual technological proficiency was another factor that one interviewee cited as contributing to the convenience of Roman script, particularly with respect to an individual's ability to incorporate another keyboard like Devanagari onto their (primarily mobile) devices. This was a notable factor in one interviewee's observations of Roman script usage on WhatsApp.

The interviewees indicated that educational medium background could be a similarly influential factor in a Boro speaker's script choice, word choice, and spelling conventions. The difference between a Boro medium educational background and another language medium, such as English, Assamese, or Bengali, impacts a young Boro speaker's exposure to their medium don't have the same access to Boro language classes where Devanagari spelling conventions are taught.

One of the primary aims of the Bodo Sahitya Sabha, according to their official website[4] is to impart a sense of urgency regarding the need for more mother-tongue education and to "expand the Bodo language by producing standard literature and Text Books in [Bodo]" (Sabha, n.d.). These efforts are part of co-author Prafulla Basumatary's current postdoctoral research on the Initial Literacy Measures of Boro Learners. Of the three Boro speakers interviewed, only one of them had received Boro medium educational training. As a result, they expressed a feeling that it was their responsibility to share Boro content on social media using Devanagari, and to also provide transliteration and translation as they

4. The official statement from the Bodo Sahitya Sabha (Bodo Literacy Society) can be found on their website at `https://bodosahityasabha.org/aims_objects.html`.

saw fit. Alternatively, the following quote is from an interviewee who received an English medium education, and details the way this background impacted their understanding of Standard Boro in Devanagari script:

> [...] most of us didn't really have Boro as a subject in our school since we were... from the English medium school, we would say that. So, we don't really, to be honest, even I'm just learning the Boro script. We didn't really have any idea about how it's written in Boro actually. So, since we just speak Boro... we just write it in Roman alphabets. Because that's easier for us rather than writing in Devanagari script since we don't really have the actual idea of how it's written in Devanagari...So, I can read it, but the problem was we didn't really understand a lot of what was written because the written words are quite different from the everyday words that we use when we're speaking. So yeah, we could read, most of us could read the Boro, but... it was like we didn't really understand. But yeah, now I think a lot of us are trying to understand what it is, by maybe taking the help of dictionary and stuff. Yeah. That's how it is.

This interviewee reported seeing Standard Boro on Instagram captions and shared posts in WhatsApp and giving up trying to read them because they were too hard for eir to understand. Another Boro speaker with an English medium background reported a higher comfort level using Standard Boro, the formal written register taught in Boro medium schools, and reported switching between writing in English or in Boro with Roman and Devanagari script depending on the nature of the post. Formality of topic was a common theme among interviewees contributing to an individual's script choice across digital platforms. Interviewees noted a difference between Standard Boro and a more informal and conversational Boro, where the primary difference between the two is word choice. They described Standard Boro as being common to domains of online posts including discussions or posts about Bodo culture, literature, and other topics of academic or intellectual significance. Additionally, groups on Facebook, particularly those disseminating information to a large audience, were reported to commonly write in Standard Boro. Posts created by Bodo news media accounts on Facebook exclusively write using Standard Boro and commonly use Devanagari. Interviewees noted that Roman script is not limited to conversational Boro and can be seen used for formal topics, however one interviewee observed that, in eir experience, those who use Devanagari on social media would be strictly using Standard Boro.

In addition to topic formality, the script choice of one's online conversation partner may also have some bearing on one's personal script choice, particularly in the comment sections of platforms like Facebook or Youtube. An interviewee noted that in their personal experience many individuals in their Facebook network (including themselves) use English as their prominent language for captioning their posts, but that

even when e creates a Facebook post in English e will engage in Boro comments with script and formality variance depending on the topic and conversation partner.

Another interviewee, who reported no longer being an active Facebook user, recalled their memories from the many years they were active on Facebook in addition to the exchanges they witnessed on other digital platforms. They reported seeing debates taking place in Facebook groups and noted that the formality of word choice might change the more heated an argument got. They occasionally observed script switching depending on the users' educational backgrounds. For example, if the digital interlocutors shared a Boro medium background the exchange might stay in Devanagari, and if not the exchange might switch from Devanagari to Roman the longer they continued to converse. They reported that online arguments might switch from English/Assamese to Boro in public groups or shared posts. Additionally, the interviewee observed that YouTube comment sections differ in formality and script choice by video domain. Often more informal content (such as music videos or funny videos) will yield a more informal form of writing in both Roman and Devanagari scripts, but in their experience, formal content like Boro political/news videos have more formal commenting and individuals more heavily utilize Devanagari. A different interviewee reported that in their experience Roman script is what they see utilized the most on YouTube, but that tone and word choice would vary depending on the content of the video in question.

That being said, the informal written register of Boro is reported to be seen across digital platforms and is commonly seen in the comment sections on Facebook and YouTube, where individuals are writing in the same way they would be likely to speak to one another in person. In one interviewee's experience Facebook comment sections tended to frequently display both Roman and Devanagari scripts, particularly when the original post was from an account or group with a large following. When prompted as to whether individuals might be motivated to use one script or another the interviewee noted the following:

> [As] far as I have noticed, they may have their own writing but all of them know the standard one. So if the other person is writing in standard form of Boro, then the other, like for me, then I will reply in there in standard form. So, like that, if I want to comment on some one friend who I have known now like from earlier, then I will write how I speak.

With respect to any type of metalinguistic discourse, all respondents agreed that this was not common practice among Boro online conversation. The Boro speaker who indicated e had observed metalinguistic discourse noted that, with respect to addressing or announcing the spelling conventions at large, they have only witnessed two individuals post anything of that nature on Facebook. E did mention, however,

that e had more frequently seen people involved in Bodo news media pointing out spelling errors to other Boro-speaking Facebook users if those individuals were sharing intellectual content, particularly relating to Bodo identity and culture.

The aforementioned interviewee's remark that for most users, Boro writing on social media is "more about the message" than the spelling, was echoed by another interviewee who felt these conversations seldom take place. Eir impression was that spelling discourse and graphol-inguistic correction was rare because many people would not see the value or impact that altering their spelling choices would have on their everyday life. This interviewee shared memories of their own personal transliteration work converting Boro from Devanagari to Roman script. E recalled consulting eir friends on WhatsApp for their guidance on the spellings of certain words and encountered two different responses:

> I didn't really get an answer from them, because they... all they would tell me is like, "This is what we have been writing, since a very long time..." Yes. Or maybe sometimes someone would say, like, when I tell them "Okay, but this person told me that this is written right," and then they'll ask me, "Okay. Where... are they from? No no, they are wrong. This is how you should write." And then again, there's another reaction to it somewhere else: "Oh, maybe you can also spell it like that." Yeah, there are like two reactions to it. Someone sometimes tells me that "No, this is wrong, you should read what I've written, I've told you," and when someone tells me "No, you can also write this one...." And then I think they accepted all at times, sometimes they even... they are like you know, "Just accept it all because, like it also... it like, you know, it's because of the dialect probably. That's why it's different so since we have to include all the dialects of the Boro, so why don't... why not include all of it all the spelling?"

Dialectal variation in spelling was reported by more than one interviewee and points to the notion that this is a common justification for said variance. Similarly, co-author Prafulla Basumatary has observed that individuals who do not know correct spelling may shorten the spelling of words in Roman or Devanagari script either by choice or without knowing their spelling is inaccurate. After years of work, Basumatary believes that the Boro Sahitya Sabha is close to the goal of having a finalized orthography. He posits that including more linguists into the workflow in addition to those who are from literature and other academic backgrounds, may also be beneficial to completing the process.

7.2. Manipuri Use Online

Similar to the frequent use of Roman script for Boro, there was consensus by Manipuri respondents that Roman script is the predominant script used online, despite Roman script having no history of an official

script. There was a general consensus among respondents that Roman is easier to use on conventional keyboards compared to Bangla or Meitei Mayek so it is often preferred. Additionally, while Meitei Mayek was added to Unicode in 2009, it is not always supported on mobile devices and there is minimal awareness of Meitei Mayek digital keyboards. One respondent shared that despite having Unicode, people do not realize and thus default to Roman script:

> I also use in Roman script, because... in the mobile phone, Android phones, or computer, ... Bengali is already there but Meitei script is something difficult to use ... we have the Meitei script ... I think we have Unicode also but people [are] not aware about that. That's why most of the people use Roman script.

As this respondent also reported, even if an individual is aware that Meitei Mayek can be used on their personal devices, it is difficult to use and Roman is more convenient for rapid online input. However, while convenience was frequently reported as a contributing factor, perhaps the most notable reason for the use of Roman script being preferred online is the sentiment that Roman script is the common script to bridge the gap between those literate in Bangla and those taught in Meitei Mayek. When Meitei Mayek became the official script of Manipuri in 2006, it resulted in a schism between those who were educated in Bangla and the younger generation who became fluent in Meitei Mayek. Younger Manipuri speakers are unlikely to know Bangla and many older speakers have not fully mastered or become comfortable with Meitei Mayek. Roman script, however, is mostly known by all speakers, despite never being an official script used by the language. Therefore, to ensure one's message can be read by all, Roman script may be preferred. As one respondent reported:

> Older people [use] Bengali but the new generation does not know about the use of Bengali script so they use Meitei script or Roman script. Because, since 2006, [we] started to use the Meitei script instead of Bengali script. That's why the new generations know only the Meitei script.

This schism in script was often mentioned by respondents and has had significant impact on the writing culture of Manipur, particularly in more informal registers such as social media. More background the schism is discussed in the Supplementary Document appended to the end of the present manuscript.

Since Roman is not, and never had been, an official script, there are no spelling conventions for its use. Writers will often use invented spellings that they feel most accurately represent the phonology of the utterance. While this does result in variation across texts, respondents shared that spellings are close enough that, with the help of context, communication is not hindered in any way. Due to lack of codified

spelling conventions, there was also a sentiment among respondents that standardized spelling was not a major concern when using Roman script on social media: "in social media it doesn't matter about the spelling or whatever, any word they like they can use and they can use whatever spelling." Roman is viewed more as a convenient way to transcript Manipuri in a script that all can understand rather than a script being preferred for official use. Some of the spelling variations reported by respondents is inconsistent use of double vowels to indicate phonemic vowel length (e.g., <aa> vs. <a> for [a:]), which is a common spelling variation seen in other languages of the region (see Chelliah and Garton (2023)). Other observed spelling variation centers around representation of aspirated consonants, with one respondent reporting that he encounters <f> and <ph> both used for [p^h].

These reports highlight the persistent issues faced by writers of uncommon and minority scripts globally, not just in North Eastern India. Accessibility of a script may not be optimal, leading many writers to opt for a majority script in certain situations. This inaccessibility can take many forms. Firstly, Unicode representation can be difficult to obtain. The Unicode consortium will only incorporate new characters once they have been vetted and approved and typefaces must be designed so that they conform to Unicode standards, which can be a tedious process requiring support from Unicode developers (Martucci, 2014).

Once Unicode support is accomplished, there are still issues with the distribution of the fonts and input methods for devices. As mentioned by Manipuri respondents, many people are unaware of the availability of digital Manipuri keyboard options. Even if awareness is achieved, there is then the issue of adoption by users. Some input methods can have issues of usability and ergonomics. Many conventional input methods, such as digital keyboard layouts and predictive text, are highly alphabet-centric and not designed with other writing system typologies in mind (Rowe, 2022). The user experience for writers of other writing system typologies can be lacking. These issues can compound and lead to cases like Manipuri, where writers default to a majority script like Roman when the register of writing is informal and ease-of-typing is a priority.

The informal register of social media could be a factor of script choice as well. Respondents did not report many original writings in Roman script on social media despite the Manipuri community having a very active writing culture, such as the publication of *Asangba Nongjabi*, "Crimson Rainclouds," a famous play written by MK Binodini Devi, who signed her works as Binodini. For more background on this publication, please see the Supplementary Document appended to the end of the present manuscript. Formal writings such as Crimson Rainclouds are published in Meitei Mayek or, if published prior to 2006, in the Bangla script. Other official publications such as learning materials, signage,

newspapers, etc. are all also in Meitei Mayek. Roman script is strictly used in informal contexts, such as social media discussions. due to convenience.

The topics of social media discussions, though informal, can be broad. Respondents reported that topics discussed online typically varied by age group and also ethnic groups and tribal affiliations. Political discussions and current events are often discussed, as seen with other languages on social media. Metalinguistic, or metagrapholinguistic, discussion was not commonly reported. However, a notable occurrence was mentioned by a Manipuri interviewee who said that when Meitei Mayek was added to Unicode there was some discussion online about this advancement. Interestingly, though many Manipuri speakers are undoubtedly aware of the inclusion of Meitei Mayek in Unicode, awareness of keyboards to input the script appears to remain lacking.

7.3. Summary of Findings

When comparing interviews across both languages, themes began to emerge. These themes can be grouped into four general categories—the writers' script choice, the topics being discussed online, spelling conventions and word choice, and metalinguistic/metagrapholinguistic discussion.

Script Choice

By far the most prevalent factor influencing script choice was ease of use and convenience. For both Boro and Manipuri writers, the use of the Roman script is by far the easiest in a digital format and, thus, is the most commonly used. Toggling back and forth between the keyboards is clunky, and in the case of Manipuri speakers not all users have access to a Meitei Mayek keyboard.

Education was also a notable factor. Not education level, but rather educational background and the year(s) in which the individual was educated. In the case of Boro, it is not the case that all Boro speakers receive a Boro medium education, and as a result this impacts non-Boro medium students' proficiency in reading and writing their language using Devanagari script and contributes to their preference for Roman script. With respect to Manipuri, as noted above, the official shift from Bangla to Meitei Mayek caused a schism, so those educated before vs. after 2006 were educated in different scripts.

Lastly, the nature of the topic being discussed was also mentioned as an influencing factor for some interviewees. For example, if a post is longer or more formal then a writer may opt to use Devanagari for Boro, as it is the official script. One interviewee also mentioned that

if they are in a conversation with someone they will often adapt to the script used by their partner so the conversation flows in one script rather than a back-and-forth. This can be considered a kind of written code-switching.

Topics Discussed

For topics discussed, speakers of both languages reported a wide range of concepts across various digital platforms. Everything from news and politics to culture, such as poetry, art or musical performances. This is a positive indication of a vibrant and healthy online writing culture, which is very promising for the long-term vitality of these

Spelling/Word Choice

Interviewees frequently reported that spelling conventions were not often regarded on social media, likely due to the informal register. One Manipuri interviewee even said "no one cares about spelling online," though some respondents said they observed social media users correcting one another's spelling. Formality of certain topics in Boro were one factor that contributed to the formality of the register. Correction of spelling and grammar seemed to be more common as a response to more formal and official posts, such as posts from official pages. One Boro respondent explained that this is because official pages are seen as representatives of the language and have higher visibility. Therefore, proper language use is perceived as more important.

Dialect was also cited as a reason for some of the spelling variation. If someone is unsure of how to spell a word, they will make a guess based on how it sounds. The phonology may differ from dialect to dialect, making these invented spellings differ in tandem.

One final theme for spelling is the issue of loan words. Respondents from both languages mentioned loanwords being a point of uncertainty with spelling because some writers wish to preserve the original spelling of the borrowed word and others may wish to nativize it and adapt the spelling to native conventions. This is particularly common when the loan word is from a language with a shared script (e.g., English, Hindi, etc.)

Meta(grapho)linguistic Discussion

One final theme is the occurrence of metalinguistic discussion, or more specifically metagrapholinguistic discussion (i.e., discussing written language in written posts). While such discussion was not as common as originally expected, Bodo respondents did mention some notable occurrences. As already mentioned, some users would correct one another's

spelling, which could be seen as a form of metagrapholinguistic interaction. Additionally, one Manipuri respondent reported discussion about the inclusion of Meitei Mayek into Unicode, which can also be considered a form of metagrapholinguistic discussion. More notable, however, was the occurrence of announcements about changes to or decisions made about Boro orthographic standards, often due to an orthography workshop. These announcements might also yield isolated comments and discussion.

8. Conclusion and Looking to the Future

In the digital age, it is propitious for minority languages to expand online, as this provides more channels for communication in the increase exposure to the international community. However, writing one's keyboards for one's native script. In these situations, writers may opt to use an already-available script as a stop-gap until Unicode expands or input devices improve. The issue of Unicode availability and the usability of digital keyboards remain serious issues for minority languages and underrepresented scripts. It would behoove the linguistic community to focus on these issues as a serious concern for language revitalization and representation.

Through the interviews conducted with native speakers and from the third and fourth authors' experiences, this paper examined the online writing culture of Boro and Manipuri speakers and explored the history and use of each language's writing system on social media.

Despite script changes and revisions of standards, both languages have active online writing cultures. A major commonality between these two writing cultures is that Roman is often the preferred script for use online despite not being official for either language. With Roman script use as well as use of other scripts, orthographic conventions are not always adhered to, but this appears to have little or no impact on communication and online assertions.

Boro and Manipuri represent two of many vulnerable languages across the globe, many of which are still growing their online presence. As seen with the cases of both Boro and Manipuri, and as urged by B. D. Lillehaugen (2016) and others, vulnerable language communities need not wait for official orthographic standards to begin writing their language. An online writing culture can flourish without codified standards of standards may not even be adhered to online even when they do exist.

This paper was written as an effort to assess the current state of Boro and Manipuri digital writing. While the objective was not to predict the shape these languages' orthographic standardization will ultimately take, we expect that it will be of continuing significance to observe how

the digital writing of both languages evolves alongside updates made to their writing systems.

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THE MANIPURI LEARNING MODULE
Using a Modern Manipuri Play as a Learning Tool

L. Somi Roy

"Binodini's Crimson Rainclouds: A Learning Module" is a set of digital documents in English and Manipuri based on a modern Manipuri play. It is designed as a learning program for people in the arts and humanities anywhere in the world who wish to learn Manipuri.

It grows out of "Crimson Rainclouds," my English translation of a Manipuri play called *Asangba Nongjabi*. The play is a work for radio and stage by the Manipuri writer, my mother, MK Binodini Devi, who signed her works as Binodini. It is about an artist caught between his art, and two women in his life. The play is celebrated in Manipur for the expressiveness and power of its realistic dialog.

I used the play "Crimson Rainclouds" to develop a learning tool for Manipuri for anyone anywhere. From this developed the Manipuri Learning Module on Zenodo which was later migrated it to the University of North Texas in Denton. Free universal access to the Module documents are available for scholars and researchers on both Zenodo and UNT Libraries portals.

The Module is made up of five parts: "Crimson Rainclouds," the English translation of the play; the Manipuri original *Asangba Nongjabi* in the Bangla script that Binodini wrote in; its transliteration into Meitei Mayek; a Roman transliteration; and, finally, an audio-recording of the play in Manipuri. One can therefore read the play in English, or the Manipuri original in Bangla, Meitei Mayek or Roman scripts. They can also listen to the play. There is also a note on the Romanization system I



FIGURE 9. MK Binodini Devi (1922-2011)

have employed, which will be discussed further below. I added a primer of the Meitei Mayek alphabet too, since the script is not well-known like Bangla.



FIGURE 10. Asangba Nongjabi by Binodini, 1967

"Crimson Rainclouds" was published in 2012 by Thema Books of Kolkata as a two-language, three-script volume. The English translation is followed by the Manipuri original in Bangla and Meitei Mayek. The two Manipuri versions were published on facing pages. The text of each page in one script corresponds to the text on the facing page in the other script.

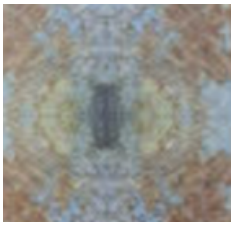

FIGURE 11. Crimson Rainclouds, 2012

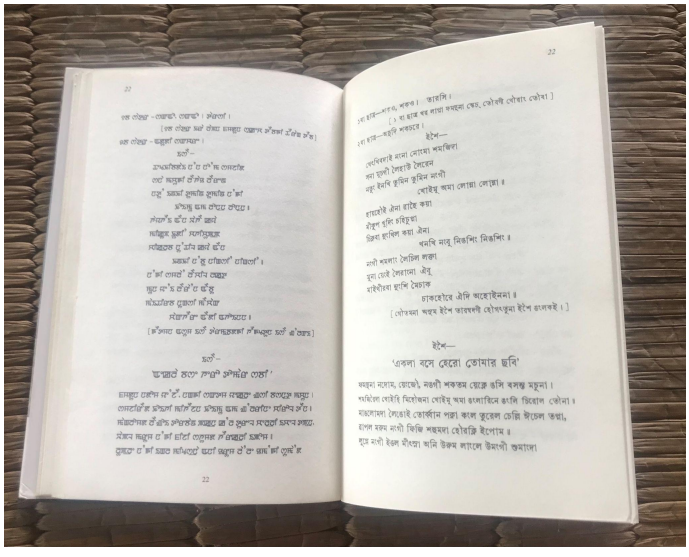

FIGURE 12. Interfacing Bangla and Meitei Mayek scripts in "Crimson Rainslouds"

The reason for the inclusion of the Meitei Mayek transliteration was because the general reader in Manipur cannot read this script. It was true in 2012 when the book came out. It is true even today.

The backstory is that language activists burned down the Central Library in Manipur in 2005. The appalling incident was the result of growing frustration at the state government's failure—over the preceding two decades—to implement its own law to replace the Bangla script with the indigenous Meitei Mayek. Their hand forced, the government hurriedly enacted the replacement. It immediately resulted in an abrupt schism in Manipuri orthography. And today, 19 years on, the below-22 generation can read Manipuri only in Meitei Mayek, while the general readership above age 22 can read it only in the Bangla script.



FIGURE 13. Manipuri primer in Meitei Mayek, archived in CoRSAL (https://digital.library.unt.edu/ark:/67531/metadc1213732/)

The dual-script approach of "Crimson Rainclouds" from Thema Books was therefore to build a bridge across this orthographic chasm. However, the non-Manipuri would still not be able to read the Manipuri texts if they do not know or first learn either of these two scripts.

To date, there is no official Romanization system developed by linguists for Manipuri in the way they have for most of the world's major text or post in Manipuri, with no uniformity and consistency, and in every and any way they choose. So in 2015, I created a Romanization system for the purpose of creating the Manipuri learning tool using the Manipuri play by my mother. I call it Mobile Manipuri because it does not use diacritical marks so as to keep it user-friendly in the manner of informal romanization currently used on mobile phones in Manipur today. Therefore, it is not IPA based. It updates the 1964 romanization system of the great scholar N. Khelchandra with elements I saw emerging with Facebook, WhatsApp and other social media. The intent was to make it simple and usable for people who wished to read *Asangba Nongjabi* or to learn Manipuri. The target users include the increasing number of Manipuris who, having been educated or grown up outside the state as a result of increased geographical mobility in India, cannot read or write either Bangla or Meitei Mayek. I used this system to transliterate *Asangba Nongjabi* into Roman to create the Manipuri Learning Module for non-Manipuri researchers and students of Manipur and Manipuri culture all over the world.

A new publication called "Binodini's Crimson Rainclouds: A Learning Module" of an expanded Manipuri Learning Module with the addition of the Roman version of the play is planned for this year.



FIGURE 14. Pundit N. Khelchandra with Manipuri Manuscripts

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Qualitative and Quantitative Validation of *Rongorongo* Glyph Strings on Easter Island Artefacts

Gordon Berthin

Abstract. Six *rongorongo* artefacts were evaluated for authenticity including the San Diego Tablet (SDT), the Rangitoki Bark-cloth Fragment (RBF), the Madrid (*Îka*) Fish Sculpture (MFI), and the 1770 Treaty Document (CST) between the Spanish and Rapanui people. Two apparently modern productions were also examined to determine if their RR-like inscriptions reproduced authentic but otherwise unknown texts. Metrics of evaluation were provenance and production technique, 'handwriting' quality, glyph vocabulary, conformity to Zipf's law (character frequency analysis), internal verse pattern, and item-specific special features. It was found that provenance/production technique and verse pattern were the most reliable predictors of authenticity. A suspected imitation piece conformed more closely to Zipfs Law than deemed-authentic artefacts. The SDT, RBF and, final two rows of the CST exhibited good evidence of authenticity and should be evaluated further. The possibility of evolved glyph definitions upon the MFI (a *ta'u rongorongo* object) may limit its usefulness somewhat in decipherment of *rongorongo*.

1. Introduction

Kohau rongorongo (RR) is the undeciphered signwriting of the indigenous peoples of Rapa Nui—remote South Pacific Easter Island (land of the *mo'ai*: monolithic human-figure stone statues). Most RR scribes and cantors were kidnapped or later perished in the genocide and disease, accompanying Rapa Nui's colonization (Fischer, 1997, pp. 8–9). By June 1869, when Bishop Tepano Jaussen discovered, subsequently studied, and publicized RR (ibid., p. 22), it is presumed that few interpreters remained alive.

RR contains about 120 unique (base) characters depicting everyday island objects, creatures, and astronomical signs. The bases may

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ISBN: 978-2-487055-06-3, e-ISBN: 978-2-487055-07-0

be linked /fused together within the inscriptions, producing hundreds of different compound forms (Barthel, 1958, pp. 314–315). Barthel (ibid., pp. 40–42) created a widely used and subsequently modified catalog, which classifies the RR glyphs. Table 1 summarizes Barthel's system. Catalogue Numbers run between 1 and 799 (#999 added later). Alphabetic-like suffixes 'i', 'j', 'k' denote locations of "lozenges" (perhaps "eyes" or "ears") attached to glyphs (see Table 1). Suffix 'f' denotes glyphs having attached hair-like follicles (Anonymous, n.d.).

TABLE 1. Barthel Cataloguing System (based upon glyph motif) Ref. Barthel (1958, pp. 40–41)

Catalogue Numbers	Category of Shape
1 thru 99	Frequent geometric shapes
100 thru 199	Infrequent or personalized geometric shapes
200 thru 299	Hominid shapes with fronting heads
300 thru 399	Hominid shapes in profile, gaping mouth
400 thru 499	Hominid shapes in profile, gaping mouth, expressive body (pantomiming)
500 thru 599	Various head shapes
600 thru 699	Heads of birds
700 thru 799	Shapes of other animals
i, j, k, f Modifications	

When cataloguing glyph sequences, distinct glyphs are separated by dashes '-'. Horizontally linked glyphs are separated by a period '.'. Vertically linked glyphs are numbered top-down (traditionally read bottom up) and separated by a colon ':'. RR glyph numbers or sequences are here introduced with 'RR'.

Steven Fischer defines an authentic RR text as the "creative transcription by a RR expert" of "a sequence of *two or more glyphs*, fulfilling a communicatory function" (Fischer, 1995, p. 509). (I will accept as authentic, compositions of a RR 'journeyman' also).[1] Authentic remnants (of RR) are documented upon 25 or 26 wooden slabs or objects, typically in tidy, seamless (unpunctuated) rows. Artefacts are designated by capital letters or common names: often, Rapanui words such as C—"*Mamari*" (egg) or specimen domicile (viz. I—"Santiago Staff") (Barthel, 1958, pp. 14–33). The RR corpus comprises approximately 14,000 signs.

The standard format for RR artefacts of trusted provenance is inverse boustrophedon (ox-turning) (Thomson, 1891, p. 516). Per Figure 1, in-

1. Solo glyphs are found on human skulls and wood and stone carvings. Some of these might also be of epigraphic utility if their glyph is contextually relevant (a contemporary example would be the metric size indicators [7, 8, 9, ...] upon modern Allen keys).

scriptions are read beginning bottom left and thence proceeding left to right with a 180° board turn around at line end to properly orient the next line for continuing (left to right) reading.[2]

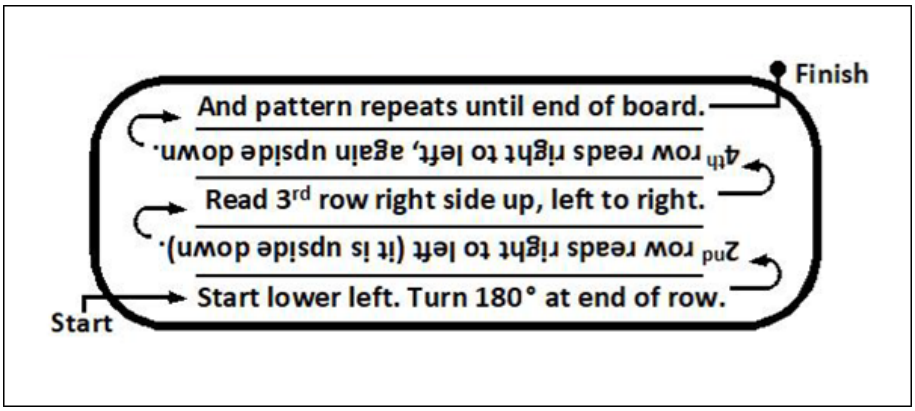


FIGURE 1. Inverse boustrophedon text—the standard layout for RR tablets of trusted provenance

Rongorongo artefacts are scarce. Only 26 items are usually listed (including Keiti Tablet photographs and transcriptions of the original board, which was destroyed by fire in 1914) (Fischer, 1997, p. 435). The debate remains open as to just how many authentic artefacts should be on the list. The surviving corpus is comprised of (wooden) tablets, a tablet fragment, an inscribed statuette, a staff, a snuff box, and two *rei miro* (gorgets or breast ornaments). Additionally, there exist a few human skulls and wood and stone carvings, each having a single rongorongo symbol etched into them (Poussart, 2010, pp. 81, 111, 113–115; Melka and Schoch, 2021, p. 139). Many stones, boards, or sculptures, adorned with RR glyphs, have been created for sale to island visitors or tourists. Production of such artefacts continues to this day. RR forgeries might be innocently imitated or purposefully deceiving (Melka and Schoch, 2021, p. 509). However, those parts of imitations, which quote directly from authentic (but now lost) texts, should be appended to the validated corpus. In view of this, some obviously modern productions

2. Forgers may also craft fake RR artefacts in reverse boustrophedon text layout to validate their wares. The famous Mazière tablet would be an example of such a deception. (Ref. Mazière (1968). Trans. by Wm. Collins Sons. New York: W. W. Norton, Company, Inc. With photographs by the author, p. 64. Originally published as *Fantastique île de Pâques*: *Des yeux regardent les étoiles...*, Robert Laffont, 1965.)

are analyzed here to determine if their RR-like inscriptions reproduce authentic but otherwise unknown texts.

2. Methodology

As Stephen Houston (2004, p. 231) well notes: "... the dissemination of retrieved epigraphic texts promote[s] scholarship." Yet authentication of artefacts remains an ongoing challenge as the meanings of the often exquisitely crafted RR inscriptions almost always remain enigmatic. To quote prominent ethnographer Alfred Métraux,

> Wooden tablets, covered with rows of small figures, are a puzzle to science and constitute the most complicated problem of Easter Island culture. (Métraux, 1938, p. 392)

With an eye toward enlargement of the validated RR corpus, this paper evaluates six artefacts for authenticity: three short inscriptions and three longer ones (>45 characters). The metrics of evaluation are *provenance and production technique* (indigenous or modern), *calligraphy* ('handwriting' quality), *vernacular* (glyph vocabulary), *conformity to Zipf's law* (character frequency analysis), *internal verse pattern*, and assessment of item-specific *special features*.

Verse patterns are found within all authentic RR inscriptions longer than 10 characters, be it by restating stanzas or parsing sections with recurrent single glyphs, bigrams or trigrams. Sproat (2003) has provided an algorithm-based list including intra board repetitive (or near repetitive) phrases of five glyphs or more. Horley (2005, p. 108) has presented sketches of A, B, C, D, E, G, H, N, P, R, S *rongorongo* boards showing locations of repeating glyph patterns (*note:* omitted board Q is a near-copy of boards H and P). Barthel (1958, pp. 151–157) and Guy (2006, pp. 53–66) have thoroughly discussed many of the different verse patterns, which are found in RR.

Lengthy RR inscriptions may be related to Zipf's general function of rank frequency distribution for languages (*Zipf's Law*) (Zipf, 1949). If the RR is underpinned by natural language then the successively ranked glyph frequencies should be linear or near-linear when plotted as a log-log relationship. Pozdniakov (1996, p. 303), theorizing RR to be a glyph syllabary, generated a rank-frequency graph comparing the classical poem *Apai* (written in old Rapanui language) to a traditionally associated glyph inscription upon the Keiti Tablet (Thomson, 1891, pp. 517–518). The plotted data sets corresponded almost exactly. Horley (2005, p. 108) compared rank frequencies for Barthel's RR sign inventory and Rapanui folklore manuscripts. both datasets conformed well to Zipf's Law. A note of caution is appropriate:

many alternative processes such as music and visual art also have stochastic component so conformity to Zipf's law is *necessary but not sufficient* proof of language (my emphasis) (Berthin and Berthin, 2006, p. 88).

3. The San Diego Tablet (SDT)[3]



FIGURE 2. The San Diego Tablet Side a. Reprinted with permission of the anonymous SDT owner. Photograph courtesy R. M. Schoch and T. S. Melka (2020, p. 483)

3.1. Provenance and Production

In 2016 the SDT (Figure 2) was purchased at an antique and junk dealership in Prescott, Arizona (Melka and Schoch, 2020, p. 483). The proprietor appraised the tablet as "a curious piece of wood with some carvings on it, which he did recognize as from Easter Island, but no real value was attached to it" (ibid., p. 504). He reported having acquired the item from an old San Diego, California estate (ibid., p. 483). Melka and Schoch posit the SDT to possibly be the Calligan tablet (ibid., pp. 504–505) (a specimen procured by Patrick John Calligan, mate on the 26 tonne *Caroline*, which went aground on Rapa Nui in 1873). Calligan later mailed

3. Inscriptions of greater length would be desirable as would specimens of richly diverse provenance (two of these artefacts were first reported by T. S. Melka and R. M. Schoch). Perhaps one day, additional materials of extended length will be happened upon, warranting careful analysis. The material chosen here is what it is, and what matters most is the expansion of the epigraphic corpus through assiduous scholarship, irrespective of each artefact or its pathway to discovery.

the RR board to his wife in California, but the tablet disappeared after that (Fischer, 1997, p. 521).

More than one researcher has searched for, or yet now continues to seek out "lost" RR artefacts or even castings of artefacts (Wieczorek and Horley, 2015, p. 127). Fischer (2010, pp. 51, 57), for example, mentions another missing artefact, the so-called and apparently 'misplaced' / 'lost' "Barthel Tablet". Most probably, such artefacts should be recognized as traditionally authentic if and when they are found. Of possible topical relevance to the SDT it is noteworthy that sleuth work (albeit unsuccessful) by Fischer (1997, p. 521) and Meroz (2003, pp. 122–125) did eventually trace the footprints of the Calligan Tablet as far as California—the same locale whence (according to the antique dealer) the ownership of the mysterious RR board originated.

The SDT has dimensions: 16.7 cm long, 6.4 cm wide, and 1.4 cm thick. Most glyph heights range from 10.0 to 12.0 mm; A few leadoff glyphs are as small as 5.5 mm (Melka and Schoch, 2020, p. 490). This board exhibits evidence of inscription by traditional methods, a strength in validating its authenticity. Per Barthel (1971, pp. 1168–1169), Fischer (1997, pp. 386–387), RR glyphs were often laid out first on banana leaves, scribed with a bone or pointed stick stylus between the leaf veins (just as one writes characters between the lines on a ruled paper sheet). Natural banana leaf vein spacing is between 10 and 15 mm (Barthel, 1971, p. 1169), the same as the height of RR glyphs upon surviving wooden specimens. RR copy was traced from leaf to wooden board surface using a sharp obsidian flake. Deep pin holes were next punched into the obsidian etching. Lastly, a deep scoring was applied with a hafted shark tooth, following the pathway of the perforations. Figure 3 shows specific indigenous tooling possibly associated with this production process: a bone awl and an obsidian graver or flake. An SDT glyph close up (Figure 3, right) reveals deep perforations in some areas.

One side of the SDT presents 5 lines of glyphs in inverse boustrophedon reading order. The other side is utterly damaged (Fischer, 1997, p. 490), possibly the result of having been stored in damp soil, a "family storage cave" or a "rock hole"—cf. Honolulu B.3629 Tablet (Métraux, 1938, p. 1) or the Great Vienna Tablet (Fischer, 1997, p. 504). Unlike several other RR boards, the SDT glyph lines are not fluted. There are traces of horizontal guiding lines akin to modern lined writing paper (Melka and Schoch, 2020, p. 494).

3.2. Calligraphy

Whereas the SDT glyphs are easily identifiable and better drawn than those upon other lengthy RR artefacts studied here (Warren Anderson Tablet or Madrid Fish Inscription), Melka and Schoch nevertheless



FIGURE 3. Indigenous graver tools and board etching details. Reprinted with permission of the anonymous owner.Photographs courtesy of R. M. Schoch and T. S. Melka (2020, pp. 522, 525)

grade the caliber of SDT glyph drawing as close to the *Verfallszeit* (declining period) (ibid., p. 510). They draw an analogy with the London Tablet (Barthel, 1958, p. 158; Fischer, 1997, p. 488), generally deemed to be an authentic, but a late period RR inscription. The SDT incorporates several lengthy parallel curving lines. Horley (2009, p. 251), scrutinizing textual corrections yet visible upon certain RR artefacts, noted that depictions of "graceful anthropomorphic signs with long necks or curved backs were quite difficult." Possessing just mediocre handwriting skill, I have determined that several of the more demanding glyph constructions (such as frigatebird heads and lengthy concentric curves) might nowadays be reproduced acceptably by importing them into a Computer Aided Drafting program and there redrawing or tracing. Therefore, at the present time, it would not be difficult to construct an artefact presenting a standard of calligraphy that imitates the work of the master scribes of old Rapa Nui.

3.3. Verse Patterns

The First (bottom) SDT row is bounded at its initial and final ends by vertical-edge glyphs "|" and "||" respectively (Rjabchikov, 2020, p. 1). From a semiotic perspective these forms resemble barriers or fences. They may or may not add additional communicatory value. Be that as it may, the prima facie appearance of the first line is of similar verticals symbols bookending an enclosed text into a single section. Lead-off glyphs of Rows 1 and 2 are, as illustrated in Figure 4, nearly parallel phrases, suggesting that each row begins with a similar refrain.

Row 3 recapitulates a version of this very same refrain into its concluding glyphs.

The third glyph-row seemingly progresses into Rows 4 and 5 since all three of these inscriptions show commonality amongst their introductory glyphs (Figure 4). The two full-belly *honu* ("sea-turtle"-like) forms (Barthel, 1958, p. 203),  which introduce Row 4, appear to be cognate variants (perhaps antonyms) of the "hollow belly" (Wieczorek, 2011, pp. 31–32)  at the beginning of Row 3. Furthermore, the 'hollow belly' detail within the hominid glyph introducing Row 3, is redrawn as the concentric circle 'bullseye'  at the start of Row 5. Upon the SDT, the 'bullseye' and 'hollow belly' or full belly '*honu*' motifs occur only at the outsets of Rows 3, 4, 5: never elsewhere. This supports the hypothesis that these forms uniquely introduce each of the last three texts/rows.

The SDT also presents 'bird-hominid' parallel passages and a grouping (Row 4) of three bigrams. As shown in Figure 4, the 'bird-hominid' inscriptions occur on both Row 4, and Row 5. The three bigrams extend to the end of Row 4 but do not 'wrap' to Row 5. Thus, even though Rows 4 and 5 appear to be closely related, there is a case for them being semantically independent of each other. Importantly, the inverse boustrophedon layout of the SDT *hides* its repetition patterns. Repeating phrases occur on adjacent lines: upside down one versus the other. If the SDT were spurious, one might expect the associable phrases to be displayed conspicuously, to satisfy the critical gaze of tablet appraisers. This could have been done by presenting the patterns *right side up* with respect to each other: i.e., by situating the two near-parallel phrases on adjacent lines of similar orientation (with a single upside-down line intervening between).

Because of wood scarcity upon Rapa Nui (Eggertsson, 2011, p. 114), a transcription of some master text would have been constrained by the dimensions of available clean boards. Consequently, the SDT text could not have been a direct row-by-row copying of some master manuscript. It has required intelligent editing.

3.4. Vernacular

Four of the ten most frequently used SDT glyphs (RR700, RR1, RR5, RR600) are also listed by Barthel (1958, p. 165) as being among the top 20 most frequently occurring signs within the classical corpus. The "cardioid" ❤ and "split circle" 'ᗡᗤ' glyphs are irregular and their usage is, perhaps, consistent with apparent novelty of subject matter upon the SDT or the vernacular style of the scribe. Moreover, such usage conforms to observable glyph selection processes across classical RR tablets. For example, the common RR76 "penis"-form (Fischer, 1995, p. 303) occurs 513 times (Melka, 2009, p. 42) upon the Santiago Staff but not

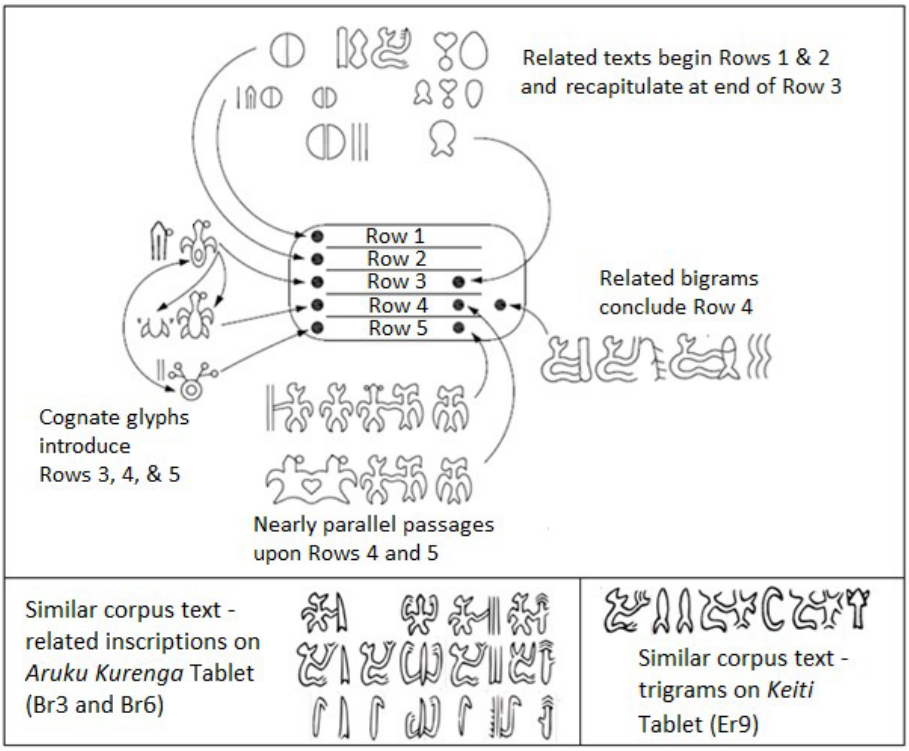


FIGURE 4. Morphologically related texts of the San Diego Tablet

even once upon the oft-studied *Mamari* board. Upon a fake artefact, one might expect to find a very commonplace glyph vocabulary rather than a slightly idiosyncratic one.

3.5. Zipf's Law

The 7th through 10th most common characters of the SDT are overrepresented (the Figure 5—Zipf's Law graph—bulges upward in this area). This is, perhaps, due to the usage of these glyphs in restated phrases or in repeating of bigrams (*viz.* the 'ᑎᑎ' form and the RR200 hominid forms).

3.6. Conclusion

The SDT scores favourably on many metrics of authenticity: familiar vernacular, elaborate display of verse patterns, and development of

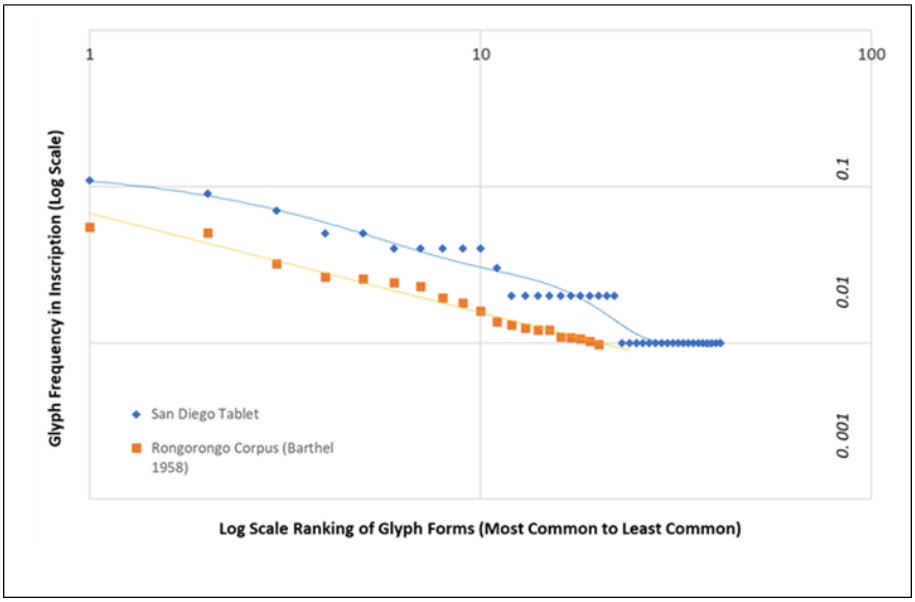


FIGURE 5. San Diego Tablet and *rongorongo* corpus conformity to Zipf's Law

bigrams, plus evidence of traditional board production technique. In one important area—provenance—the tablet is weak. In this regard the SDT is comparable to the 'deemed-authentic' Paris Snuffbox (cf. Barthel (1963, p. 176) or Pozdniakov (1996, p. 294)). This box—according to its original owners—had been held in the family for 80 years (since approximately 1880) but lacked traceability to Rapa Nui prior to that. Moreover, the Snuffbox may have been inscribed using a steel tool, indeed betraying a very latter period of production. In the opinion of this author the SDT matches or exceeds the Snuffbox in all of our metrics. Whereas the SDT may be a bit weak with respect to its glyph calligraphy, it is not markedly substandard. Considering all information at hand, the SDT should be acknowledged as an authentic RR artefact, whether made at some point during the late pre-missionary or early missionary times, i.e., pre-/post-1864/66.

4. Warren Anderson Tablet

4.1. Provenance and Production

Warren Anderson wrote that:



FIGURE 6. The Warren Anderson Tablet (a-face [top], b-face [middle], banding strap detail [bottom]). Photographs courtesy Anderson (2008)

> The board was part of the estate of my father, who died in 2005. He must have acquired it a long time ago—probably around 1960. It is an old piece so if it is a copy or a fake made for tourists it's an old one. (Anderson, 2008)

If dated before the opening of the Rapa Nui airport in 1967 then the board (shown in Figure 6) may have been traded or sold to a crew member of one of the annual supply ships from Chile (Fischer, 1997, pp. 528–529) or acquired by a visiting merchantman or member of a scientific expedition *viz.* Franco-Belgian (1934) (ibid., pp. 158–162), Norwegian (1955-56) (ibid., p. 188), German-Chilean (1957–58) (Fischer, 2010, pp. 47–57) or Canadian (1964-65) (Reid, 1965). The dimensions of this tablet are 102 mm × 400 mm. Glyph heights are about 25 mm (probably not pre-drawn on banana leaves). The WAT is atypical of RR artefacts in that its long edges are perfectly parallel, indicating that the raw board was likely trimmed using a non-indigenous technology.

4.2. Vernacular

Six of the nine most encountered glyphs upon WAT—simple forms RR1, RR2, RR4, RR5, RR8, RR10—are also listed by Barthel (1958, p. 165) as being among the top 20 most frequently occurring signs within the recognized corpus. Glyph selection by the author of the WAT tablet mirrors the vocabulary choices made by authors of classical RR artefacts.

4.3. Verse Structure

Almost none of the WAT inscription has been parsed into short, concise, glyphic verses. In this respect the WAT differs from all known authentic RR inscriptions of significant length. Per Figure 7 (left), there are three RR22 and two (morphologically similar) RR19 glyph-pairs, spaced irregularly throughout the tablet. There are also two widely separated RR380.1.3 trigrams, a triad that may have been used to parse glyph sections upon authentic boards (cf. Melka (2016, p. 223)). However, the RR1 glyph of the second trigram is poorly carved and might easily be mistaken for an elliptical-shaped RR22.

4.4. Calligraphy

The quality of glyph carving upon the WAT is poor. Nowhere do the anthropoid types display arms or legs drawn attractively with gracefully curving concentric lines. Seated hominids show no outstretched leg—only blobbed torsos. It is impossible to distinguish between the high aspect ratio ellipses (RR22 form) and the more generously proportioned (albeit rare) RR'big O' forms. Generally, the WAT appearance is of an artefact carved in haste with little display of the artistic beauty that is hallmark of classical RR and exemplified particularly by the Aruku Kurenga or Small Santiago boards.

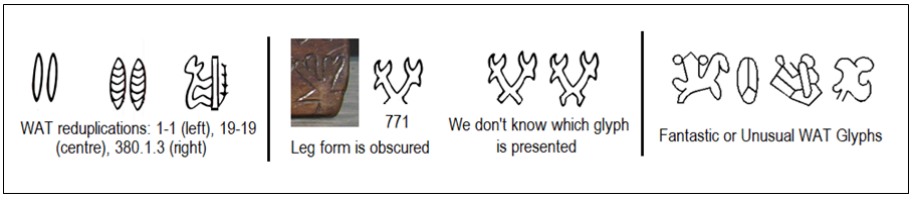


FIGURE 7. Warren Anderson Tablet glyph features - Reduplications (left), the RR771 conundrum (centre), fantastic or unusual glyphs (right)

4.5. Other

The uncommon RR771 occurs twice: at the end of the first line and in second-last position at the end of the final (3rd) line. On the first line (first reading position) the RR771 is partially obscured (Figure 7)—running off the board end—whereas the third-line form is fully visible. One would expect to find the full RR771 ahead of a partial copy, giving the board reader every chance to interpret the correct allograph of the rare form, the first time that it is encountered in reading. The WAT presents four unusual or fantastic glyph forms (Figure 7—right).

There is an imprint of a reinforced strap (Figure 6—bottom) between lines b2 and b3 (right side), indicating that the board may have been part of a packing crate. Use of polymer-reinforced strapping would preclude a board production date before the 1940s. Of note (Figure 8), there is a 6-sign phrase on WAT a3 that seems to be a *re-arranged* excerpt from the *Échancrée* (notched) tablet Db2.

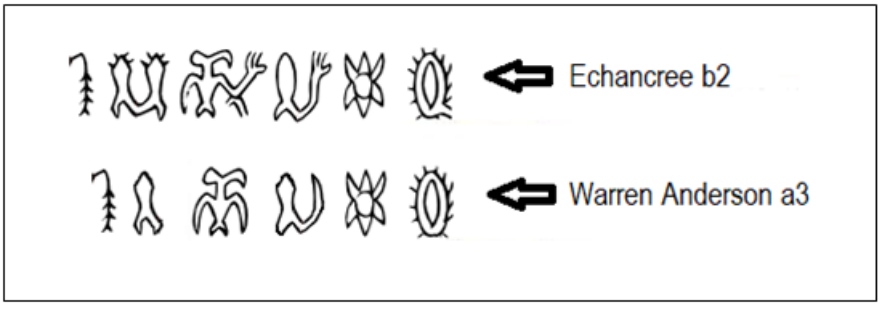


FIGURE 8. Échancrée *rongorongo* text 'quoted' on Warren Anderson Tablet

4.6. Zipf's Law

The straight-line relationship in Figure 9 indicates that the WAT conforms quite well to Zipf's law.

4.7. Conclusion

Conformance of the text to Zipf's law and correspondence of vernacular to other authentic RR artefacts is good. However, there remain serious issues with the WAT. The imprint of reinforced strapping tape (*circa* 1940s or later) on its "b" side precludes it from being a period piece.

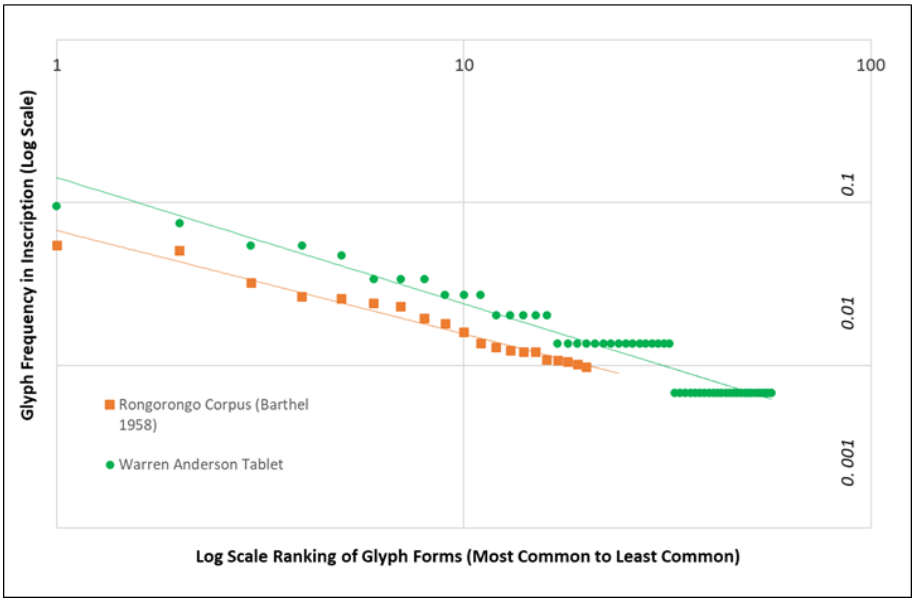


FIGURE 9. Zipf's Law conformity of Warren Anderson Tablet and *rongorongo* corpus

There is no internal verse structure, a usual hallmark of all other lengthy classical RR inscriptions. There is evidence for a short glyph section having been copied from text upon the *Échancrée* tablet. Given the conspicuously poor quality of glyph carving, it may be posited that the author of the WAT was etching in haste with probable goal of producing an artefact for sale and personal profit.

5. Madrid Fish (Îka) MFI

5.1. Provenance and Production

The MFI (Figure 10) is a fish-shaped sculpture having—on each side—"an eye, mouth and dorsal fin. The tail is cut at an angle." Glyphs are incised in 4 lines (27 signs) on the obverse side and 3 lines (21 signs) on the reverse. It has dimensions of $39.3 \times 12.3 \times 1.8$ cm (Blanco, 1996, p. 57). MFI glyphs are laid out from left to right; exclusively right side up as opposed to inverse boustrophedon. This is a characteristic of the latter *ta'u* form of RR, produced after 1877 (Fischer, 1997, p. 528).

The MFI is believed to have been carved between 1900 and 1920. It formerly belonged to Chilean president Arturo Alessandri Palma (1868–

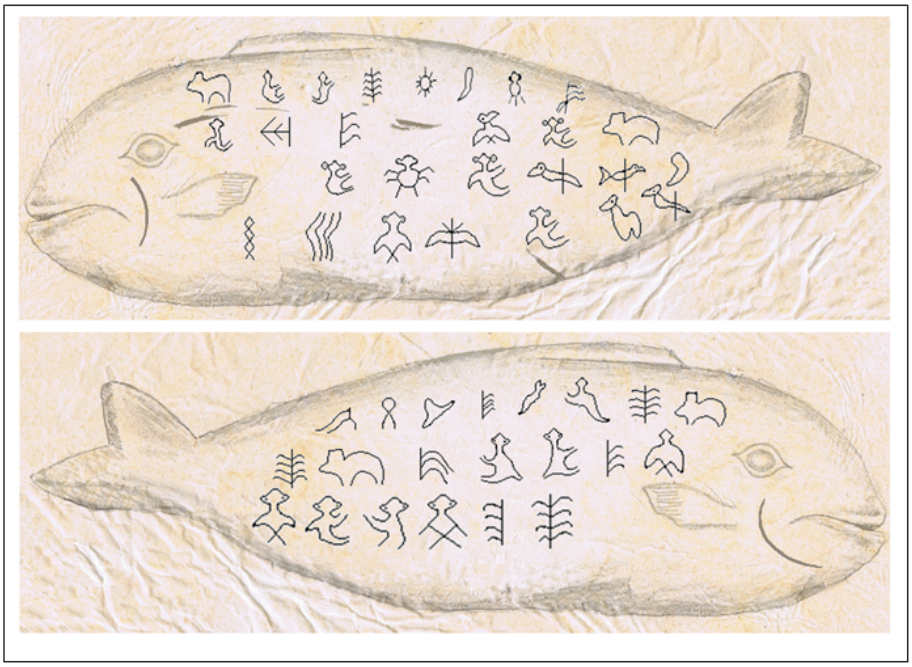


FIGURE 10. The Madrid Fish Image (sculpture) a-face at top, b-face at bottom. Artwork of Author. After photograph and sketches by Blanco (1996, pp. 57, 59)

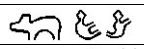
1950) who gave it to the present owners-residents of Madrid, Spain (ibid., p. 57). Garshin (2022) attributes authorship of the Madrid "fish" image to Tomenika[4]—an elderly Rapanui literate in the *ta'u* script (an imitative trade-driven form of RR created in the 1880s). Katherine Routledge, while visiting Easter Island in 1914, met with and interviewed Tomenika during his last months of life. By then his intellect had faded: "most of what the old man knew he had forgotten, and what he dimly remembered he was incapable of explaining" (Routledge, 1919, p. 253). Yet, if Tomenika had lived a normal human lifespan of 70 years (and Routledge does describe him as being "old") then he would have been in his 20s when most of the last RR men died in the 1860s. There would have been ample years of youth for Tomenika to have gleaned information about RR. Even if he had been just a journeyman with respect to RR skills, his work would remain invaluable to modern epigraphers (who, compared to former RR masters, yet understand very little of Rapanui's indigenous glyphic script).

4. If this determination is correct, then the latest reasonable date for the creation of the Madrid "fish" would be several years before Tomenika's death in 1914.

5.2. Verse Pattern

Verses appear to be laid out in a sequentially regular pattern (see Table 2) with several lines presenting one or more of a plant-glyph, then a reclining hominid, and then a hominid/zoomorphic pair of near-twins. There are certain plant signs (that I have underlined) at the start or conclusion of initial or final glyph lines, which appear to incorporate semiotic functionality. These could have been used to clarify the proper reading order for the inscription. It is uncertain as to whether these underlined signs have a dual function and are also integral to the core communication. Irina Fedorova does include them in her proposed, but unverified, translation of the MFI glyph-text (Blanco, 1996, pp. 58–59).

TABLE 2. MFI 'stanzas' are characterized by related glyph sequences.

Side a Line a1							 *(some before much following)*
Line a2							
Line a3							
Line a4							
Side b Line b1 *(some before)*							
Line b2							
Line b2 and b3							 *(well filled)*

The MFI inscription includes one reduplicated glyph-pair and additionally, each glyph line seems to present a single verse of a greater communication. There is one exception. Line b2 does wrap to the start of b3 indicating, perhaps, that the text was pre-composed and later fitted to the confines of the sculpture. In any event there was apparently no rigid imperative to parse the glyph-lines verse by verse upon the sculpture.

5.3. Vernacular

No frequently occurring glyph upon the MFI is found within Barthel's list of the top 20 most common signs in the RR corpus (Barthel, 1958, p. 165). This indicates that the text content of the artefact is different from the collective of recognized RR objects. In the late 19th century, pursuant to interactions with overseas visitors and settlers, Rapanui experienced lifestyle changes (*viz.* introduction of livestock and adoption of wood-framed housing). Some traditional glyph designs may have become dated and possibly replaced with new motifs. The extent to which

original RR glyph definitions have been modified in the *ta'u* script is not known.

5.4. Zipf's Law

Because many MFI glyphs are repeated in the development of the verse structure upon the board, the Zipf's Law graph exhibits curvature (Figure 11) *versus* the corpus plot: the third through eighth most common MFI signs are overrepresented.

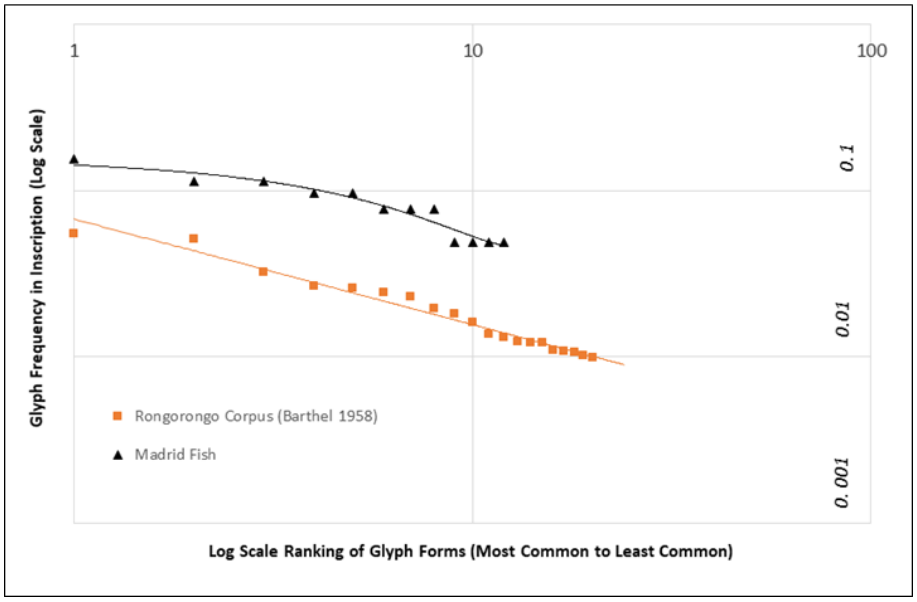


FIGURE 11. Zipf's Law conformity of Madrid Fish Image and rongorongo corpus

5.5. Calligraphy

Glyphs are drawn without an eye for artistry and a few of them appear as 'fantastic' forms. However, they are rendered just well enough to be traceable / decipherable.

5.6. Conclusion

The lovely verse structure of the MFI plus its semiotic direction markers intuits of it containing an underlying communication. This supports Fischer (1997, p. 531)'s hypothesis that the *ta'u* RR script may have been utilized as a form of writing in and of itself. If meanings of the glyphs of the MFI are similar to their equivalent classical RR forms, then the MFI may be a useful epigraphic reference.

6. Hawai'i (Polynesian Cultural Centre) Signage (HPS)



FIGURE 12. Informational Hawai'i Polynesian signage at the Oahu Cultural Centre (top) and its *rongorongo* glyphs (detailed at bottom). Photo courtesy Brenda Dinardo (2016).

6.1. Provenance & Production

The HPS (Figure 12) is a single line of 27 RR–style characters painted upon a reinforced-plastic information plaque at the entrance to a replica of a Rapanui elliptical-like canoe house (*hare vaka, hare paenga*) at the Polynesian Cultural Centre, Oahu, Hawai'i. There is no authorship information. Each of the characters is approximately 35 millimeters height.

6.2. Vernacular

The HPS vocabulary conforms to classical inscriptions. Three of its 8 different glyphs (RR1, RR430, RR76) are listed among the top 20 most common signs appearing throughout the corpus. Indeed, RR1 and RR76 are the most frequently used glyphs of all.

6.3. Verse Structure

The HPS inscription consists of one line of text containing three consecutive, identical 9-glyph verses. Single glyphs or bigrams may be duplicated three times or more, consecutively, in RR. However (and surprisingly), much longer corpus texts are never restated without variations (*viz.* the 8-character repeating sequences of the *Mamari* "lunar calendar" shown in Figure 13). Pertaining to artworks, J. M. Eisenberg (1992, p. 11) cautions that "monotonous repetition of elements—without a direct bearing on the theme" can be an indicator of a spurious creation.

6.4. Calligraphy

The HPS is the most beautifully drawn of the six artefacts investigated. Its calligraphy matches the standard of the best classical period pieces.

6.5. Other

The three identical RR "statements" comprising the HPS glyph string (Figure 12) intuit of invocations or choruses whereas the accompanying English description presents descriptive and technical data pertaining to the *hare vaka/hare paenga* (indigenous Rapanui houses). The RR text does not seem to be a translation of the companion English signage. Furthermore, each of the three identical HPS statements almost entirely

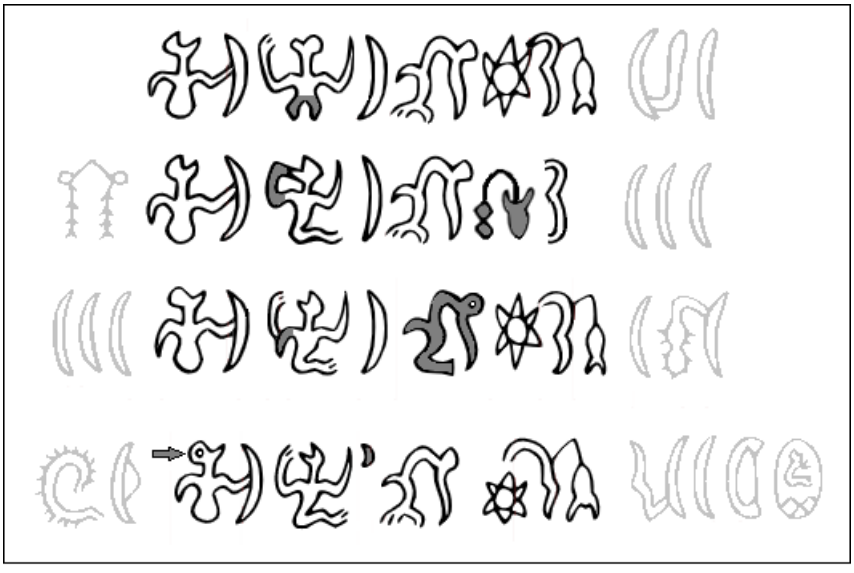


FIGURE 13. A typical lengthy, near-parallel, authentic KRR inscription set (the *Mamari* lunar calendar passages) displays variations (shown above as dark-shaded glyphs) and the related sequences are parsed by disparate glyphs (shown above in light-colour).

'quotes' from a subsection of the Small Santiago (Gv3) tablet text: RR90-430.76-670-256?-44 (shown in the Figure 14 underlined glyphs). The HPS statements then conclude with the rare characters RR: a reduplicated hapax (occurring only this one time in the corpus). However, inspection of the parallel Gv3 passage reveals that its concluding RR44 glyph is not a "stand alone". It is physically joined (presumably, therefore, connected with respect to information disclosure) to the next two linked glyphs that follow: a gaping mouthed birdman and a penis form (Figure 14, shaded glyphs). Thus, the HPS and Bv3 parallel texts diverge markedly at their endings. When considering its entire preceding quoted statement, one must conclude that the HPS offers no guidance to the RR reader in eliciting the meaning of its culminating hapax forms. Our best assumption would be that the hapax forms are synonyms of the birdman plus penis glyphs (which follow the same quoted statement as it occurs on Gv3). But there is nothing (not even morphological glyph resemblance) confirming that this (or anything else, for that matter) is the case. Here, the interpretive guidance about the hapax, provided to RR readers by the author of the HPS, is definitely inadequate.



FIGURE 14. Small Santiago (Gv3) glyph line. The Hawai'i Polynesian signage 'quotes' the underlined text.

6.6. Conclusion

The HPS is substantially an excerpt of Small Santiago Gv3 text and not a creative literary adaptation. As illustrated by the indecipherability of its hapax forms, the HPS passage is of no value to RR epigraphy.

The HPS is a forgery (or, more generously, artistic usage of RR in modern context) presenting a short text copied from a classical RR object. When assessing artefacts for authenticity, it is vital to possess a thorough knowledge of the contents of the classical RR boards, or to be supported by an algorithm (akin to the one developed by Sproat (2003)), which can match newly uncovered string catalog numbers to sequences from the known corpus.

7. Rangitoki Bark-cloth Fragment (RBF)

7.1. Provenance and Production

The RBF (Figure 15) presents ten glyphs, painted with indigenous reddish mineral pigment (Khamnueva, Mieth, Dreibrodt, and Out, 2018, p. 253) on a 15.5 cm by 4.5 cm strip of traditional tapa (bark-cloth) (R. Schoch and T. Melka, 2019, p. 120). It was gifted to Albert van Houten (AVH), a sailor who visited Easter Island in March 1869. He won the affections of a local young woman, Rangitoki, who gave him a souvenir: a small glyph-painted bark-cloth strip from her skirt. AVH retained the bark-cloth (coiled up and secured by twine) inside a pocket watchcase along with two tiny skull ornament beads (carved from bone) plus a short note of explanation in his native German language, approximately translated: "A piece from the skirt of my beloved precious Rangitoki. Given to me as a present—March 1869" (Khamnueva, Mieth, Dreibrodt, and Out, 2018, p. 123).

In 2018, Robert M. Schoch assisted with the sale of the antique pocket watch (ibid., pp. 117–118) and noted:

> the dealer who was involved with negotiations between the descendants of AVH and the new (anonymous) owner at one point implied that the watchcase might be more desirable, and thus more valuable, than its actual contents



FIGURE 15. Rangitoki Bark-cloth Fragment and glyph transcription. Photograph reprinted with the permission of the anonymous owner, courtesy of R. Schoch and T. Melka (2020, p. 113)

> (that is, the German note, two bone beads, and the bark-cloth [RR] fragment). (R. Schoch and T. Melka, 2020, p. 35)

7.2. Vernacular

The RBF vocabulary conforms to the classical corpus. Four of its 9 different glyphs (RR76, RR200, RR600, RR700) are listed among the top 20 most common signs to be found in the full RR corpus. RR76 is the second most frequently used glyph in all RR inscriptions. It contrasts with two heretofore unknown glyph variants, a claw-shaped version of RR27 and a "leaf-topped" version of the bullseye form RR107.

7.3. Verse Structure

Within the RBF are two discernable couplets (which I have parsed with vertical blue lines). Each couplet concludes with the RR76 "penis"-like glyph. If these two couplets present successive stanzas, then the entire sequence appears to be a short, Limerick-like composition of no fewer than 4 lines.

7.4. Calligraphy

The inscription is legible but glyph drawing technique is—prima facie—*Verfallszeit* (declining period). The poor detail of handwriting may be excused, given the limitations of the bark-cloth medium and the inscription method (reddish pigment applied with brush). These would have been ill-suited to any thru-tracing of a perfected copy, already scribed on banana leaf media. The final [RR39$_{Top}$:107] glyph-compound is effaced on account of a tear in the bark cloth.

7.5. Conclusion

The verse structure, evident even in this short inscription, leads one to posit that Rangitoki and her scribe invested a bit of time in its composition, perhaps generating drafts on disposable banana-leaf media before copying the final creation onto the bark-cloth. This is a delightful specimen in all respects, and I judge it to be an authentic product of the *RR* tradition.

8. Chiefs' Spanish Treaty Document of 1770 (CST)

Chiefs' Spanish Treaty Document of 1770 (CST)

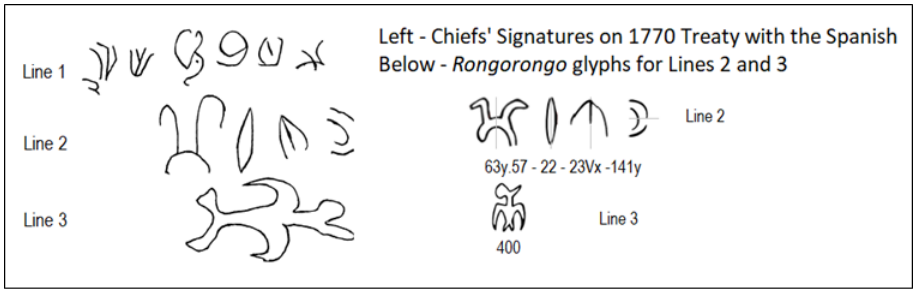


FIGURE 16. Chiefs' Spanish Treaty, document and glyph transcription. Treaty signature sketches from Harrison (1874, p. 528 and plate 27)

8.1. Provenance and Production

The treaty between the Spanish and the Rapanui was signed when the Spanish took possession of the island. The ceremony was a "religious-

military act in the Poíke area to the NE of the island" (Blanco, 2008) in which three crosses were raised on hilltops to commemorate the event. Spanish officers and three Rapanui chiefs signed the treaty document. Per commander Felipe González "… with which this act was completed, signing the possession of the corresponding individuals and three Indians of whom there were about 300" (ibid.). The Rapanui signatures are glyphic or imagined characters.

Peruvian José Toribio Gonzalez de La Rosa first showed a copy of the treaty glyphs (see Figure 16, left) to "the Anthropological Institute in London on 9 December 1873" (Langdon and Fischer, 1996, pp. 110–111). Although the original version of the chiefs' signatures has never been found, the RR epigraphic community widely regards these signature reproductions as being reliable representations. The treaty document would have been created using both ink and paper of European manufacture and each chief appears to have signed by creating a different line of glyphs.

The first line of CST signs exhibits no relationship to RR. The third line presents only one character—a birdman (RR400)—perhaps a symbol related to a chief (ibid., p. 114). The enigmatic second line contains four characters: all of them plausible RR signs. Further discussion of the chief signature document shall focus upon the second line of the treaty inscription.

8.2. Historic Analogues (New Zealand Treaty of *Waitangi*; Mayan syllabary writing shown to Spanish Friar Diego de Landa)

There are documented situations in which indigenous writers (or 'letterists') produced possible heritage inscriptions in the presence of European observers. Two of these afford relevant comparisons to the signing of the CST.

In New Zealand, in 1840, 132 chiefs—not necessarily literate in English—signed the well-preserved Henry Williams (Bay of Islands) page[5] of the Treaty of Waitangi, using either indigenous symbols or ad hoc scrawls. Only one signature of the 132 bears even coincidental resemblance to RR. Therefore, the one-off probability of correctly printing a row of four RR signs by simple chance, (without knowing the writing) would seem small.

In Central America (circa. 1566) Spanish Friar Diego de Landa transcribed Mayan characters written by his informants (Houston, Stuart, and Mazariegos, 2001, pp. 29, 33). Vis-à-vis the elegant Mayan inscriptions upon monuments, manuscripts, or pottery (Figure 17, lower row),

5. New Zealand Ministry for Culture and Heritage 2021.

de Landa's copy (Figure 17, upper row) is noticeably simplified. The '*ma*' and '*ne*' symbols are expressed as stick figures.

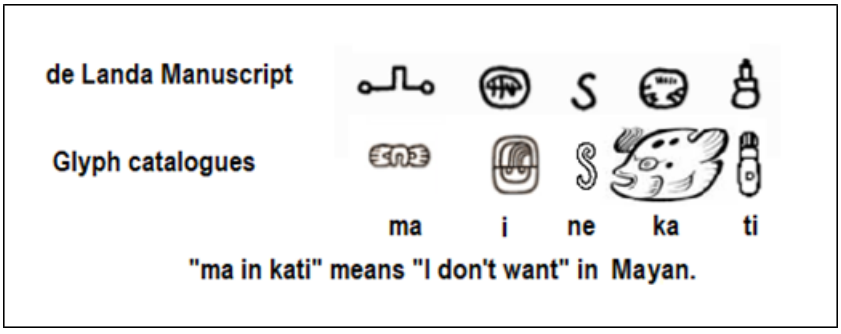


FIGURE 17. Shorthand Mayan inscription (top) compared to their more formal script calligraphy (bottom). Top row glyphs after manuscript by Diego de Landa (1566). Relación de las cosas de Yucatán (open access)

Writing ad hoc, with unfamiliar stylus and upon foreign media, the treaty-signing Rapanui chiefs might be excused for using simplified forms or stick figures in the manner of de Landa's informants. In a 2005 paper, Horley (2005, p. 115) (to cite an example) treats the CST line 2 lead off glyph as a stick figure and he redraws it as a fuller sign form.

8.3. Vernacular

None of the five RR characters on the Spanish treaty document are among the top 20 most common in the accepted corpus. However, its theme (a peace pact) may well be quite different from the exploits, which inspired production of the classical RR pieces. There is one unusual compound glyph (RR63y:57), but the base glyphs from which it was derived are easily recognizable and occur elsewhere within the corpus.

8.4. Calligraphy

Glyphs are drawn without artistic panache but well enough to be deciphered/traceable. The compound RR63y:57 is a stick figure. All second line glyphs exhibit an axis of symmetry. If it is acknowledged that RR incorporated a component of artistry as well as a simple communicative function—a perspective taken by Fischer (1997, p. 559), for example—then the conspicuous symmetry of the second line may augur for it being authentic RR. Especially, the orderly second line stands in sharp

TABLE 3. Authenticating RR Objects—Report Card

Object	Zipf's Law	Provenance and Production	Vernacular	Verse Structure	Calligraphy	Special Features	Decision
SDT	🟡	🟡	🟢	🟢	🟡	🟢	☺
WAT	🟢	🔴	🟡	🔴	🔴	🔴	☹
MFI	🟡	🟡	🔴	🟢	🟡	🟢	😐
HPS	N/A	🔴	🟢	🟡	🟢	🔴	☹
RBF	N/A	🟢	🟢	🟢	🟢/🟡	N/A	☺
CST	N/A	🟢	🔴	N/A	🟡	🟢	☺
🟢 = positive, 🟡 = questionable, 🔴 = negative							

contrast to the row of asymmetric signs upon the first line of the CST. Per the insights of Eisenberg (1992, p. 11) into art forgeries, a lack of symmetry may portend spurious work.

8.5. Conclusion

Many epigraphers do not recognize the Line 2 signs of the CST as *rongorongo*. Fischer (1997, pp. 4–6) even references this credibly dated (1770) specimen to support the theory that RR did *not* exist when the Spanish first visited Rapa Nui. On the other hand, the unusual circumstances of production of the CST ought to justify much of its abnormal vernacular and calligraphy. Ultimately, this inscription presents five consecutive, legitimate RR characters (the entire last two rows). All Line 2 signs exhibit axes of symmetry: atypical for consecutive scrawls. That said, the meaning of these characters remains enigmatic, possibly related to the event at hand, or other. This passage may ultimately be of corroborative utility in affirming RR character values that might one day be determined through epigraphy of the lengthier inscriptions.

9. Conclusions with Respect to the Authenticity of the Six Artefacts

The SDT, RBF and CST receive positive ratings (see Table 3) in most metrics of authenticity. These, therefore, appear to be genuine RR inscriptions and further investigation is warranted.

The provenances of the WAT and HPS cannot be linked to authentic RR authorship by the Rapanui. Moreover, certain special features of these two objects are unsettling. On the WAT there is a notable lack of

internal verse pattern plus an imprint of a modern reinforced strap. The HPS is mostly three identical copies of an inscription from the Small Santiago board. It is both notable and surprising that within the recognized corpus, lengthy glyph sequences (eight characters or more) never repeat identically on the same artefact.

The MFI seems to encode an intelligent communication. However, it is a *ta'u rongorongo* object. Its glyphs may or may not have the same meanings as similar forms upon earlier RR artefacts. One should use caution when drawing on material from this board for development of RR epigraphy.

In this study, provenance/production and verse structure were the most reliable means for determining whether an item is genuine. These metrics of appraisal should, therefore, be recognized for their critical importance in future assessments of artefact authenticity.

The seemingly authentic SDT and MFI do not conform well to Zipf's law. For shorter inscriptions (45 to 100 glyphs length) the rigorous verse structure, ubiquitous in RR, produces a bulge in the log-log Zipf plot, here notable in the region of the 7th and 8th most frequently occurring glyphs. By contrast, the apparently spurious (WAT) displays quite impressive log-log rank frequency linearity. In the limited context of the artefacts studied here, a yellow dot (questionable conformity) for Zipf's Law potentially indicates an authentic RR inscription, whereas a green dot (good conformity) is more likely to occur with a counterfeit. Zipf (1949) rationalized his law (indeed it is the title of his treatise) as the natural result of expending least effort to produce a successful result. Money-driven forgers would surely strive to output minimum effort in crafting convincing deceptions and perhaps that accounts for the good Zipf's law conformity displayed by the WAT.

Acknowledgment

I am indebted to the work of Philip Spaelti in authoring and sponsoring the website `http://kohaumotu.org/` (Rongorongo Tablets). This site served me well as a source for high-quality glyph images (reproduced from inscription rubbings originally obtained by Thomas Barthel (1958, End Attachments)).

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The Intersection between Art, Non-Linguistic Symbol Systems, and Writing: The Case of the Wari, Tiwanaku, and Inka Iconographies

Tomi S. Melka & Robert M. Schoch

Abstract. The present study focuses on iconographic aspects of Wari-Tiwanaku (who occupied portions of modern Perú, Bolivia, and Chile, *circa* 100 BCE to 1100 CE) artifacts. The hypothesis that the graphic Wari-Tiwanaku elements constituted a cogent semiotic system is explored. Many of the Wari-Tiwanaku elements reminisce (or evoke) the later classic Inka (= Inqa / Inca; *circa* late 15th to early 16th centuries CE) geometric-like / stylized *t'oqapu* patterns which it has been argued formed a visual system based on mnemonic-like principles with possibly emerging logographic elements per various scholars. Selected models, fundamentally from a number of textile and pottery samples of the Wari (+ Wari-Tiwanaku) and Inka cultures, have been retrieved and subjected to iconographical and comparative analyses. The results vouch for the continuity of cultural patterns among these highland pre-European Andean states, separated temporally by hundreds of years, with the Inka having possibly adopted and refashioned an unspecified number of motifs in agreement with their ideological and aesthetic agenda.

1. Introduction

This article focuses on iconographic aspects, present in some Wari-Tiwanaku and Inka artifacts, in particular, in tapestry tunics. The discussion of the Middle Horizon iconography hinges on the meaning, chronology, spatial extension, plus the Wari-Tiwanaku imagery interaction (cf. Stone, 1989 [1987]; Cook, 2004, p. 150; Isbell, 2008, pp. 732–739). These topics have been around for a long time in the mainstream research, yet they are not fully understood.

The target corpus, square or rectangular-like units often repeating themselves across vertical bands in Wari or Wari-related tunics, are

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arranged or distinguished by color sequencing, and by a number of recurrent motifs in the greater part of the artifacts (cf. Stone-Miller, 1992, pp. 342–343; Conklin, 1996b; Bergh, 1999; Oakland Rodman and Fernandez, 2000, p. 121; Frame, 2001, pp. 128–130). They are compared with other quadrangle structures organized vertically, diagonally, or horizontally in a modular fashion, displaying embedded colors, sundry patterns in a bipartite or quadripartite manner, and found in Inka or Inka-related tunics. Such geometrically conceived structures answer in our time to the name of *t'oqapu* (Rowe Pollard, 1978; Rowe, 1999 [1979]; Dransart, 1997 [1992], p. 159; Silverman, 1994, pp. 13–14; Stone-Miller, 2002 [1995], p. 212; Phipps, 1996, p. 153; Arellano, 1999, pp. 253–260; Frame, 2001, pp. 132–135; 2007; Heckman, 2003, p. 49; Stone, 2007; Clados, 2007).

For analytical and comparative purposes, a number of non-Andean artifacts coming from different cultures and eras are referred to in this essay. Technically, however, the non-Andean artifacts are not included in the Wari-Tiwanaku and Inka sampling(s).

These ancient Andean designs are not limited to textiles, being observed additionally in ceramic (urns, jars, beakers), wooden, and metal objects. Examination of the fabrics' iconography shows a notable resemblance in concept of design. However, ancient Andean images are known to reciprocate the internal textile structure, i.e., the very act of weaving creates images, and are metaphorically used to codify social thought and relations (see Frame, 1994, 2001; Conklin, 1996a, pp. 325–326; Paul, 2004; and Franquemont, 2004). The two combined aspects turn into communicative messages of sacred and secular content, in the Middle Horizon context, and in the next cultural context, the Inka.[1] Given the precedents, and due to the later *t'oqapu*[2] expanding phenomenon (Rowe Pollard, 1978, pp, 19–25), it is suggested that Inka — or better, the segment of Inka population in charge of the designing and weaving processes — benefited, and/or altered and reformatted to their advan-

1. During the *t'oqapu* analysis of the royal tunic of Dumbarton Oaks, Washington DC, Stone (2007, p. 401) thinks that "… *some of the non-Inka patterns may refer in an appropriate sense to the past of other traditions*". Other traditions refer to Nazca, Wari, or Tiwanaku.

2. Since the time when the Peruvianist Victoria de la Jara (1967, 1970, and 1975) raised the question of Inka *t'oqapu* motifs as elements of a writing system—and with their increased documentation over time—, the scholarly debate around them has not abated. Whereas the related literature is sufficiently rich (see e.g., Barthel, 1971; Rowe, 1999 [1979]; Arellano, 1999; Desrosiers, 1992; Quispe-Agnoli, 2002, 2006: 180–185; Phipps et al., 2004; Frame, 2007; Stone, 2007; Clados, 2007; Gentile Lafaille, 2010; Cummins, 2011; Silverman, 2011), the interpretative theories offered fit the range from *rational* and *plausible* to *unwarranted* speculations. For the etymology and the successive semantic shifts of the word <*t'oqapu*> one should consult Cerrón-Palomino (2005, and also 2008, pp. 99–109).

tage a selection of Wari, Wari-Tiwanaku, or pre-Wari patterns. This hypothesis may also permit searching for semantic values throughout the patterns. Similarly, we should be realistic and admit that the study cannot fully cover the Middle Horizon and Late Horizon periods.

Here we mention that the area of *t'oqapu* studies is far from being conventionalized due to both the lack of evidence and disputed putative evidence, caused especially by the not-so-well coordinated work of specialists of different areas, and by sometimes questionable (or questioned) estimates of the underlying mechanisms of *t'oqapu* compatible with assumed linguistic or pre-linguistic (= mnemonic-like) values.

Exhaustive mention will not be made in this essay of weaving techniques and processes, already discussed by scholars (Stone, 1989 [1987], pp. 71–74; Desrosiers, 1992; Frame, 1994, pp. 330–334, 2001, pp. 128–131; Stone-Miller, 1992, p. 336; 1994c, pp. 36–41; Oakland Rodman and Cassman, 1995; Conklin, 1996a, pp. 325–326; Bergh, 1999; Brinckerhoff, 1999); the technique features of Wari-style tunics compared to the Inka ones (Rowe Pollard, 1978, p. 8; Oakland Rodman and Cassman, 1995, p. 34); and dyeing techniques and colorants regarding the tapestry of Wari tunics (Stone, 1989 [1987], pp. 61–66; Conklin, 1996b), all standing for relevant, yet distinct subject matters from our own. At any event, attending comments based on the mentioned sources occur.

The term *pattern/s* used here is based on Washburn (2004, p. 47),

> By *pattern*, I mean an arrangement of marks that repeats in systematic fashion. Such patterns can be distinguished by the geometries that are used to repeat the marks.

Finally, the consistency of spelling has been enforced on certain assumed native terms, opting for the lexical forms *Wari*, *Tiwanaku*, *Inka*, *t'oqapu* and *unqu* ["a *knee-length sleeveless tunic*"]; see Rowe Pollard (1995–1996, p. 24). Exceptions in this sense would include their different use in the referenced sources. In a similar way, the caption "CE" is placed after the provided dates for the artifacts, while the acronyms "W-T" and "MH" are alternatively used with Wari-Tiwanaku, and Middle Horizon. Regarding the Inka civilization, the terms *Inkario* and *Tawantinsuyu* refer interchangeably to the land or realm of the Inka in their apogee, pointing to the Late Horizon period of the Andean culture, 1476–1532 CE, in keeping with the chronological scheme set by John H. Rowe (1965). Consistency in Inka terminology is attempted throughout the article, unless sporadic alternative variations are cited from original sources. This terminology may be contested by other experts on spelling, cultural, and individual grounds (Niles, 1999, pp. xi–xii; Steele and Allen, 2004, p. xv). Making use of such spellings does not affect their semantic content, being in the end the same units. Among the parallel (or *ad hoc*) forms present in the literature are [*Inca*, *Ynga*, *Inga*, *Incca*], [*t'oqapu*, *tokapu*,

tukapu, *ttocapu*; *tocapu*, *toccapu*, *tocapo*, *toqapu*, *tokhapu*, *t'uqapu*], and [*uncu*, *unccu*, *unku*]. Similarly, drawing on terms such as the *diamond waistband*, the *Inka key* (= "percent signs"), the *black-and-white checkerboard*—describing the basic motifs across the *t'oqapu* arrangements—is meant as a neutral and technical terminology of convenience. It should be clear that such descriptions do not imply by any means to "readings" or "translations" on our part; from the Inka perspective, we believe that these code-names—most likely—are blatant misnomers.

The term *camelid fiber*, a natural, protein-based fiber coming from animals such as alpaca, llama, or others, is employed instead of *wool*, perceived as connected with sheep's fleece (Stone, 1989 [1987], pp. 55–60). On herding and pastoralism in the Andean highlands, and techniques of preparation of fibers for weaving, see Flores Ochoa (1986, pp. 137–148), the subsection *Camelids* in Stone-Miller (1992, pp. 337–342), and Dransart (2002).

2. The Corpus Sampling Issues in the Wari and Wari-Tiwanaku Corpus

Regarding the extant textile record of Wari (= Huari) and Wari-Tiwanaku (= W-T) artifacts appropriate for a scientific analysis, Stone-Miller (1992, p. 336) states,

> Because of the primacy of fiber and the number of roles it played, the Middle Horizon textile record is fairly diverse in terms of function, technique, and style. It encompasses a number of object types, including, but not limited to: tunics... mantles... hats... quipus... and what appear to be hangings... as well as headbands, bags and belts.

The data for analysis are confined by and large to the accessible tapestry tunics, wherein individual or groups of geometric and (incidentally) non-geometric patterns are searched for. The authentic material is deposited in public and private museums and private collections, retrieved directly through *archaeological excavations*, for instance, mummy bundles wrapped in mantles or wearing tunics (Figure 1; Conklin, 1996b, p. 405, Fig. 151; Pasztori, 1998, p. 124; Kaulicke, 2000, p. 315, Fig. 1; pp. 316–317, Figs. 2, 3, 4; Longhena and Alva, 2007, p. 108; Museo Larco, 2022a); acquired through *purchases*—typically detached from an archaeological context—, see e.g., Lothrop and associates (1959 [1957]); or received as *gifts* (Rowe Pollard, 1978, p. 5; Stone-Miller, 1994a, p. 98, Plate 20; p. 129, Plate 128).

Assessing the characteristics of the W-T tapestry tunics offers a better grasp and appreciation of the analysis. Rodman and Cassman (1995, p. 37) described the common features Wari and Tiwanaku tunics share, as well as some of their clear differences. The W-T imagery, layout,



(a) (b)

FIGURE 1. (a) A Wari (Huari) funerary bundle (Museo Larco, 2022a; https://www.museolarco.org/en/exhibition/permanent-exhibition/masterpieces/huari-funerary-bundle/); inventory no. ML800001; style: Wari; chronology: Middle Horizon (600 CE–1000 CE); Region: Sierra Sur [Highlands of southern Perú]. The mummy is decorated with a golden mask, a feather headdress, and a tapestry tunic displaying geometric motifs with curlicues. (b) Lateral view (left side) of the funerary bundle described in (a) (Museo Larco, 2022b; https://www.museolarco.org/catalogo/ficha.php?id=44102).

and repetition patterns are quite similar, the shape and size being the same. In contrast to Tiwanaku, Wari tunics have two different rectangular webs seamed down to the tunic center. According to Oakland Rodman and Cassman (1995, p. 37), "*…this construction eliminates the need for a cumbersome scaffold… with the neck formed in the embroidered finishing, not within the original construction as in Tiwanaku and Inca tunics*". Tiwanaku tunics are woven from the finest camelid fibers, whereas the Wari ones contain a variety of fibers in the warp: *cotton*, *camelid*, or *cotton and camelid* plied together. Given the parallels, the Wari and Tiwanaku iconographies are here generally treated as one category when compared to Inka tapestry.

It is reasonable at this stage to question if the Wari-Tiwanaku specimens are *randomly chosen*, and if the current number of textiles is *representative* of the corpus in the W-T areas of extension and influence. Wari-styled tapestries appear in larger numbers and are better-known than those of the Tiwanaku (Stone-Miller, 1992, p. 336; Oakland Rodman and Fernández, 2000, p. 124). The answer is proportional to: (a) the high-quality sources available to the present authors, (b) their significance and association with the Late Horizon Inka patterns, basically found in *t'oqapu*, e.g., the *Greek key*, or the *stepped-diamond*, (c) the lack of a full range of variability through time and space in Wari-Tiwanaku motifs, evidently related to the criterion of corpus representativeness (see e.g., Biber, 1992). The existence of any MH artifact is evidently due to acts of randomness, supplying us, however, with needed evidence. In former times, the Andeans did not think of other people, especially not of those

living in the distant future on different landmasses, taking up studies to learn and advocate for their culture. The objects—what is left and retrieved to date using legitimate or (unfortunately) illegitimate means—are non-intentional time-capsules. Considering the vicissitudes of time, climate factors, the ingrained warfare in these states and in later cultures that expanded over their territories (e.g., Inka), the policies imposed by the Spanish conquistadores and settlers, plus the systematic looting carried on by a mixture of adventurers and *huaqueros* [grave robbers, shrine robbers][3] alike, modern scholarship is fortunate to have a substantial number of artifacts from the MH period. Studying a (much) larger corpus, apart from being an outsized employment for two researchers in terms of time and finances, will inevitably face the ensuing problems:

- *Are all the occurrences (or samples), central to the W-T iconography, whether finely preserved or damaged?*[4]
- *Do they stand regularly for extended and sequential periods of time in the assumed chronology of Wari,*[5] or *of Tiwanaku? Is the dating of the artifacts, as indicated in the cited sources, credible or somewhat credible?*[6]
- *What about the reliance on samples of private collections lacking dating information or even provenance* (Ángeles and Pozzi-Escot, 2000, p. 410)?
- *What is the margin of error if results are generalized and used in new studies, assuming always that accidental bias is part of an incomplete quantitative approach?*

The difficulties are of a major scale and can be counteracted through a diligent study that aims at integrating the internal textile structure,

3. *Huaquero* derives from *huaca* (see Rostworowski, 2007, p. 171), "*...el término huaca, voz quechua y aymara, para señalar lo sagrado, el ídolo y el santuario*" [...the term huaca, a Quechua and Aymara word, to indicate the sacred, the idol, and the shrine]. An English equivalent of the word *huaquero* could be *treasure hunter*.

4. Specifically, a fragment of Wari tapestry tunic, Middle Horizon, 500–800 CE, camelid fiber, 92 × 55 cm, *Museum für Völkerkunde, München* [Munich], inventory No. 58-1-1 (see Paternosto, 2001, Plate 6), appears to be reasonably well-preserved. On the other hand, a deteriorated fragment of a Wari tunic, 31 × 54 cm, salvaged from the site known as *"El Castillo" de Huarmey* is illustrated in Prümers (2000, Fig. 19). Despite the atrocious physical condition, the main theme of the *staff-bearer* is still recognized in its upper section. A careful examination shows a striking affinity in terms of iconography with the textile fragment in Paternosto (2001, Plate 6). Following this context, Oakland (2012, p. 3, Figures 3 and 4) illustrates a Tiwanaku tapestry tunic found in a funerary bundle, inventory no. 5382, held at *Museo R. P. Gustavo Le Paige*, San Pedro de Atacama (Antofagasta, Chile). The physical condition of this six-banded tapestry leaves much to be desired; however, one is able to discern repeating images that include animal-headed *staff-bearing figures*. Partially damaged pieces are similarly illustrated in Bergh (2013, p. 176, Figure 165) and Bergh (2013, p. 178, Figure 167).

5. Benavides (1999, p. 398) mentions three great moments in the development of Wari society: the formative process 500–700 CE, the expansive period 700–1000 CE corresponding to the Wari Empire, and 1000–1100 CE related to its decline and decay.

6. For issues related to radiocarbon dates in South American archaeology, see Silverman and Isbell (2008, p. xix).

comparative iconography, and selective radiocarbon dating. We shall return to these matters in the forthcoming sections as well.

Given the immensity of the task, we wish to respond to some of the listed problems: the approximation in dating, e.g., a piece of tapestry belonging to a time period 600–900 CE, or 600–1000 CE, is not of much assistance in verifying developmental trends; or worse, the absence of dating may affect the analysis in keeping with rigorous scholarly standards (Stone, 1989 [1987], p. 27; Bergh, 1999). Hence, scholarship has by default to depend on the textile structure itself to define plausible guidelines. In theory, any projected size of MH samples is idiosyncratic and never perfect, since it is based on a finite number of objects, and reflects the sampling criteria and physical possibilities of a researcher or of a group of researchers, and finally, it lacks precise chronology. The present corpus is an open one, meaning, more artifacts could be possibly retrieved through archaeological excavation sites, e.g., *Huamachuco*, see Topic (1991, pp. 141–164); *Wari*, see Isbell and associates (1991, pp. 19–55); *Huaca Malena*, see Ángeles and Pozzi-Escot (2000); *Conchopata*, see Isbell (2000); *Cerro Baúl*, see Williams (2001); *Moquegua*, see Owen and Goldstein (2001); *Pulacayo*; see Agüero Piwonka (2007); *Pikillacta*, see McEwan (2005, pp. 147–165) and Ligmond (2021), or unknown, new centers. Items that may appear in the future—plus the iconographic analysis—may validate (or not) the conclusions of this study. The expansive character of the W-T corpus invites other scholars to take previous and current iconographic studies into account and move forward. Establishing the degree of arbitrariness in the devised corpus may be problematic, since no thorough control or adjustment can be diatopically and/or diachronically set. Hence, caution should be exercised: it is advisable to make studies of a similar nature and look forward to verification from experts rather than to slow down the research. At this stage, the following technical points clarify that: (a) In various cases, slight modifications, i.e., isolation and/or rotation of elements, are made for ease of perception. Similarly, the patterns are not disjointed on purpose, but rather isolated for the specific analysis and comparison, plus the practical effect: image amplification and saving space. In any case, to avoid the misconception of gestalts, the complete images are more often than not printed separately, given that *the appearance of any element depends on its place and function in an overall pattern* (Arnheim, 1997 [1974], p. 5). In contrast, the retrieval of the full context (= "textile syntax") giving meaningful association to the patterns must be done by consulting the literature. (b) The provenance, or cultural links to the artifacts are consistently identified, unless they are inadequate, or omitted in the original references.

3. Sampling Issues in the *t'oqapu* Corpus

Since the scholarly accounts differ regarding understanding and explaining the *t'oqapu* motifs, a few remarks on sampling may help in better coping with the situation. The careful and accurate retrieval of data from genuine sources as an essential step for a succeeding scientific survey and feasible reconstitution of past phenomena is noted in various studies (Bouissac, 1994, p. 357; Baena Preysler et al., 1994, pp. 160–170; Meyer et al., 2006, pp. 1605–1606; Melka, 2008). Accordingly, the study and assessment of the pre-Colonial textiles are "plagued" down to our day in large measure by cultural, geographical, and historical gaps due to illegitimate diggings, or plundered and vandalized archaeological sites (Sawyer, 1961, p. 269; 1979, p. 129);[7] Rowe Pollard, 1979, p. 185; Young-Sánchez, 2006, p. 77; Gentile Lafaille, 2008, p. 10).[8] Another closely related problem, rising however above the specific Inka studies is the *sample bias*, considered "... *a danger in every research field*" (Good and Hardin, 2003, p. 7). Due to uncontrollable factors, mostly of an historical nature, the data size, i.e., the number of artifacts displaying varieties of *t'oqapu*, is not sufficiently large (cf. J. H. Rowe, 1999 [1979], pp. 604–648);[9] Heckman, 2003, p. 51). As a result of the (a) *scarcity*; (b) of *tunics and other items that fall short regarding their preservation state*; and (c) *given their diatopic and diachronic randomness*, distortion and evaluation errors may be expected even in the most rigorous inspections, and probably in later generalizations and/or replications. Modern scholars may not know if the number of the remaining *t'oqapu* textiles stand for a *substantial* or *insignificant* part of the total number of these artifacts. However, we may be inclined for the second choice, because the *unqu* corpus in the late days of the Inkario (i.e., Inka empire) was reportedly enormous, consisting of "countless" pieces, amassed in storehouses,[10] and circulating across its territory as distinctive outfits or redistributed as praised gifts (see

7. Sawyer (1979, p. 129), "Researchers dealing with ancient Peruvian textiles are faced with a number of major problems in establishing the date and function of specimens under study. Most of the Peruvian fabrics in the world's collections lack provenience and grave-association information".

8. "Muchos objetos andinos prehispánicos, *descontextualizados mediante el huaqueo...*" [Many pre-Hispanic Andean objects (are; *our note*) removed from their context through plunder...].

9. See the former assessment by Rowe (1999 [1979], p. 648), "It must be remembered that we are dealing with a very small sample, *made up in large part of tunics published with very inadequate information and illustrated with black-and-white photographs. Because of the limitations of the sample, we have been able to discuss mainly certain aspects of patterning and size*".

10. Such as in the sites of Huánuco Pampa, Hatún Jauja, Pumpu, Valle Calchaquí, Huamachuco, Mantaro Valley (see D'Altroy and Hastorf, 1984; D'Altroy and Earle, 1985; LeVine, 1992).

especially Murra, 1991 [1962], for Inka diplomacy regarding the finely woven textiles).

It should be noted that the collection of data is straightforward. Samples are extracted and investigated from published sources (in printed and electronic forms). Nonetheless, as John H. Rowe (1999 [1979], p. 648) notes, there should be further, untapped exemplars accommodated in a number of museums, private collections, or in the custody of auction houses and antiques stores (see H. A. Galleries, 1999–2010). Such genuine tunics with *t'oqapu* compositions remain unpublished and undescribed due to researchers' ignorance of their existence (see in particular Rowe Pollard, 1978, p. 5), or "because they are considered to belong to '*well-known*' *types*" (Rowe, 1999 [1979], pp. 648–649). With due attention and in time, they may resurface and potentially serve the interests of scholarly study. Incorporating additional textiles—primarily tunics and other garments—, will increase the reliability of the work. The integrity of inferences and conclusions will correlate with the nature and condition of the targeted samples (*v. supra*); some tunics and other artifacts bear *t'oqapu* that are blurred, scraped, or disfigured beyond recognition. By the same token, personal variables, concomitant idiosyncrasies, sloppy or deviant behavior in Inka textile manufacturing should be anticipated. It may be assumed hereafter that the Inka weavers were not copying *ad litteram* the entire time from *t'oqapu* designs of prior, or of other, exemplars. Despite what they were taught, it is likely the *qumpicamayoc* (= a class of selected expert weavers) might have developed on occasion their own styles and practices in creating the tapestry tunics. Weaving styles or identities apart, they do not interfere with the classification of some of the basic *t'oqapu* motifs discussed below.

4. Overview of the Wari, Tiwanaku, and Inka Empires

Researchers have described and commented upon the Wari polity in a number of publications: the beginnings, expansion from its heartland Wari, near the modern city Ayacucho, through coastal and highland areas of present day Perú, and the later weakening and decline (Menzel, 1964; Gonzáles Carré and Gálvez Pérez, 1981; Isbell and Cook, 1987; Kolata, 1993; Knobloch, 1993; Stone-Miller, 1994c, p. 35; Cook, 1994, 2004, pp. 149–150; Benavides, 1999; Schreiber, 2001; Bauer and Jones, 2003; Isbell and Vranich, 2004, pp. 167–181; D'Altroy and Schreiber, 2004, pp. 271–278; McEwan, 2005; Janusek, 2008, pp. 291–292; Isbell, 2008; and Figure 2). Differences and similarities between the major cult centers Wari and Tiwanaku, coexisting and interdependent as peer-polities deriving in a bicephalic "socio-political organism," or probably as sovereign forces vying for dominance, are explored elsewhere (Stierlin, 1984,

pp. 131–132; Stone, 1989 [1987], pp. 20–25; Cook, 1994; Conklin, 1996b, p. 375; 2004, p. 180; Bergh, 1999; 2004, p. 154; Isbell, 2000, pp. 12–15; 2008, pp. 738–753; Williams, 2001, pp. 67–83; Schreiber, 2001, p. 92; Williams León, 2001, p. 59; Young-Sánchez, 2004a, pp. 66–69; McEwan, 2005; Janusek, 2008, pp. 250–289; Isbell, 2008; Ligmond, 2021). In our opinion, since the interrelation Wari-Tiwanaku remains a matter of contention (see Bergh, 1999), assumptions are not taken for granted. There is, however, a partial consensus among scholars regarding the nature of the Wari state (see also Isbell, 2008, p. 753),

> Most researchers agree that Wari was an expansive state, an empire that consolidated power rapidly. Cook (2004, p. 146)

As for the timespan, there are still differences of opinion, although the main idea is distilled when one refers to four different sources. Hughes (1995, p. 106) discussing the Middle Horizon period, claims that it spans approximately four centuries from 600–1000 CE. Benavides (1999, p. 398) remarks on three great moments in the development of Wari society, the formative process 500–700 CE; the expansive period corresponding to the Wari empire 700–1000 CE; and the decline and decomposition 1000–1100 CE. Bauer and Jones (2003, p. 1) on the other hand state that *the Wari began to expand from their traditional power base in the Ayacucho region of Peru sometime after 550 AD and that state expansion continued through at least 900 AD., after which the state appears to have suddenly collapsed*. Cook (2004, p. 158) in turn, follows along the lines of Benavides (1999, p. 398), "Instead of a *200-year span* (*approximately 650–800 AD*) *during which time the* [Wari; *our note*] *empire flourished*, *the time frame has doubled* (*approximately 550–1000 AD*)."

The understanding of the social dynamics, the religious and military strategies (provided we are dealing with a true imperial expansion, or with something more than a religious proselytism, cf. Stierlin, 1984, p. 134; Isbell, 2000, p. 12) and its final decay are nevertheless beset with difficulties, as explained by Schreiber (2001, p. 70),

> For the earlier Wari empire we can rely only on archaeological data. We have no literary record of the words or thoughts of the people of Wari; we do not even know what they called themselves.

The situation, nonetheless, should not prevent scholars from bringing together their efforts toward additional material evidence; see especially Isbell (2000, pp. 10–11).

Now we turn our attention to the other ancient Andean civilization: that of the Inka. Regarding the mythological universe and socio-cultural-economical profile, the rise and fall of the largest political and military structure of the pre-Conquest Americas, there are a number of essays and books, e.g., Murra (1991 [1962]); Rowe (1999 [1979]);

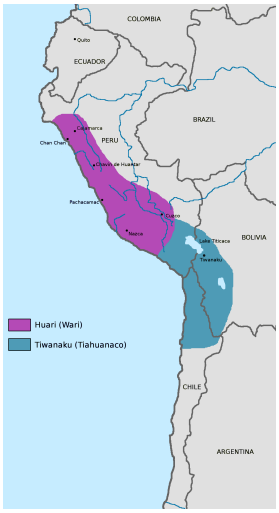


FIGURE 2. Expansion area of influence of the Wari (Huari) and Tiwanaku (Tihuanaco) cultures. File: Huari-with-tiahuanaco.png. Author: Zenyu~commonswiki - Own work. Public Domain; Created: 18 December 2004. https://upload.wikimedia.org/wikipedia/commons/0/00/Huari-with-tiahuanaco.png (accessed 22 March 2022).

Urton (1990); Centro Cultural de la Villa de Madrid (1991); Pärssinnen (1992); Morris and Von Hagen (1993); Pease, G.Y. et al. (1999); D'Altroy (2001, pp. 201–226; 2005 [2002]); MacCormack (2001); Cummins (2004, pp. 2–16); Steele and Allen (2004); D'Altroy and Schreiber (2004, pp. 261–270); McEwan (2006); Rostworowski (2007), Stone (2007), Covey (2008, pp. 809–830) — to name a few of them. According to scholars, the expansion of Inka imperial order began around 1400 CE (D'Altroy and Schreiber, 2004, p. 261; Covey, 2008, p. 814). Though shrouded in between history and mythology, an important figure appears: the ninth Inka sovereign, Pachacuti, or Pachacutec Inka Yupanqui (*ca.* 1440–1450 CE), promoter of conquest campaigns and founder of Tawantisuyu [in Quechua] "The Land of the Four Quarters," with Cuzco as the capital (see D'Altroy, 2005 [2002], p. xiii; McEwan, 2006, p. 3l; and Figure 3).

The Inka Empire saw the onset of its destruction upon the arrival of a Spanish expeditionary force in 1532, succeeded by the conquest and imposition of the outsiders' rule. Such a short timespan matches up to some extent with the Late Horizon period, 1476–1534 CE, per John Rowe's (1965) scheme. Before Francisco Pizarro's arrival, the Inka realm included large tracts of the coast and highland areas corresponding to what currently is a portion of southern Colombia, Ecuador, the greatest

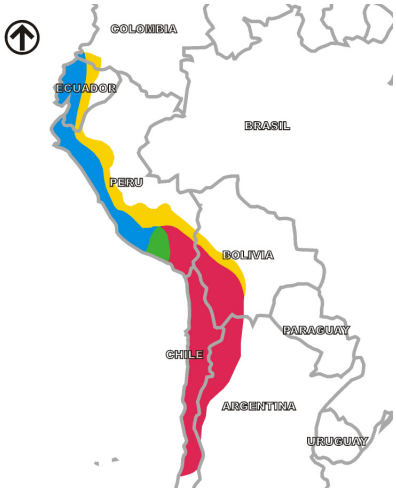


FIGURE 3. The four *suyus* (provinces / quarters) of the Inka Empire, respectively *Chinchaysuyu* (I) (Northwest); *Condesuyu* (IV) (Southwest); *Antisuyu* (III) (Northeast); and *Collasuyu* (II) (Southeast); see Zuidema (1991, p. 155). Author of the diagram: *Wonnie~commonswiki*; 2 October 2005; last edited on 6 November 2021. CC BY-SA 3.0. `https://commons.wikimedia.org/wiki/Atlas_of_the_Inca_Empire\#/media/File:Inka_Provinces.jpg` (accessed 22 March 2022).

part of Perú, and considerable sectors in Bolivia, and in northern Chile and Argentina. The statecraft and other singular feats of the Inka civilization continue to captivate modern scholars. Seen in this light, it may be said that the future holds room for more research, in particular, regarding issues that still remain elusive and complex; e.g., communicative systems (notational or not) and correlated devices, historical chronology, i.e., the pre-imperial to imperial system, cultural contact and interface with pre-Inka civilizations (especially with Wari / Wari-Tiwanaku), analysis and interpretation of sacred and secular imagery, astronomical observations, etc.

5. Writing Systems in the Andean Area and the Definition of Writing

The mainstream belief among scholars is that pre-European South American cultures did not have *writing systems* in the sense that such are conventionally perceived outside the Inka area of control; to be precise, they did not have writing systems composed of *physical signs* able to fully *express* and *represent speech* (Stierlin, 1984, pp. 190–191; Franquemont, 1986, pp. 81–82, 84; Mignolo, 1994, pp. 234–237; J. H. Rowe, 1996,

p. 463 in A. P. Rowe, and J. H. Rowe, 1996; Mitchell and Jaye, 1996, p. 16; Quispe-Agnoli, 2006). Some scholars privilege *phonetic writing* as the climax of socio-cultural development, whereas pictorial-like and "logographic" forms / systems characterized as "partial" / "limited / "emblematic" / or even "pseudo-" / "non-writing" are ("inherently") related with less sophisticated and archaic human communities (aka *the oral societies*); cf. e.g., Boone (1994b) on the Aztecs. Although dealing specifically with the context of Mesoamerican scripts, the comments of Carlo Severi (2019) also apply to South America:

> The relationship between picture-writing and 'real' (phonetic) writing is usually understood in terms of a temporal sequence: picture-writings, regularly defined as rudimentary drawings used in oral traditions to represent basic ideas, are said to precede in time the invention of writing. They are also, very often, seen as unstable and unreliable means of storing knowledge. In studies devoted to the history of writing, it is often stated (Cohen, 1958; Diringer, 1937; Gelb, 1952) that 'true writing,' once invented, is soon recognized as a better tool for recording and transmitting information. Consequently, the use of a writing system rapidly replaces old, rudimentary picture-writings and extends to cover the totality of a spoken language.

Many scholarly estimates of notation systems of a numerical and non-numerical nature that existed in pre-European South America present them as being as efficient as phonetic scripts or perhaps even more efficient, their differences being part of a divergent "evolution" [= developmental tendency] in the way of thinking and representation (Métraux, 1963; Naville, 1966; Paternosto, 1996 [1989], p. 171; Zuidema, 1991, p. 151; Prada Ramírez, 1994; Boone and Mignolo, 1994; Phipps, 1996, p. 154; Sassoon and Gaur, 1997; Grube and Arellano Hoffmann, 2002, pp. 51–52; D'Altroy, 2005 [2002], pp. 15–19; Cummins, 2002b, p. 190; Quispe- Agnoli, 2002, 2005, pp. 264–265, 2006; Heckman, 2003, p. 41; Fedriani Martel and Tenorio Villalón, 2004; Salomon, 2004; Steele and Allen, 2004, pp. 36–40; McEwen, 2006, pp. 182–185; Kulmar, 2008, 2010, p. 139; González and Bray, 2008, pp. 1–4; Melka, 2010b; Bergh, 2013; Severi, 2019; Clados, 2020). At present, these systems are thought to be *largely mnemonic*-like and *semasiographic* (Sampson, 1985), although logographic or rebus-like elements cannot *a priori* be ruled out. For this reason, it may be said that we are dealing here qualitatively with a different *literary model* (Franquemont, 1986, p. 83; Boone and Mignolo, 1994; Quispe-Agnoli, 2006, pp. 145–180), where the textile motifs (or various *quipu* arrangements, for instance, in another context) did not articulate continuously the information in clear-cut words, but rather, they stood for the *real meaning* in view of their structure (= the "syntax" of concatenation of motifs / symbols), material, colors, and weaving processes applied in the whole practice.

In contrast to the hypothesis that most or all notation systems that existed in ancient South America were *largely* mnemonic-like and se-

masiographic, some researchers propose that some of these systems involved logo-syllabic coding, or whole / partial phonetic components; examples suggested include the cases of *quipu*, *t'oqapu* geometric patterns, the Moche Lima beans, and the religious texts of the indigenous Aymara; see Ibarra Grasso (1953); V. de la Jara (1967, 1975); Barthel (1970, 1971); Totten (1985); Laurencich Minelli (1996); Burns Glynn (2002); Salcedo Salcedo (2007). If such claims are to be carried further in the serious scientific agenda, hard evidence should be searched for and properly documented (cf. Barthel, 1976, p. 27). Mitchell and Jaye (1996, p. 16) address bluntly such suggestions by writing, "The arguments and evidence of these authors, *however*, *tend to be speculative and not very vigorous*."

6. What is Writing?—An Important Digression

In *A Study of Writing*, Gelb characterizes writing as, "a system of human intercommunications by means of conventional visible marks" (Gelb, 1963 [1952], p. 12). Gelb (ibid., p. 190) suggested that *phonography* is the stage of representation in which writing expresses language, while *semasiography* (colloquially, "writing" using symbols, iconic signs, or pictures) is an earlier, less developed stage in which *pictures* (aka *pictographic representations*) convey meaning. The key issue regarding Gelb's definition is that the system must be *conventional*; the signs must be understood in the same way by all users and not need the intervention of the "writer" to interpret the message. One can argue that this approach rules out things such as *cave paintings*, in which the creator may use conventional signs but does not necessarily follow rules that are understood in the same way by all people—but if the cave painter's audience did consistently understand the conventions and rules, would it / should it be considered writing? Additional views on writing assist us in dissecting and reconstituting the discussed notion:

> What is writing? To 'write' might be defined, at a first approximation, as: to communicate relatively specific ideas by means of permanent, visible marks. (Sampson, 1985, p. 26)
>
> Because writing is use of conventional signs in a conventional system as instruments in mental processes, writing is a form of thinking. Certain kinds of writing enable certain kinds of thinking. (Powell, 2009, p. 54)

In either definition (Sampson, Powell), there is some perceived ambiguity as we may deem it entirely possible to remove *writing* from the conservative context of recording spoken language. After all, various mnemonic devices resort to permanent, visible marks, conventional signs, and they reflect the mental processes of their creators, similar to the logo-syllabic or alphabetic systems. In turn, Daniels (1996, p. 3) states that,

> ... writing is defined as a system of more or less permanent marks used to represent an utterance [= speech] in such a way that it can be recovered more or less exactly without the intervention of the utterer.

What may be considered the conventional or conservative standpoint holds that *writing* must be tied to the human spoken language: "Writing is a direct symbolic record of the speech act, or '*visible speech*'" (after John DeFrancis, 1989).

Rogers (2005, p. 2),

> We can define writing as the use of graphic marks to represent specific linguistic utterances. The purpose of a definition is to distinguish a term from other things [= non-linguistic types of communication].

However, we should consider that writing in "early stages" did not necessarily or always record continuous and explicit oral communication / utterances through the signs used; cf. Egypt, Mesopotamia, or Mesoamerica. This apparent fact renders *problematic* the exacting definitions. A "solution" in this context is offered by Peter Damerow (2006 [1999]), introducing the term *protowriting* to describe the systems that display "weak connections to *oral language*" or are connected with the "nascent" stages of writing. This is not to suggest that *proto-writing* is in some way inferior or primitive; it is simply more dependent on the reader or chanter being aware of the context of the document, and having the ability to fill in the missing information. Robinson (2009, p. 4),

> We can call them 'proto-writing': permanent visible marks capable of partial / specialized communication. Some scholars limit proto-writing to the earliest forms of writing, but in this book the term is applied much more widely. Thus there are endless varieties of proto-writing.

Other scholars may be inclined to argue that there is no such thing as *proto-writing*. If the so-called proto-writing includes confirmed phonetic units even to a small degree (say, rebus-like devices) then it is *writing*, conservatively (or not) speaking.

A different approach is represented in Elizabeth Hill Boone (among others); as Boone (2000, p. 29) writes,

> Writing is not merely a type of notational system, but an entire cultural category. It has been used to distinguish literate people from preliterates, people with history from those without, and even civilized people from barbarians or primitives... Given these meanings, how can we deny that the Aztecs and Mixtecs had writing?

The key idea of Boone is to develop a co-"evolutionary" model of writing, in which phonetic and "pictorial" / "pictographic" / "non-linguistic" systems are taken to be developmentally equivalent and in a "hybrid"

mode, each functioning to fulfill the need to communicate with an audience who may not speak a common language or may have inconsistent literacy skills. Earlier, Boone (1996, p. 314)—regarding the broad definition of writing—was aware however that "…, *the distinction between writing and nonwriting carries, unconsciously or not, certain value judgments that raise phonetic writing above other forms of communication*".

A number of scholars of non-Western subject-matter are proponents of a reassessment of writing as recorded speech. Albertine Gaur, in *History of Writing* (1987 [1984]) argues for a functional concept of writing defined as any form of "information storage" that properly fulfills its purpose for the society that implements it. This role is adequately carried out, Gaur proposes, by mnemonic devices, winter counts, knotted cords, or the alphabet. "Evolutionary" approaches to non-alphabetic information systems may be uninformative, and instead, approaches that treat scripts individually as complex and contextually developed devices may better answer questions regarding their function (Gaur, 2000, p. 3). Furthermore, Boone (1996, p. 313) notes "… *situations where language writing does not effectively serve a culture or a group within it and the members develop alternative forms of graphic communication to serve their record-keeping needs*".

7. What is Art? Wari, Tiwanaku, and Inka Iconographies—Are They Art?

Beyond questions of how an ancient symbol system may develop, with progressive abstraction from naturalistic shapes, into a linguistic system and a form of writing (whether referred to as pre-writing or protowriting; terms to be used without a subjective overburden of judgment values, as the level of sophistication of some such systems is extraordinary; cf. Gelb, 1963 [1952]; Daniels and Bright, 1996; Garrod, Fay, et al., 2007), the study of the Wari, Tiwanaku, and Inka iconographies is of more general interest in terms of art, language, and writing. Arguably the abstract visual art of these pre-European Andean cultures equaled (or even surpassed) the work of the Cubists, Expressionists, and other avant-garde artists of the late nineteenth and early twentieth centuries (see Golding, 1988 [1959]; Reid, 1986; Blotkamp, 1995 [1993]; Janssen and Joosten, 2002; Shiff, 2004; Hess and Grosenick, 2005; Aichele, 2006; Pasztory, 2010; Hughes, 2019). Another line of study is analyses of similarities and differences among Wari-Tiwanaku iconographic elements, the Inka *t'oqapu*, and modern emojis and related symbols that have become part of modern visual, written, and digital communication (Melka and Schoch, 2021). Studies of these symbolic systems lead to such penetrating questions as *how a language conceptualized in iconographic terms becomes* "art"? and *what is* art *after all*?

The 'Lima Tapestry' (Figure 4a) is a Middle Horizon Wari-Tiwanaku artifact; *Dimensions*: 100 × 92.3 cm; made of camelid fiber and cotton, and stored in the collection of the *Museo Nacional de Antropología, Arqueología e Historia del Perú* (T.01650); see Benavides (1999, p. 355); cf. Paternosto (1996 [1989], p. 228; 1999, pp. 10–11); Stone-Miller (2002 [1995], p. 148, Figure 119); Bergh (2013, p. 182, Figure 174). It appears to be the culmination of the process of geometric formalism. The original zoomorphs / anthropomorphs — the staff-bearing creatures, known as "staff god" and "profile attendants" — are rearranged in pure angular and rectangular shapes, producing a "masterfully abstract interpretation…" of the motif; see Stone-Miller (2002 [1995], p. 148, Figure 119). One is tempted to think that the initial figure (cf. Figure 7a, b) has "faded away" and yields an abstractionist and cubist-like modern painting of the 20th century; see Janssen and Joosten (2002); Aichele (2006). It comes as no surprise that the Wari tapestry geometric designs have gained notability and admiration in their own right among modern researchers and artists. Pasztory (2010, pp. 11–12) is very explicit in this context,

> *So it was that with the emergence of Cubism in the West, many Andean things became 'beautiful' and 'interesting' works of art.* Subsequent developments in Western abstraction, especially Conceptual art of the second half of the twentieth century have brought out many hitherto unappreciated aspects of Andean art and culture. [Emphasis added by the present authors.]

Dynamic, geometric patterns—characterized by a strong abstract and synthetic stylization—are equally observed in the middle section of a tapestry tunic held at *Juan B. Ambrosetti Ethnographic Museum*, Buenos Aires (Argentina); Figure 4b. The decomposition of patterns carried out by Iriarte (1999, p. 416; Plate 2) clearly shows the elements integrating the geometric designs.

Serial imagery in the Wari-Tiwanaku tapestries, that is, *the recurrence of modular designs* essentially swapping colors and symmetries, possibly emphasized prominent symbols, related to the cult personality (*staff-bearer* / "decapitator") and cult objects (e.g., *step fret*, *step and volute combined*, or the *rhombus*). A similar technique is noticeable in Andy Warhol's portrayals of some high-profile personalities of the 20th century related to assertive power, wealth, or iconic sex appeal, that included Marilyn Monroe (1926—1962; see for instance, Shanes, 2005, p. 43, Photo 34); Elvis Presley (1935—1977); Mao Zedong (1893—1976); Elizabeth Taylor (1932—2011), and others; see Reid (1986, pp, 16–17). Despite the differences in the underlying motives of these cross-cultural creations, the end *per se* in both premises is possibly *mass consumption*. Indeed, the Wari-Tiwanaku state ideologues laid emphasis through weaving on the cosmic / spatial order and divine forces (Stone, 1989 [1987], pp. 193–196; Stone-Miller, 2002 [1995], p. 148), sanctioned or imposed all over their sphere of influence, whereas we may note that Warhol was engaged



(a) (b)

FIGURE 4. (a) A MH Wari-Tiwanaku artifact made of camelid fiber and cotton known as the "Lima Tapestry" is stored in the collection of the *Museo Nacional de Antropología, Arqueología e Historia del Perú* (inventory no. 01650); see Benavides (1999, p. 355). (b) The central section of an incomplete tapestry tunic, made out of camelid warp and weft, 204 × 98 cm, inventory no. 23054, held at Juan B. Ambrosetti Ethnographic Museum, Buenos Aires (Argentina; Iriarte, 1999, p. 416; Plate 2) shows geometrical designs. The sobriety of designs in both tunics, combined with the subtle and refined tone of the dies, displays a skillful balance; see Hughes (1995, p. 120). The applied aesthetics seems to reflect a tendency toward deconstruction and minimalism, where bare lines and crisp shapes marry with colors to form something very intellectual and surreal alike, see also Pasztori (1998, p. 145), "*In the Tiahunaco/Huari tradition the image was already greatly reduced to a few canonical forms, and broken up by weavers into intellectually complex fragments. As time went on, the fragmentation proceeded further, such that the earlier logic of the design was completely dispersed; designs were now mixed together in a way that was pleasing but non-systematic.*"

in a billboard-like propaganda of secular and materialistic symbols, intended to feed the minds of the public by proselytizing the pop culture (Reid, 1986, pp. 16–17).

Some sober and crisp geometric features in the Middle Horizon tapestries are reminiscent of certain paintings of *avant-garde* artists of the stature of Piet Mondrian (1872—1944; see specifically "Composition (Checkerboard, Dark Colours)" 1919, in Blotkamp, 1995 [1993], p. 123; Plate 95); Paul Klee (1879—1940; see specifically "Einst dem Grau der Nacht enttaucht," 1918 [Once Emerged from the Gray of Night, 1918], in Hamburger, 2011, p. 252, Figure 3, and Hughes, 2019, pp. 40–41); Joaquín Torres García (1874—1949; see e.g., Hughes, 2019, pp. 16–17); Barnett Newman (1905—1970; see specifically Hughes, 2019, pp. 44–45); or Mark Rothko (1903—1970; see specifically Hughes, 2019, pp. 64–65); cf. Reid (1986, p. 22); Conklin (1996b, p. 378); Pasztory (1998, p. 125);

Paternosto (1999, pp. 15–16; Plate 4 and 5); Janssen and Joosten (2002); Shiff (2004, pp. 45, 89); Hess and Grosenick (2005, pp. 40–41, 72–73); Aichele (2006); for a critical view see Bergh (2013).

Compared to European and North American conceptualizations and rationalizations of Art, ancient South Americans (or other pre-industrial people) had different notions regarding the concept of Art. It is worthwhile to quote Esther Pasztory (*Inka Cubism*: *Reflections on Andean Art*, 2010, p. 10).

> Although the book is about 'art' in the vernacular meaning of the term, it is understood that the concept of art is a Western concept and does not correlate with anything Andean. Over the years, scholars, collectors, dealers, museum curators, and others selected objects that, from the Western point of view, exhibited superior form and craftsmanship and fitted within Western styles of art. Although anthropologists designate all objects as 'material culture,' they have tended to accept the 'art' designations created by the art world. As I discussed in Thinking with Things, there is no indwelling quality in objects that make them 'art'—individuals and societies decide what is art for their own reasons. For my purposes, art objects are things made or found that seem to have communicated on a visual or cognitive level among ancient Americans as well as with us.

It in an earlier work, Esther Pasztory (1990/1991, p. 110) pointed out the biases involved in some of the standard Western distinctions made regarding art of different peoples and cultures:

> Major unspoken distinctions are made between the abstractions of Western and so-called primitive peoples. For the modern artist an important aspect of abstraction is the reaction against the naturalistic classical tradition. In the case of Picasso in particular, there is proof in his early career that he could work in a naturalistic vein. Yet the assumption is that Eskimo artists, for example, cannot produce a realistic image, that abstraction alone is accessible to them. In other words, for the modern artist abstraction is a choice, but for the non-Western artist it is a given. Moreover, for the modernist artist abstraction is a great achievement, while for the non-Western artist it is merely an inadequate attempt at representation. This point of view has been expressed most forcefully by Gombrich (1960) who argued that 'conceptual' abstract art predates the development of 'perceptual' naturalistic art, and that the creation of abstraction is easy and comes naturally, while the development of realism is a slow and difficult process comparable to the successive discoveries in Western science. Although Gombrich has been refuted by Bryson (1983) and others, his developmental model is still the dominant one.

8. Naturalistic *versus* Geometric-like Models in Wari Iconography

The section deals with the question of stylization and abstraction,[11] common in the MH artifacts, in particular in the Wari-style tapestry. The main concern here is an archetypical figure with supernatural looks—a rather complex subject that merits a separate comprehensive study (see e.g., Makowski, 2001, pp. 337–373; Isbell and Knobloch, 2006, pp. 307–351). Yet, the extent and effects to which it assists the understanding of the abstract-geometric model in the studied artifacts make it an obligatory reference.

The central character around whom seems to orbit much of the Wari patterned imagery is a mythical being—the *Staff God*—flanked by attendant winged entities carrying similarly a *staff*, all being carved on the frieze of Tiwanaku's Gateway of the Sun (see Figures 5 and 6) The archetype of *staff-god*[12] (*front-face deity*) and the *attendants* have been repeatedly commented upon and illustrated in the literature, being perhaps the most popular image/s of the pre-Conquest Andes; see Wiener (1880); Lehmann and Doering (1924, Plate 2); Stierlin (1984, p. 133, Figs. 125 and 126); Kolata and Ponce Sanginés (1992, p. 325, Fig. 11); Stone-Miller (1992, p. 336; 1994c, p. 35; 2002 [1995], pp. 132–133); Pasztory (1998, p. 125); Paternosto (1999, p. 10); Makowski (2001, pp. 339–341); Williams León (2001, p. 59); Isbell (2001, pp. 120–121; 2008, pp. 734–737); Young-Sánchez (2004a, pp. 36–37); Cook (2004, p. 147); Longhena and Alva (2007, p. 36); Viau-Courville (2014, p. 12, Figures 3 and 4; pp. 14–15); Bergh (2017, p. 25, Figure 1a); Baitzel and Trigo Rodríguez (2019, p. 3). The generally held view of scholarship is noted in Stone-Miller (1994a, p. 117),

> … the staff-bearing figure, [is the; *our note*] hallmark of the Wari and Tiwanaku states of the Middle Horizon period
>
> … is commonly seen in two forms: the winged profile attendant figure *and the frontal deity*….

The significance and frequency of occurrence of this symbolic deity, and especially of the secondary winged figures in the examined Middle Horizon textile corpus, see Stone-Miller (1992, p. 336), may be compared to some extent (though arbitrarily) with the Western tradition of

---

11. See Stone-Miller (1994b, p. 23), "Abstraction by definition seeks the essence of a shape, *reducing it to its most fundamental character, which often in Andean art assumes a geometric appearance…*".

12. The designation "Staff God" was first proposed by John Howland Rowe (1967, p. 85) to describe the central figure of the Chavín Raimondi Stele; see, e.g., `https://commons.wikimedia.org/wiki/Category:Estela_de_Raimundi?uselang=it`.

art from 13th up to 19th centuries, where the Christian theme and its ramifications and variations were the leitmotiv of much artistic expression (cf. Reid, 1986, p. 14).

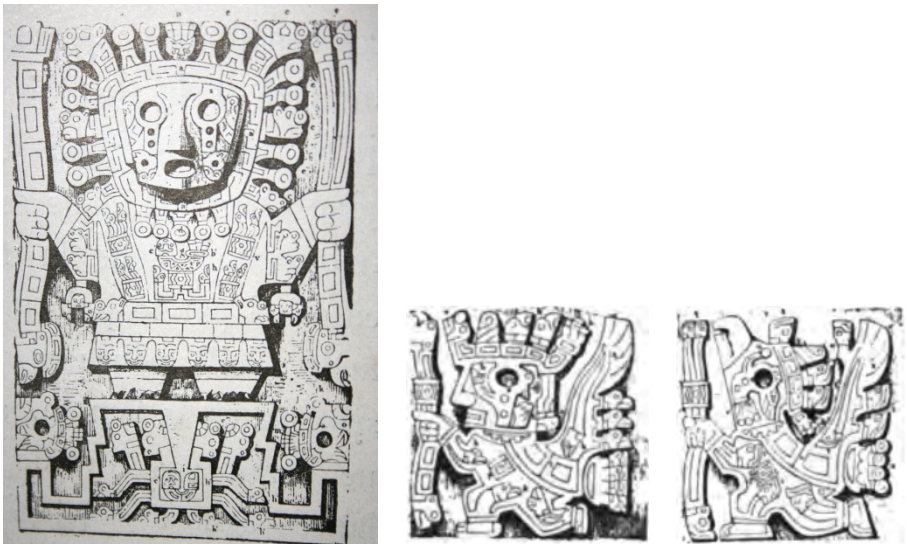


FIGURE 5. *Gateway of the Sun* [Puerta del Sol]. File:*Puerta del sol Tiwanaku.jpg*. author: Marek Grote. Creado el: 28 de septiembre de 2013, 12:01:13. CC BY-SA 3.0 https://es.wikipedia.org/wiki/Puerta_del_Sol_(Tiahuanaco)\#/media/Archivo:Puerta_del_sol_Tiwanaku.jpg

Upon long-term observations of the tapestry tunics inventory and other textile pieces, we may consider the possibility of a naturalistic style in an early phase in the Wari culture, later typified in conventionalized (or distorted) forms with a strong geometric content; see Sawyer (1963); Paternosto (1996 [1989], pp. 226–228); Stone-Miller (1992, p. 336; 1994b, p. 41); Hughes (1995, p. 106); Conklin (1996b, p. 396); Manrique P. (1999, pp. 54–56); Bergh (1999, 2017); Benavides (1999); Iriarte (1999); Oakland Rodman and Fernández (2000, p. 121); Jiménez Díaz (2006, p. 111); Viau-Courville (2014, pp. 12–13).

The term *naturalistic* implies the ability of the image to be satisfactorily recognized by random viewers given its primordial shape. The gradual metamorphosis of the *staff-bearer* is not yet firmly established: it is certainly difficult to determine (1) *when* the turning point occurred, (2) *when* the changes signaled specifically a break with the naturalistic tradition, (3) or if (ultimately) the advancing geometricization is related to ordered chronological stages. Susan Bergh (2013, p. 183, note 50) aptly points out, "*The so-far unproven implication of some of these views is that distortion registers chronology, that its effects became more profound through time as weavers pushed the system to its extreme and logical conclusion*".

When facing uncertainty in the context of sense-making, one has to look for additional evidence regarding the metamorphic process observed in the W-T tapestry tunics. Henceforth, a meticulous chrono-



(a) (b1) (b2)

FIGURE 6. (a) Sun god, central low relief of the monolithic *Gate of the Sun*, Tiwanaku; drawing by Charles Wiener (1880); see also Longhena and Alva (2007, p. 36); Clados (2007, p. 94, Figure 30); Bergh (2017, p. 26, Figure 1b); Baitzel and Trigo Rodríguez (2019, p. 3); Genotte (2019, p. 238, note 49). The roots of this deity, plus the surrounding pantheon, are traced back in several early South Andean cultures (see Rowe, 1967). However, the transition and adaptation period of this iconography by the Wari-Tiwanaku polities / communities, remains mostly unclear (see Isbell, 2008, p. 736). (b1) (b2) Staff-bearing figures (aka *attendant angels*, or *profile attendants*) from the frieze of Gateway of the Sun, Tiwanaku, modern-day Bolivia. Drawings by Charles Wiener (1880); see also Paternosto (1996 [1989], p. 227); Hughes (1995, p. 120); Paternosto (1999, p. 10); Makowski (2001, p. 350); Isbell (2008, p. 737); Bergh (2017, p. 26, Figure 1b); Baitzel and Trigo Rodríguez (2019, p. 3).

logical study of the samples would require accuracy in dating, which, if we refer to the cited bibliography, is *rather approximate*, or in other cases, in particular to various artifacts pertaining to private collectors, is *absent*. To compensate for this, a complementary approach combining the iconographical analysis of a large number of samples, the textile analysis of the structure of tunics, plus the "evolutionary" assessment of Wari pottery style, are required. More easily said that done, the proposed task would require the commitment of several international experts for considerable periods of time. The argument is also submissive to *stylistic changes*, i.e., variants of the accepted core format (see Figures 7a and 7b), linked with improvising by weavers and workshops that very likely happened during the process. Oakland Rodman and Cassman (1995, p. 39)

possibly identified in "…*separate work sections*…" of Wari tunics, "…*a variety of hands*," attributable to the presence of lazy lines (see Stone, 1989 [1987], pp. 86–88). Quite expectedly, and in a more general context, among the dexterous Wari weavers, more than one awkward hand may have been present. It is likely then, that weavers working in a wide loom applied on occasion their individualistic style and perception, aside from the learned conventional rules; see Stone-Miller (1994b, pp. 11–13; 2002 [1995], p. 146). Nonetheless, from a pragmatic standpoint, the discovery and classification of such specifics as "improvising weavers and workshops" begs for further substantial investigation. Under the circumstances, a comparative study based on the formal iconography of different examples is liable to shed light on the subject-matter.

So far as we know: *abstract*, see Stone-Miller (1992, p. 341, Fig. 8, 13; 1994a, p. 119); *human*, see Stone-Miller (1992, p. 342, Fig. 12; 1994a, p. 117); *animal*, see Stone-Miller (1992, p. 336, Fig. 3, 11, 12; 1994a, pp. 113, 116); and *other natural elements*, appear to have been rendered in the W-T textiles the way they were conceived by the genius of their creators, and imbued with symbolism and communicative power. The sharp, severe, and essentially rectilinear and angular designs, arrayed in band-like or grid-like sections, are mostly executed in a bilateral symmetry with the antithetical parts tending to attract and/or complement each other. On the other hand, undulating lines and curlicues are by no means absent in Wari-Tiwanaku tapestry; see Stone-Miller (1994a, p. 105); Bergh (2013, p. 178, Figure 161 and ibid., p. 181, Figure 172). As mentioned above, the *staff-god* character (known for longevity in the ancient Andes; see Jackson, 2008, p. 27) or other similar composite figures, i.e., falcon- or condor-like and/or jaguar-like, bearing the indispensable staff (the embodiment of a power instrument), appear initially in a naturalistic shape; see Figure 7. Supposedly, at some chronological stage, it is suspected that the familiar naturalistic patterns began to be discarded while undergoing dynamic variations at the different hands of Wari weavers. Proceeding on these continual improvisations and alterations the end results were quite often highly stylized, fractioned, and nonfigurative shapes and designs, a virtual tribute to minimalist forms. Similar to the claim of Garrod et al. (2007, p. 963) about the transition from iconicity to symbolism (geometric- / cursive-like forms) of the sign inventory of real-world scripts,

In particular, we will argue that during the evolution [= development] *from iconic to symbolic graphical representation, structural complexity migrates from the sign to memory representations in sign users.*

We believe that the ingenious and punctilious Wari (or Wari-Tiwanaku affiliated) weavers / designers had already memorized the correlates of the original naturalistic shapes prior to conveying the *complex geometric patterns*.

For all intents and purposes, such creations, reminiscent of *t'oqapu*-like structures and difficult to be "unpacked" by an untrained eye, seem to become mainstream in the tapestry weaving tradition. These remarks strongly reflect Stone-Miller's (1992, p. 336) and Hughes's (1995, p. 106) statements respectively,

> (a) the iconography of Tiwanaku sculpture, particularly to the secondary figures on the Gateway of the Sun...; but the Huari style demonstrates a marked progression away from the legible communication of the religious figures....
>
> (b) ... [MH; *our note*] weavers squeezed, stretched, split, abstracted, recombined block units as well as varied their spatial and color sequencing. The resulting transposition of elements is such that one must be familiar with the prototype motif [the staff-bearer figure; *our note*] to have any inkling of what is meant.

The selection of "readable and abstracted versions of the staff bearer" (Stone Miller, 1994b, p. 41), anthropomorphic or not, for analyses is dependent on the artifacts currently available for any specific study, including our current work. A reasonable concern for any single paper and accompanying discussion is the available space, since not every piece of tapestry can be subject to examination—thus, for additional details, we direct the reader to: Reid (1986, Plate 30, pp. 31, 32); Stone-Miller (2002, [1995], pp. 136–137, Figure 109); Ángeles and Pozzi-Escot (2000, p. 421, Fig. 12); Oakland Rodman and Fernández (2000, Fig. 5); Paternosto (2001, Plate 6, Plate 7), Bergh (2017, p. 29, Figures 5 and 6). A specialized monograph garnering samples on the order of hundreds, would probably serve better the purpose; see Stone-Miller (1989 [1987]); Bergh (1999).

At the outset, it should be stated that in both versions of the *staff-bearer* symbol, bodily parts like eyeballs, teeth or fangs, beaks, hands or claws, staffs, tails, are widespread within the examined grid, some of them more perceptible than others. The discernment (= "legibility") of images is always dependent on the performed degree of abstraction or transformation; see Multi-Figure 7 herein. Gayton (1978, p. 296) conveys the idea very clearly,

> ... the textile decoration of the Tihuanaco Huari [W-T] style shows a change in the whole pictorial representation of the figures of the deities to an abstract style composed of fragmentary elements, distributed in rectangular divisions: principally eyes, nose and teeth. *This disintegration of a total and coherent design is one of the most fascinating transformations in art*.

The increasingly used distortion and abstraction in the *staff-bearer*'s "continuum" (7a) → (7h), is neither the result of an iconoclastic drive nor misunderstanding of the component elements; neither are these last ones slavishly put together. The patterning derives from a deep percep-

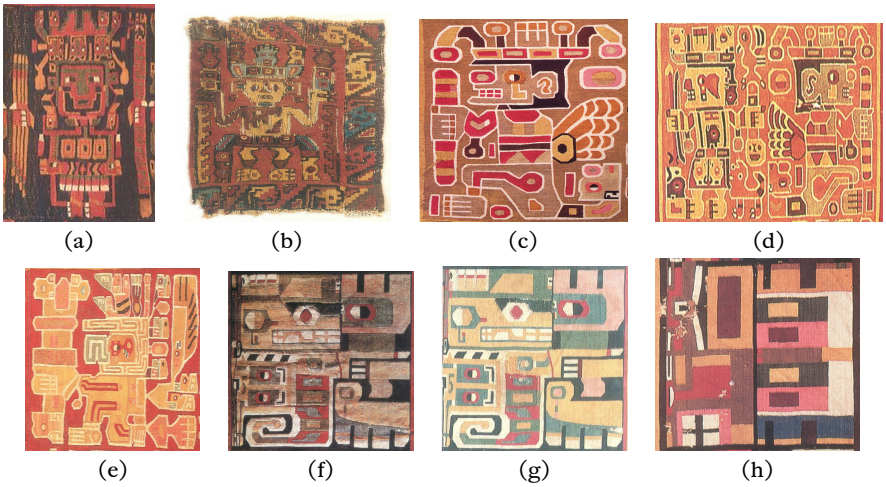


FIGURE 7. In Multi-Figure 7, a frontal figure similar to that found on the Gateway of the Sun (Tiwanaku) is portrayed in this fragment of tapestry tunic (a) of early Tiwanaku style, 200–400 CE, Perú or Chile, camelid fiber, private collection; see Young-Sánchez (2004b, pp. 46–47) and also Figures 5 and 6. (b) Likewise, the figure with staff is easily observed in another fragment showing a recognizable *staff-bearer* figure; see Stone-Miller (1994a, p. 117). (c) The staff, eye, wings, and other components of a slightly abstract but overall recognizable depiction of a *staff-bearer* are readily distinguishable in this fragment; see Benavides (1999, Plate 6; pp. 375; 408). (d) The wings, the head and body, the bisected eye, and the staff of an avian-anthrope, a "bird"-man, are distinctly visible, if stylized, in this depiction; see Benavides (1999, Plate 7; 377). (e) The staff, the eye, the wings, and the overall form of a bird-like figure are noticeable in an isolated square pattern; see Manrique P. (1999, Plate 13; p. 55). (f) The eye and the mouth with teeth, along with the tail, of an abstracted feline creature are evident in an isolated square pattern; see Benavides (1999, Plate 11; p. 387). (g) A Wari tapestry tunic fragment from Perú, 600–1000 CE; see Pasztori (1998, p. 125); 500–800 CE; see Stone-Miller (1992, p. 344, Fig. 14). The tunic is made of camelid fiber and cotton; *dimensions*: 103.5 × 50.5 cm, and is held at the Metropolitan Museum of Art, New York. A staff-holding feline is identified sitting on its tail, being a color variant of Figure 7(f). The last image (h) is part of the 'Lima Tapestry', a Wari-Tiwanaku artifact made of camelid fiber and cotton, stored in the collection of the *Museo Nacional de Antropología, Arqueología e Historia del Perú* (inventory no. T.01650); see Benavides (1999, p. 355). One view is that such an "evolving" / multi-phase model leads to the climax of the abstraction, with the subject itself, i.e., the primordial *staff-bearer*, having "lost" against the artistic creation, made of a mixture of pure bars and rectangles; see Stone-Miller (2002 [1995], p. 146). One wonders if the artistic and intellectual potency of Pablo Picasso or Juan Gris could have done better under the premises (cf. Figures 7g and 7h). On the other hand, given the absence of a proven chronology regarding the "distortion" / geometricization process observed in several Wari tapestry tunics, Bergh (2013, p. 183, note 50) urges caution.

tion of the underlying textile structure and an act of aesthetic recreation, through the assembling and disassembling of shapes and colors, which ultimately embody the *staff-bearer* himself on another level (see Stone-Miller, 1994c, pp. 35–36). Apparently, the MH weavers needed to express their cultural ideas and relationships in a form that transcended the "look-like" images, assuming non-representational shapes, yet able to be a powerful vehicle of communication (Washburn, 2004, pp. 53–54). Despite the acknowledged variability, the fundamental shape of the *staff-bearer*, acted as a "universal" badge or insignia, reinforcing the religious identity and its veneration among the Wari and Tiwanaku populations, or among other subdued / proselytized ethnic groups. The perceived visual experience is very dynamic (cf. Arnheim, 1997 [1974], p. 11), a product of the interplay of the elements in the portions of the square unit itself. In the larger scale of the whole tunic, this experience is amplified and often produces a strong intellectual stimulation, nearing some type of *psychedelic bedazzlement*.

9. Description of *t'oqapu*

A cursory look may describe *t'oqapu* as small, multi-colored, square units set in a band- or grid-like structure, having mostly a recurring character and running lengthwise (horizontally and/or vertically) on the most common artifact: an Inka-made or Inka-inspired fine tapestry tunic (Figures 8 and 9), or on other support materials (such as wood, metal, ceramic, and masonry). A closer look at tunics and other artifacts upholds the previous observation, and reveals a few additional details as reported over the decades (see Markham, 1969 [1910], p. 122;[13] Bankes, 1977, p. 172; Rowe, 1999 [1979]; Feltham, 1989, p. 57; Zuidema, 1991, p. 151; Delgado Pang, 1992, p. 291; Silverman, 1994, pp. 13–14; Stone-Miller, 2002 [1995], p. 212; Phipps, 1996, p. 153; Dransart, 1997, p. 159; Arellano, 1999, p. 257; Roussakis and Salazar, 1999, p. 276; Manrique P., 1999, p. 65; Frame, 2001, pp. 132–135, 2007; Cummins, 2002a, Fig. 4.3, 2011; Quispe-Agnoli, 2002, 2006; Heckman, 2003, p. 49; Steele and Allen, 2004, pp. 36–37; Stagnaro, 2005; Clados, 2007; Gentile Lafaille, 2008, p. 2; Williams, 2008, pp. 48–50; Femenías, 2017; Beaule, 2018, pp. 19–20).

13. The description of Markham (1969 [1910], p. 122), although genuine, is most likely based on limited observations of one or two *t'oqapu* types, "The later Incas wore a very rich kind of brocade, *in bands sewn together, forming a wide belt. The bands were in squares, each with an ornament, and as these ornaments were invariable there was probably some meaning attached to them. The material was called* tocapu, *and was generally worn as a wide belt of three bands. Some of the Incas had the whole tunic of* tocapu".

Researchers seem to agree at this point on the following: the squares (or rectangles) arranged in rows bear a strong, abstract geometrical content[14] of a conceptual and bipolar nature; there is a simplicity or diversity of motifs according to the status of the tunic-wearer, with the modular units revealing plain or varying colors and topological orientations (see Cummins, 2011; and Figures 8 and 9). Likewise, depending on the type and function of the *unqu* (Rowe, 1999 [1979]), a sense of linear and/or diagonal order, or otherwise of apparent disorder and random variations (Rowe Pollard, 1978, p. 21; Paternosto, 1996 [1989], p. 170; Stone, 2007, p. 399), are discerned. Although the message is conveyed—as often as not—in a linear fashion, which hints at a writing system (cf. Jean, 1998 [1989], p. 25; Sproat, 2013), this feature is by no means liable to generalizations regarding the *t'oqapu* system. Ignoring the linearity in other symbolic systems is misleading,[15] and may risk objectivity.

The entry *unqu* in Gisbert (1980, pp. 120–121) under "Atributos y Signos Distintivos de los Reyes Incas" [Attributes and Distinctive Signs of Inka Kings] reads:

> *Uncu.....túnica o camiseta corta* (*Arzans, Siglo XVIII, la vestimenta real*)
>
> [Uncu.....tunic or short blouse (Arzans, 18th century,[16] the royal garment)]

On the other hand, Ann Rowe Pollard (1995–1996, p. 24) describes it succinctly as "... *a knee-length sleeveless tunic*..." (see also Phipps, 2009, pp. 239–240), with Pillsbury's (2002, p. 69) characterization running parallel to the above authors, "Unku, *the principal male garment in the Inka culture of the Late Horizon* (*1476–1532*) *in Peru, was a sleeveless garment that extended to the knees of the wearer and was worn over a* wara [= huara] (*loincloth*)...". Although it essentially reflects the former reports, Marta Ruiz's (2002, p. 207) description offers more details,

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14. It appears that the ancient inhabitants of the Andes either were fond of the celebration of geometrical designs or displayed a real obsession regarding them, rarely matched in the history of humankind. The extremely common *geometrical principle* crops up in a variety of ways in the explored Inka tunic or non-tunic exemplars in our current review.

15. The Kuna "pictography" of the indigenous population of the region of San Blas, Panamá (Nordenskiöld, 1928, pp. 276–282; Jean, 1998 [1989], p. 29; Howe, 2009, p. 156), or the so-called Cretan "hieroglyphs" (Brice, 1992, pp. 21–24, Olivier et al., 1996) are systems characterized by linearity; yet, they are not fully-fledged phonetic writing systems, strictly speaking.

16. Possibly Gisbert (1980) is referring to the work of Bartolomé Arzáns de Orsúay y Vela (1705), "Relatos de la Villa Imperial de Potosí" [Narrations on the Imperial City of Potosí]. The book was reprinted in 2000 by PLURAL Editores in La Paz (Bolivia).

> El unku (ccahua *en aymara*; camiseta *o* túnica *en español*) *es una prenda formada por una sola pieza y de esa manera es sacada del telar, la pieza concluida se dobla sobre sí misma cosiéndose en los costados, dejando así la abertura para los brazos. La abertura del cuello es ya considerada en el tejido. Pueden encontrarse con mangas, aunque no es lo más frecuente* (Gisbert et al., 1992)
>
> [Unku (*ccahua* in Aymara; shirt or tunic in Spanish) is a one-piece garment, and is extracted from the loom in this manner; the finished piece is folded over itself being sewn in the flanks, leaving an opening for the arms. The neck opening is already made in the fabric itself. You could also find pieces with sleeves, although they are not the most frequent ones].

We should make clear the idea that researchers—with various degrees of self-confidence and insight—perceive in the *t'oqapu* patterns compressed information of a semantic quality reflecting a different form of literacy (basically visually-driven), and not inert or inferior records (see Frame, 1994, p. 295; 2001, pp. 113,[17] 135; Silverman, 1994, pp. 14, 18–19; Quispe-Agnoli, 2006, pp. 183–184;[18] Stone, 2007; Williams, 2008, p. 49; Gentile Lafaille, 2010). Such ideas are explored further in the course of the present study.

10. *T'oqapu* Patterns in Other Textile Formats and Other Media

A great number of Inka artifacts—many far removed from the classic tunic-format—reveal that *t'oqapu* or *t'oqapu*-like iconography was transmuted, appearing in different manners and on diverse material supports across the Inkario.

Among the vehicles for their transmission were woven bags and pouches, widely diffused among Andeans and non-Andeans over time as plausible carriers of *coca* leaves (= *chuspa*/s), and intended also for other uses (Taullard, 1949, Láminas [Plates] 176–182; Vanstan, 1967, pp. 3–15; Stone-Miller, 1994a, p. 96, Plate 18; 1994a, pp. 143–144, Plate 47;[19] Roussakis and Salazar, 1999, pp. 264, 274–275, 291; Agüero Piwonka, 2000,

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17. "Pattern, *particularly in the art of non-literate peoples, reflects systems of classification and modes of cognition of their makers… Pattern is given its fullest expression in the Andes on large, flat expanses of fabric, although abbreviated versions of the same patterns occur on smaller objects in other media*".

18. "Al parecer los textiles y los trajes andinos fueron depositarios de información y de una posible *literalidad prehispánica*" [The textiles and the Andean garments were apparently repositories of information and of a possible pre-Hispanic literacy].

19. A "bag with abstract interlocked birds (?)" credited to the Nazca culture, is assigned to the Early Intermediate Period, *about* 500 CE (Stone-Miller, 1994a, p. 96, Plate 18). A *double-cloth bag with animal and geometric motifs*, belonging to the Chancay culture of the Central Coast, is assigned to the Late Intermediate Period, 1000–1476 CE (Stone-Miller, 1994a, pp. 143–144, Plate 47).



(a) (b)

FIGURE 8. (a) An Inka tapestry weave tunic displaying the "key motif" style (zigzag pattern), reportedly found in the Ica valley, Perú, Late Horizon, ca. 1460–1534 CE, held at *The Textile Museum*, Washington DC (2010), with inventory no. 91.147. *Dimensions*: 88.9 × 73.7 cm; acquired by George Hewitt Myers in 1932; Public Domain; see Zuidema (1991, p. 173, Figure 9d) and MetMuseum, 2022; `https://www.metmuseum.org/exhibitions/listings/2011/the-andean-tunic-400-bce1800-ce/photo-gallery`. A similar Inka *unqu* exhibiting the monotonous alternation of the "key motif" pattern is found in *Museo de Lima*, Perú (Taullard, 1949, Lámina [Plate] 16). Figure b illustrates in all probability a royal *unqu* (see Pasztory, 1998, pp. 152–153, Fig. 111; Kelly, 2001, pp. 44, 48, Figure 4; Pillsbury, 2002, p. 73, Fig. 7; Stone, 2007, p. 394; Cummins, 2014 [2009], p. 226, Figura 1; DeMarrais, 2017, p. 658, Figure 1; Dumbarton Oaks Research Library and Collections, Pre-Columbian Collection, Washington DC at `http://museum.doaks.org/objects-1/info/23071`), a rich and precious apparel according to Inka standards, showing *corner to corner* a mixture of *t'oqapu* motifs. At first glance, the complexity of the visual space and color vibrancy in this *unqu* is overwhelming, hinting at the status and aesthetic choices of the noble wearer. Looking at the distribution of motifs across this all-*t'oqapu* tunic it is hard to tell *a priori* if they encode speech (or not)—although, on the other hand, it is difficult to dismiss the possibility that each motif (symbol) had "[...] *a well-defined* [socio-] *cultural function*" (see Sproat, 2013).

pp. 12–13; Finley Hughes, 2010). Rowe Pollard (1978: 13, Fig.14) illustrates a self-styled bag made from a cut-off diamond band, featuring a single stepped rhomboid design. The piece is held at *The Textile Museum*, Washington DC, and the specified measurements are 12.5 × 11.5 cm. Next, Rowe Pollard (1995–1996, p. 31) reproduces an item also deposited in *The Textile Museum*, filled with bands of "key motifs". Vouka Roussakis and Lucy Salazar (1999, p. 274) replicate the "checkerboard pattern," inserted in lateral and vertical stripes of *t'oqapu*, found in a bag at *Museo Na-*

cional de Antropología, Arqueología e Historia del Perú (MNAAHP), Lima. Given the patterns' significance, a higher status may be inferred, being that of the imperial court, of elite individuals, or military personnel (Steele and Allen, 2004, p. 37; see especially Finley Hughes, 2010). Because of the limited examples featuring standard *t'oqapu*, it is difficult to take a broad and deep view on their use.[20] Yet, given the available pieces, it may be suggested the main *t'oqapu* patterns are successfully applied along this textile format.



(a) (b) (c) (d)

FIGURE 9. Picture (a) shows an Inka tunic held at *The Textile Museum*, Washington DC., featuring the structured "black-and-white checkerboard" pattern combined with a stepped yoke (see Rowe, 1999 [1979], p. 606, Figure 2); (b) Inka tunic, Perú, ca. 1400–1532, *black-and-white checkerboard* style; camelid fiber weft, 88.3 × 80 cm; inventory no. 1995.32 MCD; Dallas Museum of Art, The Eugene and Margaret McDermott Art Fund, Inc., in honor of Carol Robbins (see Pillsbury, 1992, p. 72, Fig. 5, and the color image in Finley Hughes, 2010, p. 170, Figure 17); (c) the pattern of "black-and-white checkerboard" with a stepped yoke appears on another Inka-styled *unqu*, held at *Museo de Arqueología de Alta Montaña*, Ciudad de Salta (Argentina); MAAM (2021). *The Field Museum* (2010) in Chicago, Illinois, has a similar designed tunic, sporting in addition a number of butterfly motifs. *The Museum of Fine Arts*, Boston (William Francis Warden Fund [inventory no. 47.1097]) also holds a Man's tunic (*unqu*) with "checkerboard" design pertaining to "Inca, *late fifteenth–early sixteenth century*" (see Zuidema, 1991, p. 173, Figure 9c, and Phipps, 2018, Figure 6.4.1). (d) A checkerboard *Inka* tunic dated 16th century, belonging to the geographic area of modern Argentina, Perú, or Bolivia; inventory no. 2017.674. Medium: camelid fiber; Dimensions: height 87 × width 76.5 cm. Credit Line: Purchase, Fletcher Fund, Claudia Quentin Gift, and Harris Brisbane Dick Fund (2017); Public Domain; see MetMuseum at `https://www.metmuseum.org/art/collection/search/751901`. It is evident that the iconic interface (wearer ↔ observer) is minimal and direct: we can speculate that the visual display was not meant so much (if at all) to be pleasing, rather than to deliver an outspoken message in terms of authority, militancy, or imposing masculinity.

20. Various *coca bags* (cf. Finley Hughes, 2010), on the other hand, feature *llamas* as an emblematic figure among the Andean Inka.

A miniature tunic (*unqu*)[21] with checkerboard design, property of a private collector, is published in Phipps et al. (2004, pp. 141–142). The given dimensions for this 16th century small tunic are 27.3 × 20.3 cm. The purpose of such a reduced item was *ritualistic*: adornment of figurines intended as offerings (in burial or burning contexts), or for dressing statuettes and other natural sacred objects (see Figures 10–12). It certainly comes as no surprise that this small-sized tunic (Phipps et al., 2004, pp. 141–142) is not the only one that has survived to date. Another miniature (Inka) tunic of 14th–early 16th century (The Metropolitan Museum of Art, 2000–2021a; and see Figure 11 below) is another addition to the corpus of such items. In terms of tangible *t'oqapu* motifs, this tunic (*unqu*) shows one occurrence only: the "stepped-diamond"-like design which eventually goes down almost perfectly with other artifacts / structures characterized by this motif (see e.g., Figures 11, 14, 22, 36, 37). Furthermore, Margarita E. Gentile Lafaille (2010) referring to the work of Bárcena (1988) and Ceruti (2003)—among others—concerning archaeological remains found on some of the highest peaks of the Andes, *cerro Aconcagua* and *cerro Llullaillaco*, comments on small statuettes (*figurita de oro / figuritas de mullo*—made of *Spondylus* shell) and on miniaturized *unqu*, displaying *t'oqapu* motifs No. 1, and No. 49 to 52 according to Victoria de la Jara's (1967, p. 242) taxonomy. The retrieved material was connected with sacrificial rituals involving children or youth and assorted votive objects (= *capacocha*[22] / Besom's 2009, p. 25 rendition along this context is *Qhapaq Hucha*); for extensive information regarding the several ritual offerings located and retrieved across the high Andean mountain-range and elsewhere; see Pasztory (1998, p. 151, Fig. 110); Schobinger (1999); Ceruti (2007, 2015); Besom (2009); Abal de Russo (2010); Rein-

21. More "doll"-size (= small) shirts, are described in detail in Vanstan (1967, pp. 16–19), though the greater part of them are plain / undecorated, while the remainder lack the patterns under scrutiny.

22. Schobinger (1999, p. 17) lays out the term as follows, "... *una* capacocha (*o*, *en escritura más correcta*, capac hucha), *es decir*, *el sacrificio ritual de un niño de menos de 12 años* (*que según las crónicas debían ser 'hermosos*, *puros y sin manchas'*), *o de 14 años*, *en el caso de mujeres*, *en ceremonias que eran dirigidas por el poder del Estado* [... a *capacocha* (or in a more correct orthographical form, *capac hucha*), meaning, the ritual sacrifice of a child less than 12 years old (who according to the chronicles had to be 'beautiful, pure and spotless'), or 14 years old in the case of young women, in ceremonies presided [over] by the State power]; otherwise, Gentile Lafaille (2010) renders *capacocha* as, "Conjunto *de objetos ofrecidos por el Inca o la Coya en circunstancias especiales*; *podía incluir una o varias personas jóvenes, cuyo oráculo se consultaba periódicamente*" [Collection of offerings bequeathed by the Inca emperor or the Coya (emperor's consort in this context; *our note*) under special circumstances; it (= the ritual; *our note*) could include one or several youths, whose oracle was regularly consulted]. Lau (2019, pp. 162–163) offers a comprehensive depiction of the terms currently discussed, plus a number of relatable bibliographic sources.

hard (2016); Lau (2019); Carbonell (2020 [2019]); Socha, Reinhard, and Chávez Perea (2021).



FIGURE 10. Two miniaturized *unqu* (= tunics): the one on the left shows the "black-and-white checkerboard" pattern; the other one relates to the "Inka key" pattern (see also Figure 31 below). These textiles, used to dress small anthropomorphic statuettes, were recovered from sacrificial offerings that took place on Llullaillaco volcano (at the modern border between Argentina and Chile); see B. Carbonell (2020 [2019], p. 165, Figura 8a; Archivo MAAM [*Museo Arqueológico de Alta Montaña*], Ciudad de Salta, Argentina); see MAAM (2021b).

Next, Phipps et al. (2004, pp. 276–277), mention that mini-garments were produced in the Andes since ancient times; therefore, the above miniature *unqu* with "*checker-board*" design or the one with the "Inka key" motif seem to have precedents. In Young-Sánchez (2004a, p. 52) is reproduced a beautiful exemplar of a miniature tunic of Tiwanaku style, 600–800 CE, coming from Southern Perú or northern Chile. A small sleeved tunic (ca. 800–850 CE) featuring a design of winged, staff-bearing attendant figures, a common motif in Wari imagery, is illustrated in Figure 12.

Furthermore, in Stone-Miller (1994a, p. 159, Plate 56) *a miniature tunic with bird motifs*, probably belonging to the Rimac Culture (?) of the Central Coast, is dated to the Late Intermediate Period, 1000–1476 CE. The author (Stone-Miller, 1994a, p. 159) also shares the opinion that the diminutive versions of tunics were "… *apparently made expressly as burial offerings*" as substituting the life-sized ones, whose manufacture was costlier and more time-consuming.

The status of *t'oqapu*-like motifs as important conveyers of the Inka / Andean cultural lore is also evidenced by the outer textile wrapping of a mummy bale—held rigid by a basket framework; see Fleming (1986, p. 42, Figure 5); Reinhard (2016, p. 12). The textile features patterns in tricolor checkered structures with opposite / complementary



(a) (b)

FIGURE 11. (a) The front side of a miniaturized Inka tunic (*geographical area*: Perú) pertaining to 14th–early 16th century is illustrated. *Material*: Cotton, camelid hair; *Dimensions*: Height 4-1/2 in. *Credit Line*: Bequest of Arthur M. Bullowa, 1993; *Accession Number*: 1994.35.114 (see The Metropolitan Museum of Art, 2000–2021a). (b) Back-side of the miniaturized tunic is shown for effects of comparison. A single "stepped-diamond"-like *t'oqapu* unit features on both sides of the tunic.



FIGURE 12. A miniature tunic with staff bearer entities, ca. 800–850, south highlands of Perú; Wari style. *Material*: camelid hair, cotton; tapestry weave. *Dimensions*: 16 × 26 cm. Private Collection. Most surviving Wari tunics lack sleeves, but evidence suggests that some early examples had sleeves that were later removed; see The Metropolitan Museum of New York (2022a)

stepped-diamond-like designs, suggestive of *t'oqapu* No. 175 in de la Jara's (1967, p. 243, Figure 2) original inventory; see below Figure 13a. An additional Inka-related mummy bundle exhibits the "black-and-white checkerboard" technique combined with a red stepped yoke (cf. also Figure 9); the tunic (= *unqu*), of sufficient size for a full-grown man, wraps the bundle where a sacrificed boy was cocooned (Figure 13b). In symbolical terms, we think, this life-size *unqu* was the garment of preference the boy-child would have worn in adulthood. We could be looking

at a plausible assumption herein, since the "black-and-white checkerboard," plus the upper red area (the color red, most likely representing the human circulatory fluid), was associated with military expeditions, warfighting skills, and other affairs of a similar nature.[23]

Whether in contexts dealing with *the living* or *the sacred realm of the beyond*, the Inka admittedly reveled in and venerated the animated actors and related non-animated artifacts by means of textiles infused with *t'oqapu* motifs.

In architectonic samples, models affined to *t'oqapu* are not absent. In Lehmann and Doering (1924, Collotype Plate 7) and in D'Altroy (2005, p. 137, Plate 6.8) under the legend "Pink rhyolite monoliths in the unfinished temple complex at Ollantaytambo," we see *stepped-diamond patterns* in the fourth monolith (going from left-to-right), still traceable despite the unmitigated natural elements and resultant effacing. In a subsequent publication (Hogue, 2006, p. 115, fig. 17) is displayed a lingering wall of the *Temple of the Sun* at *Ollantay-tambo* where "[...] *only vestiges of the three stepped diamond shapes remain*". To that effect, Paternosto (1996 [1989], p. 140, Figure 20) and Hogue (2006, p. 115, fig. 18), refer to an earlier illustration of Ephraim George Squier (1877) and show the pattern undamaged. Another instance (Gisbert, 1980, Figura 190) depicts the frontage of an *acllahuasi*[24] (= *house of the sun virgins / cloistered virgins*) of Coatí Island, with stepped-diamond patterns similar to those observed in *unqu*(s) and empty niches. In like manner, an elaborate quadruple jambed niche at Iñaq Uyu (on the eastern shore of *Isla de la Luna* [= Coatí Island], Lake Titicaca, Bolivia) is shown in Jean Pierre Protzen (2018, p. 638, Figure 6.3.6); the upper section is reminiscent of the diamond-like (waist)band, a standard *t'oqapu* motif (see also Figure 14). Marianne

23. M. C. Ceruti (2015, p. 4, Figure 2) illustrates a mummy from Mount Chuscha (over 5300 meters high) in northwestern modern Argentina, corresponding to a young female. Among the retrieved associated offerings, the *cumbi* tunic she is wearing relates to the "black-and-white checkerboard" technique combined with a red stepped yoke. The odds are that this sacrificial victim was the daughter of a provincial official / military commander, or of a *curaca* (local ruler) who willingly accepted the sacrifice as an imperial obligation, a great social honor, or as an act of expiation in response to local conditions (e.g., an uncontrollable natural disaster).

24. Regarding *acllahuasi*, see also Pasztory (1998, p. 154), "Young women, *the so-called 'chosen women' were collected into 'nunneries' where they spent their time weaving until they were given away as wives*"; and McEwen (2006, p. 207), "Quechua Word for the house of the chosen women"; see also Ceruti (2015, p. 7) "The Inca *Empire institutionalized a system of selection, seclusion, and redistribution of 'chosen women' or* acllas, *who were taken from their homes prior to the onset of puberty and kept in special houses or* acllahuasi. *Here they were kept under the close surveillance of consecrated women known as* mamacona *who would teach the young girls to weave and to prepare chicha* ([62, Murúa], 333). *At the age of 14, the young women were taken out of the acllahuasi and some would be selected to be given as secondary wives to nobles while others would be consecrated to serve as priestesses or Wives of the Sun*".



(a) (b)

FIGURE 13. Figure 13. (a) The caption in Fleming (1986, p. 42, Figure 5; see also Niu [Penn Museum Blog] (2011; https://www.penn.museum/blog/museum/mummy-of-the-month-pachamac-mummy-bale-no26626/attachment/baleperu/) reads, "Mummy bale of a child, *held rigid by a basket framework set up just beneath its beige, black and red-checkered outer shroud and a plain inner cotton shroud. The small pouches of the necklet contain dried-out leaves and stems from the kinds of plants that are now thought to have figured strongly in early Peruvian folk medicine* (*coca, quinoa, mucuna, etc.*) *and dye-making* (*annatto, taya, chica, etc.*). *The University Museum, no. 26626. H*(eight) *0.94 m*"; (b) the caption in Shaw (2019; https://www.apollo-magazine.com/mummies-secrets-life/) reads, "Inca mummy bundle, *dressed in the tunic of an Incan officer but containing the mummy of a boy, from* c. *1480–1560, Museum der Culturen, Basel* [Switzerland]".

Hogue (2006, p. 115) deems that such an architectural design *would have the same iconographic implications in the textile medium*.

This hallmark motif is also commented upon in Cummins (2014 [2009], p. 256, p. 237, Figura 10) regarding a different geographic location, "En este sentido, *Teresa Gisbert* (*1996*) *señaló que las* chullpa[25] *de la cultura Caranga, en la región del río Lauca en Bolivia, están pintadas con diseños incas dispuestos en una banda horizontal de formas adiamantadas que igualmente son de tipo* tocapu (Figura 10) [In this sense, Teresa Gisbert (1996) pointed out that *chullpa*(s) belonging to the Caranga culture, situated in the region of river Lauca (Bolivia), are painted with Inka designs along an horizontal strip in the guise of diamond-like shapes that equally fit the *t'oqapu* type (Figura 10)]". The discussion is supported by Duccio Bonavia (1985 [1974], pp. 155–157, 170–172) who—among other ancient

25. *Chullpa*(*s*) are stone towers related to burial practices in the Inka tradition.



(a) (b)

FIGURE 14. (b) Frontage of an *acllahuasi* (= Aqlla Wasi) [House / Nunnery / Temple of the Sun Virgins] located on *Isla de la Luna* [= Coatí Island], Lake Titicaca (Bolivia); cf. wikimedia.org (2021b); (a) the layout of an empty niche / window of the *acllahuasi* (wikimedia.org, 2021a) is reminiscent of the diamond-like (waist)band, a customary *t'oqapu* motif.

Peruvian cultures—collected data on mural paintings across the former Inka territory. It is significant that the Inka rendered paintings with an intense geometrical content similar to *t'oqapu*, e.g., at Huaca de la Centinela,[26] Chincha Valley (1985 [1974], p. 157, Fig. 114) with *triangle*, *rhomboidal*, and *meander-like hook* patterns (see below Figure 15), or at the Fortress of Paramonga where remains of a *checkerboard* design are visible on one of the inner walls (Bonavia, 1985 [1974], p. 172, Fig. 122). Clados (2007, p. 98, Fig. 37) has a drawing based on a ceramic Inka artifact[27] of a man that features a horizontal band characterized by meander-like hook patterns or z-formations in a "key"-fashioned pattern, slightly similar to the reproduction of Bonavia (1985 [1974], p. 157).

In this sub-section we also reference M. Ruiz (2002, pp. 202, 203, Figura 1). The author (2002) takes us to the archaeological complex of *El Pukara de Rinconada* [= Fortress of Rinconada], located on the high-plateau of Jujuy (Province of Jujuy), in the most extreme part of the Argentinean Northwest, which borders on Chile and Bolivia. Ruiz (2002, p. 202) reports that on one side of the Pukara is found "*El Cerro o Mesada de las Pinturas*," the western slope of which has "[...] *aleros o chullpas que han sido utilizados como soporte de las manifestaciones pictóricas* [flanks or chullpas (= funerary stone towers / tombs) that are used as a support for pictorial manifestations]. Upon one of the flanks (the so-called *Boman Panel* because it was initially documented by Eric Boman in 1908), across the various sections of the panel there are groups of painted anthropomorphic figures displaying (among other paraphernalia) Inka tunics of dif-

26. See also Dwight T. Wallace (1998).

27. The artifact is held at *Staatliches Museum für Völkerkunde*, *München* [Munich].



(a) (b)

FIGURE 15. (a) Here is illustrated a reconstruction drawing of a mural on walls of an Inca (= Inka) structure as seen by the archaeologist and anthropologist John Howland Rowe in 1958; Inka style, Late Horizon (Bonavia, 1985 [1974], p. 157). The walls, part of the pyramid of Huaca de la Centinela, are located in the province of Chincha (Ica region, modern-day Perú). (b) The meander-like hook patterns embedded in mirrored-like rectangular designs are attested on a fragment of an earlier Wari-styled tunic (http://www.latinamericanstudies.org/wari/wari-tunics.htm).

ferent designs and colors, including "unkus ajedrezados blanco y rojo" [white-and-red checkerboard tunics]. Ruiz (2002, p. 203) assesses the situation by drawing eventually attention to, "Boman (1908) *concluye la descripción del panel diciendo que puede ser un cuadro conmemorativo, un acontecimiento, una asamblea, una gran fiesta o el retorno de una expedición guerrera* [Boman (1908) concludes the description of the panel by noting that it was perhaps a commemorative tableau, an event, an assembly, a great celebration, or the return from a military expedition].

Qero (= quero / kero) and *aquilla* (ceramic, wooden and metal cups / beaker-like vessels), destined for *chicha de maíz* [fermented corn / maize beer] libations, and symbols of reciprocity,[28] homage, and imperial obligation in the Inkario, are another format where *t'oqapu* or *t'oqapu*-like motifs emerge quite frequently (Rowe, 1999 [1979], p. 606; Zuidema, 1991, p. 151; Arellano, 1999, p. 257; Frame, 2001, Plate 22; Cummins, 2002a; Heckman, 2003, p. 51; Phipps et al., 2004, pp. 135–136; Mulvany, 2004; Phipps, 2005, p. 85; Meisch, 2006, p. 381; Ziółkowski et al., 2008; Gentile Lafaille, 2010; The Ohio State University (OSU), 2015; Prieto-Olavarría and Tobar, 2017, p. 153, Figura 6; and Figure 16 herein). The items under description (and other types of ceramic objects) find a clear reflection in Prieto-Olavarría and Tobar (2017, p. 138),

28. See e.g., The Ohio State University [OSU] (2015), "Chicha was also important due to its effects of intoxication. *For the Inca, as well as many other cultures, drunkenness was a way to communicate with otherworldly beings, spirits, or even gods. The act of getting drunk also represents aspects of togetherness and community—to the Inca, sharing drink with another person was seen as an act of friendship and understanding*".

> *La cerámica inca fue un importante medio de difusión ideológico, ya que se distribuyó ampliamente desde los centros productores a todo el Imperio, vinculándose a actividades relacionadas con los alimentos y la política. Más que un indicador del Estado, su importancia radicó en articular la producción, el consumo, la identidad y los procesos políticos del imperialismo inca* (Bray 2003, 2004). *Su carácter ceremonial y político se evidencia en que las formas más representadas se relacionan con el almacenamiento, el servicio de la comida* (*aríbalos, platos y pucos*) (D'Altroy et al. 1994), *la entrega de regalos y el brindis ritual* (*kero y aquillas*) (Cummins 2002)"
>
> [The Inka pottery was an important medium of ideological transmission, since it was amply distributed from the producing centers to the whole Empire, linked to activities concerning sustenance and politics. More than an indicator of statecraft, its importance rested on articulating the production, the consumption, identity, and political processes of the Inka imperialism [...]. Its ceremonial and political character becomes evident in the fact that the most representative forms are related to storage, food service (pitchers, plates and bowls) [...], gift offerings and ritual toasting (keros and aquillas) [...].

T. B. F. Cummins (2002a, Fig. 4.4.) references an Inka *qero* displayed at *Staatliche Museen zu Berlin, Preussischer Kulturbesitz, Museum für Völkerkunde, Berlin, acc. No. VA1603.* A band with zigzag or meandering motifs in a serpentine-like fashion is viewed, resembling the repeated "key *motif*" of the *t'oqapu*; see also Figure 8a. Likewise, in Cummins (2002a, Fig. 4.5) we see an *Inca quero with concentric rectangles, zigzag bands, and diamond shapes organized into five horizontal registers.* The receptacle preserved at Phoebe Apperson Hearst Museum of Anthropology and the Regents of the University of California (Cummins, 2002a, Fig. 4.7a; see also Figs. 4.7b, 4.7c), acquaints us with an *aquilla with embossed design of schematic arms and head*, reminiscent of a snaking strip following the "key motif" in the *t'oqapu* tradition. Phipps et al. (2004, pp. 135–136), while examining a number of Inka beakers highlight this motif as consistently used in these types of objects.

In J. H. Rowe (1999 [1979], p. 606) the occurrence of *t'oqapu* is also reported on generic pottery, "Also, *the Inka key* [see Figure 17 herein] *though primarily a textile design, is also occasionally found on Inca pottery* (*Museo Arqueológico, Cuzco, u. 1881, no provenience*) *and on provincial Inca pottery* (*Robert H. Lowie Museum of Anthropology, University of California, Berkeley, 4-3936, from the Chincha Valley, Tomb E 5*; *Kroeber and Strong 1924a*: *Fig. 1e*)". Tamara L. Bray (2000, pp. 169–178, Figure 8) analyzes the imagery of a number of storage jars—alternatively called *urpu* or *aríbolas* [pitcher-like vessels]—finding in them, rhomboid, quincunx, and other designs, closely resembling the *t'oqapu* elements, and suggesting insignias of the Inka dynasty and statecraft (see an excellent amphora-like pot in Katz, 1983, p. 310, Catalog entry 186; and Figure 18 herein). In another geographical setting, yet culturally of the same orbit, Williams (2008, p. 49) compares some of the Inka imperial symbols—*t'oqapu* designs—in ceramic and tex-



FIGURE 16. An Inka wooden *qero* of the 15th–early 16th century shows the diamond / rhomboidal-like pattern alongside its bottom strip (The Metropolitan Museum of Art, 2000–2021b). https://www.metmuseum.org/art/collection/search/317791. The middle strip depicts what appear to be a series of fox-like creatures (possibly the Andean fox, aka the Andean wolf) moving forward one after the other.

tile artifacts recovered in the northwestern part of (modern-day) Argentina.

The possibility that these out-of-standard tunic patterns are value-laden (as they are meant to be intentional and interrelated) cannot be dismissed. The persistence in replicating such a dynamic in ordinary and high-quality manufactures suggests we are not witnessing some casual or rampant pastime. It would seem rather a socially and mythologically-driven activity in accord with Inka logic, and the conception of time and space in their universe (cf. Estermann, 1998; Cummins, 2011). In this sense, the evidence encountered so far also calls for concerted work, especially from art historians, anthropologists, textile experts, local informants, semioticians, and linguists, so as to verify or clarify their encoded meaning (cf. Quispe-Agnoli, 2006; Cerrón-Palomino, 2008; Florio, 2013). Now, the fact that some *t'oqapu* motifs appear regularly, e.g., *the diamond waistband*, *the Inka key*, *the black-and-white checkerboard*, reveals not only their diffusion in Tawantisuyu, but also their simple "statement/s" and their high-frequency use in terms of significance and other conventions along this semiotic system. A similar occurrence is noticed in other pre-industrial societies. Payne (1987, p. 55) in discussing the heraldic practices of the 13th to 15th centuries in England, mentions that some symbols were used extensively, "The range of pictorial images was not large; *but subjects like the symbolic lion*, *the eagle and the cross were popular*".



FIGURE 17. In this figure, the undulating Inka *key pattern* in a textile fragment (Taullard, 1949, Lámina 16 [Plate 16]) produces optically the effect of a *snaky stripe*; cf. Clados (2007, pp. 72–73, Fig. 1a). Structurally, however, the external image responds to the technique of twisted fibers as applied by the Tawantisuyu's weaver/s; see Frame (2001, p. 119), "The serpent metaphor is often applied to twisted strand imagery, *a natural connection given the sinuous quality of snakes and cords*". The patterns of Inka textiles are related to the perception and construction of space and motion, found at the very core of the weaving process. Such serial patterns, initially found in rope and cordage manufactured items, plus fabrics, were transferred later onto other media and contexts (Frame, 2001, pp. 114–115). Alternatively, considering the statistical distribution of this motif across some Inka-styled tunics (cf. Figure 8a; or Carbonell, 2020 [2019], p. 166, Figura 9), one might ponder whether there is a text in the original Quechua or Aymara language that show a corresponding repetitive statistical distribution in terms of a *morpheme* or *syllable*.



(a) (b)

FIGURE 18. (a) Storage bottle / storage jar (*aríballus*); Inka Horizon, Late Period, 1470–1532 CE; inventory No. PE-313; (Museo Chileno de Arte Precolombino, 2021). Notice the bipolar and complementary nature of the design along the horizontal band. (b) The repetitive quadri-partite diamond-like motif is noted in a similar Inka storage jar held at MAAM (Museo de Arqueología de Alta Montaña, Ciudad de Salta, Argentina, 2021). An additional fine print of an Inka "aríbalo" is found in DeMarrais (2017, p. 661, Figure 5).

11. Guamán Poma de Ayala's Drawings: *t'oqapu* Motifs as Indicators of Royal Status

For the prospective *t'oqapu* scholar, looking for Inka or immediate post-Inka sources of information is based on reason and sagacity. The earliest chronicle with some credible records which laid unnoticed until 1908 in the Royal Library at Copenhagen, Denmark (see Markham, 1969 [1910], p. 16; Montell, 1929, p. 176; Steele and Allen, 2004, p. 46), is that of the Peruvian Amerindian Felipe Guamán Poma de Ayala. The indigenous colonial writer wanted to do justice to the Inka social values and the mythic traditions he related to Felipe III, then king of Spain (see Poma de Ayala, 1980 [1615]; Quispe-Agnoli, 2006; Frame, 2007; Ossio Acuña, 2008). While it is not known if the work is truly fact-filled, it still adds up to a major source of data, in particular in view of his line-drawings.[29] Markham (1969 [1910], pp. 16–19); Montell (1929, pp. 176, 198); Rowe Pollard (1978, p. 6; 1995–1996, p. 5); J. H. Rowe (1999 [1979], pp. 582–587); Anton (1987 [1984], pp. 188–189); Zuidema (1991, pp. 151–152); Niles (1994, p. 59); Phipps (1996, p. 147; 2005, pp. 84–85); Dransart (1997 [1992], p. 159); Silverman (1999, p. 810);[30] Roussakis and Salazar (1999, p. 276); Cummins (2002b, p. 190); Heckman (2003, p. 51); Eeckhout and Danis (2004, pp. 309–311); Quispe-Agnoli (2005, 2006); Pillsbury (2006, p. 129); Clados (2007, pp. 86–88); Frame (2007); Stone (2007, pp. 394–397); Gentile Lafaille (2008, p. 2); Trever (2011, pp. 40–41, 48, 50–51); Carbonell (2020 [2019])—inter alia—draw on his manuscript "*El Primer Nueva Corónica y Buen Gobierno*" [The First New Chronicle and Good Government] in which appear graphic depictions of twelve Inka overlords garbed in clothes with full or partial woven designs, bearing a striking resemblance to *t'oqapu* patterning; see Figure 19. The royal dresses were manufactured of *the finest tapestry-woven cloth*, while the *standardized sets of abstract and geometric designs* were possibly *imbued with cultural and political significance* (Phipps, 2004, p. 73). As we look through the pages of *Nueva Corónica*, *t'oqapu* motifs come into sight in waistbands of women's clothes—unrelated however to Inka nobility (Quispe-Agnoli,

29. See e.g., an assessment in Trever (2011, pp. 54–55), "His illustrations [Guamán Poma's; *our note*] *are rich visualizations of religious forms in colonial perspective and they express varying degrees of ethnographic detail and Christian rhetoric depending on the demands of their ideological contexts. These images constitute neither a linear development of pictorial practices nor a single unfolding of increasing cultural understanding, but rather a complicated, and at times contradictory, path through the artist's often ambivalent attitudes toward the religious traditions of the pre-Hispanic Andean past*".

30. "Guaman Poma (1980) *has left us drawings of the clothes worn by the Inca nobility decorated with* tocapus. *The seventh Inca, for example* (*Guaman Poma* 1980: 75), *wears a sleeveless tunic* (uncu) *decorated with* tocapus *on the upper half of this garment. Geometric motifs which include a diamond, stars, circles, the letter Z and the numbers 3 and 4 are represented.* (*Plate 11*)".

2006, p. 182). Still, it may be concluded that (as a rule) *t'oqapu* drawings laid special emphasis on the upper-class personages, contextualized in social rituals dealing with cyclic events and in military scenes (Eeckhout and Danis, 2004; Quispe-Agnoli, 2006, pp. 182–183).

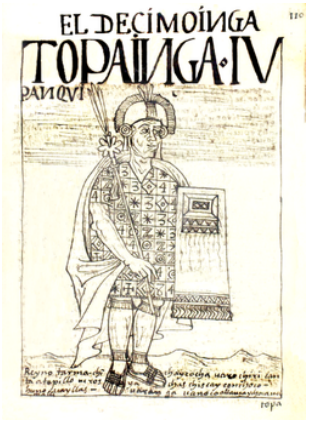

FIGURE 19. A drawing from Guamán Poma de Ayala (1980 [1615], Folio 110; see also Zuidema, 1991, p. 157, Figure 2 (10); Eeckhout and Danis, 2004, p. 314, Fig. 5; Quispe-Agnoli, 2005, p. 290, Figura 14; Clados, 2007, p. 87, Fig. 19b) shows the tenth ruler Thopa (Tupac) Inka Yupanqui (reigning *ca.* 1471–1493) of the Inka dynasty in an all-*t'oqapu unqu*, regarded as a token of the uppermost social rank. We consider that the *unqu* exhibiting *t'oqapu* designs throughout (plus the other particular accoutrements) helped the ruler/s to codify and project his / their authority in the inner circle and beyond it.

12. Plausible and/or Random Meanings Assigned to Ancient Iconic and Iconographic Systems

The destruction of the Inka civilization by the Spanish invasion and subsequent colonization, along with the shortage of historical documents conveying evidence on the function and meaning of *t'oqapu par excellence*—the tapestry tunic special designs—(Rowe Pollard, 1995–1996, p. 9; Cummins, 2002b, p. 190; Phipps, 2005, p. 85; Quispe-Agnoli, 2006, p. 184), would remind us of possible present-day misconceptions. In a similar manner and along the same chronology, selected *quipu* arrangements would mostly hold their secrets as long as their encoded data would largely respond to mnemonic-driven data, *barely known to* or *still*

eluding modern researchers (Barthel, 1976, p. 27; Stierlin, 1984, p. 192;[31] Conklin, 1996a, p. 327; Kulmar, 2008, pp. 138–140; for recent work on *quipu*, see Hyland, 2017; Medrano and Urton, 2018). As a matter of fact, the authors pointing at the dangers of assigning values to symbols and iconographic representations of a long-extinct human community or culture are as extended as they are convincing in their ideas. George Herbert Mead (1934, pp. 47, 71–72, 268–269) indicated nearly a century ago, *significant symbols have an arbitrary meaning conventionalized to the members of a specific society. If the society is dead and no recognizable cognitive bridges survive, then by definition, the meaning of the icon is lost* (cf. also Franquemont, 1986, p. 84;[32] Jean, 1998 [1989], pp. 11–28; Heckman, 2003, pp. 36, 41). In real historical terms it is next to unknown if such a symbolism—articulate, however, to its former users—had a univocal value or multi-vocal values in a given context; hence, any gullible estimation may be prone to exaggeration. In this line, additional examples include the rock art records in Arizona, New Mexico, and California (Brandt et al., 1975, p. 48);[33] the *Mi'kma'q* "hieroglyphs" attested on the Atlantic seaboard island of Newfoundland (Hewson, 1988 [1982], pp. 60–61);[34] the *rongorongo* signs of pre-missionary Easter Island (Routledge, 1919; Melka and Schoch, 2020); heraldry in the Plantagenet England of 1200–1400, many aspects of which may be difficult to comprehend centuries later (Payne, 1987, p. 55); the textile iconography of Paracas (Perú), inaccessible and out of date for current observers (Paul, 1992, p. 289); the motifs of *the painted / incised Lima beans* of Moche polities (Melka, 2010b), and so forth. With the demise of those who commanded such expressions and with the loss of the accurate cultural background, it is nearly to entirely impossible to summon clear and convincing scientific arguments. In the absence of a substantial corpus and other telling ethnographic information, proving or disproving theories will (most likely) amount to a constant conundrum.

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31. "The quipu, *in short, admirable though it was for book-keeping purposes and for the transmission of concrete, quantitative information, could not be used to convey ideas or abstract philosophical and historical concepts. Its interpretation depended on an oral code which has failed to survive, and no matter how many* quipus *may be found in coastal cemeteries, the information they were intended to convey will never be revealed to us*".

32. See Franquemont (1986, p. 84) in a more specific context, "Most of the secrets of the ancient Andean textiles will never be unraveled for us—*the system is too elaborate, the societies too distant, and the concerns of the people who made them too foreign to us*".

33. "It should be noted that the interpretation of ancient rock art is a very uncertain subject, *beset with pitfalls and inherently subjective*".

34. "Obviously, *this form of writing is not very profitable, since* [it] *would take a long time to master, and one needs to know the text first, so that the hieroglyphics are only a reminder of a text that is already known: it would be difficult to read a text that had not been seen or known before*".

Apart from the contextual and the comparative studies of the existing data and the pursuit of new evidence, there is no certain way regarding how to reverse this unfavorable situation. Pinpointing each *t'oqapu* design and isolating the variants is most helpful. Comparing the pre-Colonial with Colonial *t'oqapu* and compiling a catalog with the shared features as well as the disparities, plus any assumed developmental process, is another bonus in seeking out results (see a tentative effort in http://tocapu.org/tocapu/, 2020). The study of John H. Rowe (1999, pp. 571–629 [1979, pp. 239–264]) bears witness to a systematic model of approaching the description, sorting and standardization of *t'oqapu* patterns and tunics (see also Phipps et al., 2004, p. 137; Pillsbury, 2006, p. 124), whose dispersion across the museums of the world has hampered research. In theory, among the many hypotheses, the best-formed and the most plausible ones, founded on archaeological, ethnographical, and structural data would appear to gain ground. In any event, we are inclined to think that the unsuspecting examination of the literature regarding *t'oqapu*, though certainly helpful, and heuristic, alone may not yield the answer to the meaning or to the final decoding of *t'oqapu*.

13. Parallel Cultural Environments

The Inka *t'oqapu*, presumably based on *a level of cognitive association on the part of the audience* (Brown, 1998, p. 14), are not the only recorded system—all the way through the history of humankind—where mnemonic or quasi-mnemonic conventions bear significance, if not a built-in attribute (see e.g., Sassoon and Gaur, 1997, pp. 18–19). However, it is worth noting that any attempt to draw on similarities among far-flung systems (in geographical and/or chronological terms) intending to reveal the meaning of the *t'oqapu*, may be *settling down in complacency*, if not *arbitrary constructions*.

In view of the efforts of Ibarra Grasso (1953), Barthel (1976, p. 28) estimated the picture-writings of *Christian-religious texts produced by the Aymara and Quechua Indians* and notes that such documents were *condensed* (fewer signs than the actual words of prayer) *with the aid of cues*, making *the mnemonic goal especially obvious*. On the other hand, Gillow and Sentence (1999, pp. 50–51) turn to the raised patterns of cables found in woolen Aran sweaters, serving to local fishermen as silent identifiers or reminders of their home ports. In a like manner, Michelle Brown (1998, p. 14) cites Kurdish rugs and Welsh love spoons carrying *all sorts of meaning in their abstract decoration, but you need to have been told how to interpret them*. In another somewhat similar context, Ann Payne (1987, p. 55) remarks on heraldic practices in Plantagenet England (1200–1400), characterized by clear conventions in their geometrical shapes. The author (ibid., 1987, p. 55) points out that such *heraldic device*[*s*] were *displayed in ways*

in which they could be seen by all in more than a few surroundings. Payne (1987, pp. 55–57) contends that *heraldry was more than simply ornamentation*; it signaled *allegiance*, *commitments and alliances*, *dominance and subservience in social orders*, *pride and dignity concerning ancestry*, *ownership*, *individual 'signatures'*, and so forth. Her explanations (ibid.), realistic in their logic and socio-historical background, incidentally echo the contributions of several Andeanists regarding *t'oqapu* functions. Even so, we should allow for universal commonalities in traits and behaviors arising from the human condition; thus, conveying *marks of distinction* or the *depiction of lineages* is one of the most frequent aspects in symbolic or graphic representations across the globe. As Ignacio Bernal (1975, p. x) wrote, "Genealogies, *authentic or embroidered on*, *were a political weapon just as history was*".

If not studied within the context of their cultural premises, any assumptions regarding these systems involving shared features across time and space may be taken on various occasions as misinterpretations of the data, or—possibly—as reckless pontificating.

14. *T'oqapu* in the Eyes of Modern Researchers

The bulk of the literature, first and foremost, deems the *t'oqapu* examples as expressions of a visual-symbolic system used in the Inka-dominated territories, otherwise known as Tawantinsuyu.[35]

While lacking empirical certainty, the description of theories may ensure a better grasp of the topic. By extension, distinguishing assumptions from facts is vital to the subject. We focus at this point on Christiane Clados (2007, pp. 78–79, subsection '*4. Forschungsgeschichte* [4. Research Background]')—the author offers an interesting collection of efforts aimed at the understanding and decoding of *t'oqapu*-patterns, covering a period of 38 years, 1964–2002. More to the point, various researchers have offered various hypotheses regarding *t'oqapu* placements and their meaning, while a few others have hypothesized an underlying phonetic code. As noted previously, pre-planned analyses (or not) concerning the positional order of patterns are not absent (see Barthel, 1971; J. H. Rowe, 1996, pp. 457–463, in A. P. Rowe and J. H. Rowe, 1996; Stone, 2007; Silverman, 2011). As we shall see, there have been alternative treatments on "ideographic" (= logographic) elements built in *binary* or *complementary oppositions* in the examined system (Victoria de la Jara, 1975, was the most determined in this sense). In any event, it should

35. The place-name Tawantisuyu is translated / rendered in English as "*The Land of the Four Quarters*" (Stierlin, 1984, p. 224; Frame, 2001, p. 127; McEwan, 2006, p. 3; Kulmar, 2010, p. 138); "*... the unit with four quarters...*" (see Bouysse-Cassagne, 1986, p. 201); "*The Four Parts Together*" (see D'Altroy, 2005, p. xiii), or "*The Inca empire was called Tawantinsuyu* (*Q* [echua]. *the four sectors together*)"; see Meisch (2006, p. 385).

be pointed out that de la Jara's (1975) assessment is viewed as *dubious* by many scholars, and no general agreement yet exists regarding precise "readings" or interpretations. The most severe shortcoming in *t'oqapu* studies, according to some, is the lack of associated information between the pre-Colonial and Colonial times (Cummins, 2002b, p. 190;[36] Phipps, 2005, pp. 84–85; Quispe-Agnoli, 2006, pp. 180–184); though A. P. Rowe and J. H. Rowe (1996, p. 453) were inclined to entertain a more optimistic approach, "the technical and design characteristics of Inca tunics are *relatively well understood, both because the evidence is relatively abundant and because it has been studied*". In principle, Thomas's (1999, p. 87) axiom[37] is by and large valid, although a reciprocated nexus between Inka individuals and their artifacts needs further examination.

The various scholarly proposals are structured along the following lines, assuming that *t'oqapu* horizontal and vertical groupings were designed for a variety of purposes, retaining and conveying "*... critical cultural information*" (Pillsbury, 2006, p. 126).

Line (1) follows the hypothesis of *t'oqapu* as a visual, diagrammatic system of communication that, aside from aesthetic (or emotion-inducing) motivations, was used perhaps to send out diverse messages surpassing linguistic, ethnic, and spatial boundaries.

Line (2) follows the hypothesis of *t'oqapu* as some sort of "writing system," basically of a logographic nature, in analogy with *logograms* found in other real-world known scripts.

(1) Given the fact that *unqu* were luxurious garments, the standard assumptions and evaluations focus on the high social status / hierarchy and places of origin. The schematic designs of *t'oqapu* were considered to silently convey information comparable to a visual book—that is, no speech was implied given the fact that they were unvoiced symbols—understood by the Inka members of any nearby audience, who seemingly also took delight in their beauty. The argument here deems the actual size of *t'oqapu* in tunics—especially if they were multi-patterned—and their artistic quality as important. Hence, it can be estimated that they could be truly and distinctly seen *only* in

36. "No se registrado ningún interés de los españoles para especificar el sistema de significado de los tocapu *y los andinos no tuvieron ninguna razón para querer explicar de qué manera los operaban, motivo por el cual no se entiende completamente el sistema hasta hoy. Así, carecemos de cualquier comprensión precisa de los* tocapu *como la de cualquier otra marca gráfica incaica, tenga ésta una forma figurativa o abstracta*" [There was no interest on behalf of Spaniards in specifying the system of meanings of *tocapu*, whereas the Andeans did not have any reason in wanting to explain in which manner they functioned, hence the system remains poorly understood to this day. Thus, we lack any precise comprehension of the *tocapu*, as well as of any other Incan graphic markings, be that figurative or abstract].

37. "*... understanding the person behind the artifact is more compelling than the artifact itself*".

close proximity to be safely recognized. In this sense, the discussed context would remind us of the properties of a notational system,[38] such as a musical, mathematical, or a chemical one, *et cetera*, or in another extended case, of the figurative imagery on the stained-glass windows in varied Christian churches (see e.g., Jean, 1998 [1989], pp. 27–28). A reason for such an estimation is that, at present, in the era of widespread information and social communicative platforms, the phenomenon of writing and texts in all conceivable formats and media, is such a common practice in (developed) countries that some of us forget to raise significant questions or doubts about them. However, in the past (in pre-medieval or medieval times, for instance), in the absence of massive literacy,[39] human memory is expected to have been trained in different ways regarding accessibility, flexibility, ease of recombining and processing patterns, and storage space (see Camille, 1987, p. 33, and also the excellent treatise on mnemotechnics of Carruthers and Ziołkowski, 2002).

Below, the authors are sorted into six broad categories according to their concrete proposals. Readers are advised to consult them relative to their own interest and possible inquiry.

(a) For *specific* and/or *mythical places of origin* (= paqarina), *locations*, *local distinctions*, and *ancestry*; see Harrison (1989, p. 60); Zuidema (1991, p. 192); Classen (1993, p. 30); Grube and Arellano Hoffmann (2002, p. 57); Cummins (2002b, p. 190); Phipps (2005, pp. 84–85).

(b) For *ethnic*, *political*, and *religious status*, *as indicator of social hierarchy*,[40] *prestige* and *power*; see Rowe (1999 [1979], p. 648); Feltham (1989, p. 57); Harrison (1989, p. 60); Zuidema (1991, p. 192); Delgado

38. For more, see Jiménez Borja (1999, p. 22), "These [textile; *our note*] *designs do not form sentences. They are like notes of a melody. They allude to the time in which they were made, to the status of the owner, whether he was single or married. To the property, the animals and the fruits of the field, etc.*".

39. See especially Claridge (2008, p. 248), "The majority of the population before the (*late*) *19th century was illiterate and thus could not produce any linguistic sources* (*with the exception* e.g., of *witness depositions and letters taken down by scribes*): *illiteracy in particular affected the lower and middle segments of society, so that historical corpora to a large extent reflect the language of social and educational elite—which in earliest times mostly overlaps with the religious elite*".

40. The notions of *hierarchy* and *stratification* were deeply rooted in the Inka society. According to Demarest and Conrad (1983, p. 388), such notions laid down during Sapa Inka Pachakuti's reign, were bolstered in the course of time, "Under the guidance of *Pachakuti and his advisors*, elaborate *hierarchies were constructed to channel the heightened ambitions of the Inca nation. As the empire grew through conquest, this governmental structure grew with it, supervising the growing labor taxes that supported the ruling class and the state religion. Not surprisingly, this accelerated political stratification was reinforced by a reworking of oral history and traditional social codes… The revised myth and history also claimed that Inca militarism and imperialism were both the traditional way of life and a sacred obligation of Inca leadership*".

Pang (1992, p. 291); Dransart (1997 [1992], p. 159); Silverman (1994, p. 12); Cummins (1994, p. 198); Stone-Miller (2002 [1995], p. 212); J. H. Rowe (1996, p. 464, in A. P. Rowe and J. H. Rowe, 1996); Arellano (1999, p. 257); Manrique P. (1999, p. 65); Phipps (2005, pp. 84–85; 2009, pp. 239–241); D'Altroy (2005, p. 294); Quispe-Agnoli (2005); Gentile Lafaille (2010).

(c) For *mythological ideas*, *heavenly origin*, and *cosmogony*; see Dransart (1997 [1992], p. 155); Classen (1993, p. 31); Roussakis and Salazar (1999, p. 274); Heckman (2003, p. 35).

(d) For *royal functions*, *control*, *dominion*, and *war strategies*; see Stone-Miller (2002 [1995], p. 212); Arellano (1999, p. 257); Cummins (2002b, p. 190); Stone (2007, p. 394); for an *expansionist message*, see Stone (2007, p. 399); for *conquests*, see Stone (2007, p. 407); Hogue (2006, p. 111) condenses the proposal, "Another way in which the Inca demonstrated their *rulership over a territory*, *its goods*, *and its inhabitants was with textiles*. *Garments such as the royal tunic* (Figure 8b above; → of the Robert Woods Bliss Collection; *our note*) *served as woven signifiers of the* vastness *of the Inca empire*".

(e) For *heraldic* and *calendaric information*; see Rojas y Silva (1981); Zuidema (1991, p. 195); Delgado Pang (1992, p. 291); Eeckhout and Danis (2004); and Figure 20.

(f) For proposals regarding the connection between staple products (i.e., *maize*) and patterns in Inka textiles; see Meisch (2006, pp. 385–386); for the identification of *t'oqapu* motifs based on *agricultural technology*; see Silverman (2011).

(2) The inquiries of Victoria de la Jara (1967, 1970, and 1975;[41] see also later sources commenting on her work, e.g., Anonymous, 1970; Stierlin, 1984, p. 191; Harrison, 1989, p. 60; Rostworowski de Diez Canseco, 1994, p. vii; Silverman, 1994, p. 18; J. H. Rowe, 1996, p. 463 in A. P. Rowe and J. H. Rowe, 1996; Arellano, 1999, p. 257; Jiménez Borja, 1999, p. 22; Manrique P., 1999, p. 65; Paternosto, 2001, p. 55; Eeckhout and Danis, 2004, p. 307; Cummins, 2014 [2009], pp. 227; 2011; Melka, 2010b, pp. 94, 102) highlighted the active principle of the *t'oqapu* system, where sound / phonetic values could have been included to a small or large extent essentially via logograms, similar in some ways to the Maya calligraphy. Thomas S. Barthel (1970, 1971), the German investigator of the Maya script and Easter Island *rongorongo* script (see also Anonymous, 1970; Stierlin, 1984, p. 191; Anton, 1987 [1984], p. 190; Liebscher, 1986, pp. 81–88; Harrison, 1989, p. 60; Delgado Pang, 1992, p. 291; J. H. Rowe, 1996, pp. 464–465, in A. P. Rowe and J. H. Rowe, 1996; Rowe, 1999 [1979], pp. 644–

41. Victoria de la Jara (1975, p. 32), "La escritura de los inkas es un sistema logográfico, *y como consecuencia*, *no tiene* 'letras'." [The Inka writing is a logographic system, and as a consequence, it does not possess "letters" (= alphabetic characters; *our note*)].

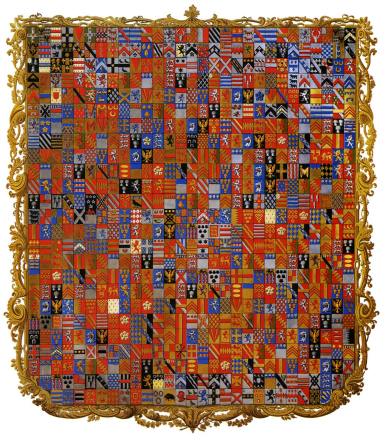


FIGURE 20. The *Stowe Armorial* coat of arms is the centerpiece of the Gothic Library at Stowe Temple-Grenville, 1st Marques of Buckingham, between 1805 and 1807 (Wikimedia.org., 2021c). The armorial is a 1.4 m diameter heraldic painting of the 719 quarterings of the Temple, variations of the English Royal arms, the arms of Spencer, De Clare, Valence, Mowbray, Mortimer and De Grey (see Wikimedia.org., 2021c, Author: Tilman, R. [2018]). The layout of the "quarterings" reminds us of the grid-like structure of the *t'oqapu* found in the royal *unqu* held in the Bliss Collection at Dumbarton Oaks, Washington, D.C. (cf. Pasztory, 1998; Kelly, 2001; Pillsbury, 2002; Stone, 2007; Clados, 2007, p. 75, Fig. 4; DeMarrais, 2017, p. 658, Figure 1; and see Figure 8b above). Generally speaking, and to express some caution, no equivalence between the Inka and the English armorial traditions is sought after at the present juncture. The contents of each cited specimen are individually and culturally devised / curated, having *no meeting point* whether in temporal or locative terms.

648; Paternosto, 2001, p. 55; Grube and Arellano Hoffmann, 2002, p. 52; Eeckhout and Danis, 2004, p. 307; Stone, 2007, p. 397; Cummins, 2014 [2009], pp. 227, 229), based on the research notes of V. de la Jara (1967, 1970), studied her proposition and offered a complex account, unverified to this day, on the meaning of the Bliss Collection royal *unqu*'s *t'oqapu* (Rowe, 1999 [1979], pp. 640–641); J. H. Rowe, 1996, pp. 463–464, in A. P. Rowe and J. H. Rowe, 1996; Stone, 2007; Cummins, 2011, pp. 307–308). This specific *unqu* (Lothrop et al., 1959 [1957], Plate CLXI), is described as a welter of *t'oqapu* patterns (Stone, 2007, p. 399) since, as maintained by modern researchers (see Lothrop et al., 1959 [1957], p. 292; Phipps et al., 2004, p. 153), they do not follow a logical, mathematical, or a clear syntactical order. Indeed, the Inka masters did not attempt *in illo tempore* to endorse "disorder" and "mystery" in that piece of royal garb, and much less, to exercise modern Andean scholars' minds. Recall that *t'oqapu* was a culturally-specific phenomenon and the intrinsic "accidental noise"

in them, in line with information theory (Shannon, 1948), causes the loss or distortion of information from the source up to the decoding process. Consequently, the "readings" thus far call for further research. Despite their originality, the work of V. de la Jara and T. S. Barthel is regarded as *unproven* and *problematic*, if not downright farfetched, by many authors (see Eeckhout and Danis, 2004; Cummins, 2011). It was criticized by John H. Rowe (1996, p. 463, in A. P. Rowe and J. H. Rowe, 1996), "... *from time to time someone with more enthusiasm than judgment decides that there must have been ancient writing in the Andes. One such enthusiast was Victoria de la Jara in Lima*," whereas, "Barthel's 'decipherment' [= of 1971] *was pure guesswork, and he did not know enough about Inca culture or the Inca language to make plausible guesses*". At present, a suggestion to be tendered is that further progress on this issue depends on logical analyses of reliable data with the added hope that there might be some consensus regarding potentially useful approaches to this often-divisive issue.

15. The Concepts of Duality and Complementary Oppositions in Textiles as Mirror Images of Spatial Organization and Mythology

Scholars of Peruvian antiquity (moderate or extreme in their claims) have demonstrated that *duality*, *oppositions*, and *harmony* are important qualities in the basic arrangement of *t'oqapu*. In a similar vein, following personal observations regarding direction, color inversion, interlocking, and possible hidden meanings of *t'oqapu*, we note the importance of the attribute of *yanantin* (= *binary patterns*) which is present in many samples (Stone-Miller, 1994a, p. 161; Frame, 2001, p. 135; Stone, 2007, p. 385;[42] Florio, 2013; Carbonell, 2020 [2019], pp. 165–166). Andrea Heckman (2003, p. 51) in a cautious report, points toward "... *the juxtaposition of many of the units in the Inca tocapu demonstrates concepts of repetition, inversion, and reversal, while the use of black and white and color expresses duality and balanced opposition, and, the use of red accents to denote the Inka, the color generally associated with him*," while Victoria de la Jara (1967, p. 247)—in a dashing statement over the nature of *t'oqapu*—specifies, "... *l'écriture inca est fondée sur des groupements dualistiques*" [the Inka script is founded on dualistic groupings]. In

42. See e.g., Stone (2007, p. 385), "Completing dualities—*the wet and dry seasons, the light and the dark portions of the night sky, upstream and down—define the Andean environment and condition human responses thereto. Movement along continua between such poles constitutes the principle of order, sanctioned by the circling planets but constantly mirrored in wild animal migrations, human transhumance, and many types of economic and aesthetic changes of goods. Within such a dynamic system, art often serves to echo, create, and perpetuate this endemic restlessness...*"

a following booklet, Victoria de la Jara (1975) goes into more details and applies to her satisfaction her methodology. Thus, making use of the principle of fusion (i.e., "ligaturing" / compounding),[43] de la Jara (1975, p. 47; see also Figure 21) offers two symmetrical *t'oqapu* rectangles "Apu (Señor [= Lord])" + "Illapa (rayo [= lightning])," that after recombination yield = "Apu *Illapa* (Dios Rayo [= Lightning God])." In another parallel case, "Apu (Señor [= Lord])" + "Capac (grande [= great]),"[44] produce = "Capac *Apu* (Rey [= King / Supreme Ruler])".

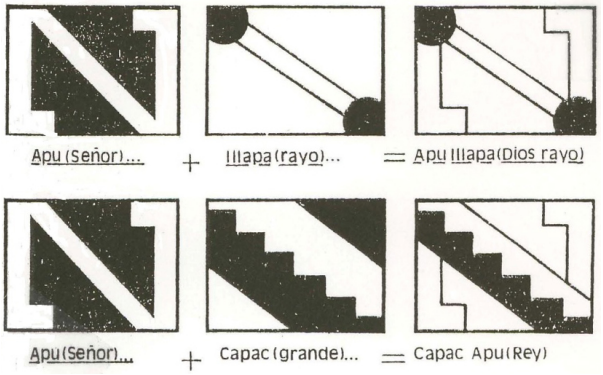


FIGURE 21. Logographic "readings" offered by de la Jara (1975, p. 47), based on the merging of two distinct *t'oqapu* units. Whether or not the correct readings, compounding or "ligaturing" is a script-like property observed in several real-world writing systems.

Examining various bibliographic sources, we realize that these concepts and thoughts are as ancient as the very inhabitants of the Andes. William G. Gartner (1998, p. 262, citing Guillet, 1992), speaks of "... *the architectural manifestations of dual social and territorial organization*," found in the pre-ceramic period (*ca.* 3000–2000 BCE) sites of Río Seco, La Galgada, and Kotosh. In a similar fashion, the structural design and art of the Chavín de Huántar temple, plus the iconography of the area, give us an idea about *the principle of dual organizations*; see Burger (1992, pp. 273–274). Next, Gordon F. McEwan (2006, p. 34) also points out that Chavín canons and compositions are infused by a *bilateral symmetry* and *reversibility*, suggesting the idea of balance and the bringing together of opposites.

43. de la Jara (1975, p. 48), "... *se amplió el repertorio de formas básicas por fusión de signos o adición de emblemas, símbolos de jerarquía o distintivos divinos*" [(...) the inventory of basic forms was expanded by way of sign fusion or addition of emblems, hierarchy symbols, or divine insignias].

44. See Lau (2019, p. 162), "Capac *is a Quechua honorific* ['*supreme*', '*royal*,' '*grand*'] *and title given to lords and things deserving utmost regard*".

Divisions in a twofold and fourfold fashion organizing the social and symbolic space at Tiwanaku are reported by Kolata and Ponce Sanginés (1992, p. 324). These authors (ibid., 1992, p. 325) describe also "… *the dual division of Cuzco into* hanan *and* hurin *segments, this partition*…" reflecting "… *patterns of social, economic, political, and religious organization*" (see in addition Cerrón-Palomino, 2008, pp. 225–243, for a significant assessment of the duality in the Andean societies and the terms *hanan* and *hurin*). In turn, Jane W. Rehl (2006, p. 20) sees "balance and reciprocity (relationships) *in the ancient Andes*" as an adaptation strategy, "… *as a way of life*" (ibid., 2006, p. 21) in the harsh environment of the highlands and lowlands of Perú.

In this schema, expanding a little more on the subject, four particular reports merit our attention (see Classen, 1993; Estermann, 1998; Regalado de Hurtado, 2000; Rostworowski, 2007). Written at different time periods, all of them coincide on a *central argument*: the existence of pairings in conjunction with the existence of real or symbolical opposing matters, entities, parties, or forces that need each other for the final balance, control and order, while pursuing oneness. Constance Classen (1993, p. 3) analyzes the structures of the human body and its dualities—*of right and left, high and low, male and female*—, which corresponded to the fundamental structures of Inka cosmology. In a further comment, the author elaborates (1993, p. 12), "The most basic expressions of Andean dualism—*male / female* (urco / china), *right / left* (paña / lloque), *high / low* (hanan / hurin), *external / internal* (hahua / ucupi), *and so on—originate in the structure of the human body* (ucu). (*pages 12–13*)". Joseph Estermann (1998) reiterates through Chapters 5 and 6 the "relacionalidad cósmica" [cosmic relationship] imbuing the Andean worldview with the principles of *correspondence* and *complementarity* as the main vectors. In a like manner, Liliana Regalado de Hurtado (2000, pp. 68–70) breaks through the "cosmovisión" [the Andean view of the universe] and reveals the fundamental ideas and mechanisms governing it: *duality along with further subdivisions in a double* way, and *complementary opposites* typified by *opposition* and *complementary parts*. Accordingly, such notions are to be understood as powerful "… *engines of the cosmic and social dynamics of the pre-Hispanic Andean world*" (Regalado de Hurtado, 2000, p. 71). On the other hand, María Rostworowski (2007, pp. 27–28, 172) evaluates the Andean mythology, and detects several twin patterns, for example, major and minor masculine deities organized in conflicting and complementary pairs or double pairs. Her remarks meet Platt's (1978) explanation, "Estos conceptos andinos están muy de acuerdo con el pensamiento indígena de mitades antagónicas y adversas que sin embargo se complementan y necesitan" [These Andean concepts agree completely with the indigenous thought of adversary and antagonist halves, which however are complemented and needed]. Studies of modern- day Aymara communities in Bolivia, Perú, and Chile, conclude in a similar manner. Cereceda (1986, pp. 167–

169), commenting on patterns and designs found in *talegas* (cloth bags or sacks) of the people of Isluga, an Aymara township on the Chilean altiplano in the province of Taracapá, discerns dichotomies in the form of paired oppositions or conjugal pairs, "*Each* chhuru [= small arable patch] *is given its precise and complementary opposite*: *a wide*, *light* chhuru *receives a narrow*, *dark* qallu; *a dark band is issued a light stripe*. *Equilibrium is thus achieved through an exchange of differences*". Bouysse-Cassagne's (1986, p. 213) message simply runs alongside that of Cereceda (*v. supra*), "... *Aymara space and socioeconomic relationships are governed by a double dualism*...".

Two opposing geometric structures, where "the ... *nature of the technique also points up the fundamental notion of complementarity*..." (Stone-Miller, 1994a, p. 161), follow (see Figures 22 and 23). Despite time-factored considerations, a degree of affinity is evidenced in the subsequent contexts.



FIGURE 22. A bisected "stepped-diamond"-like pattern appears on this pre-Inka textile fragment (pre-Late Horizon), retrieved during excavations at the necropolis of Ancón (Lima region, central coast of Perú) by Reiss and Stübel (1880–1887, Vol. 2, Tafel 54 [Plate 54]; cf. Beatrix Hoffmann, 2017, p. 181, Fig. 3, bottom left). The multicolored pattern upholds the principle of opposing and complementing forces. The image is rotated 90 degrees for a better evaluation. A photographic snippet depicting a similar "stepped-diamond"-like pattern is reproduced in Frame (2014 [2009], p. 273, Figura 30). The related caption reads, "Un diseño infinito con cuadrados y tres elementos escalonados en la parte superior de una túnica. *Staatliche Museen zu Berlin*, *Ethnologisches Museum VA 16618* [An endless design with squares and three stepped elements in the upper section of a tunic. State Museum, Berlin. Ethnological Museum, inventory no. VA 16618]. Likewise, another pre-Inka specimen (see Stone-Miller, 1994a, pp. 160–161) displays a double-cloth fragment with felines and birds, of the Late Intermediate period; culture of Rimac province; origin Central Coast, 1000–1476 CE.; 28 × 20.3 cm; plain weave double cloth; inventory no. 35.1126; part of the Samuel Putnam Avery Fund. The author in question (1994a), while analyzing the technique of weaving, concludes that the "*two layers of cloth*, *exchange of threads*, *and color reversals are all aspects of the principle of complementarity*...".

16. Are *t'oqapu* Designs Evocative of Wari-Tiwanaku and Other pre-Inka Cultures?

The analysis of *t'oqapu* and other Inka iconographic forms would indicate some shared structural features with various designs attested on pre-Inka artifacts (see Delgado Pang, 1992, p. 291; Stone-Miller, 1994b, p. 35; Roussakis and Salazar, 1999, p. 267; Clados, 2007; Bjerregaard and Von Hagen, 2007, p. 49; Gentile Lafaille, 2008, p. 2). Mary Frame (2001, p. 135) identifies geometrical structures overlaying tenaciously (in part or in whole) various Andean objects found in ancient pre-Inka horizons, "Elements and ordering principles evident in the t'oqapu *suggest there is a continuation in the tradition of embodying pattern and meaning in accordance with the logic of fabric geometry*". Despite circumstantial observations and the admitted belief that visual symbols *have old roots in Perú* (Heckman, 2003, p. 40), researchers cannot claim a compelling cultural relation in the all-Andean domain. In the absence of historical records regarding pre-Inka statecraft and polities, such hypothesis must be pursued through more archaeological evidence. The query—given the advantage of carefully organized excavations and the assessment of first-class material *in situ* and *ex situ* (= in major and peripheral museums and other collections)—would require a cautious study to validate it on multiple cultural levels across time and space. Still, authors Conklin and Moseley (1989, p. 147) offer a good starting point, "... *where pattern configurations can be related to earlier or later ones, they are presumed to reveal cultural continuity*". The term "pattern" is treated here following Schürmann's (1996, p. 1) statement that:

> [...pattern; *our note*] means something exhibiting certain regularities, something able to serve as a model, something representing a concept of what was observed. A pattern is never an isolated observation, but rather a collection of observations connected in time or space or both. The pattern exhibits, as a whole, a certain structure indicative of the underlying concept.

In the history of ancient Perú, there were predecessors expanding and projecting influence beyond their cultural and physical loci, the foremost being those of Chavín de Huántar in the central-north part of Perú (see Anton, 1987 [1984], pp. 37–47; Burger, 1992, p. 277; 2008, pp. 681–707;[45] Gartner, 1998, p. 271; Pasztori, 1998, pp. 103–109; Cordy-Collins, 1999, pp. 133–135; Thomas, 1999, pp. 313–319; Steele and Allen, 2004, p. 9; D'Altroy, 2005 [2002], p. 39; McEwan, 2006, pp. 33–34), of

45. "The acceptance of the temple's *role, first by local groups and later by more distant highland and coastal communities, had a profound impact on Peruvian prehistory. By about 400 BC, the symbol system of the Chavín temple spread over a vast area and was used, with some local variation, to decorate pottery religious paraphernalia, jewelry, and other items among groups that previously had shared few, if any, cultural features*...".

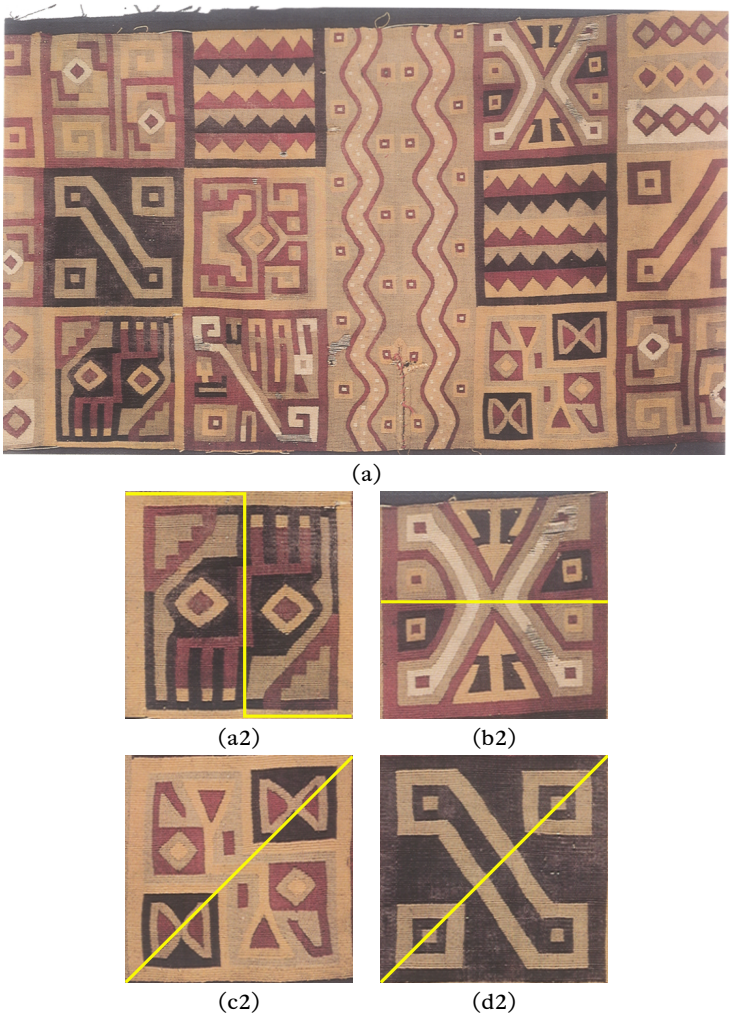


FIGURE 23. The exemplar (a) is extracted from CDMT's (2010) database at http://imatex.cdmt.es; see also Solanilla i Demestre (1999, pp. 254–255, inventory No. 157). The fragment is of a pre-Hispanic Inka fabric made of cotton and camelid fiber, referenced with inventory No. 02573, held by *Centre de Documentació i Museu Tèxtil*, Terrassa, Catalonia (Spain). Given the incompleteness of the piece (60.5 × 24 cm), it is not possible to estimate its original size. Possibly a tunic section, this exemplar reveals compartmentalized and well-structured antagonistic geometric units. See especially in (a2, b2, c2, and d2) the four bisected individual *t'oqapu* below the larger piece of (a).

Tiwanaku, south of Lake Titicaca (see Stierlin, 1984, pp. 141–146; Anton, 1987 [1984], pp. 101–111; Kolata and Ponce Sanginés, 1992, pp. 317–334; Gartner, 1998, pp. 279–282; Pasztori, 1998, pp. 121–127; Manrique P., 1999, p. 54; D'Altroy, 2005, p. 41; McEwan, 2006, pp. 37–39; Isbell, 2008, pp. 731–759), and of Wari in southern highland Perú—its heartland being near modern Ayacucho (see Stone-Miller, 1994c, p. 35; Cook, 1996; Manrique P., 1999, p. 58; González Carré and Mesía Montenegro, 2001, pp. 35–38; Schreiber, 2001, pp. 80–92; Glowacki and Malpass, 2003, pp. 432–434; D'Altroy, 2005 [2002], p. 41; McEwan, 2006, pp. 39–42; Isbell, 2008, pp. 731–759). Detailed speculations on the complex nature of these inadequately known cultures is avoided here since the data are far from complete; even so, a few remarks can be made. In times of war, any flow of patterns and related objects from the afore-mentioned trio would seem to have been imposed through raw power on succumbed, affected, or inhabited regions. On the other hand, it is very likely that during the absence of hostilities and outside the temporal and spatial perimeter of natural cataclysms, the phenomena of (a) *cult expansion*, (b) *exchange of goods*, plus *intended transport*, and (c) *human travel* would have additionally brought these important centers in contact with various unrelated ethnic groups. Therefore (at best) motifs,[46] architectural features, and objects (see Gartner, 1998, p. 282; Cordy-Collins, 1999, pp. 134–135; Schreiber, 2001; Frame, 2001, Plates 21 and 23) could have been dispersed to the benefit and intelligence of those who needed and appreciated them, or (at worst), in times of conquest, a forced diffusion—in the case of the Wari imperial culture, and possibly of the religious proselytizer Tiwanaku—may have caused disruption in the fabric of other indigenous societies.

Regardless of cross-cultural stylistic affinities, *only* the general setting will be captured in the artifacts described herein. In this manner, various authors mention observed similarities, in particular between Wari and Inka iconography (cf. Barthel, 1970, p. 96;[47] Delgado Pang, 1992, p. 291; Stone-Miller, 1992, p. 337; 1994c, p. 35; 2002 [1995], p. 212; Rowe

46. See Lanning (1967, p. 146), "Weaving was obviously a skill of high prestige, *as it had been at the Paracas Necropolis and in the Middle Horizon and as it was to be under the Incas. Artistic standards remained high, as witnessed by the predominance of Late Intermediate Period pieces in museum exhibits of ancient Peruvian textiles. Although each region had its own style, as it did in pottery, the differences from region to region were less marked and many motifs were spread over very large areas*".

47. "*Wohl mag es Wurzeln für einige Grapheme in nichtinkaischen Kulturen—sei es auf dem Horizont von Tiahuanaco-Huari, sei es im Reiche von Chimor—gegeben haben; die Synthese und der Ausbau zu einem verbindlichen System war eine spezifische Inkaleistung des 15. Jahrhunderts*" [Probably, some graphemes (= *t'oqapu* motifs; *our note*) were derived from non-Inka cultures—as from the horizon of Tiwanaku-Wari, and also from the kingdom of Chimor (= Chimú culture)—whereas the synthesis and the development toward an obligatory system was a specific Inka outcome of the fifteenth century].

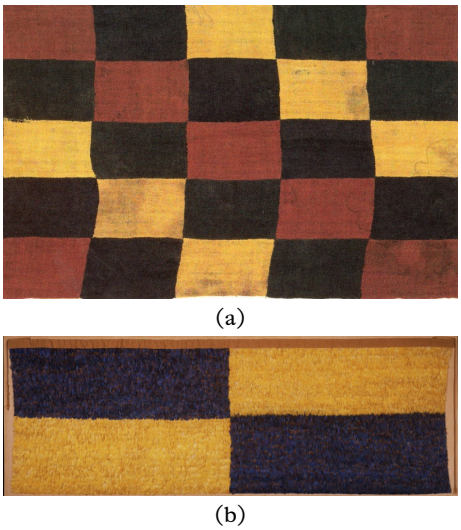
Pollard, 1978, p. 8, 1996b, p. 410; Conklin, 1996b; Cook, 1996, p. 86; Schreiber, 2001, p. 92; Steele and Allen, 2004, p. 37; Hoobler, 2018, p. 55; Clados, 2020). Shared geometrical shapes are assumed in and described also from the Nasca [= Nazca] culture (see Arellano, 1999, p. 257, citing Stone-Miller, 1992).

It should be reaffirmed however that the "evolutionary" schemes in Wari textiles are pursued, yet they are sketchy due to heterogeneous provenance, or worse, due to unprovenanced material and lack of a fixed chronology. Fine tapestry-woven textiles with beautiful designs have been basically uncovered in dry coastal cemeteries (Stone, 1989 [1987], p. 27; Oakland Rodman and Cassman, 1995, p. 37; Conklin, 1996b, p. 375). Textile preservation is not common in the highlands because of the rainy climate, yet Oakland Rodman and Fernández (2000, p. 123, Figures 9a and 9b), report on findings of tunic fragments in Vegachayoc Moqo, in the heartland of the Wari state. Such discoveries, if repeated, will influence the nature and direction of research in Middle Horizon tapestry tunics, by resolving the geographical "anomaly" of the disproportionate recovery of the artifacts. Consequently, the corpus will be more balanced, prompting scholars to respond to this new reality. Modern technical studies, i.e., the piecemeal structural analysis of the existing iconography, combined with the study of archaeological data related to Wari ideology and cosmology, are essential (Isbell, 2000; Ángeles and Pozzi-Escot, 2000; Oakland Rodman and Fernández, 2000; Prümers, 2000; Kaulicke, 2000).

Now we review a number of earlier artifacts, Wari-Tiwanaku or otherwise, sharing in part or in whole elements and motifs with the latter Inka ones. Lapiner (1968, Fig. 22) comments more specifically upon a "ceramic cup decorated with alternating panels of geometric steps and mice," belonging to Nasca [Nazca], *ca*. 100–400 CE. Next, Hughes (1995; and see below Figure 24a) offers a partial image of a man's tunic dating back from 300–600 CE. Although the Nazca style tunic flaunts a tricolor checkerboard motif, the structural similarity to the *black-and-white checkerboard* motif of the Inka timeframe is apparent. Following this line, in Figure 24b, is illustrated a "Blue and Yellow Panel," from the Wari culture, Middle Horizon *ca.* 810–970 CE. The "Panel" flaunts rectangular units made of feathers and cotton in opposing colors; see Dumbarton Oaks Research Library and Collection, Pre-Columbian Collection (2021b). Furthermore, Martell (1999, p. 18) published the figure of a Nascan [Nazcan] seated woman (on pottery) displaying opposed pairs of stepped designs.

In another case, Lapiner (1968, Fig. 43) presents a ceramic female figure with upraised hands of Chancay, Central Coast, *ca*. 1300–1500 CE. Repetitive geometric patterns are noticed on the headband of this ceramic sample. Kolata and Ponce Sanginés (1992, p. 333, Figures 18 and 19) reproduce the images of two ceramic cups (*qero*) belonging to

the Tiwanaku culture, with geometric and *t'oqapu*-like sequential designs at the bottom section areas. In Stone-Miller (1994a, pp. 153–154; Plate 53) there is an illustration of a *fringed tunic with interlocked birds* of Late Intermediate Period, 1000–1476 CE, attributed to the Chancay culture of the Central Coast. In the middle area, a stepped diamond-shaped structure is featured.



(a)

(b)

FIGURE 24. (a) The image rotated 90° rightwards for effects of convenience shows a Nazca styled *checkerboard* tunic (half). *Material*: camelid fibers; balanced interlocking plain weave discontinuous warp and weft. *Provenance*: Far south coast of Perú (300–600 CE). *Dimensions*: 72″ × 61″ (Hughes, 1995, Figure 19). The key structural / visual concept is rooted in a recurring combination of tricolor squares resulting in an appealing *checkerboard* design layout. (b) "Blue and Yellow Panel"; Wari, Middle Horizon ca. 810–970 CE; *dimensions*: 69.6 cm × 198.8 cm; *material*: (macaw) feathers, cotton; inventory no. PC.B.522; see Dumbarton Oaks Research Library and Collection, Pre-Columbian Collection, Washington D.C. (2021a).

Solanilla i Demestre (1999, pp. 250–251, catalog No. 156) published a fragment of a strip of clothing made of cotton and wool (= camelid fiber), found in the Central Coast of Perú, referenced as MDHN 4015, and residing at *Museu Darder d'Història Natural* (2010), Banyoles, Catalonia (Spain). The examined piece is of the Intermediate Late Horizon and pertains to the Chimú-Inka culture. A repetitive stepped-diamond pattern is visibly patent. Such a pattern is typical of many Inka *t'oqapu* units, as stated in Rowe (1999 [1979]). Christiane Clados (2007), in her turn, describes a number of Wari patterned artifacts scattered in

a range of worldwide museums, apparently precursors of Inka motifs (Clados, 2007, pp. 85, 90, 92–93). The designs and symmetries on a four-cornered pile hat of Wari culture (Paternosto, 1996 [1989], p. 164; Plate 99), are in the same way reminiscent of the Inka *t'oqapu*. Along the same lines, Ellen Hoobler (2018) studied another Wari man's four-cornered hat (600–900 CE; camelid fibers with corners; *dimensions*: 9.5 × 15.1 × 14.6 cm), and concludes,

> This changing of colors in a checkerboard pattern, as well as the geometricization and simplification of images within those squares, recalls the Inca tunics known as unku, with patterned squares at their waists known as tocapu. These were described by [historical; *our note*] Spanish sources as being akin to coats-of-arms [of] different provinces of the Inca empire. (ibid., 2018, p. 55)

Caution needs to be exercised, however. As aforesaid, attempting to give full credence to particular patterns spreading through the ancient Andes since early periods to the Late Horizon Inka times, should *not* be forthrightly taken without supporting evidence, i.e., on grounds of diachronic and spatial representation.

In light of current knowledge, it is difficult to determine if these patterns underwent semantic modifications not strictly through time, but also throughout the geographical area of Inkario (see Figures 25 through 28 herein). By *semantic modifications* we understand the possible "recycling" and reinterpretation of a *basic sign / motif*, in line with the prevalent cultural and social codes in a segment of the Andean pre-history, enriching it with new layers of meaning (see, e.g., Jean, 1998 [1989], pp. 125–127). A guardedly scholarly view on such possibilities is suggested now; although the Inka, as a driving and imposing force during the Late Horizon period, would have appropriated, manipulated, and put to their service the socio-cultural concepts of other communities, we think. J L. Pino Matos's (2004, p. 309) observation echoes similarly along the context,

> *Al hacer uso de ideas que existían en los territorios conquistados, y usarlas para legitimar su posición de Imperio, aseguraban también la dominación ideológica*
>
> [By exploiting the ideas that existed across the conquered lands, and in using them to legitimize their Imperial status, (the Inka; *our note*) also ensured their ideological domination].

17. Concluding Remarks

There can be no advancement in learning about ancient societies and communities without studying their correlated symbolic practices. Irrespective of any speculation about their semantic / linguistic values,

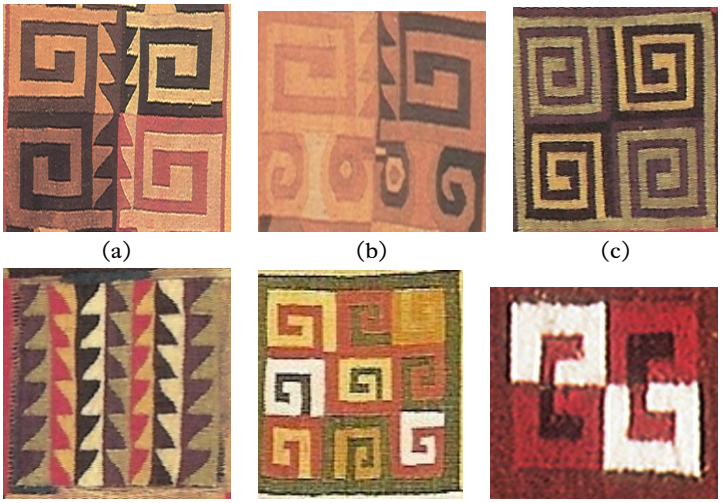


FIGURE 25. In this figure, pattern (a) is "cut off" from the upper left front part of a Late Wari tunic 900–1100 CE, cotton and camelid fiber (Reg. 91 533), at *The Textile Museum in Washington DC* (see Benavides, 1999, p. 395; Lámina 15 [Plate 15]. In contrast, pattern (b) is "cut off" from a Wari *unqu*, from the southern area, 500–1100 CE (CCEM, 2001, pp. 456–457; Petit Palais, 2006, p. 122). Patterns or *t'oqapu* (c) and (d) are "cut off" from the front part of the *unqu* found on the Island of Lake Titicaca and acquired by Adolph Bandelier in 1895. It is said to be mid-to late 16th century, and it is deposited at the present time in the *American Museum of Natural History*, New York (Lehmann and Doering, 1924, Plate 158; Rowe Pollard, 1978, p. 17; Phipps et al., 2004, pp. 156–157). *T'oqapu* (e), for the meantime, is "cut off" from the tunic of Bliss Collection at Dumbarton Oaks in Washington DC. (Rowe 1999 [1979], pp. 642–647). *T'oqapu* (f) is "cut off" from a Peruvian mantle of Late Inka to early Colonial period, about 1550 CE, made of camelid fiber. The mantle is held at *The Museum of Fine Arts*, Boston, Massachusetts (Tuchscherer, 1988, p. 37; Stone-Miller, 1994a). In another extra-context, Stone (2007, p. 402) reproduces the image of a Nazca tunic, 300–500 CE, bearing the *Greek key*, or *L-motif*, similar to the pattern (c) from the Dumbarton Oaks' royal tunic. The similarities in these patterns, distanced by some 500 or more years, are striking, with emphasis in the purported *Greek key* motif (complex or simplified), see (a), (b), (c), (e), (f), and the triangular serrations, aka *saw-teeth*, see (a), (b), (d). While discarding the idea that patterns are *accidental*, the permanence of tradition may be a plausible answer. Apparently, the Inka or their direct descendants were not mere imitators of previous productions, but rather blended and recreated former cultural conventions (including textiles) at the benefit of their ideology and mythology (see e.g., Bákula, 2000 [1992], p. 220).

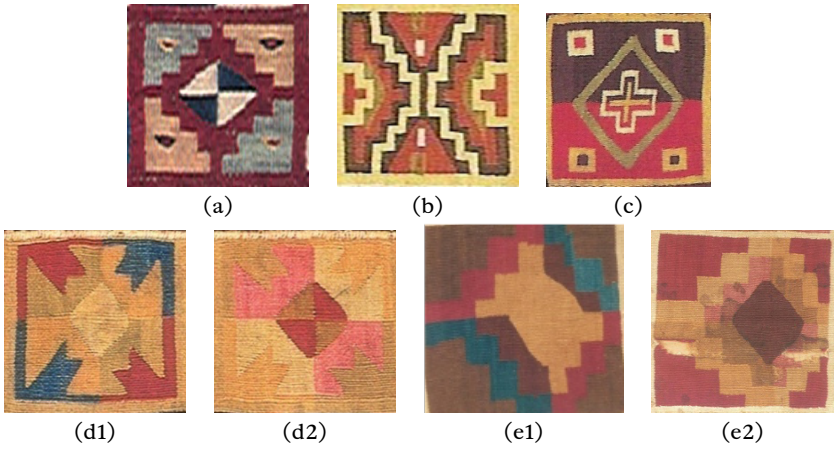


FIGURE 26. In this figure, *t'oqapu* (a) originates from the front part of a post-Inka *unqu* said to have been found in Ancón, Perú, probably late 16th century, and to this day kept in *Staatliche Museen zu Berlin*, *Ethnologisches Museum* (Arellano, 1999, p. 258; Phipps et al., 2004, p. 167; Ramos Cárdenas, 2005, pp. 58–59). *T'oqapu* (b) derives from the tunic of the Bliss Collection at Dumbarton Oaks in Washington, DC (Rowe, 1999 [1979], pp. 642–647; Stone-Miller, 2002 [1995], p. 212; 2007, pp. 386, 394; Phipps et al., 2004, pp. 153–155). *T'oqapu* (c) derives from the post-Inka *unqu* deposited in the *American Museum of Natural History*, New York (Lehmann and Doering, 1924, Plate 158; Rowe Pollard, 1978, p. 17; Phipps et al., 2004, pp. 156–157). Patterns (d1 and d2, still discernible in the color format), viewed as plain color variants, draw from a Wari-Tiwanaku small rug made of cotton and wool, 600–900 CE (Benavides, 1999, p. 367, Lámina 4 [Plate 4]; Leyendas [Captions], p. 408). The *stepped-diamond* patterns (e1, e2), also variants, correspond to a Wari tapestry tunic of Middle Horizon, probably from South Coast 500–800 CE, housed at *The Museum of Fine Arts*, Boston; see Stone-Miller (1994a, pp. 101–103). The similar quadripartite configurations, the symmetrical perception, the use of colors in a contrastive fashion are noticed in some Wari-derived and Inka patterns. The idea that the majority of the Inka *t'oqapu* came into existence out-of-nothing, begs for reluctance (Melka, 2010a; 2010b). General and particular patterns appear to have endured through time by imitation and further elaboration, while cementing in the Andean collective memory. Despite the common balanced and paired designs, the issue that these motifs had an identical value in cultures far removed from each other, i.e., Wari and Inka, is contested. Symbols generally contain more than one meaning, which can be *psychological*, *religious*, or *moral* (Julien, 1996), corresponding to the ethnic and social background that produced them. It is quite possible that the coded Wari information in the guise of textile patterns, sacred or not, was subsumed in the Late Horizon period by new meanings ascribed to similar or identical shapes. We have to restrain ourselves in asserting the solution to the meaning while searching for more comparable and analyzable cross-cultural patterns.



(a1) (a2) (b) (c1) (c2)

FIGURE 27. In this figure, *t'oqapu* (a1) (a2) are isolated from the royal tunic of the Bliss Collection at Dumbarton Oaks in Washington, DC (Rowe, 1999 [1979], pp. 642–647; Stone, 2007, p. 386). *T'oqapu* (b) is retrieved from a cotton-made Inka fragment of fabric, currently at the *Centre de Documentació i Museu Tèxtil* (Terrassa, Catalonia, Spain, with inventory no. 157, CDMT 2573); see Solanilla i Demestre (1999, pp. 254–255). Due to the fragmentary condition, the examined *t'oqapu* was reconstructed for technical purposes by affixing the conceivable missing portion. Design-patterns (c1, c2) are isolated from a colorful checkerboard Wari-influenced tunic, 700–850 CE, property of a private collector (Frame, 1999, Lámina 25a [Plate 25a], p. 339). The units have been grouped in view of a common feature: the lozenge-like, or the diamond-like chain traversing lengthways all their extension. A dichromatic Wari *unqu*, red and orange, of the Southern Region, 500–1100 CE, shows a succession of rhomboidal designs, very similar, if not almost identical to the design-patterns (c1, c2) (CCEM, 2001, pp. 458–459).

the symbols—as the calling cards of these societies and communities—, require scholarly attention in order to grasp many of their social, ideological, cognitive, and historical aspects. In this sense, the analysis of the relatively and/or highly abstracted imagery in pre-European Andean textiles—in relation to the textile structure—are both challenging and intriguing for modern researchers. The nonfigurative images of Wari or Inka textiles, compared, for example, with the patterns of Coptic textiles,[48] or the images of *La Dame à la Licorne* [The Lady and the Unicorn],[49] show the contrast between the Middle Horizon reductionist-geometric and the European and non-European pictorial-like and ornamental textile models. A number of patterns, topological configurations, and the structural relations in Wari or Inka iconographies may qualify *prima facie* for *a visual language* and reflect a different way of communication based on relational thinking and without recourse to spoken language (Boone, 1994a; González and Bray, 2008, pp. 1–4). Another option that we cannot neglect is that logographic values were embedded across various discussed patterns (with some of the researchers claiming this with

48. "*…textiles from Egyptian finds dating from the Late Roman period into Islamic times*" (Thompson, 1971, pp. 1, 3).

49. A series of six tapestries of the end of fifteenth century held in the *Musée National du Moyen Âge* (*Musée de Cluny*), Paris, France (MNMA, 2009).



FIGURE 28. A continuous meander-like motif (b), resembling a "two-*eyed snake*" is enfolded in the middle of an Inka fragment of fabric (a); see CDMT's (2010) database at http://imatex.cdmt.es and Solanilla i Demestre (1999, pp. 254–255). The meander-like motif is also spotted alongside the modules of this fragment of a Nazca-Wari (c); *ca*. 700–850 CE, two-panel garment for a woman. The section under consideration is originally set sideways and the tunic itself is preserved at *The Textile Museum*, with inventory no. 91 281; see Frame (1999, p. 333, Lámina 20 [Plate 20]; p. 348). (d) The meander- or snake-like motif attains its full stature and representation as a lifelike design in a tunic with serpents; *ca*. 800–950 CE; South Highlands, Peru; Wari-related style; *Material*: camelid fiber, cotton; *Technique*: tapestry weave; *Dimensions*: 74.6 × 101.6 cm; private collection (see The Metropolitan Museum of New York, 2022b). The related commentary of MetMuseum (2022b) follows, "This tunic, *though of typical Wari construction and color, is aberrant in both technique and design, perhaps as a result of a provincial influence. The snake design is unknown in other Wari-style tunics, but the small spotted cats and bird-headed figures can be found on a few other pieces. Areas of reweaving are present and the lower edge is missing, but the original effect of the design can still be seen*".

remarkable assuredness and other ones being more guarded along the context).

Similarly, all of the discussed symbolism in these semiotic systems was not created in an *ideological vacuum* (Chaplin, 1994, pp. 63–65), rather than reflecting the dominant ideology of their time, with the patterns working as a political and aesthetic apparatus in achieving the goals Wari and Inka establishments had in their agendas.

A number of visual / structural coincidences that surpass the likelihood of *mere chance* are noticed among some Wari-Tiwanaku—or Wari-affiliated—and Inka iconographic patterns. In this vein, bearing in mind the spatial and temporal vastness, independent and fortuitous developments would have been unlikely; e.g., the ancient Greek motif of the "Greek key," a recognized and widely diffused Wari design. Elsewhere, Givenchy's logo—the French cosmetic and leisure company–, or likewise Versace's logo—the Italian-based high fashion company—most probably Greek or Roman-inspired, would point to the importance of the symbolic patterning across times and cultures.

Our findings support the assumptions of previous researchers, sanctioning the idea that the Inka inherited from former Andean models and lifestyles, adopting to their needs and aesthetical canons many artifacts and their corresponding iconography. Very likely, the Inka sovereigns, the nobility, the religious practitioners, and even a non-negligible number of commoners, must have been aware of and responsive to different degrees to the long-ago Peruvian cultures of Nazca, Tiwanaku, Wari (Reid, 1986, p. 18; Bonavia, 2000 [1992], pp. 135–137; Morris and Von Hagen, 1993; Hughes, 1995; D'Altroy and Schreiber, 2004, p. 255; McEwen, 2005, p. 164; Covey, 2008, p. 825; Ligmond, 2021), and also to the earlier culture of Chavín de Huántar. Apparent and unapparent connections identified in the Wari and Inka samples are characterized by innovation and reinterpretation of their traditional forms. The connections tend also to suggest that several Wari motifs established within their known geographical boundaries permeated the Inka expressions to a large degree, specifically in the tapestry tunics. The results may have predictive value for new data, though the success or failure of such a guess is in proportion to: (a) a larger and more comprehensive body of *t'oqapu* patterns; (b) the assumed time-frame of such a body, analogous to the already scanned and explored models; (c) the inclusiveness in spatial terms of Wari and Inka items, be they textile, ceramic, stoneware, or metal-made; (d) the further understanding of the Wari material culture via *in situ* investigations, C^{14}-dating, and additional seriation studies in textile and pottery alike, e.g., Menzel (1964); and concurrently of (e) its

political and ideological programs.[50] Future studies may expand also on the complex topic of differentiation: on the range of Wari symbols rationalized and "sanitized" in line with the Inka agenda, and of other symbols that over time may have been abandoned (cf. Fontana, 2003, pp. 27–28).[51] Lending further legitimacy to this assumption would assist in better determining the timeframes of these cultures.

It may be said that the patterns, many of them enjoying a high level of artistic quality and labor intensity, were meaningful and intentional regarding conveying information about mythological and sacred themes (Stone-Miller, 1994c; Conklin, 1996a, p. 343; Bergh, 1999), social standing, and local or individual affiliation. The ordered patterns are not strictly the end-result of psychotropic plants acting on the neurochemistry of the Andean mind, nor are they comparable to a product of an insect-like collective employing them in a functional way, with disregard of socially-related aims and aesthetics (Ball, 1999, pp. 48–49). The deconstruction of representational forms in Wari or Wari-related artifacts and the conceptualization of information *indicates a shift in a different direction in the use of visual arts* (Pasztori, 1998, p. 146), in contrast to animated pictorial models, e.g., Moche imagery (Jackson, 2008), or to the Gobelin tapestries (Candee, 1935 [1912], pp. 90–144; Ellul, 1996, pp. 46–54, 56). Functionality, communication of political and ideological messages, and textile art, appear structurally blended in a natural manner to the point that it is difficult to say which was of *prime importance* in the Wari mindset. Given the different states of preservation of the examined samples, this seems to have been applicable for ceremonial and utilitarian objects. It would seem that the Andean "priests" / "spirit mediums" and experienced weavers in ancient times did not visualize such matters as Westerners do today (see Boone, 1994a, 1994b; Pasztory, 2010). Yet, modern connoisseurs of abstract expressionism (Hess and Grosenick, 2005) and other art experts tend to qualify scores of surviving Wari or Wari-related tapestry objects as true masterpieces.

Given the present inadequacies of the corpus, we believe a special inventory registering all the *t'oqapu*-like designs in textile, earthenware, and other media of the Middle Horizon Wari and Tiwanaku should be seriously pursued. Any paper-based and/or expandable online version would be a valuable asset for the present scholarship, dedicated

50. In a similar manner, the iconographic analysis may help the understanding of the social connotations that some of the "borrowed" Wari-patterns had for the later Inka culture.

51. It has been long known that "old" symbols are "exploitable" (with several of them disposable) by the more advanced elites of human societies in many parts of the globe. The Inka *vs.* Wari-Tiwanaku model provides one instance of this kind.

to the understanding and interpretation of pre-Inka motifs. Future researchers may bring the data under experimental control by operating with more accessibility and continuing enhancement. Online repositories of corpora of Mesoamerican and South American scripts, recording systems, and artifacts, are already available, see e.g., *FAMSI*, Foundation for the Advancement of Mesoamerican Studies, Inc. (2009), and the *Khipu Database Project* at Harvard University (Urton and Brezine, 2009). A large catalog of Middle Horizon tapestry tunics and related information about them, would be a valuable addition in cyberspace, similar to the Mesoamerican records and inscriptions, plus the knot-recording devices, identified as *quipu* (*khipu*).

Whereas the debate on *t'oqapu* readings is far from settled, conceivable possibilities regarding such "readings" need to be treated with much caution. Concurrently, since we have pondered their iconographical and ethnographical surroundings, as well as establishing cross-cultural contrasts, it is noted that we have done so without isolating *t'oqapu* graphemes, or allotting phonetic values to them. As the vicissitudes of time cannot be totally reversed, the reconstruction of the meaning of *t'oqapu* should be cogently based on the surviving artifacts (textiles or not), whilst acknowledging that *social rank*, *high prestige*, *place of origin*, and *ethnic / group identity* were associated with them. Considering that the cognitive, mental processes of the *t'oqapu* creators / transmitters (be they Inka rulers, *amautas* [knowledgeable masters / wise mentors], or "artists" and expert weavers) are gone, any evidence from other backgrounds is crucial to their explanation. At the same time, while evaluating the various models, new lines of investigations should be pursued.

As Stone (2007, p. 397) properly argues in reference to the *t'oqapu* welter in the Bliss Collection's royal *unqu* (cf. Figure 8b above), the wearer (in this case, the supreme Inka ruler seriously engaged in reigning and administrating) was not supposed to hang around quietly and motionless so the message/s[52] encoded in the small-sized rectangular or square *t'oqapu* could be verbally retrieved in a prearranged mode. There was no showmanship at play.[53] As nearly as we can determine, any plausible "reader"—be that a courtier, an attendant, or a bystander—however intimate to the premises, (a) could have offended the absolute dynast while attempting to approach him or sneak into his vicinity (see Anton, 1987 [1984], p. 195); (b) could have bungled the "reading" due to the uneasy

52. The message is understood as the expected interplay of *t'oqapu* patterns, resulting in a manageable and intelligible communication, e.g., a minimal text, for those conversant with the system in question.

53. Despite the fact, we recognize that the royal unqu *t'oqapu* conjured most certainly a sense of awe and creativity in the eyes of "readers": courtiers / attendants / bystanders.

situation; and most likely, (c) would have ended up seized by the sovereign's personal guards, and summarily executed "at the end of the day". If we use classic logic in this respect, countering the rationale offered by Stone (2007) would be highly questionable. Save cryptography and comparable environments with security primacy, experiments or practical jokes, real-world symbols and scripts are normally *not* conceived to mystify on purpose the minds of recipients, or of any possible and interested audience. To maintain a proper rapport with the intended audience, static objects (such as hanged banners or pennants), drinking / storage vessels, or real-size and customized *unqu* wrapping the body of Inka mummies / bundles of sacrificial offerings (see Cassman, 2000, p. 255; Pillsbury, 2002, p. 76; Shaw, 2019; *v. supra* Figures 10a and 10b) or the miniature textiles adorning the male and female gold and silver figurines across numerous *waka*/s (*huacas* [sacred spots / shrines])[54] found *en route* to or departing from Cuzco (seat of Inka power), might have preferably endorsed a stereotyped "phonetic" use and been decoded at liberty.

Two subsequent issues arise: did only the convened people—for example, Sapa Inka's [= *unique Inka* / top ruler] followers, courtiers, and other needed assistants—in a circumscribed event of *ceremonial* (festivity), *administrative* (customary meetings with provincial governors or *curacas*[55]; see Davies, 1995, pp. 154–158, Kulmar, 2010, p. 138), or *military* (public appearance) nature, "read" the *t'oqapu*? Or, did the average, local person—of Inka or non-Inka stock—living in the culturally shared space make the most of them as well? (see Arellano, 1999, p. 260). Many of the Spanish chroniclers' descriptions mention the select few of the society, its headquarters in Cuzco, and mythical traditions (Montell, 1929, p. 174; MacCormack, 2001, pp. 419–435; Steele and Allen, 2004, p. 45). Hence, it is difficult to state whether the major Inka centers of decision influ-

54. See Rowe (1981); Phipps (2005, p. 89). In turn, R. M. Cerrón-Palomino (2008, p. 245) provides the following explicative terms for *waka* (*huaca*), "adoratorios de *las divinidades incaicas*" [adoratories of the Inka deities] and "santuarios" [shrines]. The same notion is reflected in Brooklyn Museum's (2021) description, "[…] *the* capacocha, *a sacred Inca ritual that took place on mountains, islands, and other revered places called* wakas". Another scholar, L. Trever (2011, pp. 39–40), puts it this way, "'Huaca' *is a Quechua and Aymara term that is often glossed in early Spanish dictionaries and chronicles as* '*idol*' (*González Holguín 1901* [1608]: *123*; *Bertonio 1879* [1612]: *277*) *but that more appropriately refers to a range of numinous Andean subjects including local gods, shrines, statuary, and sacred features in landscapes*".

55. Anton (1987 [1984], p. 191) explains *curacas* as "the nobility of the conquered peoples" who were allowed by the reigning Inka to "remain as officials and dignitaries for diplomatic reasons"; see also Finley Hughes (2010, p. 159), "A governor, *who was an ethnic Inca and who also spent time in Cusco, managed the affairs of each province, but employed intermediate elites, usually hereditary local elites, called* curacas, *to act as administrators on behalf of the* Sapa *Inca at the household level*".

enced seriously all the faraway provinces and peripheral outliers when *fashion* (clothing and designs) comes into attention. Pledging commitment to and abiding by Inka-issued edicts (including the "fashion statements") would have been more achievable for communities or ethnic groups in close proximity to Cuzco or other centers directly related to the Inka axis of power, we infer. Meisch (2006, pp. 387–388), for instance, comments upon a particular case, which grounds the previous remarks,

> Augustinian friars arrived in Huamachuco in 1552, just 20 years after the conquistadors landed nearby on the coast of Peru. Although the friars made concerted attempts to "extirpate idolatry" and Christianize the natives, many pre-Hispanic household religious practices survived—the sara belts [maize belts; *our note*] are a prime example. The Huamachuco region is relatively isolated, and probably escaped the more intense suppression of Inca religion around Cusco.

The presence of numerous storage facilities, great hydraulic works (fountains / irrigation / drainage / sewage systems), an extensive and functional road system (with rest stops / relay stations for the weary traveler) spread as far afield as in desert areas and highlands, of specialized messengers and ancient *quipu* bureaucrats, would suggest most of the time, however, a centralized control and organization throughout this ambitious empire (cf. Hyslop, 1984; D'Altroy and Hastorf, 1984; D'Altroy and Earle, 1985; Mitchell and Guillet, 1994; Sherbondy, 1998; Pasztory, 1998, pp. 154, 155, Fig. 112; McEwan, 2006; Kulmar, 2010, pp. 137–142; Dean, 2011; Bray, 2013).

Victoria de la Jara (1917–2000) is a household name in the *t'oqapu* studies. In her time, V. de la Jara (1967, pp. 242–243) spearheaded the efforts to devise a catalog by offering an index list consisting of 294 *t'oqapu* units. Given the elapsed years, newly discovered material, and the structural-analytical and iconographical approach, the afore-mentioned list calls for updates and a critical reassessment. Particular attention should be paid to the core *t'oqapu* units *versus* the variant forms, i.e., allomorphs. It is difficult to entertain the idea that the mass of weavers across Tawantisuyu[56] were involved in an uneventful routine, producing base and rigid stencils on any given day. While not advocating for their neat phonetic nature, *t'oqapu* allomorphs require careful study, similar to the

56. See in this sense Phipps (2018), "*Hundreds, possibly thousands of weavers and craftspeople contributed to the production of* cumbi *cloth. Among the five or so great weaving centers of the Inca period known to us, those most lauded by Spanish chroniclers were in the Lupaca region, around Lake Titicaca, an area still known for its fine weaving. Milliraya, one of these centers, was established during the reign of Huayna Capac, one of the last Inca kings, and reportedly supported a thousand* cumbi *weavers and feather cloth workers* (Spurling, 1992; cf. D'Altroy, 2002, pp. 96–97)".

scribal allographs, bearing in mind the contextual associations and their morphology. A substantial body of textile texts is required for any scientific analysis and reliable conclusions as to the previous task. In this sense, a likely proposal would be the construction of a *t'oqapu* corpus in the fashion of the *Khipu Database Project* at Harvard University (cf. Urton and Brezine, 2009). Careful cataloguing of any Inka sample would allow for committing this great legacy to a non-profit online for distribution and further study. The outcome would assist in better tackling with the known diachronic and diatopic randomness, while pursuing validity, statistically speaking or not.

The current investigation also prompts the questions: was there an undeniable correlation of *t'oqapu* figures, whether painted, incised, embossed, woven, or knit, attested in different material supports? Was there a standard interpretation (a coherent decoding) throughout Inkario by its inhabitants, or were there regional and sub-regional variations? In this respect, the yet undetermined chronology also calls for time-factored variations. Steele and Allen's (2004, p. 37) awareness on this subject is justified, "... *unfortunately*, *there is no obvious* [and fluid; *our comment*] *development process for* [the pre-Colonial; *our note*] *Inca tocapu*," and we may restate that consensus on the topic remains elusive among the Andeanist scholars.

One may even claim a subliminal message relative to identity, propagandistic goals, and power projection of the authoritarian head and the Inka establishment (in general). Similarly, we wonder if interlaced or separate *t'oqapu* had prophylactic properties as well, so as to repel mythological demons and other devious spirits. How can we maximize the potential of these suppositions and how far can they be taken?

Provided that the *t'oqapu* arrangements reflect symbolically the spatial and cultural perception of the Inka world, then the phonetic hypothesis may be indefinitely reduced in importance. The total number documented so far in the *t'oqapu* stock (*ca.* 300) would suggest, at best, a limited semasiography, obliging the Inka in selecting the textile "language" according to the weight of a particular situation and its practical function. Needless to say, this number of symbols could barely express or encompass all the human thoughts as regards the vast knowledge and technological achievements evidenced and applied across Tawantisuyu. One may also question how incoming neologisms could have been efficiently developed, if the chosen language was merely fixed via logograms (or possible morphemes) during the weaving endeavors (cf. e.g., in a theoretical setting, Sproat, 2000, p. 137).

Nevertheless, at this point, we neither intend to diminish their value nor dislodge the entire intellectual ideas / perceptions over the *t'oqapu*, rather than regard such a peculiar phenomenon beyond the Euro-

pean canons of phonetic writing, culture, and art. More specifically, Damerow (2006 [1999], p. 2) seems to transcend in his statement the limits set for his case-study (i.e., the proto-Cuneiform in Mesopotamia),

> From the viewpoint of historical epistemology, proto-writing is not seen merely as a deficient representation of language but rather as a successful means of representing knowledge and transmitting it from one individual to another, and eventually from one generation to the next.

If *t'oqapu* motifs prove to be ultimately an instance of pre-writing, or a liaison between pure semasiography and incipient writing (with logographic or certain rebus-like elements), it may be assumed that many of the referenced authors would validate their reasoning and intuition, or else, recognize misplaced beliefs (see the discussions of Eeckhout and Danis, 2004; González and Bray, 2008; Cummins, 2011; Clados, 2020). Hereafter, the *archaeology of symbols*, baffling and challenging as it is in anthropological and linguistic sciences, raises particular interest in the case of Inka *t'oqapu* designs and orders more multidisciplinary teamwork on a local and international level.

Appendix: The Interpretation of *t'oqapu*

No clear one-to-one correspondence is demonstrated conclusively (see Harrison, 1989, p. 60), meaning, the precise semantic or phonetic values assigned to the full inventory of *t'oqapu*, still elude today's research. To be sure, the modern Andean scholars are qualified to explore the existing corpus and related patterns at their discretion. A few *t'oqapu* here and there can be interpreted; temporary or even some plausible solutions can be offered, but the premises[57] on which the whole system was built and refined are largely out of our grasp (see Paternosto, 1996 [1989], p. 169).[58] At times, the distributional properties of the *t'oqapu* alignments strongly defy the known human grammar by relegating the phonetic theory, and obviously one cannot avoid getting "a little" leery of the suggested readings. This is observable in particular when a monotonic, boundless repetition is on the way: the Inka "key pattern" (*v. supra* Figure 8a). Indeed, the multiplication of this motif, mimicking a continuous visual litany, lowers the property of informativity. On the other hand, though, it reflects the intended semantic statement of the Inka (see in a slightly different context, Beaugrande and Ulrich Dressler, 1972 [1981], pp. 54–55).

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57. By "premises" we refer to the oral and institutional context in which the *t'oqapu* system was conceived / inherited and applied.

58. "*… it must be acknowledged that a convincing reading of the whole* [t'oqapu; *our note*] *system has not yet been advanced*".

In an unidentified symbolic or writing system, or in an encrypted cipher, *telltale regularities* (Poundstone, 1988), cohesion, and frequency distributions are primarily exploited by analysts conversant with epigraphy, cryptanalysis, and statistics.

Yet, such regularities (or irregularities) are very idiosyncratic in the case of the remaining *t'oqapu* samples, producing every so often disparate, spontaneous patterns, suggestive of thematic changes, or otherwise, unrestrained linear repetitions (Rowe Pollard, 1978, p. 5; Paternosto, 1996 [1989], p. 170; Rowe Pollard and Rowe, 1996, p. 463). One way of working out the difficulty is by analyzing iconographically the tokens and checking if their likelihood of occurrence is dependent on (or independent from) other contextual tokens. To this effect, *subtle* or *major* semantic differences may be tracked down by studying the degrees of association between *t'oqapu* occurrences in the largest possible corpus. Thus, inspecting which *t'oqapu* motif "attracts" or "repels" which in more than one environment enables us to confirm if they are (a) essentially grammar-oriented; (b) if linguistic features are highly marginal; (c), or in a last instance, if they are nil (being otherwise fully visual- / mnemonic-oriented). Quantification is desirable in the sense that it may reveal how frequent a geometrical "unit" or "structure" must be to count as a discrete *t'oqapu* motif. In view of this, multivariate tables collating the data may facilitate insights as to the intimate nature of the examined phenomenon. Therein, the approach may greatly benefit from the use of computer technology.

A few interpretative models from international researchers follow, while abstaining from fully endorsing any of them, or monopolizing the truth regarding the meanings of *t'oqapu*.

(1) *T'oqapu* No. 65 (Figure 29), alias "croix traversée" [double-slashed cross] (see de la Jara, 1967, p. 241, and the compiled index-list "1–294" in V. de la Jara, 1967, pp. 242–243) after the chronicler Martín de Murúa,[59] was an attribute of the last Inka authority Atawallpa, captured and put to death by the Spanish conquistadores. This particular *t'oqapu* appears six times in the waistband of an *unqu* (probably of the late 16th century); see Phipps et al. (2004, p. 167). A series of variations of this motif (comprising the simple key pattern and the double-slashed cross) is offered in Frame (2014 [2009], pp. 257–258, Figuras 10, 11 - *Variaciones en la familia de la llave inka*). The variations show the ingenuity of the weavers when it came to articulating and compounding one simple pattern (i.e., the "key") into attractive and complex *t'oqapu* samples.

(2) Gentile Lafaille (2008, pp. 8–12) sets forth multi-referential "readings" about the *t'oqapu* No. 285 (in keeping with V. de la Jara's 1967,

59. The derived reference is Martín de Murúa's (1616) *Historia General del Perú*; cf. also Thomas B. F. Cummins and Barbara Anderson (Eds.). (2008).

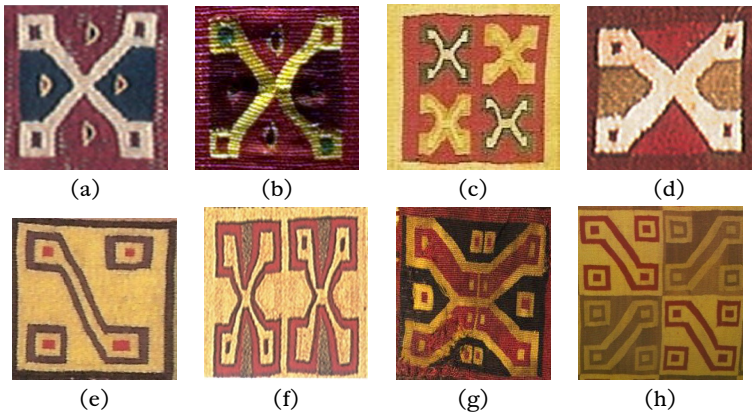


FIGURE 29. In this figure, *t'oqapu* (a) or # 65 in de la Jara's index-list "1–*294*," resembling a "double-slashed cross" (or "the cross of St. Andrew") with four quasi-mini-lozenges, is salvaged from the front part of an *unqu* said to have been found in Ancón, Perú. The artifact is kept to this day at *Staatliche Museen zu Berlin, Ethnologisches Museum* (de la Jara, 1967, p. 244; Arellano, 1999, p. 258; Phipps et al., 2004, p. 167; Ramos Cárdenas, 2005, pp. 58–59). *T'oqapu* (b) is part of an Inka tunic's waistband, found at *Museo Arqueológico de Cuzco* (Museo Inka), Perú (de la Jara (1967, p. 244, Fig. 4, upper band). Iconographically, (b) is the same realization as *t'oqapu* (a). Subsequently, *t'oqapu* (c), a grouping of four juxtaposed "double-slashed crosses," is salvaged from the front part of the Bliss Collection's *unqu* at Dumbarton Oaks; see Phipps et al. (2004, pp. 153–155). *T'oqapu* (d), a single double-slashed cross, coming from a post-Inka shroud preserved at *The Museum of Fine Arts*, Boston (Massachusetts), is markedly similar to Inka-era *t'oqapu* (a) and (b). *T'oqapu* unit (e), in turn, is recovered from the front part of the *unqu* purchased by A. Bandelier in 1895. Nowadays, the artifact is deposited at the American Museum of Natural History, New York (Rowe Pollard, 1978, p. 17; Phipps et al., 2004, pp. 156–157). The backward slash-form *t'oqapu* if merged crosswise with a "forward slash"-like *t'oqapu* seems to generate the "slashed cross" (a) and (b). Research is tempted to consider the token in question as *adjustable* or better said, as a *core productive element* in the set of the *t'oqapu* system. Unit (f) belongs also to the Bliss Collection's *unqu* at Dumbarton Oaks, Washington D.C., and is shaped in a pair-forming structure: a "double-slashed" cross configured side-by-side. As the observations go, duplication of the "core element" (e) is more than plausible in its structure. Pattern (g) is retrieved from a piece of an auctioned Inka tunic, 1450–1530 CE (see H. A. Galleries, 1999–2010; and Frame, 2014 [2009], p. 257, Figure 9a). The whole "crossed" pattern in the condensed *t'oqapu* unit (g) results from the arranged sum of four similar "slashes," as seen in (h). In fact, image (h) corresponds to four *t'oqapu* units, in line with the "core element" (e). The Inka designers / weavers were familiar with the (re)combinatorial properties of the geometrical shapes, employing them resourcefully so as to expand the number of the basic motifs. To prove this point, more analysis and deconstructions of complex *t'oqapu* patterns are required over a significant number of samples. Subsequently, the measured and collated data may be organized in numerically labeled grids of statistical graphics, should one aspire to do so.

pp. 242–243, index 1-294; see also *t'oqapu* No. 267 and No. 268 in the same source). Given the case, it is difficult to say how much conjectural (or realistic) is Gentile Lafaille's (2008) approach regarding this *t'oqapu*, styled after a "*fleur-de-lys*" shape (Figure 30). Such a move may be attended by significant risks if not tested and confirmed effectively in the greatest possible corpus of *t'oqapu*. Her three suggestions attempt to shed light on the alleged meaning of the *t'oqapu*,

(1) *Resumiendo esta primera aproximación tenemos que, en la época preincaica, un dibujo similar al* tocapu 285 *formó parte de los mensajes dirigidos a una divinidad que era un viento que soplaba desde el sudoeste, y que se hacía presente cuando se necesitaba agua para regar* [Summing up the first approach, we may instill that in the pre-Inka era, a similar drawing to *tocapu 285* was part of the messages addressed to a deity in the shape of a wind blowing from the southwest, materializing itself when water was needed].
(2) *Resumiendo la segunda aproximación tenemos entonces que los personajes que muestran sobre el pecho una versión del* tocapu 285 *representarían a los especialistas en temas agropecuarios y sus rituales, pero no se sabe si eran seres humanos, divinos o semidivinos* [Summing up the second approach, we may instill that the individuals displaying over the chest a version of *tocapu 285* would stand for the experts in agricultural and livestock subjects and their rituals, but it is unknown if they were human beings, divine or half-divine].
(3) *Resumiendo esta tercera propuesta tenemos que el felino está representado sintéticamente en el* tocapu 285… [Summing up this third proposal, we obtain the feline synthetically represented in the *tocapu 285*…].

(3) Rowe Pollard (1978, p. 7); Anton (1987 [1984], p. 194);[60] Roussakis and Salazar (1999, p. 280); Steele and Allen (2004, pp. 36–37); Quispe-Agnoli (2006, p. 182); and Finley Hughes (2010, pp. 169–170) consider that the *black-and-white checker-board* motif was used in costumes by the military and/or administrators. Phipps et al. (2004, p. 142) think of the "checkerboard" tunics as "… *symbols of Inca administration*," and a "… *manifestation of … loyalty to the sovereign*". Rebecca Stone-Miller (1994a, p. 172) in turn, suggested that this particular motif—minute versions of which are also evident as one of the *t'oqapu* patterns in the royal *unqu* of the Bliss Collection at Dumbarton Oaks—, "… *in one form or another, played a special role in the ruler's entourage and in the army*". Her suggestion is apparently anchored in two chronicles, that of Francisco de Xérez in 1534,[61] and the other one, being that of Guamán Poma de Ayala. A. R. Pollard and J. H.

60. Anton (1987 [1984], p. 194) comments that "The chequerboard pattern [checkerboard motif; *our note*] *in* Plate 182 *was the badge of exceptional warriors or high-ranking commanders*".

61. Francisco López de Xerez (1534) authored *Verdadera Relación de la Conquista del Perú*.



(a)



(b)



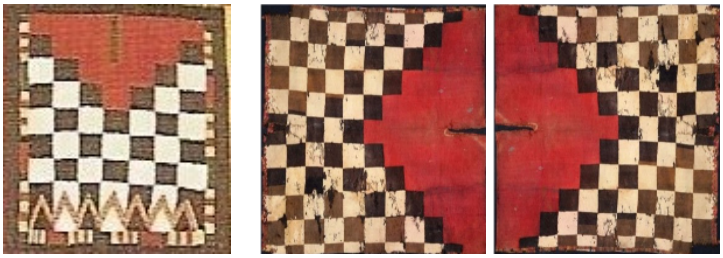
(c)



(d)

FIGURE 30. (a) Let us consider that *t'oqapu* # 285 resembles the *fleur-de-lys* motif. The shape occurs several times in a frontal horizontal band of *t'oqapu* in the *unqu* retrieved from the ruins of Pachacamac temple in 1780, and later added to *Museo de América*, Madrid (Taullard, 1949, Lámina 3 [Plate 3]; Rowe, 1999 [1979], pp. 640–641; MAM, 2010a). The isolated *t'oqapu* deriving from this specific *unqu* of Late Horizon (inventory No. 14501) is made of cotton and camelid fiber. The motif is part of an original photograph of Joaquín Otero Úbeda, Museo de América, Madrid (MAM, 2010). The "*fleur-de-lys*" was a common theme in the Middle Horizon, corresponding with the rise and fall of the Wari state (*ca.* 600–1100 CE; see Benavides, 1999, p. 398), which pre-dates the Inka by hundreds of years. Figure 30b portrays a double spout "Middle Horizon I" bottle, 600–800 CE, of *Atarco* style, featuring a sizeable "*fleur-de-lys*" shape (CCEM, 2001, pp. 424–425). In Figure (c) we see a decorated "Plaque" made of an alloy of gold and silver pertaining to the Wari, Middle Horizon 650–800 CE; *Dimensions*: 7.9 cm × 18 cm × 0.07 cm; inventory no. PC.B.473; cf. Dumbarton Oaks Research Library and Collections, Pre-Columbian Collection, Washington DC (2021b). It is interesting to observe that the *fleur-de-lys* motif occurs in different support materials, be they fabric, ceramic, or metal. (30d) The "*fleur-de-lys*"-like design is similarly attested on the upper section of a textile *Panel fragment with a checkerboard pattern* (Dallas Museum of Art, 2021a). *Date*: (Late Horizon) 1460–1532 CE; *Material*: Camelid fiber; *Dimensions*: 44.45 × 44.45 cm; inventory no. 1976.W.2138; *Credit line*: Dallas Museum of Art. The Nora and John Wise Collection, gift of Mr. and Mrs. Jake L. Hamon, the Eugene McDermott Family, Mr. and Mrs. Algur H. Meadows and the Meadows Foundation, Incorporated, and Mr. and Mrs. John D. Murchison. © *Image Courtesy* Dallas Museum of Art.

Rowe (1996, p. 461) in their turn would rigorously agree in one point, "*Only one of the* t'oqapu *patterns on this tunic is a recognizable depiction of something. Pattern 1 is a picture of another Inca tunic woven in the standard Black and White Checkerboard pattern*"; see Figure 31a.



(a) (b)

FIGURE 31. Figure (a) depicts "pattern 1" in Rowe Pollard and Rowe (1996, p. 461), or "t'oqapu *1*" in de la Jara's index-list (1967, p.242). This isolated pattern is retrieved from the front part of the Bliss Collection's *unqu* at Dumbarton Oaks, Washington D.C. (Phipps et al., 2004, pp. 153–155). (b) If we unfold a "*black-and-white checkerboard*" tunic and stretch it in a horizontal manner (see Figure 10a regarding the Inka-styled *unqu* featuring this pattern, held at *Museo de Arqueología de Alta Montaña*, Ciudad de Salta, Argentina; MAAM, 2021a), a big stepped-diamond pattern is visible. The key concept of this motif is conversely visualized as a separate *t'oqapu* unit in the Inka inventory design and fashion (Figure a).

Given the chroniclers' testimonials and the apparent consensus, it sounds reasonable that this recurrent motif was indeed associated with the *Inka* administration and its war machine. A motivation for recurrence in these textile "texts" are situations where stability and exactness of content have important practical consequences (see e.g., Beaugrande and Ulrich Dressler, 1972 [1981], p. 59), as in the production of standardized military uniforms on grounds of the *Inka* expansive policies. In fact, the *checkered pattern* and its graphic derivatives have *a very strong visual effect*; the trained Inka male-warriors (under the orders of higher instances) would have exploited this effect to their favor to shock and discourage their adversaries in the battleground or during rapid sweeps. As far as our observations go, such an effect is also applied in present days; Frutiger (1998, p. 85) comments, "… *it is for quite definite reasons of visibility that the judge at a motor race waves a checkered flag*". In this context, the author (ibid., 1998) will definitely get no argument from us.

We also make a note of the "*black-and-white checkerboard*" motif found in the Wari iconography—the assumed Inka's historical precursor. Thus, José Ochatoma and Martha Cabrera (2000, pp. 449–488) found ceramic urns in the area of Conchopata, Perú, which after restoration, yielded

images of warriors with patterned tunics remarkably similar to the Inka ones (Figure 32, and *v. supra* Figure 9).



FIGURE 32. The reconstructed design of an armed Wari warrior. The male figure drawn on a piece of ceramic, equipped with an axe and a shield covered with feline heads, appears to be crossing a lake in a *totora*-like boat (Ochatoma and Cabrera, 2000, Figure 10b).

(4) Clados (2007), after a multi-leveled iconographical and comparative analysis of the systematic "key motif" (= the "percent signs"), is inclined to identify segments of a sacred and legendary "serpent". The "*snake-like arrangements*," due to the characteristics of the inner textile structure, i.e., weaving technique and qualities of the involved material, were carefully analyzed earlier in several fabrics of the ancient Andes by M. Frame (1994, 2001). The imagery, whether belonging to Inka or Wari tapestry tunics, is a direct outcome of such a classic structure (*v. infra* Figures 33 and 34). Therefore, any possible cross-cultural interpretation must automatically refer to it. Similarly, the image of single-headed snakes or double headed-snakes is evidenced since the remote ages of the Huaca Prieta and Chavín cultures (Anton, 1987 [1984], pp. 8–11; Paternosto, 1996 [1989], p. 163). Along these lines, Taullard (1949, p. 41; see Figure 33) reproduces six "*motivos culebroides*" [serpentine-like motifs] extracted from Reiss and Stübel (1880),[62] documented in the region of

62. The cited work of the German duo Wilhelm Reiss (1838–1908) and Alphons Stübel (1835–1904) is "Das Todtenfeld von Ancon in Perú. Ein Beitrag zur Kenntniss der Kultur und Industrie des Inca-Reiches nach den Ergebnissen eigener Ausgrabungen" [*The Necropolis of Ancón in Peru*: *A Contribution to Our Knowledge of the Culture and Industries of the Empire of the Inkas*]. 3 Vols. Trans. by A. H. Keane. A. Asher & Co., Berlin (1880–1887); in this context, see also B. Hoffmann (2017, pp. 178–184).



FIGURE 33. Three of the six "serpentine"-like motifs after Taullard (1949, p. 41) are depicted. The motif (33c) has been placed upright for practical reasons. (33d) An elaborate Moche/Wari tunic (7th–9th century)[63] exhibits the "double-headed" serpentine motif in an analogy to the drawing of Reiss and Stübel (1880–1887); see 33a. The zigzagging serrated "serpents" are interconnected and highly geometricized. A border at the lower edge repeats a small profile figure at regular intervals, hinting at a monkey or a class of hybrid animal. *Material*: camelid hair and cotton; *Dimensions*: H(eight) 87 × W(idth) 147.3 cm; *Credit line*: Bequest of Jane Costello Goldberg, from the Collection of Arnold I. Goldberg, 1986; *Accession Number*: 1987.394.706 (The Metropolitan Museum of Art, 2010–2021c). *Moche-Wari Tunic 7th–9th century*. `https://www.metmuseum.org/art/collection/search/315786` (accessed 13 November 2021).

Ancón, reinforcing the point under discussion. An additional example is provided by Mary Frame (2001, p. 118, Fig. 6) with regard to a *Late Paracas* (*Ocucaje*) style looped tunic, with *double-headed serpents* yielding a pattern that corresponds with Z-plied yarns. The examined tunic (from South Coast, 200–100 BCE) is in *The Textile Museum*, Washington, D.C.; inventory no. 91.934.

63. See The Metropolitan Museum of Art (2000–2021c).

Furthermore, Mills and Taylor (1998, p. 15) view the discussed motif (together with that of the "*black-and-white checkerboard*") as a depiction of "*... the rows of stone storehouses* (collca[64] *or* colca) *to which agricultural tribute flowed...*" from all the provinces of Tawantisuyu (see also D'Altroy and Hastorf, 1984; Quispe-Agnoli, 2006, p. 177). Their observation reflects closely Zuidema's (1991, p. 151) standpoint regarding the *colcapata* pattern. Marianne Hogue (2006, p. 109), on the other hand, takes a different position on the question by considering the winding line as "*... an ancient symbol of water*," linking it with the *waistband diamond-like pattern*, discussed further on. In any case—and yet unable to get by without independent confirmation—, Clados's (2007) supposition cannot be graded as *a figment of the imagination* since this archetype, i.e., the "snake" symbol, is common and solid in every ancient civilization (Julien, 1996, pp. 382–386; Gallagher and Dexter, 2004, pp. 81–82), meaning in many myths the "*... perpetual renewal of life*," the "*libido* and *creation*" or "*wisdom*". As this universal symbol spans the ages, Inka iconography could have been well in line with that of the ancient Egyptians, Chinese, Hindus, Greeks, native North Americans, and Aztecs. In the same way, Gallagher and Dexter (2004, p. 81) bring a point that complements Hogue's (2006, p. 109) premise, if such there be: "coiled snakes (apart from dynamic energy)... *frequently were associated with water*". In view of the mixed state of affairs, scholarship has to content itself with mentioning that more systematic research is needed *en route*, especially regarding diachronic correlations and idiosyncratic interpretations between the Inka textile structure and iconography (Desrosiers, 1992; Frame, 1994, 2001).

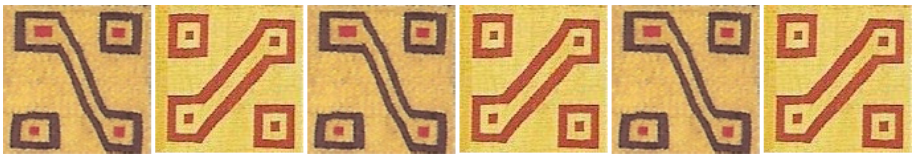


FIGURE 34. As already noted, the successive arrangement of the "key motif" *t'oqapu* is iconically reflecting *a rising and falling structure*, resembling the mythical "serpent" model proposed by Clados (2007); see also Figure 33. Now if this motif was intent on fulfilling the expected function, we may probably still have some doubts. Scholarly suggestions aside, the analysis of structural and iconographical properties is *crucial* in reaching a solution to the specific meaning of each *t'oqapu*.

64. Cf. also Quispe-Agnoli (2005, p. 267), "La palabra collca [qollqa; *our note*] *en quechua hace referencia a una terraza de almacenes*" [The word *collca* in Quechua language refers to storehouses on a stepped terrace (of a mountainside; *our note*)].

Cinzia Florio's (2013) hypothesis comes next in the train of possible explanations regarding the "key motif" (Figures 34 and 35), present in many *t'oqapu* arrangements (ibid., 2013, Figures 6, 7, and 8). The author claims that "There are many interpretations of the Inca key, *but unfortunately they remain self-referential as they find no confirmation in the Spanish chronicles*"; then, she mentions a booklet written in Latin by Blas Valera around 1600, discovered in the last decade of the 20th century.[65] The text, titled "*Exsul Immeritus Blas Valera Populo Suo*" (Valera, 2007 [1618]), presumably contains the meaning of the "Inca key tocapu,"

> Valera relates this tocapu to the number 2 and to Quechua words 'auca callpacuna': the opposite forces. But number 2 and opposite forces pointedly recall the concept of duality, which as we noticed before seems to be expressed also by the geometric shape of the table-yupana. At this point, one might well wonder whether these two things are related. Let us compare the image of the Inca key to a type of the table-yupana (Figure 16).... (Florio, 2013)

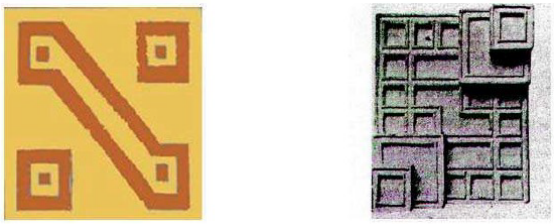
We note that *yupana* [= counter/s, *ENG.* / contador/es, *SPA.*] stood for some kind of *calculating boards*, made of stone, wood, or clay, whose general configuration reminds one of a "chessboard"; they incorporated some type of a central Z- or an S-shape; there are two 'towers' with one, two or three levels of height, situated at the opposite peaks of a quadrilateral (details are found in Leonard and Chakiban, 2010; Florio, 2013; Prem, 2016; and Figure 35b).

Remember also that the notion of dualistic and complementary agents among the Inka (part of a broader philosophical and cosmological model) is well-explored by modern scholars (*v. supra* section *The Concepts of Duality and Complementary Oppositions in Textiles*...). Through stylization processes, the geometrical duality or the binary opposition/s of the *yupana* was painted as evidence pointing at the "Inka key" motif. In other words, the raw configuration of *yupana* was further conventionalized and transferred creatively into a *t'oqapu*-related design, with the concept of *opposing / balancing forces* underlying it. All in all, Florio (2013) does not claim to have finally resolved the meaning of the "key motif," rather than delivering an interpretative option to this particular *t'oqapu*,

> Obviously, this is my personal interpretation; some can see a perceptible resemblance, someone else a very faint one and thinks to [= of] a simply coincidence (ibid.).

(5) Phipps et al. (2004, p. 138) suggest the "quartered diamond," i.e., the *diamond-like motif*, appearing frequently on tunics' waistbands or cloth

65. Whether this document is authentic or a late (or modern) forgery, this is altogether another issue for discussion in another forum.



(a) (b)

FIGURE 35. Illustrations of the "Inka key" motif (35a) and of a table-*yupana* (35b); see Florio (2013). The author (ibid.) theorizes that the "Inka key" is a stylized representation of the table-*yupana*. In light of the earlier conjectures by other scholars[66] who may think there is plenty to argue over the equation "table-*yupana*" = "Inka key motif" (or variants of it), one could deem that the subject of this identification may not be explicitly and entirely off limits.

fragments (see Figures 36, 37, and 38) is possibly related to the notion of "… *Tahuantisuyu*, *the four-quartered Inca empire*". Such a proposal—in need of falsification—cannot be straightforwardly rejected or agreed to. Although we really don't know if it marks a watershed in the *t'oqapu* studies,[67] we have to proceed on the premise that in the possible levels of meaningfulness in the general Inka context, "*the four-quartered Inca empire*" underlying the "*diamond-like motif*" seems to be a realistic interpretation.

This model is also shown in Lehmann and Doering (1924, Coloured Plate XI) in a carpet fabric of Nazca provenance. The end result of Phipps et al.'s (2004, p. 138) hypothesis is poor in this context since the inception and expansion of Tawantisuyu falls centuries later in the chronological scale. Here it may be safely deduced that the Inka had the ability to synthesize to their own advantage from earlier cultures (Barthel, 1970, p. 96), while injecting new meanings to apparently former designs (Arellano, 1999, p. 257). Such appropriations and reinterpretations, parallel to the use of military coercion, assisted eventually in the imperial control of conquered territories.

More to the point, based on the devised morphology of the diamond shape (the quadripartite layout) and the ethnographical and historical data at hand, the idea seems not misleading. The Inka regarded Cuzco as the *center* (= *omphalos*) of their identified universe (Paternosto, 1996

66. See Frame (1994, 2001); Mills and Taylor (1998); Gallagher and Dexter (2004); Hogue (2006); Clados (2007).

67. In the Andean iconography, the continuous diamond-like pattern set in a stepped Greek fret is said to be related with the flow of "… *water and other sacred fluids*"; see Hogue (2006, pp. 108–109). Obtaining multiple interpretations of the same symbol in an unidentified system with a restricted corpus, whose chronological sequence is poorly understood, makes matters worse and may (duly) increase skepticism.



FIGURE 36. Man's tunic (*unqu*) showing a band of successive diamond-like motifs; late 15th—early 16th century, Perú; *Material*: cotton and camelid hair; *Dimensions*: height 88.9 cm; Rogers Fund, 1982 (inventory no. 1982.365), displayed at *The Metropolitan Museum of Art*, New York (2000–2010) `http://www.metmuseum.orgtoah/works-of-art/1982.365` [October 2006].

[1989], p. 151; Finley Hughes, 2010, pp. 168–169), from where their rule, laws, and customs were radiated in four directions. Here we engage specifically with Finley Hughes (2010, p. 168) who quotes Ramirez (2005, p. 19) about the term *Cuzco*—the understood capital of Inkario.

> Central to the ideology of the Inca body, Inca cosmology, and how authority was figured in the Inca Empire is the understanding of the word cuzco. The capital of the Inca Empire was the city of Cusco in the central highlands of Peru; however, the word cuzco might not have been the Inca designation for the name of the city. Rather, the term cuzco referred to a person who was the center of the Inca world. Evidently, it was customary for the Inca people to refrain from using the Emperor's given name, hence they used the term cuzco to refer to the imperial individual. (Ramirez 2005: 19)

This attitude of being "the navel of the world"—observed elsewhere and prevalent in other earlier or later cultures (Harley, 2001, p. 66; e.g., the Omphalos of Delphi, `https://whc.unesco.org/en/list/393/`)—aimed at securing the claims of the Inka's imperial jurisdiction and political impact, and not distorting the spatial reality, whether known or not to them. Interestingly, as in the case of Clados (2007), the assumption is founded on the appearance of the examined *t'oqapu*, i.e., that the token was somewhat used as an immediate reference to a concept or a real object across the Inka realm. Therefore, while assuming recoverable meanings in them, the current approach would point to the fact that *t'oqapu* stand for a mixture of contrived semasiographic signs. While Phipps et al. (2004, p. 138) remains an interpretative option, it is necessary to cite also Cook (1996, p. 98) in this context,

> The diamond in a square symbol [= the "diamond-like motif"; *our note*], as well as an abbreviated form of this design structure, is present on the garments we associate with Inca rulers and with the offices held by their highest-ranking dignitaries (Rowe, J. 1979, Figs. 9-11). In addition, the diamond in a square, which clearly defines Figure A in Wari contexts, is also present in the tunic designs of most of Guaman Poma's illustrations of ruling Incas and some of the Inca 'capitanes' [chiefs].



(a)



(b)

FIGURE 37. In Figure 37a are illustrated waistbands from a tunic with a consistent sequence of the *stepped-diamond* motif (Late Horizon, Inka culture, 1476–1534 CE, made of interlocked tapestry, cotton, and camelid fiber, Arthur Mason Knapp Fund, 42 489; inventory no. 234, Museum of Fine Arts, Boston); see Stone-Miller (1994a, pp. 174–175; cf. Rowe Pollard (1978, p. 15, Figure 20). (37b) Diamond waistband from a tunic (= *unqu*), Dallas Museum of Art (2021b); *Date*: 1400–1534; *Material*: cotton and camelid fiber; *Dimensions*: 142.24 × 12.7cm; inventory no. 1994.282; *Credit line*: Dallas Museum of Art, gift of Silas R. Moutsier III from the Collection of Nora E. H. Wise and in her honor. © *Image Courtesy* Dallas Museum of Art. The right-angled, conjoined rhomboidal structures (*the stepped diamond-like* pattern) are recorded in many of the Andean textiles; see several diamond bands fitted in *unqu* or disconnected from them in Rowe Pollard (1978, pp. 8–9, 12–15, 22; see also Lehmann and Doering, 1924, Collotype Plate 126, bottom; Silverman, 1994, pp. 46–51; Phipps, 2005, pp. 70–72, 90; Hogue, 2006, p. 109; The Metropolitan Museum of Art, 2000–2010). Similarly, in Ferdinand Anton (1987 [1984], Figure 169) a "Fragment of a *man's garment with ornamental bands in slit tapestry*. *South Coast* [of Perú], *ca. 1400–1530*" has all the hallmarks of depicting the *stepped-diamond* motif.



(a) (b) (c) (d)

FIGURE 38. In this figure, a number of cut off *t'oqapu* extracted from various tunics show quadripartite formats. The overall pattern is organized around a nucleus, characterized by a *diamond* or a *plain square shape*, subdivided in dual oppositions using coloring or geometrical shapes. *T'oqapu* (38a) derives from the front part of a post-Inka *unqu* said to have been found in Ancón, central coast of Perú, probably late 16th century, and held currently at *Staatliche Museen zu Berlin*, *Ethnologisches Museum* (Arellano, 1999, p. 258; Phipps et al., 2004, p. 167; Ramos Cárdenas, 2005, pp. 58–59). (38b) is part of the *unqu* of Pachacamac (see MAM, 2010a, a Late Horizon tunic [1460–1550 CE], coded under inventory No. 14501). *T'oqapu* (38c) derives from the post-Inka *unqu* held at the *American Museum of Natural History*, New York (cf. Lehmann and Doering, 1924, Plate 158; Rowe Pollard, 1978, p. 17; Phipps et al., 2004, pp. 156–157). *T'oqapu* (38d) is a constituent part of an Inka tunic's waistband, held at *Museo Arqueológico de Cuzco*, Perú (Museo Inka, 2010); cf. de la Jara (1967, p. 244, Fig. 4, upper band).

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Life of Chaim

Zofia Janina Borysiewicz

Abstract. This paper explores the history and revival of the Chaim typeface, a Hebrew type design created in the early 20th century by Jan Lewitt. Describes Chaim's journey from its origins in Poland to its prominence in Israel, reflects the evolution of Hebrew typography and its impact on cultural identity. The study also introduces Aviva, a modern Latin-script typeface inspired by Chaim, designed to address the need for multi-script typography. By merging (info Chaim Aviva font) historical context with contemporary design practices, the paper sheds light on the challenges and responsibilities of creating typefaces that transcend cultural boundaries, offering insights into the dynamic relationship between design and linguistic heritage.

You may ask yourself, who is Chaim? Wasn't it supposed to be a text about type design?

Yes, but before I tell you about the font Chaim, I wanted you to know that it's also a common Jewish name that means "life." You will see why this fact is important.

Many documents got lost during the Second World War, so we do not know where and how Chaim was born. The story is full of assumptions rather than certainties. There is a discussion among researchers about who exactly was responsible for bringing Chaim to the world. Was it Pesach Ir-Shay or Jan Levitt[1]?

1. Chaim

According to documents from the patent office in Warsaw, Chaim was born on March 18th, 1929 (Szydłowska and Misiak, 2015). It was registered by Idźkowski & Company Type Foundry. Its father was Jan Lewitt—a young, self-taught graphic designer who was born in Częstochowa in 1907 (Mrowczyk, 2016, Chapter "Levitt and Him") and died

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1. Also known as Le Witt and Lewitt.

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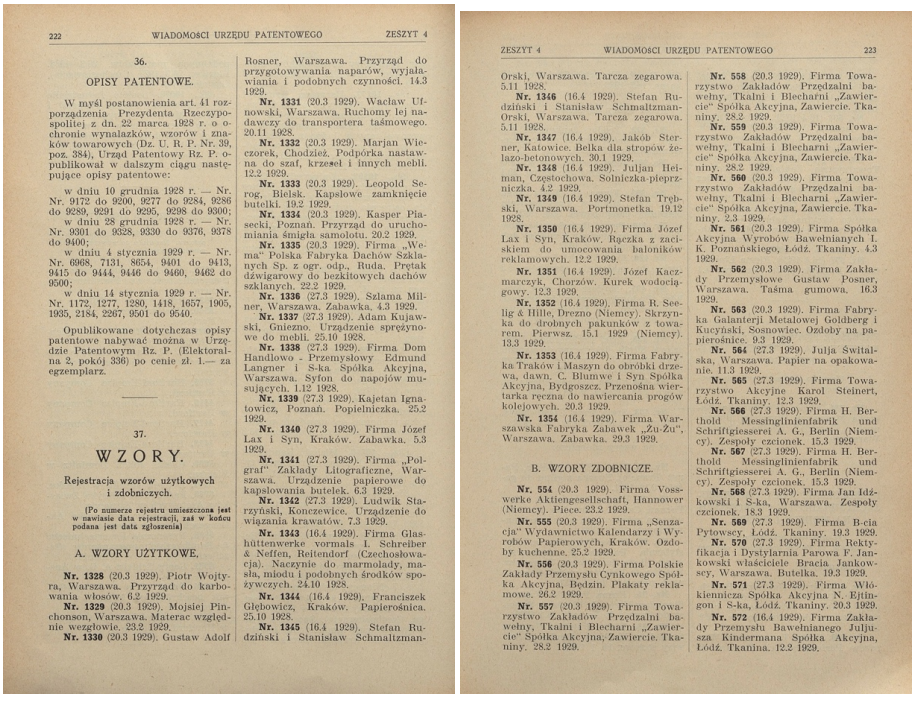
Grapholinguistics and Its Applications (ISSN: 2681-8566, e-ISSN: 2534-5192), Vol. 10.
Fluxus Editions, Brest, 2024, pp. 611–623. https://doi.org/10.36824/2022-graf-bory
ISBN: 978-2-487055-06-3, e-ISBN: 978-2-487055-07-0



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36.

OPISY PATENTOWE.

W myśl postanowienia art. 41 rozporządzenia Prezydenta Rzeczypospolitej z dn. 22 marca 1928 r. o ochronie wynalazków, wzorów i znaków towarowych (Dz. U. R. P. Nr. 39, poz. 384), Urząd Patentowy Rz. P. opublikował w dalszym ciągu następujące opisy patentowe:

w dniu 10 grudnia 1928 r. — Nr. Nr. 9172 do 9200, 9277 do 9284, 9286 do 9289, 9291 do 9295, 9298 do 9300;

w dniu 28 grudnia 1928 r. — Nr. Nr. 9301 do 9328, 9330 do 9376, 9378 do 9400;

w dniu 4 stycznia 1929 r. — Nr. Nr. 6968, 7131, 8654, 9401 do 9413, 9415 do 9444, 9446 do 9460, 9462 do 9500;

w dniu 14 stycznia 1929 r. — Nr. Nr. 1172, 1277, 1280, 1418, 1657, 1905, 1935, 2184, 2267, 9501 do 9540.

Opublikowane dotychczas opisy patentowe nabywać można w Urzędzie Patentowym Rz. P. (Elektoralna 2, pokój 336) po cenie zł. 1.— za egzemplarz.

37.

WZORY.

Rejestracja wzorów użytkowych i zdobniczych.

(Po numerze rejestru umieszczona jest w nawiasie data rejestracji, zaś w końcu podana jest data zgłoszenia)

A. WZORY UŻYTKOWE.

Nr. 1328 (20.3 1929). Piotr Wojtyra, Warszawa. Przyrząd do karbowania włosów. 6.2 1929.

Nr. 1329 (20.3 1929). Mojsiej Pinchonson, Warszawa. Materac względnie węzgłowie. 23.2 1929.

Nr. 1330 (20.3 1929). Gustaw Adolf Rosner, Warszawa. Przyrząd do przygotowywania naparów, wyjaławiania i podobnych czynności. 14.3 1929.

Nr. 1331 (20.3 1929). Wacław Ufnowski, Warszawa. Ruchomy lej nadawczy do transportera taśmowego. 20.11 1928.

Nr. 1332 (20.3 1929). Marjan Wieczorek, Chodzież. Podpórka nastawna do szaf, krzeseł i innych mebli. 12.2 1929.

Nr. 1333 (20.3 1929). Leopold Serog, Bielsk. Kapslowe zamknięcie butelki. 19.2 1929.

Nr. 1334 (20.3 1929). Kasper Piasecki, Poznań. Przyrząd do uruchomiania śmigła samolotu. 20.2 1929.

Nr. 1335 (20.3 1929). Firma „Wema" Polska Fabryka Dachów Szklanych Sp. z ogr. odp., Ruda. Prętak dźwigarowy do bezkitowych dachów szklanych. 22.2 1929.

Nr. 1336 (27.3 1929). Szlama Milner, Warszawa. Zabawka. 4.3 1929.

Nr. 1337 (27.3 1929). Adam Kujawski, Gniezno. Urządzenie sprężynowe do mebli. 25.10 1928.

Nr. 1338 (27.3 1929). Firma Dom Handlowo - Przemysłowy Edmund Langner i S-ka Spółka Akcyjna, Warszawa. Syfon do napojów musujących. 1.12 1928.

Nr. 1339 (27.3 1929). Kajetan Ignatowicz, Poznań. Popielniczka. 25.2 1929.

Nr. 1340 (27.3 1929). Firma Józef Lax i Syn, Kraków. Zabawka. 5.3 1929.

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Nr. 1342 (27.3 1929). Ludwik Starzyński, Konczewice. Urządzenie do wiązania krawatów. 7.3 1929.

Nr. 1343 (16.4 1929). Firma Glashüttenwerke vormals I. Schreiber & Neffen, Reitendorf (Czechosłowacja). Naczynie do marmolady, masła, miodu i podobnych środków spożywczych. 24.10 1928.

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ZESZYT 4 WIADOMOŚCI URZĘDU PATENTOWEGO 223

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Nr. 1347 (16.4 1929). Jakób Sterner, Katowice. Belka dla stropów żelazo-betonowych. 30.1 1929.

Nr. 1348 (16.4 1929). Juljan Heiman, Częstochowa. Solniczka-pieprzniczka. 4.2 1929.

Nr. 1349 (16.4 1929). Stefan Trebski, Warszawa. Portmonetka. 19.12 1928.

Nr. 1350 (16.4 1929). Firma Józef Lax i Syn, Kraków. Rączka z zaciskiem do umocowania baloników reklamowych. 12.2 1929.

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B. WZORY ZDOBNICZE.

Nr. 554 (20.3 1929). Firma Vosswerke Aktiengesellschaft, Hannower (Niemcy). Piece. 23.2 1929.

Nr. 555 (20.3 1929). Firma „Senzacja" Wydawnictwo Kalendarzy i Wyrobów Papierowych, Kraków. Ozdoby kuchenne. 25.2 1929.

Nr. 556 (20.3 1929). Firma Polskie Zakłady Przemysłu Cyrkowego Spółka Akcyjna, Będzin. Plakaty reklamowe. 26.2 1929.

Nr. 557 (20.3 1929). Firma Towarzystwo Zakładów Przędalni bawełny, Tkalni i Blecharni „Zawiercie" Spółka Akcyjna, Zawiercie. Tkaniny. 28.2 1929.

Nr. 558 (20.3 1929). Firma Towarzystwo Zakładów Przędalni bawełny, Tkalni i Blecharni „Zawiercie" Spółka Akcyjna, Zawiercie. Tkaniny. 28.2 1929.

Nr. 559 (20.3 1929). Firma Towarzystwo Zakładów Przędalni bawełny, Tkalni i Blecharni „Zawiercie" Spółka Akcyjna, Zawiercie. Tkaniny. 28.2 1929.

Nr. 560 (20.3 1929). Firma Towarzystwo Zakładów Przędalni bawełny, Tkalni i Blecharni „Zawiercie" Spółka Akcyjna, Zawiercie. Tkaniny. 2.3 1929.

Nr. 561 (20.3 1929). Firma Spółka Akcyjna. Wyrobów Bawełnianych I. K. Poznańskiego, Łódź. Tkaniny. 4.3 1929.

Nr. 562 (20.3 1929). Firma Zakłady Przemysłowe Gustaw Posner, Warszawa. Taśma gumowa. 16.3 1929.

Nr. 563 (20.3 1929). Firma Fabryka Galanterji Metalowej Goldberg i Kucyński, Sosnowiec. Ozdoby na papierośnice. 9.3 1929.

Nr. 564 (27.3 1929). Julja Świtalska, Warszawa. Papier na opakowanie. 11.3 1929.

Nr. 565 (27.3 1929). Firma Towarzystwo Akcyjne Karol Steinert, Łódź. Tkaniny. 12.3 1929.

Nr. 566 (27.3 1929). Firma H. Berthold Messinglinienfabrik und Schriftgiesserei A. G., Berlin (Niemcy). Zespoły czcionek. 15.3 1929.

Nr. 567 (27.3 1929). Firma H. Berthold Messinglinienfabrik und Schriftgiesserei A. G., Berlin (Niemcy). Zespoły czcionek. 15.3 1929.

Nr. 568 (27.3 1929). Firma Jan Idźkowski i S-ka, Warszawa. Zespoły czcionek. 18.3 1929.

Nr. 569 (27.3 1929). Firma B-cia Pytowscy, Łódź. Tkaniny. 19.3 1929.

Nr. 570 (27.3 1929). Firma Rektyfikacja i Dystylarnia Parowa F. Jankowski właściciele Bracia Jankowscy, Warszawa. Butelka. 19.3 1929.

Nr. 571 (27.3 1929). Firma Włókiennicza Spółka Akcyjna N. Ejtingon i S-ka, Łódź. Tkaniny. 20.3 1929.

Nr. 572 (16.4 1929). Firma Zakłady Przemysłu Bawełnianego Juljusza Kindermana Spółka Akcyjna, Łódź. Tkanina. 12.2 1929.

FIGURE 1. Source: https://polona.pl/item/wiadomosci-urzedu-patentowego-r-6-z-4-30-kwietnia-1929,NjY1OTU3NjM/17/

in London in 1991. During 1925-1926, he traveled across Europe, and in 1928, he spent some time in Palestine. Probably then, after returning to Warsaw (in 1928) while being an employee of a newspaper published in Yiddish, he saw the need to develop a new Hebrew typeface.

I share the opinion of Messner (2015–2023), who thinks that Chaim was initially meant for Yiddish, not Hebrew. Back then, Yiddish was a common spoken and written language of the Ashkenazi Jewish diaspora. They used it in everyday communication, as well as in Poland. Another argument favoring this opinion is that the project did not include nikud. At the same time, biblical Hebrew was a sacred language—used mainly in holy books and religious services. Only later modern Hebrew was used by supporters of the Zionist movement. In the late 19th to early 20th century, secular Jew Eliezer Ben-Yehuda was working on a revival of the Hebrew language that could be used in the modern era by modern Jews in their new country. However, both languages (Yiddish and Hebrew) share the same Hebrew script.

Objects of design sometimes live different lives than intended by their creators. Just like kids, typefaces live their own lives. While be-

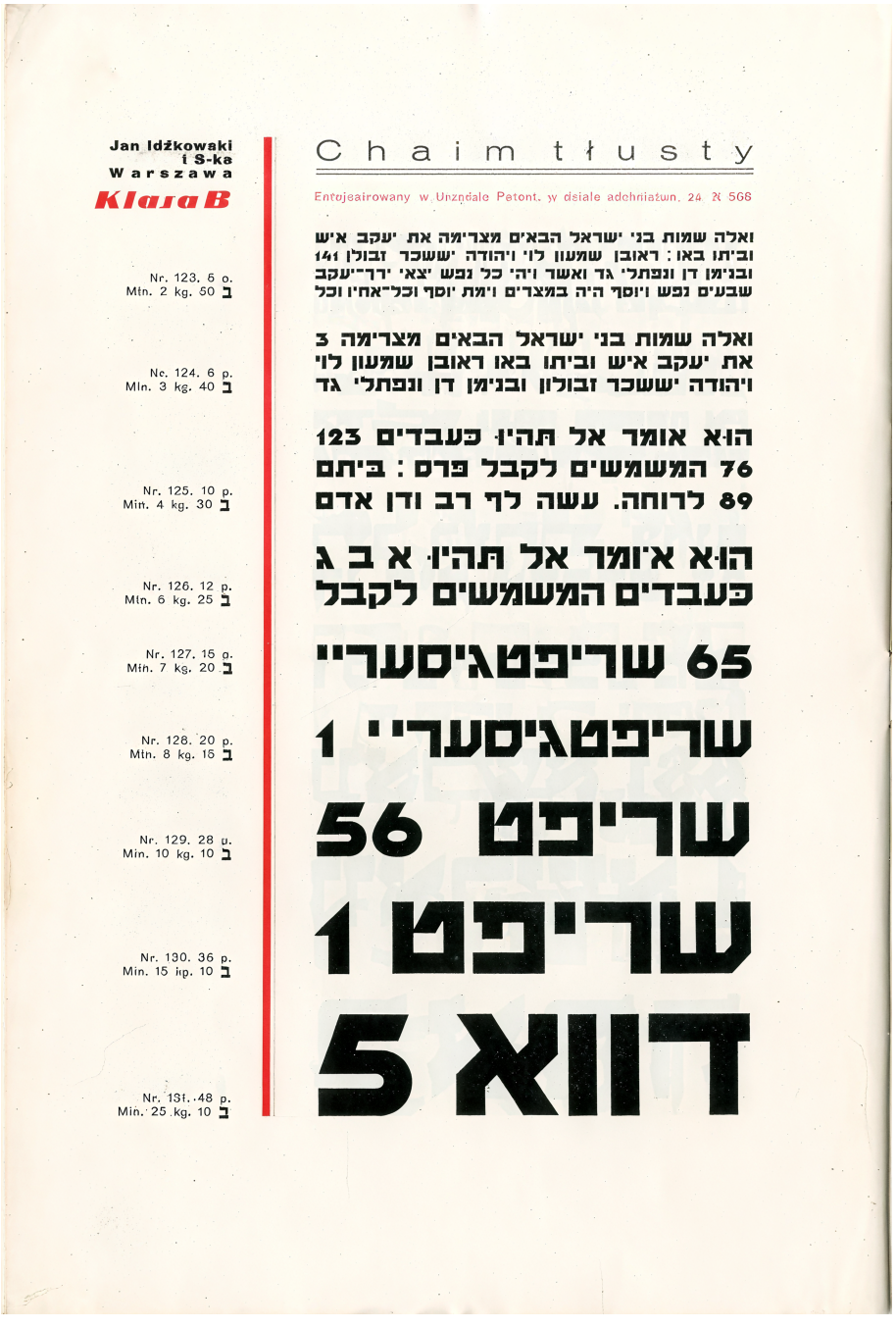

FIGURE 2. Specimen of typefaces by Idźkowski I Sk-a Type Foundry from archives of Dom Słów—Izba Drukarstwa in Lublin

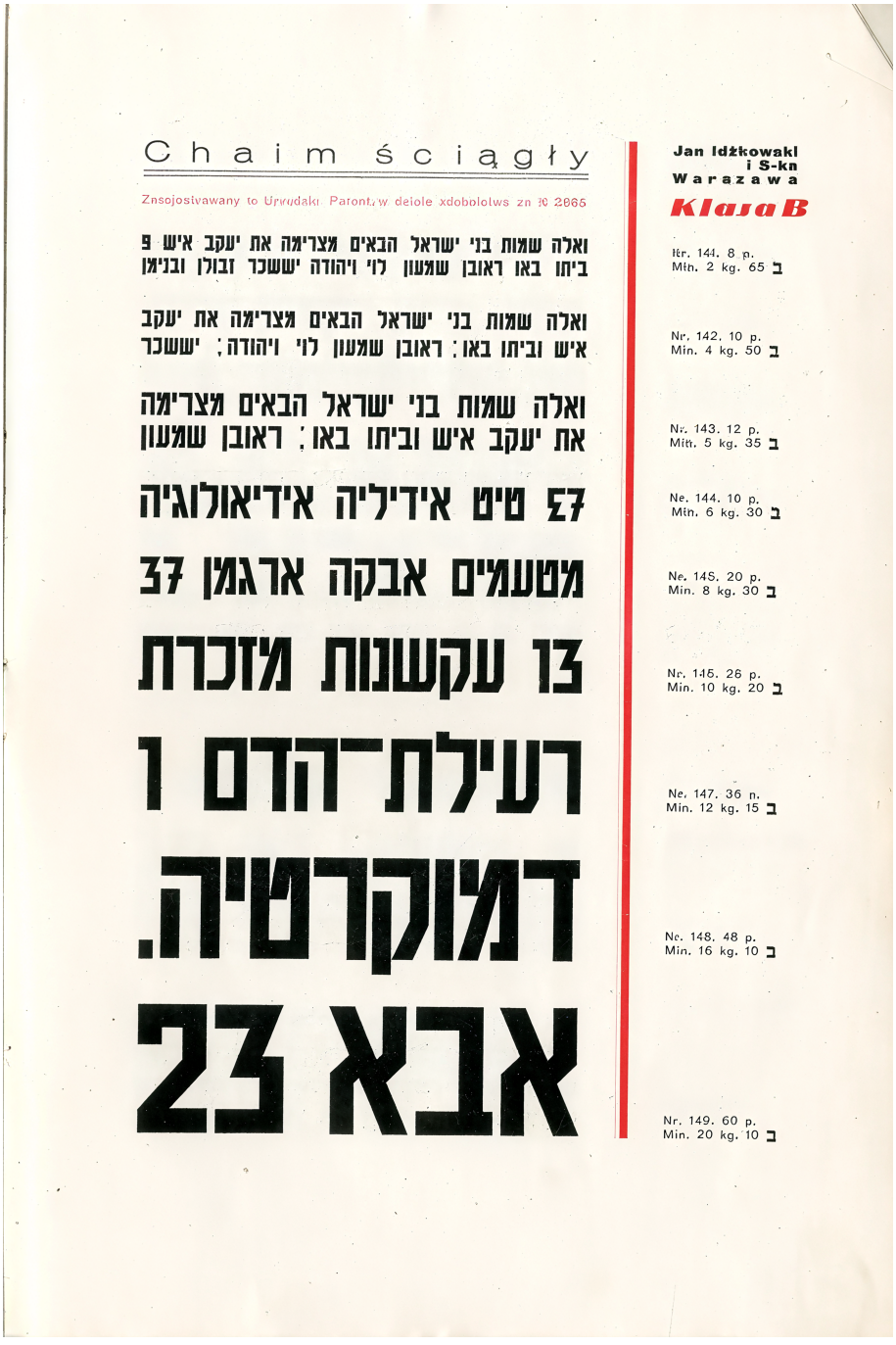
Chaim ściągły
Znsojostvawany to Urvudaki Parontaw deiole xdobolotws zn 30 2065
ואלה שמות בני ישראל הבאים מצרימה את יעקב איש 9
ביתו באו ראובן שמעון לוי ויהודה יששכר זבולן ובנימן
ואלה שמות בני ישראל הבאים מצרימה את יעקב
איש וביתו באו: ראובן שמעון לוי ויהודה; יששכר
ואלה שמות בני ישראל הבאים מצרימה
את יעקב איש וביתו באו; ראובן שמעון
57 טיט אידיליה אידיאולוגיה
מטעמים אבקה ארגמן 37
13 עקשנות מזכרת
רעילת־הדם 1
דמוקרטיה.
אבא 23
Jan Idźkowski
i S-ka
Warszawa
Klasa B
Nr. 141. 8 p.
Min. 2 kg. 65 ב
Nr. 142. 10 p.
Min. 4 kg. 50 ב
Nr. 143. 12 p.
Min. 5 kg. 35 ב
Ne. 144. 10 p.
Min. 6 kg. 30 ב
Ne. 145. 20 p.
Min. 8 kg. 30 ב
Nr. 146. 26 p.
Min. 10 kg. 20 ב
Ne. 147. 36 n.
Min. 12 kg. 15 ב
Ne. 148. 48 p.
Min. 16 kg. 10 ב
Nr. 149. 60 p.
Min. 20 kg. 10 ב



FIGURE 3. From the private archive of the author

ing widely used in Europe, Chaim bold acquired an unmatched set of digits. As Simon Prais writes in "Design considerations affecting the simultaneous use of Latin and Hebrew typography," it happened without Levitt knowing of it (Prais, 1985, p. 44). The numbers were probably from a different typeface. Which exactly, we don't know. The numbers in bold weight are rounded and are designed in a different style than the letters. It is quite a mismatch, but on the other hand, it is also a part of Chaim's history. In this unintended form, it has been used until now.

After the great success of bold weight, there was a need for something more condensed to reduce the print cost. As an answer to this need, Chaim's condensed brother was presented to the public in 1936. The numbers in that one fit better with the style of letters.

In the 1930s, after being wildly used in Europe, Chaim became hugely successful in Palestine (later the State of Israel) and held its position until new digital typefaces were introduced. Nowadays, the digital versions of Chaim are still in use. We still see Chaim in newspaper headlines, especially when something very important happens. Other than this, it appears on old buildings, parking lots, backyards, and signs in the neighborhoods that represent cultural heritage. However, the users do not treat it with respect.

Look at this paradox: A common death notice is one of the few things that keep Chaim alive. And it looks almost like a sign of the death of the font itself. But Chaim got its second chance, as we will see later.

2. Aviva

But let's leave him for now and look at Aviva, the font I designed while working on my graduation project. I wanted to design a font for Latin



FIGURE 4. From the private archive of the author

script that wouldn't be based on Latin design conventions. I intended to shed light on the story of Chaim—my starting point for Latin—that encourages new generations of designers to use it again in their projects in different ways.

For an outsider, it might seem that the number of existing fonts is overwhelming. Indeed, it is true, but only for the Latin script. But when it comes to Hebrew, Arabic, or Cyrillic, not to mention the other scripts, the range of available fonts is nothing close to Latin.

The situation is even worse when it comes to multi-script typeface families. There is a real need for typographers to develop those. One of the goals of my project was to answer that need. So why did I design another font for Latin?

I did it because my native language—Polish—is based on the Latin script. As a native user, I wanted to reverse the logic and reimagine the common practice of designing other scripts to look similar to Latin. So I ask myself: what if Latin-based languages were in the minority? Could I design for Latin script but have for example, Hebrew script conventions as a starting point?

The differences are notable.



FIGURE 5. From the private archive of the author

1. Hebrew direction is from right to left, and Latin is the opposite.
2. Latin has a lot of curves, sometimes rounded edges.
3. Hebrew has only one case of letter, while Latin has two.
4. In the case of Chaim, glyphs are constructed rather than reflecting the calligraphic or cursive way of writing.

I digitalized my version of Chaim and added a new set of digits to the bold weight. I thought Aviva should be a perfect live companion for Chaim.

While designing Aviva, I followed Hebrew and Chaim characteristics and made it peruse only in uppercase and without any curves. Moreover, in some cases, I even copied glyphs from Hebrew to Latin, which I know is not a traditional approach.

Therefore, I merged them into one multi-script type family. Just like the original Chaim, at the beginning, Aviva also has only two weights—bold and condensed, but later I made it Variable and added four more weights.

Aviva is modern and edgy, and its design makes conventional Latin letters look bold and fresh, just like her name, which means “spring.” In her company, Chaim seems lighter and more relevant.

During the process, I also used my anthropological experience. My first degree was in cultural anthropology. I spent almost half a year in



FIGURE 6. From the private archive of the author

Haifa. All of this helped me to understand better where, when, and by whom Chaim is used nowadays.

I often think about the responsibility that comes with the privilege of being a designer.

I also know that it's impossible to control everything. At some point, especially while designing a typeface, it is essential to finish and let our projects live their own lives.

Chaim is a very good example. Jan Levitt was trying to reflect the period in time rather than follow certain aesthetics, for example, the Latin script. With his project, he answered a need for a modern typeface for Yiddish. And he couldn't predict that his avant-garde project will be one of the most popular typefaces in Israel, which did not exist back then.

This reminds me of a quote by one of the greatest singers and songwriters, Nina Simone, who said: "The artist's duty is to reflect the times." I think it's true, also or maybe especially in the design field. Nowadays, we can see that some cultures and languages are not represented enough, while others are omnipresent. This imbalance was something that I wanted to point out with my project.



FIGURE 7. From the private archive of the author

Chaim & Aviva is, at the same time, the revival and multi-script project as well as the reflection of the current situation.

At this point, I would like to thank everyone who contributed to the project. Special thanks go to my patient supervisors, Viktoriya Grabowska and Agata Szydłowska. Also, this project wouldn't be possible without the research findings of Marian Misiak, Ianek Yontef, Ada Wardi, Philipp Messner, and Simon Prais, as well as the help and support of Borys Kosmynka, Shani Avni, Liron Lavi Turkenich.

Since my graduation (in 2019), together with Nika Langosz, I have improved Chaim & Aviva. Thanks to the Adam Mickiewicz Institute, it is available for free for personal and commercial use.[2]

I am happy that Chaim's second life has already started, and I hope that more is waiting for him and Aviva shortly. For sure, that's only the beginning of their new life together.

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FIGURE 8. From the private archive of the author

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FIGURE 9. From the private archive of the author



FIGURE 10



Figure 11

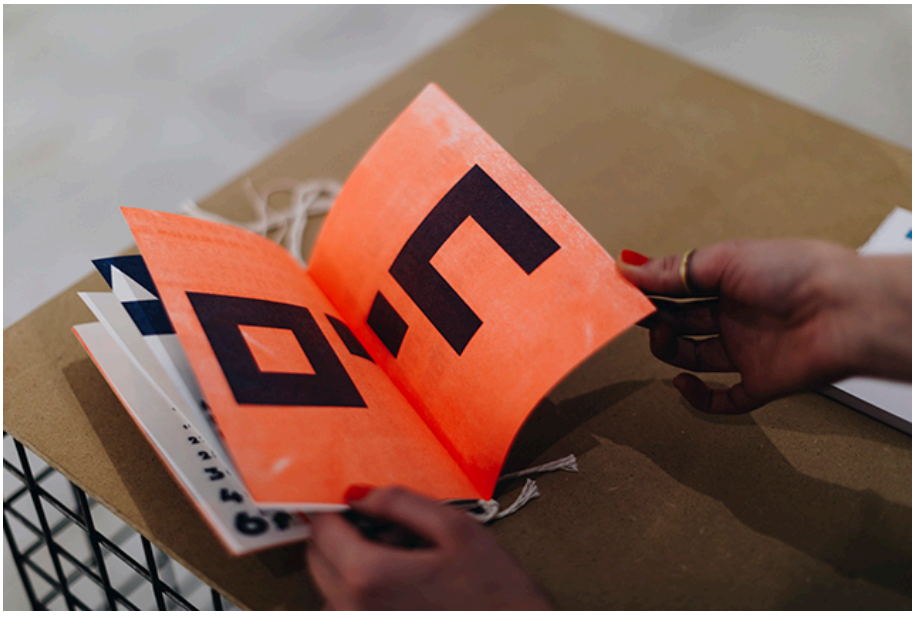

Figure 12



Figure 13



Figure 14

The Sorcerer's Brew

The Unexpected Results of Typographic Innovation

Kamal Mansour

Abstract. The history of typography is lined with sundry brilliant inventors. Beginning with Gutenberg, pivotal protagonists altered the course of typography through innovative solutions to discrete problems. In numerous cases, their inventions prompted additional unanticipated changes, or even morphed into themes that eventually became integral to typography. We capture several pertinent cases and examine their manifestation in contemporary typography.

1. The Father of Type

In a simplistic way, Johannes Gutenberg (Fig. 1) is usually considered the founder of Western typography (Rees, 2006). To gain a better understanding of Gutenberg's role, it is crucial to view his work in light of his goals. In the 1400s, demand for books had risen sharply, but making copies by hand was slow, laborious, and expensive. The production of books was entirely in the hands of the scribes. Gutenberg wanted to produce books of comparable look and quality as the scribes, but faster and more economically. By inventing movable type, Gutenberg had created the instrument to effectively beat the scribes at their game.

To produce his printed edition of the Bible around 1450, Gutenberg had calculatedly created a typeface that replicated the scribes' handwriting as closely as possible. As we can see from the detailed image (Fig. 2), Gutenberg meticulously imitated the scribes' lettering style, including abbreviations, and other writing conventions. He even added decorations in color as they did in their manuscripts. Even so, Gutenberg never intended to create a new class of letter forms to be used exclusively for the printing press. He didn't foresee that in the future, people would strive to design families of letter forms that would never be written by hand. This stark separation between handwritten and typographic form was gradually introduced by other typographic innovators after Gutenberg, and in the long run, became expected.

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ISBN: 978-2-487055-06-3, e-ISBN: 978-2-487055-07-0

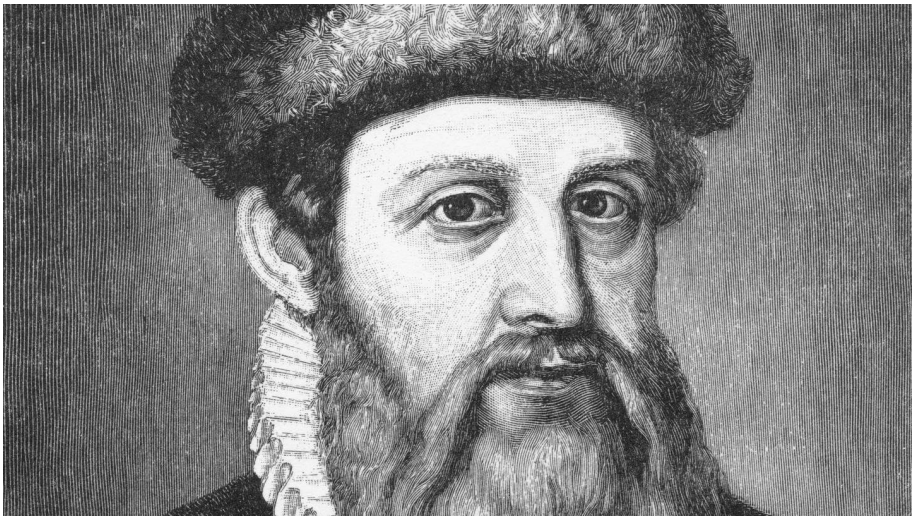
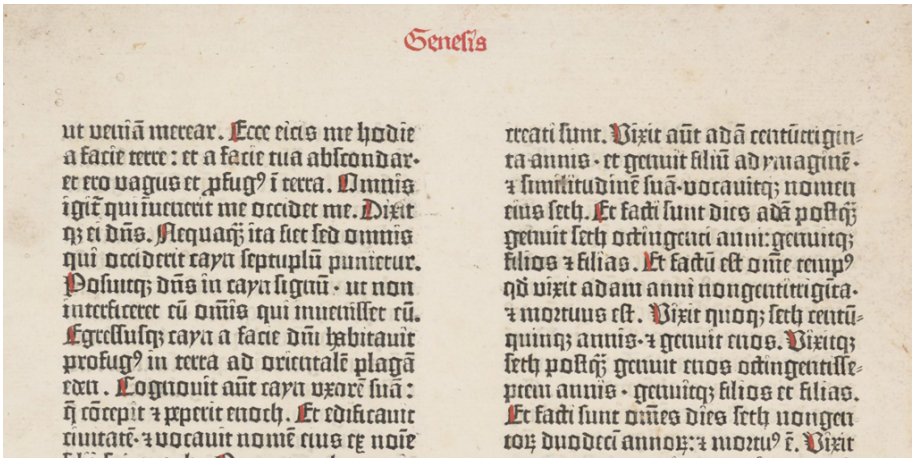


FIGURE 1



Genesis

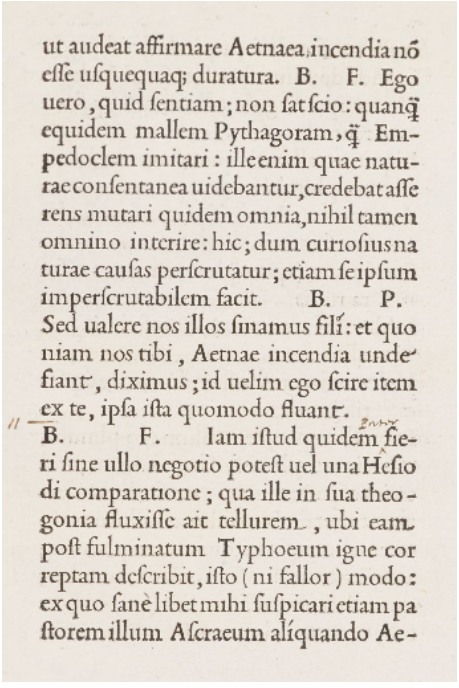
ut veniā merear. Ecce eicis me hodie
a facie terre: et a facie tua abscondar·
et ero vagus et ꝓfug⁹ ī terra. Omnis
igit̄ qui īuenerit me occidet me. Dixit
q; ei dn̄s. Nequaq̄ ita fiet sed omnis
qui occiderit cayn septuplū punietur.
Posuitq; dn̄s in cayn signū · ut non
interficeret eū om̄is qui inuenisset eū.
Egressusq; cayn a facie dn̄i habitauit
profug⁹ in terra ad orientalē plagā
eden. Cognouit aūt cayn vxorē suā:
q̄ cōcepit ⁊ ꝑperit enoch. Et edificauit
ciuitatē· ⁊ vocauit nomē eius ex noīe

creati sunt. Vixit aūt adā centūtrigin-
ta annis · et genuit filiū ad ymaginē ·
⁊ similitudinē suā· vocauitq; nomen
eius seth. Et facti sunt dies adā postq̄
genuit seth octingenti anni: genuitq;
filios ⁊ filias. Et factū est om̄e temp⁹
qd̄ vixit adam anni nongentitrigīta·
⁊ mortuus est. Vixit quoq; seth centū-
quinq; annis· ⁊ genuit enos. Vixitq;
seth postq̄ genuit enos octingentisse-
ptem annis · genuitq; filios et filias.
Et facti sunt om̄es dies seth nongen
tor̄ duodecī annor̄: ⁊ mortu⁹ ē. Vixit

FIGURE 2

About fifty years after the publication of the Gutenberg's Bible, the printed edition of Bembo's work, *de Aetna*, was produced. Although its typeface was also based on a handwritten form, it was further tooled into a distinctly typographic design. In fact, the typeface in this book would have looked alien to Gutenberg.

Thus, the craft of typography was born from the seed of Gutenberg's movable type.



ut audeat affirmare Aetnaea incendia nõ eſſe uſquequaq; duratura. B. F. Ego uero, quid ſentiam; non ſat ſcio: quanq̃ equidem mallem Pythagoram, q̃ Empedoclem imitari: ille enim quae naturae conſentanea uidebantur, credebat aſſe rens mutari quidem omnia, nihil tamen omnino interire: hic; dum curioſius naturae cauſas perſcrutatur; etiam ſe ipſum imperſcrutabilem facit. B. P. Sed ualere nos illos ſinamus filĩ: et quoniam nos tibi, Aetnae incendia unde fiant, diximus; id uelim ego ſcire item ex te, ipſa iſta quomodo fluant. B. F. Iam iſtud quidem fieri ſine ullo negotio poteſt uel una Heſiodi comparatione; qua ille in ſua theogonia fluxiſſe ait tellurem, ubi eam poſt fulminatum Typhoeum igne correptam deſcribit, iſto (ni fallor) modo: ex quo ſanè libet mihi ſuſpicari etiam paſtorem illum Aſcraeum aliquando Ae-

Figure 3

2. The Extension of Invention

As commonly happens to a successful invention, people put it to use in ways that its inventor never foresaw. To explain this phenomenon, we can liken Gutenberg to an unwitting sorcerer who mixed a brew in his caldron, unaware what it would ultimately bring forth when taken over by his successors.

Into this brew, Gutenberg threw numerous elements, many of which later became indispensable to the typographic craft. Numbering among these elements are:

1. Letter forms based on a pattern.
2. Paper as a medium.
3. Ink as a pigment to render letter forms visible.
4. Lines composed of letters.
5. Galleys that hold all the composed lines in place, enabling the repeated printing of any given page.

As the craft of typography evolved over the centuries, Gutenberg's successors invented new techniques to enhance the typographic arts. They also, one after the other, flung new elements to the sorcerer's brew.

Together, all the elements churned in the brew, and brought forth what no one could have foretold at the time.

3. Griffo and Italic Style

Since we cannot mention the contributions of all typographic innovators, let's pick out a few that, over the centuries, have made pivotal changes to the field.

We begin in the late fifteenth century, only 50 years after the publishing of the Gutenberg Bible. In that brief period, the printing arts spread quickly in Europe. Venice had become a hotbed of typographic work and innovation.

Francesco Griffo, also known then as Francesco da Bologna, had refined his skills at various print shops in Venice before joining Aldo Manuzio's workshop as a punchcutter. Himself a foremost innovator, Manuzio recognized Griffo's exceptional talent, and even lauded him publicly. By then, Manuzio had designed an elegant typeface style that had been used in several editions, as seen in Fig. 4 (Tinti, 2015).

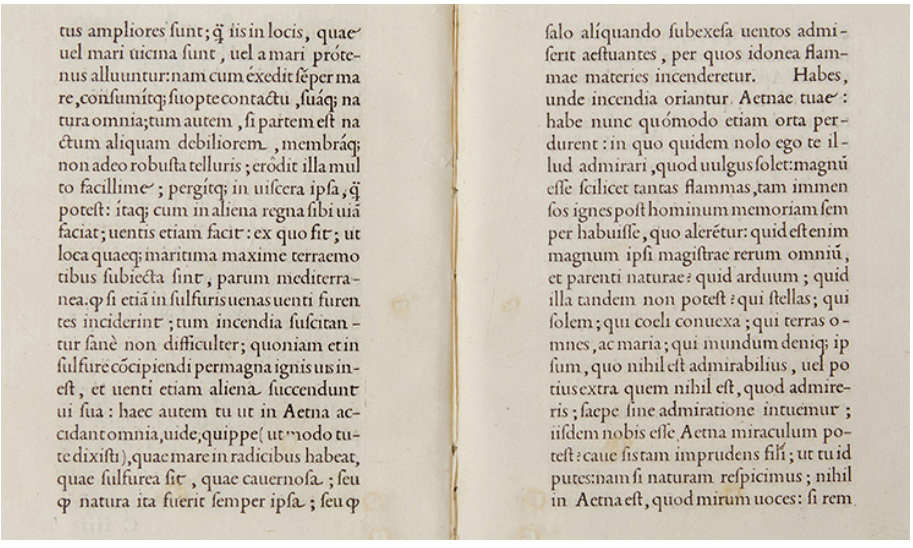

tus ampliores ſunt; q̃ iis in locis, quae uel mari uicina ſunt, uel a mari prótenus alluuntur: nam cum éxedit ſẽper mare, conſumítq; ſuopte contactu, ſuáq; natura omnia; tum autem, ſi partem eſt nactum aliquam debiliorem, membráq; non adeo robuſta telluris; erodit illa multo facillimè; pergítq; in uiſcera ipſa, q̃ poteſt: ítaq; cum in aliena regna ſibi uiã faciat; uentis etiam facit: ex quo fit; ut loca quaeq; maritima maxime terraemotibus ſubiecta ſint, parum mediterranea. q̃ ſi etiã in ſulfuris uenas uenti furentes inciderint; tum incendia ſuſcitantur ſanè non difficulter; quoniam et in ſulfure cõcipiendi permagna ignis uis ineſt, et uenti etiam aliena ſuccendunt ui ſua: haec autem tu ut in Aetna accidant omnia, uide, quippe (ut modo tute dixiſti), quae mare in radicibus habeat, quae ſulfurea ſit, quae cauernoſa; ſeu q̃ natura ita fuerit ſemper ipſa; ſeu q̃ ſalo alíquando ſubexeſa uentos admiſerit aeſtuantes, per quos idonea flammae materies incenderetur. Habes, unde incendia oriantur. Aetnae tuae: habe nunc quómodo etiam orta perdurent: in quo quidem nolo ego te illud admirari, quod uulgus ſolet: magnũ eſſe ſcilicet tantas flammas, tam immenſos ignes poſt hominum memoriam ſemper habuiſſe, quo alerétur: quid eſt enim magnum ipſi magiſtrae rerum omniũ, et parenti naturae? quid arduum; quid illa tandem non poteſt? qui ſtellas; qui ſolem; qui coeli conuexa; qui terras omnes, ac maria; qui mundum deniq; ipſum, quo nihil eſt admirabilius, uel potius extra quem nihil eſt, quod admireris; ſaepe ſine admiratione intuemur; iiſdem nobis eſſe Aetna miraculum poteſt? caue iſtam imprudens filí; ut tu id putes: nam ſi naturam reſpicimus; nihil in Aetna eſt, quod mirum uoces: ſi rem

Figure 4

Wanting to fit more text than usual on a page, Griffo came to realize that existing typefaces could not satisfy such a requirement. Because of its relative compactness, Griffo decided to create a typeface based

on chancery handwriting (*cancelleresca corsiva* in Italian). This writing style had been perfected by renowned scribe, Bartolomeo Sanvito, from whom Griffo likely took his inspiration (Fig. 5).

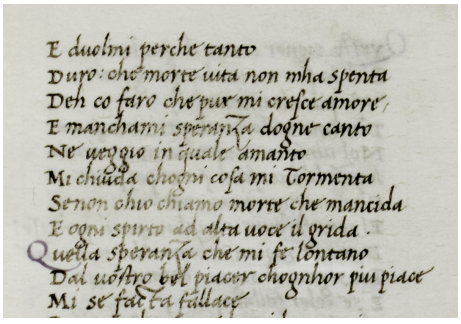
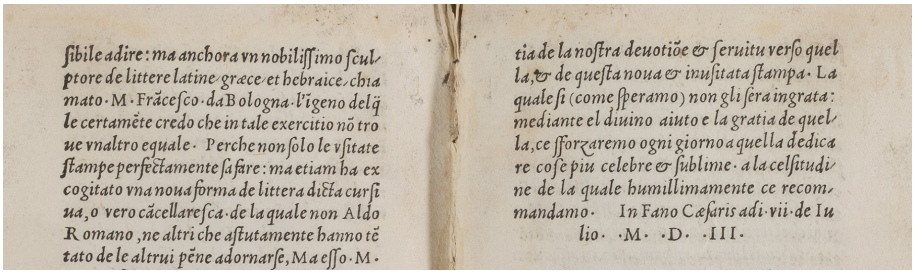

E duolmi perche tanto
Duro: che morte uita non mha spenta
Deh co faro che pur mi cresce amore,
E manchami speranza dogni canto
Ne ueggio in quale amanto
Mi chiuda chogni cosa mi Tormenta
Senon chio chiamo morte che mancida
E ogni spirto ad altra uoce il grida.
Quella speranza che mi fe lontano
Dal uostro bel piacer chognhor piu piace
Mi se facta fallace

Figure 5

Below we see the second chancery typeface (Fig. 6) engraved by Griffo for Soncino's *Opere volgari di Messer Francesco Petrarca*, published in 1503.


ſibile adire: ma anchora vn nobiliſſimo ſcul-
ptore de littere latine græce et hebraice, chia-
mato M. Frãceſco da Bologna l'igeno delq̃
le certamẽte credo che in tale exercitio nõ tro-
ue vnaltro equale. Perche non ſolo le vſitate
ſtampe perfectamente ſa fare: ma etiam ha ex
cogitato vna noua forma de littera dicta curſi-
ua, o vero cãcellareſca de la quale non Aldo
Romano, ne altri che aſtutamente hanno tẽ
tato de le altrui pẽne adornarſe, Ma eſſo. M.

tia de la noſtra deuotiõe & ſeruitu verſo quel
la, & de queſta noua & inuſitata ſtampa. La
quale ſi (come ſperamo) non gli ſera ingrata:
mediante el diuino aiuto e la gratia de quel-
la, ce ſforzaremo ogni giorno a quella dedica
re coſe piu celebre & ſublime. a la celſitudi-
ne de la quale humillimamente ce recom-
mandamo. In Fano Cæſaris adi. vii. de Iu
lio. .M. .D. .III.

Figure 6

In the early sixteenth century, no one would have called such a typeface "italic" because this term referred to anything from the Italian Peninsula, and was not yet associated with the concept of a leaning style. In fact, the angle of his *cancellersca corsiva* was most moderate, while its capital letters were fully upright, as in Sanvito's model.

Griffo had flung this new style into the bubbling brew, oblivious to its subsequent reverberations in typography. Little did he know that with the passing of time, his typeface would come to be called "the first italic". As far as Griffo was concerned, all his work was *italic*. Even more unthinkable to Griffo would have been the eventual pairing of an italic

style as a complement to an upright one within a typeface family—a concept that we have by now espoused as a natural part of typography.

By the mid eighteenth century—about 200 years after Griffo's original italic design—the pairing of an upright and a leaning style was becoming conventional, as evidenced by this specimen of Caslon's work. It is worth noting that *Roman* had come to mean upright, while *Italic* meant leaning.

4. Bodoni and the Inevitable Stroke

Let us return to Ancient Rome to contemplate this famous inscription (Fig. 7).



Figure 7

The flaring at the ends of the stems was a characteristic typical of Roman letter forms, evidence of the chisel that engraved them into stone. At the time, this flaring, or serif, was minimal and unassuming. It was simply an inevitable artifact of the tool. Calligraphic letter forms also manifested a similar feature as evidence of pen and ink. When classical letter forms were later conscripted into typographic service, the serif was kept. There, it remained a quiet guest.

Along came Giambattista Bodoni in the late eighteenth century, stretched the serif, and made it thin as a slice of Parma prosciutto (Lester, 2015). By doing so, he succeeded in changing what was once a secondary feature into a primary one (Fig. 8). Bodoni had made the serif a *thing*.

With these changes, the serif plunged into the simmering brew, and started drawing attention from other type designers.

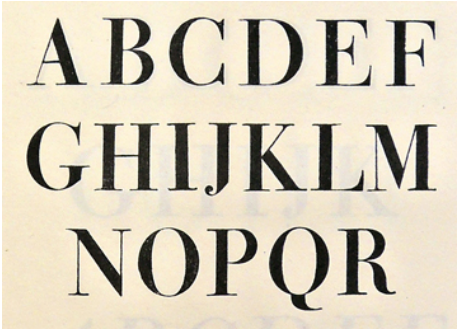


FIGURE 8

As various typographers altered the shape of the serif to suit their tastes, the differences became conspicuous, and were associated with specific styles.



FIGURE 9

Little did Bodoni know that one day in the twentieth century, a common typographic classification (Fig. 9) would use the shape of the serif as a prominent attribute.

Could Bodoni have ever imagined that his own typeface would be classified as *Modern*?

5. Benton and the Pantograph

Moving forward to the end of the nineteenth century, demand for printed material was rising to new, unprecedented levels. Noting this unmet demand, Linn Boyd Benton astutely detected an important bottleneck in the publishing cycle: the process of creating new type was slowed down by the need to manually engrave metal punches in different sizes. As no predecessor had, Benton envisaged that by scaling a fixed pattern to various amounts, different sizes could be created (Cost, 2011). By inventing the pantograph, punches for various sizes of type

could be engraved based on a single drawing (Fig. 10). In fact, Benton's pantograph not only could enlarge or reduce a pattern, but it can condense, extend, and slant it also.

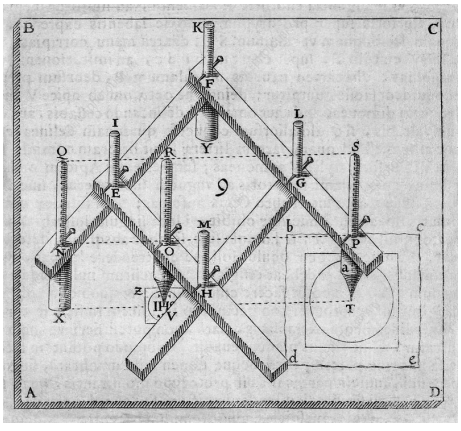


FIGURE 10

Did Benton imagine that letter forms would eventually be scaled using light and lenses? Or that later on, letter forms would be defined as polynomial curves? Today, we take it for granted that the pantographic principle can apply to all letter forms, even non-physical models such as Bézier curves. Did Benton even surmise he might be hurling the element of *scale* into the roiling brew?

6. Composing Lines

Although Benton recognized a significant inefficiency in the preparation of printed matter, two other astute observers detected another critical bottleneck: the process of composing lines manually out of individual letters was extremely time-consuming. The first of these observers was Ottmar Mergenthaler—who later founded the Linotype Company, while the other was Tolbert Lanston, inventor of the Monotype machine. Using divergent approaches, the Linotype and Monotype machines upstaged manual composition by mechanizing the process, thereby accelerating significantly the typesetting process (Romano, 1986).

The composing stick (Fig. 11) went by the wayside and was replaced by a keyboard. For each line of text, lead type was freshly cast from molten metal (Fig. 12) during composition, and did not need to be



FIGURE 11

fetched out of type drawers anymore. As a result, the quantity of newspapers and other printed matter boomed in the early twentieth century. Linotype and Monotype machines improved efficiency of print production unlike any other innovation at that time.

Through their respective inventions, Mergenthaler and Lanston lobbed the worm of automation into the sorcerer's brew. Over the following decades, it continued to morph, but it never died.

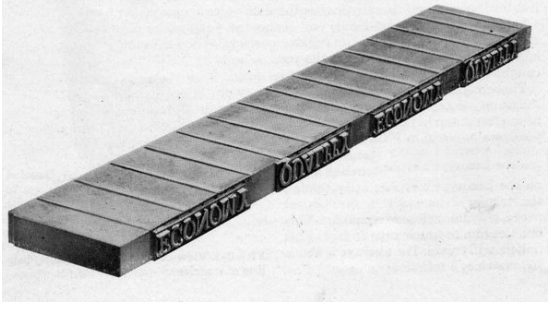


FIGURE 12

7. From Metal to Photons

Metal type continued to reign as sole sovereign until the middle of the twentieth century. To imprint the image of the letter form on the line or the page, metal was composed and impressed with ink on paper. That remained so until two French engineers, René Higonnet and Louis Moy-

roud, came along with a new idea. Why resort to metal when light could imprint letter forms on film? After all, photography was well established by then and was utilized in numerous fields.

Higonnet and Moyroud invented a process that flashed light through letter-shaped patterns to compose lines of text on film (Fig. 13). From there, film could be seamlessly converted to lithographic plates for printing, a process much simpler than the previous one based on metal type. The era of photocomposition was thus launched (Romano, 2014).

Light not only eliminated the need for metal letter forms, but also made page galleys nearly weightless, all while chasing away the lead fumes from the composing room.



FIGURE 13

If churning a sorcerer's brew could turn metal into light, what else might it be able to do? Were Higonnet and Moyroud aware that photons would continue to grow dominant and take the place of metal as the new sovereign in the typographic world?

8. The New Medium

Since its inception, typeset text has appeared printed on paper. Metal, ink, and paper were the triumvirate of the typographic arts. As metal began to lose its dominance as the bearer of letter form, the role of

photons began to expand. In photocomposition, photons impressed images of letters on film. By the 1970s, photons began to display letter forms also on cathode-ray-tube (CRT) screens. Paper was no longer the sole medium. Afterall, why not see a fleeting image on a screen first before committing it to paper? Light became the *softcopy*, while paper was renamed *hardcopy*. As screen-quality improved in the 1980s, the early wysiwyg screens rendered a lower-resolution proof of typeset lines (Fig. 14), while a laser printer or film typesetter produced the final, higher-resolution hardcopy. The screen began to compete for its new role as a medium, chipping away at the centuries-long dominance of paper. The screen took on the duty of defacto proofing medium.

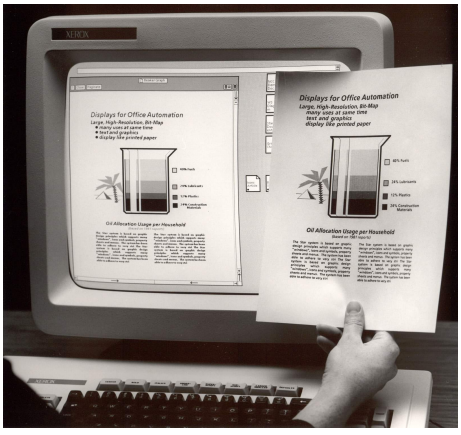


Figure 14

At the time, two discerning type designers, Kris Holmes & Charles Bigelow, realized that a significant technological shift was under way. They perceived that the role of the screen was in flux. Bigelow and Holmes surmised that the screen was not destined to remain in a secondary role as a proofing tool for images rendered on paper, but that it was turning into a new medium in its own right. With this coming transformation in mind, they set out to design Lucida, a new family of typefaces, to look good even on the low-resolution screens of that time (Carter, 1987).

The brew roiled and bubbled as it gave birth to a new medium.

Today, we live in a visual world where we are increasingly dependent on the medium of the screen for all sorts of information. Many of us now read published material of all types more often on-screen than we do on paper (Fig. 15). Screen resolution is high and rising. Type is sharper than ever.

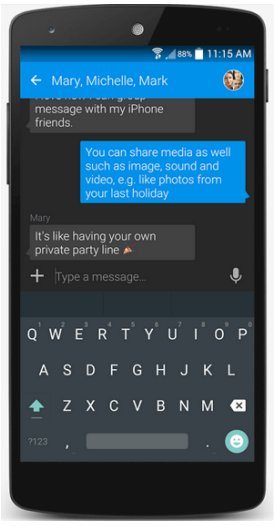


FIGURE 15

The photons are replacing metal & ink.

9. Beyond the Goal

Once a ball is propelled in a particular direction, it rolls towards its intended destination. Sometimes, after reaching its goal, it continues to roll on its own. At times, it can be picked up by someone else who sends it in a new direction. Without fail, all the innovators we have cited reached their goals; their inventions achieved the desired results—and a little bit more...

10. To the Unwitting Father of Type

Dear Johannes Gutenberg,

Just a short note to bring you the latest news from the world of typography.

Letter forms are now made of polynomial curves that we can scale, stretch, and compress as we please. They have replaced the metal punches and molds.

Ink is still around, but letter forms can also be rendered through light alone. Has news of LED screens reached you?

Lines are composed of phantom letter forms lined up next to each other.

We still make galleys to produce faithful replicas of typeset pages, but they don't weigh a ton anymore. We call them PDFs. Recently, someone invented a new, flexible galley that goes by the name HTML.

And, by the way, thanks for the good brew. It's still bubbling after six centuries.

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Fantastic Letters
Writing in a Fictional World

Marc Wilhelm Küster

Abstract. This paper explores the concept of fictional writing systems over 500 years, from Thomas More's Utopia to modern examples such as J.R.R. Tolkien's Middle Earth and the Klingon script from *Star Trek*. Fictional writing systems are deliberately constructed to enhance world-building in fantasy and science fiction, creating a sense of "otherness" while reflecting familiar linguistic models. Case studies from European and Sino-Japanese traditions, including Ascendance of a Bookworm and video games like *Genshin Impact*, illustrate their role in shaping immersive narratives.

The study contrasts closed fictional systems—fixed symbol sets designed for specific worlds—with open systems, which evolve over time. Examples such as More's Utopian alphabet and Tolkien's Tengwar script show how authors use familiar models to give their worlds credibility. The analysis also touches on more abstract systems like the non-linear ideograms from the short story and film *Arrival*, discussing the challenges of creating open systems and exploring why authors rather opt for closed ones.

Some readers may recall from their teenage years the scene in the *Lord of the Rings* where Gandalf and his companions desperately try to solve a riddle to open the Doors of Durin in their wish to escape from howling wolfs and lurking monsters. They may remember how this riddle is written in mysterious but beautiful letters, shining in the moonlight (Fig. 1).

These intriguing, glittering letters were also my first encounter with a fictional writing system.

Fictional writing systems[1] are constructed writing systems[2] created deliberately for use in a fictional universe. Many writing systems are ultimately constructed, whether we know their creators as in the case of

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1. The terminology is adapted from the Omniglot online encyclopedia of writing systems & languages, cf. https://omniglot.com/conscripts/fictional.htm, consulted on 2022-01-16.

2. Cf. above.

Y. Haralambous (Ed.), *Graphonlinguistics in the 21st Century 2022. Proceedings*
Graphonlinguistics and Its Applications (ISSN: 2681-8566, e-ISSN: 2534-5192), Vol. 10.
Fluxus Editions, Brest, 2024, pp. 639–652. https://doi.org/10.36824/2022-graf-kues
ISBN: 978-2-487055-06-3, e-ISBN: 978-2-487055-07-0

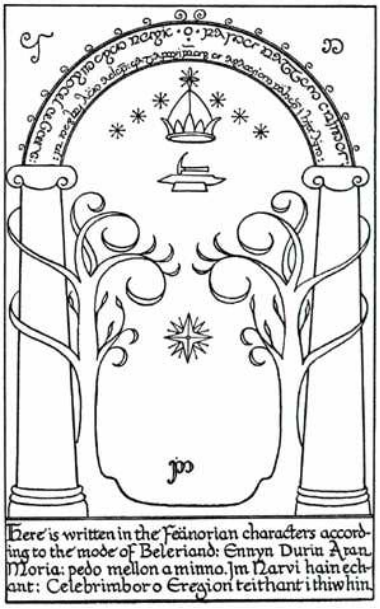


FIGURE 1. "An arch of interlacing letters in an Elvish character," (Tolkien, 2005, p. 305)

Hangul[3] or whether their names have been lost in the mists of time as it is likely the case with the Greek alphabet[4] and perhaps even the Proto-Sinaitic script[5]. Others still were meant by their creators for wider use in the real world, but have failed to catch on.

A fictional writing system on the other hand is intended for use in its fictional universe only. It may or may not be linked to fictional languages which are written in this writing system. This does not exclude that in a small number of cases such as Klingon the writing system has stepped out of its fictional universe and found users in the real world.[6]

3. Hankul / Hangul goes back to a reform initiated by King Seycong and announced in 1443/1444, cf. King (1996, 219ff).

4. Jefferey discusses the indications for the creation of the Greek alphabet around the middle of the 8th century BC, (Jeffery, 1990, 17ff).

5. Chesson et al. (2006, 90ff).

6. Klingon has now a language that you can actually learn on mainstream language learning platforms such as Duolingo, `https://www.duolingo.com/enroll/tlh/en/Learn-Klingon`, consulted on 2022-01-16. The other fictional language on that platform is High Valyrian from George R. R. Martin's *Game of Thrones*, but it actually seems to be written in the Latin script, cf. `https://dothraki.com/2013/05/gryves-se-rina-litse/`, consulted on 2023-06-11.

Cyphers such as the dancing men in Arthur Doyle's eponymous Sherlock Holmes story are even in their fictional universe recognized as such. Therefore, they do not count as fictional writing systems.

In this little study I plan to look at fictional writing systems over a period of roughly 500 years. In doing so I will build on reflections on *Open and closed writing systems*[7] and some musings on the *mystic messages—the magic of writing*[8].

This overview is naturally not complete, the number of fictional writing systems may well count into the hundreds or even thousands.[9] To give nevertheless an overview, I have selected for this abstract five initial examples both in the European and Sino-Japanese traditions, mostly taken from popular culture. I start from the hypothesis that authors may imagine fictional writing systems along the lines of models most familiar to them.

The choice of these books is no coincidence either. All of these examples fall into the categories of fantasy literature or science fiction. As Jameson specifically put it for Thomas More's masterpiece, the "travel narrative marks Utopia as irredeemably other," a conscious "withdrawal or 'delinking' from the empirical and historical world"[10]. All these works can be read as travel narratives—a departure from our day to day world to an imagined other. This other world may, indeed, be radically different, but it may also just be a slightly distorted mirror of our present. The writing systems that their creators give to their worlds are a puzzle piece to create this otherness, often in equal measure foreign and familiar.

1. Writing in Nowhere

The earliest example of a fictional writing system that I am aware of is More's alphabet for the Utopian language. For his groundbreaking *Utopia* More invented the *Utopiensium alphabetum*[11] which is supposed to give more credence to the fictional narrative of More's ideal world.

Having a script marks the Utopian society as a civilization more than on par with the European society of his day. He therefore adds this alphabet to the beginning of his oeuvre alongside a map of the island of

7. (Küster, 2019).

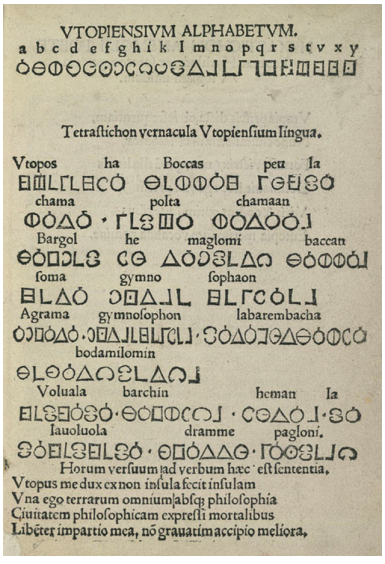
8. (Küster, 2020).

9. To date, to my knowledge no comprehensive overview of fictional writing systems has yet been attempted.

10. (Jameson, 2005, p. 23).

11. Utopia cited after More (2013).

Utopia, creating an unbroken tradition of maps that are associated with fantasy worlds.[12]


VTOPIENSIVM ALPHABETVM.

a b c d e f g h i k l m n o p q r s t v x y

Tetraſtichon vernacula Vtopienſium lingua.

Vtopos ha Boccas peu la

chama polta chamaan

Bargol he maglomi baccan

ſoma gymno ſophaon

Agrama gymnoſophon labarembacha

bodamilomin

Voluala barchin heman la

lauoluola dramme pagloni.

Horum verſuum ad verbum hæc eſt ſententia,

Vtopus me dux ex non inſula fecit inſulam

Vna ego terrarum omnium abſq; philoſophia

Ciuitatem philoſophicam expreſſi mortalibus

Libẽter impartio mea, nõ grauatim accipio meliora,

FIGURE 2. (More, 2013, p. 5)

As this illustration shows, the Utopian alphabet is actually the Latin alphabet in disguise. Structurally it maps to the Latin alphabet as it was used in More's time. This is not necessarily a drawback in the humanist worldview, in which the Latin language was held up as an example to emulate. In the shapes of the letters, however, he opts for a logical geometric structure—first a circle with a stroke upwards which then turns by 90 degrees to create the elements of b etc. This is in line with More's idea of an alphabet that within his fictional world's chronology was given to the Utopian people by their first ruler, king Utopos.

2. Hebrew in Middle Earth

The next specimen follows well over four hundred years later, and it is the one we have already encountered at the beginning of this article. Perhaps the single person most famous for having invented writing systems is J.R.R. Tolkien. His fascination for writing systems long predates

12. Thomas More actually invented the rudiments of the language to go along with his fictional alphabet.

the *Lord of the Ring*, the work for which he is best known. However, it is the Lord of the Rings through which his writing systems gained fame.

Tolkien was a linguist and intimately aware of everything around real-life languages and writing systems with a specific focus on Germanic languages and writing systems. Also his fictional languages evolved over time, and hence he conceived various stages of development for their respective writing systems.

Tolkien described the most important aspects of the writing and spelling of the languages of Middle Earth—the core of his fictional universe—in an annex to his *Lord of the Rings* trilogy.[13] All of Tolkien's writing systems are closed, but not all of them are alphabets. The Fëanorian letters of the Tengwar script are descripted as "a system of consonantal signs, of similar shapes and style, which could be adapted at choice or convenience to represent the consonants of languages observed"[14]. They are essentially ordered phonetically, much like Japanese kana. In contrast to More's Latin based alphabet, however, Tolkien chose a much more sophisticated approach, making the Elves write in an abjad[15] built around a rigorous phonetic model (Fig. 3).

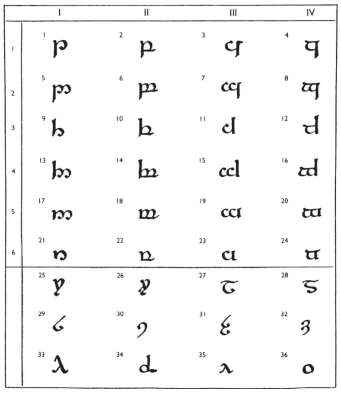


FIGURE 3. "The Tengwar," (Tolkien, 2005, p. 1119)

On the substance, Tolkien's motivation for his choices were likely similar to that of More, though. The also deeply Catholic Tolkien envisaged his Elves to be pupils of the gods, angel-like beings. Hebrew is in

13. (Tolkien, 2005, Annex E).
14. (ibid., p. 1117).
15. (Daniels and Bright, 1996, p. xxxix).

the Kabbalah the language and the writing system of God and angels.[16] Giving the Elves a structurally similar writing system thus transports the same sublime message as More's Latin-inspired alphabet—a writing system close to perfection.

This model could, as Tolkien notes, be adapted to any target language that is being written in the Tengwar writing systems. Much like vocalisation marks in Hebrew and Arabic, so-called tehtar could be used to express vowels in Tengwar if needed. The following extract gives an idea of Tolkien's level of precision:

> *The vowels* were in many modes represented by *tehtar*, usually set above a consonantal letter. In languages such as Quenya, in which most words ended in a vowel, the *tehta* was placed above the preceding consonant; in those such as Sindarin, in which most words ended in a consonant, it was placed above the following consonant [...] (Tolkien, 2005, p. 1120)

For the purposes of this abstract I will not deal with the other writing systems that Tolkien has invented, e.g., Cirth, the alphabet of the Dwarves, clearly inspired by runes and as such also containing letters for vowels.

3. Closed Writing Among the Stars

The next writing system follows just a good decade later, though it may feel much longer—the Klingon language and writing system that was invented for the Star Trek franchise. It is the fictional language that has probably passed furthest into real life.

Klingon is both the language and the script used by one of the main races in the Star Trek universe. The canonical definition of Klingon is Marc Okrand's *Klingon Dictionary*.[17] The language of this warlike people is said to be highly guttural, designed to sound rough and unfriendly.

Strangely, no official version of the complete writing system exists, though fans have constructed one based on footing shown in the various films of the Star Trek franchise (Fig. 4).

Each character represents exactly one sound, making this an example of a perfectly phonetic writing system. This equally applies to its canonical transcription into Latin letters, which also the Klingon Dictionary applies.

16. Cf. Küster (2020) for a more detailed discussion.
17. (Okrand, 1992).

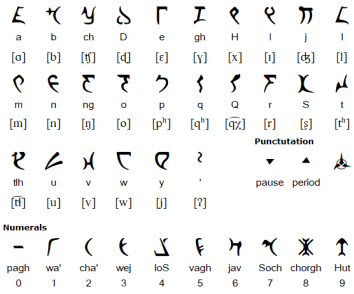


FIGURE 4. https://www.omniglot.com/conscripts/klingon.htm, consulted on 2022-01-15.

4. A Novel All About Writing

The three examples so far are all closed writing systems, but they also all stem from the Angloamerican sphere. To broaden this picture, the paper will now look into examples from Eastern modern popular culture. Miya Kazuki's Japanese light novel series 本好きの下剋上～ 司書になるためには手段を選んでいられません～, translated into English as *Ascendance of a Bookworm*, is probably as close to an grammatological novel as one could imagine.[18] The heroine of the story, Urano Motosu, is an obsessive book lover—that is actually the literal meaning of 本好き—about to realise her life's dream to become a librarian.

Urano dies in an earthquake when she's crushed to death by her own immense collection of books, and then finds herself reincarnated as Myne, a sickly five-year old girl, with her memories of her past life intact. However, her family in this late mediaeval, vaguely European fantasy setting lives very much down the social ladder. While her parents deeply care for her, books are out of their reach, both economically and educationally. Writing is something her father, a town guard, only masters to a quite limited degree.

Our heroine is thereby put into a difficult position. Her one passion in life, books, is inaccessible to her. She attempts techniques she remembers from her voracious reading in her past life—she tries her hand at fashioning papyrus, clay tablets and mokkan (with an explicit reference to the Chinese Yellow River culture) as she has remembered from her lessons about the origins of writing. However neither of these approaches flies. Her next attempt—not evident for a 5 year old girl—aims even higher: recreating paper to make writing generally more accessi-

18. Since Kazuki's novel is not as widely known as the previous examples, I will go in a bit more detail here already in the abstract.

ble to the populace. She deliberately wants to usher in the Gutenberg revolution (下剋上 could be translated as insurrection).

While this may be interesting for the series' reader, and a good introduction for children on the origins of writing, none of this is directly relevant to this study. However, another aspect is: Myne remembers the Japanese writing system with which she has grown up in her previous life, but as a five-year-old girl she obviously does not yet know the writing system used in her new fictional world. Fortunately for her, one of her father's comrades also works as the guard's scribe and volunteers to teach her the letters using a stone slate, the only writing material accessible to a normal citizen in this world.

We never see the full writing system in action, but the illustrated light novel gives us a clear idea of how this writing system is supposed to work. The girl's first encounter with writing is actually her own name: "Otto wrote my name, Myne, at the top of the slate before setting down the slate pen and a cloth"[19].

Myne's name in the Katakana spelling of the original Japanese edition, マイン (ma-i-n), has just three characters, whereas the illustration clearly shows four as you would expect for phonetic writing (though the letters seem to correspond to the phonetic rendering m-a-i-n rather than to the English spelling). In other words, the author imagines her heroine's name to be spelled alphabetically. Myne herself muses on the nature of the alphabet which Otto is teaching her:

> This world's writing system was similar to the English alphabet. There were no syllabaries like hiragana, nor logograms like kanji. The letters themselves determined the sound and meaning of words. Spelling was everything[20].

So even though the author is perfectly aware of the nature of writing systems and writes herself in Japanese, she still chooses to give this world a closed, alphabetic writing system. On one hand, this may seem natural, given the story's late medieval, European setting. On the other hand, she would have been free to fashion any writing system had she wanted.

5. Minting Money

The second case pivots to the gaming world, focusing on a commercially successful computer game created by the Chinese company miHoYo. Computer games, and in particular role playing games, live of

19. (Kazuki, 2019, p. 88).
20. (ibid., 113f).



FIGURE 5. Myne writing her name, (Kazuki, 2019, p. 89).

the player's immersion into the fictional universe they are supposed to inhabit. Players should navigate the world, interact with people and possibly other players and for this they need a believable description of the world. In Mèmeteau's words, they need "cette dimension mythologique exportable à tout jeu qui implique un personnage"[21].

There are many computer games to choose from for this study—the Hylian scripts from *The Legend of Zelda* would come to mind, as would be Dovahzul from *The Elder Scrolls*. I want to look here specifically at a fictional universe from a Chinese creator that is still easily accessible and popular in the West. Genshin impact, which came out first in 2020 and has grossed $2 billion in its first year, is such an example.

The game incorporates multiple writing systems, with one being particularly prominent. It features so far imagined regions, loosely modelled on a medieval Germany, China, Japan, and the orient, with plans for additional countries in development.

21. (Mèmeteau, 2014, p. 165).

The one figured in the first screenshot is supposed to be the one of Khaenri'ah, a civilisation that was said to be destroyed five hundred years prior to this fictional universe's present—ever since Tolkien, at least, fictional writing systems can also help to evoke an (equally invented) past, giving further depth to the universe (Fig. 6).



FIGURE 6. Screenshot taken from the gameplay.

While miHoYo, the Chinese company behind the game, has to my knowledge not released a comprehensive documentation on the Teyvat language and its writing system, the community has reconstituted the underlying alphabet from the many text samples shown in the gameplay (Fig. 7).



FIGURE 7. https://genshin-impact.fandom.com/wiki/Teyvat_Language, consulted on 2022-01-15.

Much like More's *Utopiensium alphabetum*, the denizens of Teyvat write in an alphabet that reflects the English one, this time in a quite literal

sense. The shapes of its letters seem inspired by a mirrored version of Fraktur. Structurally, it is a full bijection to the English alphabet.

Again, like Miya Kazuki, miHoYo, though being Chinese, chose to make the characters of their world write in a number of closed writing systems.

6. Open Writing From Outer Space?[22]

The linguistic and graphematic conceptualisation presented in the film "Arrival" explores language and writing systems. It dissects the intriguing idea of a simultaneous, non-linear form of communication, while acknowledging its impracticality in real or imagined writing systems.

The exploration of cinematic and literary narrative through the lens of linguistics reveals novel perspectives and potential challenges to conventional understanding. The film was directed by Denis Villeneuve and premiered in Cannes in 2016.

The protagonist, Louise, is a linguist and (much like Myne in Kazuki's light novel) very much aware of the theory of writing systems, offering a self-referential element to the discourse. Louise, along with a physicist companion, encounters extraterrestrial lifeforms in a tightly controlled setting. These alien beings exhibit symmetry, bearing seven limbs, and they evidently occupy a non-linear, non-sequential reality.

The alien creatures use a distinct mode of communication, composed of circular sentences, which are true ideograms or semasiograms. Each ideogram, symmetrically arranged, forms an integral part of a larger whole, analyzed extensively by Louise and her associates (Fig. 8).

For the film only about forty such logograms were actually produced. This highly constrained grammar can hardly express the full gamut of human—or alien—language.

"Arrival" is based on the short story "Story of Your Life"[23], authored by second-generation American writer Ted Chiang. It showcases the profound possibilities of literature, as evidenced by its Nebula Award in 2000. Chiang's Chinese heritage, apparent in his name, lends an intriguing backdrop to the narrative. The story is actually more explicit in the theory of writing. The heptapods are said to utilize a semasiographic writing system. This system imparts meaning independently of speech and is adapted for species possessing simultaneous modes of consciousness, in which the concepts of past, present, and future are synchronous.

22. I would like to thank the anonymous reviewer for directing me to 'Arrival', which I had not been aware of before.

23. (Chiang, 2016).



FIGURE 8. https://www.youtube.com/watch?v=r8nTifCIr0c, position 7:24, consulted on 2023-06-23.

This groundbreaking idea, while fascinating, is a "linguistic warp drive". Warp drives, which are a common trope in science fiction and theoretically enable spacecraft to exceed the speed of light, provide a convenient literary device, but unfortunately clash with the known laws of physics. Similarly, the writing system presented in these narratives, despite its conceptual intrigue, is not realistically plausible, either in real or speculative linguistics. Nonetheless, it serves as an engaging model, forcing us to question and reflect upon the fundamental nature of writing. Despite its inherent implausibility, the concept and its resultant discussion enrich our understanding of language and writing.

7. Conclusions

Except for Chiang's semasiograms all examples of created writing systems that we have seen are closed. I am inclined to think that this is not a coincidence. There is certainly a pragmatic aspect to this decision—conceiving a writing system that is essentially a mirror of the Latin or English one is by far the easiest way forward, and for the shallow methodology of Genshin impact it realises just that right mix of slightly obscured familiarity that can capture its players.

However, such an argument does not apply in equal measure to a erudite linguist such as Tolkien nor to a very self-aware author like Kazuki. I believe that there is a more fundamental reason: Open writing systems cannot be created, they can only evolve.

Whereas a closed writing system has a limited number of signs—even if, as in the case of Hangul, this number may be quite significant —, an open writing system can and must be extended by its users over time. Even the open writing system that is growing under our very eyes—a writing system based on emojis[24]—is not a constructed writing system. It brings together in one place—Unicode/ISO/IEC 10646—characters from many different sources that can be used to encode even complex full literary works[25].

For closed writing systems these observations put a question mark behind Daniels' apodictic statement that the "normal way for a society to acquire its own script is by evolving, adopting, or adopting an existing writing system"[26]. Constructed closed writing systems are a fixture in fantasy—but many closed writing systems now in use were likely equally constructed at one point in time. Open writing systems, instead, have their own temporality inscribed into them.

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24. (Benenson, 2015).
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De-aestheticizing the Artist's Brush. Calligraphy Manuals and the Pragmatics of Calligraphic Writing

Helen Magowan

Abstract. Before the twentieth century, Japan had a highly developed publishing culture using woodblock print technology to produce books that maintained the appearance of a handwritten original text. This paper explores the making of meaning in pre-typographic Japanese through close reading of 18th century printed books. Focusing on manuals published for women teaching a particular script form called *nyohitsu*, I problematise the term "calligraphy" in its privileging of visual aesthetics, and argue that writing's formal properties had pragmatic functions which operated to discursively construct social relationships. *Nyohitsu*'s distinctive graphic qualities demonstrate a complex indexicality, recasting the calligraphy brush as a tool for sophisticated modulation of the social effects of text in a manner which is unavailable to typography.

1. Print and Manuscript in Edo Japan

The Edo period in Japan (1603-1867) was characterised by a flourishing book market serving an eager public with extensive levels of literacy and a voracious appetite for books of all kinds. (Kornicki, 1998, pp. 37–38; Moretti, 2020, p. 48) This was a marketplace where woodblock technology dominated, offering complete flexibility for layout, images and script forms, since pages were effectively facsimile reproductions of handwritten text. This only changed at the end of the 19th century, when mass adoption of typography was one of many other wholesale reforms which constituted Japan's precipitate adjustment to western modernity. (Kornicki, 1998, p. 165) Movable type was not an innovative western technology: metal type had been in use in Korea by the early 13th century, and in Japan books were being printed using wooden movable type at the end of the 16th century. (ibid., pp. 128, 130) However this early experiment did not lead to typographic domination; rather it seems to have reconfirmed the advantages of woodblock technology, since by by 1650 movable type had been largely dropped, indi-

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cating the high cultural value invested in handwritten aspects of text. (Chance and Davis, 2016, p. 106)

Woodblock's facility for representing handwriting is illustrated by *Wakamidori* (若みと里 "Young Green"), first published in 1707 (Fig. 1).[1] Authorship was not valorised in the modern way and is not always recorded, but there is no reason to think that the writer, Hasegawa Myōtei, a woman famous in her time as a calligrapher, was not the composer as well as the inscriber of the text.[2] *Wakamidori* contains a description of Kyoto, the capital at that time, using a lyrical, poetic diction. Figure 1 shows the opening four pages, which say:

> This capital was begun in the time of Emperor Kammu, on land blessed by gods of the four directions. Under the august reign of our Lord, when the barrier gates are open one ought to survey the city.[3]

The text continues with a list in elegant prose of the important sites of the city, primarily shrines and temples, starting with the sacred mountain Higashiyama.

The printed page here is not a vehicle for text content, but emphasises the brush stroke, with its weight and line, that makes up the letterforms. The script is highly cursive, rounded and abbreviated, with vertical extension and a fluid and connected line which even extends to an upwards trail from the bottom of one column of text to the top of the next, progressing from right to left along the vertical lines of Japanese writing.

These stylistic qualities are particularly evident when contrasted with another book which uses the same linguistic text, but presents it in a different calligraphic style (Fig. 2).[4] This later version is much more information-dense, with just a few lines corresponding to four whole pages of the first example, but the script difference is also clear, with far more angular letterforms, less connection and little vertical movement.

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1. Premodern Japanese book titles were highly variable, leading to the modern bibliographic convention of "unified title". Here I use a short form of the unified title, *Nyobitsu wakamidori*. Union Catalogue of Early Japanese Books ID no. 1045745. (Hasegawa, 1707)

2. The figure of the author emerged in popular prose in the late 17th century. Moretti (2020, p. 85)

3. Early modern Japanese text presents a palaeographic challenge, and *nyobitsu* even more so. I am deeply grateful to Professor Takahiro Sasaki, Keio Institute of Oriental Classics, Keio University, Tokyo, for his help in deciphering the writing of Hasegawa Myōtei. As well as title variations, editions of early modern Japanese books can vary, for example with the addition or removal of frontispieces. Here I give page references for a copy held in a private collection, Suzuran Bunko (Cambridge) and generously shared with me by the owner. (Hasegawa, 1707, f.1r-f.2v)

4. (都往来并国尽 *[Miyako Ōrai Narabini Kunizukushi/A Description of the Capital with a List of Provinces]* n.d.)

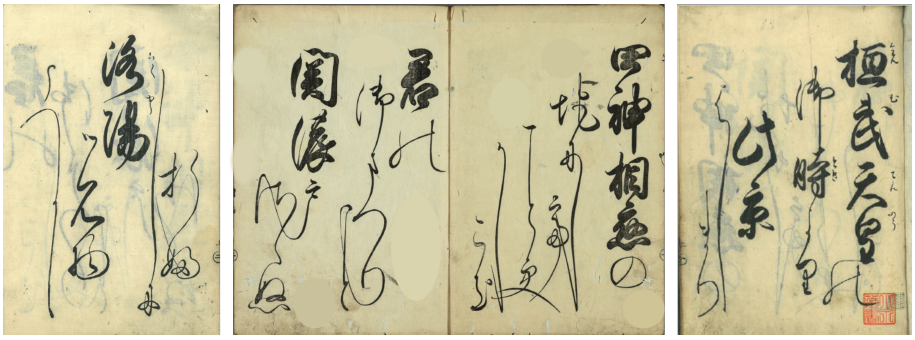

FIGURE 1. *Wakamidori* ('Young Green'), Hasegawa Myōtei, 1707. Vol. 1 f.1v-2r. Image courtesy of Suzuran Bunko (Cambridge)

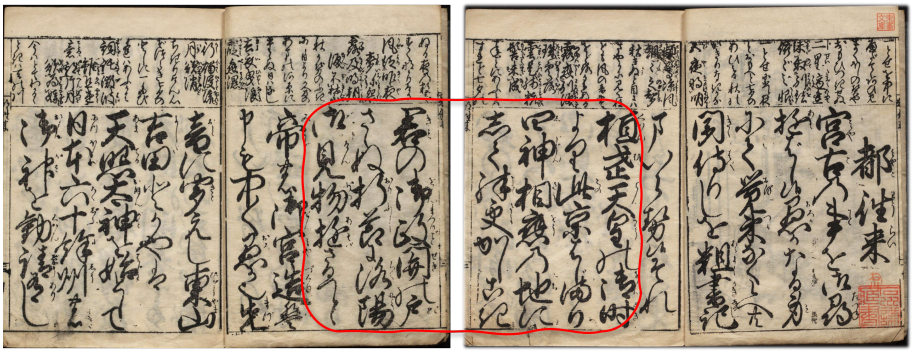

FIGURE 2. *Miyako ōrai narabini kunizukushi* ('A Tour of the Capital with List of Provinces'), anon., 1799. f.1v-3r. Image shows equivalent text section to 1 highlighted at f.2r-2v. Image Tōsho Bunko under CC.

2. The Problem of "Calligraphy"

The first book, *Wakamidori*, was written in *nyohitsu* (女筆, lit."woman's brush"), a calligraphic style which was particularly in vogue from the mid-17th to mid-18th centuries. (Koizumi, 1999, p. 36) *Wakamidori* is understood to be a calligraphy manual for *nyohitsu*, a text which one could copy out in order to learn *nyohitsu* and improve one's brush skills. Calligraphy copybooks more often took the form of letters, in books constituting a "publishing genre" called *ōraimono* (往来物, literally, "things coming and going").[5] This was an expansive category which used letters for the transmission of all kinds of knowledge, alongside the written register

5. Unlike "genre" in the modern book industry, there is no evidence of authors writing into preexisting publishing categories, and 'boundaries of publishing genres

appropriate for different kinds of correspondence. These could function explicitly or implicitly as *tehon* (手本), copybooks for calligraphy.[6] *Nyohitsu* copybooks usually took this form, as it was a calligraphy style particularly associated with letter-writing.



FIGURE 3. *Onna shokan shogakushō* ('A Beginners Guide to Correspondence for Women'), Isome Tsuna, 1690. Vol. 1 f.14v-15r. Image courtesy of Koizumi Yoshinaga.

Figure 3 shows an example of a *nyohitsu* book. The page has a large lower section with a main text, and a narrow upper register containing parallel or secondary information, a layout typical of educational books of the Edo period. The lower register contains a sample letter in *nyohitsu* calligraphy, while the upper register uses a different form to discuss metatextual points regarding the letter below. It is the calligraphed letter in the lower register which draws focus. First however, consider the upper register. This is in an unremarkable form, but though it is unmarked, in terms of method of production it was brushed, and even by the same hand, as the lower register—a professional print-industry calligrapher. "Calligraphy" tends to mean writing produced by hand with attention to aesthetics, but this is an environment where there is no

were often porous, with titles travelling from one category to another over time.'. See Moretti (2020, pp. 86–87).

6. See Moretti (ibid., p. 179) on the seventeenth century publishing genre of *ōrai-mono* and *tehon*.

epistemological separation between the handwritten and print. (Chance and Davis, 2016, p. 92) Handwriting for reproduction necessarily implies a degree of attention to aesthetics: calligraphy for woodblock print was professional work albeit executed with varying levels of expertise, perhaps depending on the publisher's budget. We also see on the pages of these books a wide variation in script styles and forms. The term "calligraphy" not only falls short for the purpose of describing adequately what we see on the page: in positioning writing as a visual artform, a further epistemological separation is engendered between language and the visual, disconnecting linguistic analysis from the eye. Nevertheless, the term remains convenient and not inaccurate; books demonstrating script forms were a specific commodity, and among these, *nyohitsu* was visually highly distinctive.

3. Stylistics of *Nyohitsu*

Nyohitsu was not purely a graphic form, but worked in relationship to the language it carried, preferring 'native' Japanese language and expression. This is within the *wakan* dialectic (*wa* 和 Japanese, *kan* 漢 "Chinese") which underpinned much Japanese thinking, where that which was Japanese was placed in apposition to that which was Sino-Japanese. In writing, the *hiragana* syllabary was *wa*, while *kanji* graphs were considered *kan*. *Nyohitsu*'s strongly *wa* character tended to thus prefer *hiragana* syllables to overmuch *kanji*, and words from the *wa* lexicon over *kan* lexical choices. This is somewhat analogous to choices in English between words of Germanic and Latin origin, in particular with reference to the more intellectual flavour of Latin.

Visually, the script form here has the characteristics described above in regard to *Wakamidori* in Fig. 1, albeit in a more restrained and less flamboyant hand. That is to say, in Fig. 3 we see *nyohitsu*'s fluidity, extension, connection and abbreviation, with dynamic changes in size, weight, and line. This letter also demonstrates one of *nyohitsu*'s unusual ways of articulating lines of text. Vertical columns could be arranged with equal line heights in the ordinary way (Fig. 4, left). However columns could also be disarranged, with differing lengths, aligned neither at top nor bottom, in a manner called "scattered writing" (*chirashigaki* 散らし書き) (Fig. 4, right).

A more complex articulation than scattered writing involved text doubling back on itself, a manner called "returning writing" (*kaeshigaki* 返し書き) (Fig. 5). Here the larger characters signify the starting point and initial reading path. Reading the large characters only, the reader proceeds vertically right to left; at the end of the page the reader returns to the beginning to read the smaller, often interlinear writing. While confusing to modern eyes, and like scattered writing somewhat resistant to

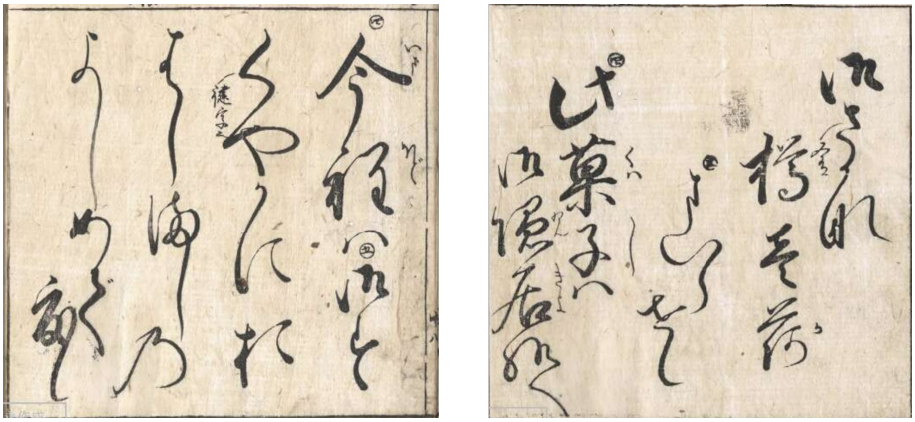

FIGURE 4. Left: aligned text (*narabegaki*). Right: scattered text (*chirashigaki*). Details from *Onna shokan shogakushō*, Isome Tsuna, 1690. Vol. 2 ff.8v and 14v. Original images courtesy of Koizumi Yoshinaga.

typographic transcription, two or three returns were conventional for contemporary readers. Late examples can be found with up to nine returns, but this appears to have been an ostentation, and had an impact on comprehensibility. (Koizumi, 1999, p. 43)

4. Pragmatics of *Nyohitsu*

What did it mean to choose more or less complex articulations of text, or to write with exaggerated connection and fluid extension? The received view is that *nyohitsu* was a feminine accomplishment like embroidery or music, and was a way for women to write polite, refined notes to each other. However *nyohitsu* was not the only style of writing available to women, and furthermore despite the name both men and women wrote in this style. Close reading of metadiscourse reveals a far more complex system than simply elegant feminine handwriting; rather, a writer's choices, both linguistic, calligraphic, and of line articulation, had interactional, pragmatic functions.

The page shown above in Fig. 3 is from *Onna shokan shogakusho* (女書翰初学抄 "A Beginner's Guide to Women's Correspondence"), written, again in terms of both composition and inscription, by a woman called Isome Tsuna.[7] This book was highly influential, being republished several times under different titles, and operates as both a letter manual

7. (Isome, 1690) Union Catalogue of Early Japanese Books ID no. 299536.

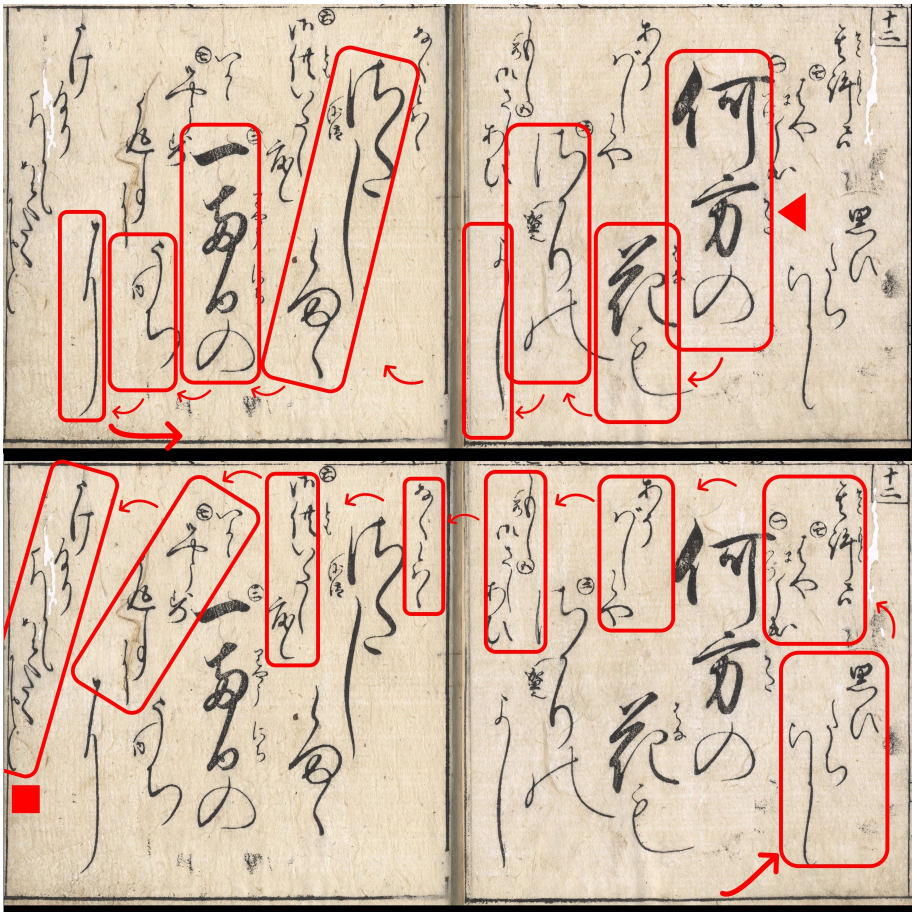

FIGURE 5. Returning text (*kaeshigaki*). Top: first pass, starting at triangular mark. Below: returning for the second pass, ending at square mark. *Onna shokan shogakushō*, Isome Tsuna, 1690. Vol. 1 f.14v (detail). Original image courtesy of Koizumi Yoshinaga

and calligraphy copybook.[8] It has model letters in *nyohitsu* which would probably be copied out by would-be letter-writers, and the upper register contains metatextual and other useful information in an unmarked script.

8. Namely: *Onna yōbunshō taisei* 女用文章大成 (1698 "Attaining Success in Useful Letters"); *Tōryū nyohitsu taizen* 当流女筆大全 (1699 "The Complete Woman's Brush"); *Onna bunko takamakie* 女文庫高蒔絵 (1721 "A Library for Women in Embossed Gilt Lacquer"); *Onna bunrin takarabukuro* 女文林宝袋 (1738 "A Treasure Bag of the Forest of Women's Letters").

The letter in Fig. 3, the 12th of the first volume reads:

> I would like to let you know that everywhere the cherry blossoms are at their peak, so I plan to go within the next day or two. I think that you may soon go, and if it were not to be a hindrance, I would like to go together. Please let me know how that would be. Kind regards.

The upper register offers the following suggestions for varying the letter text:

> Everywhere the cherry blossom—or the cherry blossom all around—or the cherry blossom here and there—or the cherry blossom in the hills and fields
>
> At their peak, so—or at the perfect moment, so—or are competing in their colours, so—or now are at their peak

Her previous book pointed out words and phrases which were vulgar, amending them to more polished and acceptable ones. (Isome, 1994) Here she gives elegant variations, expanding the vocabulary of the reader and giving them the tools to compose their own letters.

These are the kinds of letters polite ladies might send to maintain and cultivate their social relationships, and the book was probably valuable to women seeking the social capital projected by accomplished letter-writing. In fact Tsuna's book is concerned not with brush skills or letter-writing per se, but with elegance and refinement of the social person in general. She offers advice about etiquette and deportment such as:

> When viewing flowers, do not do things like going near the bottom of the tree and touching the branches, saying this and that in appreciation of the flowers. Also … it is poor form to break them off and take them. It is refined to simply gaze at them placidly.

Tsuna informs the user about refined, polite sociality in language and deportment, particularly as enacted through writing letters.

It is only at the end of the third volume that Tsuna touches on practices of writing in a short prose passage. Alongside metadiscourse from other sources, this provides an account of some of the pragmatic aspects of *nyohitsu*. In her previous book she had explained that *nyohitsu* is not appropriate for people of higher status than oneself.[9] In her second work on this subject she drills down further, saying:

> When you add ink to your brush, it is very respectful to write darker, but it is vulgar if the ink is too dark.

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9. 'In writings where one is respecting one's superiors, though a woman it is acceptable to say 'I humbly send this brief note'.' This phrase, 一筆申し上げ候 *ippitsu mōshiage sōrō* typically appears in 'men's' (or rather, unmarked) letter-writing models, indicating *nyohitsu* is marked and appropriate for closer or more equal relationships. The question of gender is further touched on briefly below.

and:

> In trying to write the shapes of words elegantly, if by all kinds of scattering it becomes difficult to read this is extremely rude. Therefore do not write long *ten hiki sute hane* [terms for different calligraphic strokes].[10]

Ink colour demonstrates a writer's personal qualities, whether of vulgarity or refinement, and constructs their social relationship with the addressee as one of distance or intimacy, while graphic execution of strokes is discussed in terms of manners and politeness. Clearly, paralinguistic features of written language can have social effects, both desirable and undesirable, with ink colour and calligraphic stroke contributing to discursive constructions of oneself and one's relationships with others.

The complex articulations of *nyohitsu* are also a factor in the discursive construction of social relations. Scattered writing and returning writing emerged in the Heian period (8th to 12th centuries), a "golden age" of literary and artistic production among courtiers and aristocrats. Scattering one's lines became associated with personal letters and poetry, evoking the idea of a writer too overcome with emotion to align their writing carefully. (Carpenter, 2019, p. 33; Kaya, 2013, p. 140) In the early modern period then, scattered writing may carry some of the refined literary resonances of its antecedents, but Tsuna's discourse explicitly positions the returns of *kaeshigaki* in relation to affect:

> It is most important that marriage congratulations should have *nengoro* returning writing.[11]

Nengoro (懇ろ) can be understood as a kind of warm friendliness which is kind and sincere, easy but polite. She also says:

> Letters of condolence should be written with thin ink, without returning writing.[12]

Complexity of articulation projects the emotional warmth and sincerity of *nengoro*, whereas if more emotional reserve is called for, a more straightforward articulation is appropriate. Other manuals propose the same differentiation regarding not returns but scattered writing. (Koizumi, 1999, pp. 44–45, 54) Apparently amongst *nyohitsu* choices, a more involved *mise-en-page* changes the affective stance of a letter.

This discretionary line articulation is also subject to discourses of gender, in that some sources suggest men should avoid using scattered writing. (ibid., pp. 44–45) However, it is clear from contemporaneous

10. All transcriptions and translations my own. (Isome, 1690, vol. 3 f. 22^{v}, 24^{r})
11. ibid., vol. 3 f. 23^{r}.
12. ibid.

sources that men did use this—for example letter manuals instructing men in how best to succeed in the game of love sometimes use scattered writing for their model letters.[13] Since it is not clear that men used such line articulation in their male homosocial correspondence, it seems that the affective quality of scattered writing made it appropriate for men when they wished to express sincerity and unmediated emotionality towards women.

Tsuna has a longer discussion of the quality of *nengoro* which sheds light on this issue:

> It is better to write *nengoro* phrases; rather than speaking face-to-face, it is better to let the brush speak, so everyone ought to be able to write. However, it should be to the degree that one would usually address a person. Being more intimate [*mutsumajiki* 睦まじき] in letters than in one's usual addresses exposes falseness, and the shabbiness of your inner feelings comes across like a courtesan. One should be careful.[14]

The matter of the courtesan is key here, since courtesans used *nyohitsu* in their profession, writing convincing love letters to their patrons. Overdoing the warm friendliness of *nengoro* could turn one from a sincere person into an insincere one; a letter intended to express friendly intimacy could be misconstrued, positioning one in an undesirable way. Being 'friendly to the degree that one would usually address a person' shows *nyohitsu* constructing a relationship as intimate, whether socially or sexually. *Nyohitsu* could project a sincere and warm affection; but Tsuna also warns against negative or undesirable effects, and we see the potential for accidental overfamiliarity, vulgarity, disrespect or indifference.

5. Indexicality of *Nyohitsu*

Evidently *nyohitsu* had pragmatic functions in the written construction of social relationships; however other *nyohitsu* books demonstrate that the complex mesh of features made for a rich resource. With linguistic, calligraphic, and mise-en-page features, sophisticated modulations were possible. This can be considered as *nyohitsu*'s indexical field of potential meanings, which Penelope Eckert describes as a 'constellation of ideologically related meanings, any one of which can be activated in the situated use of the variable'. (Eckert, 2008, p. 454)

13. Key love letter manuals include *Fumi no hayashi* (文の林 'A Forest of Letters'), a title which labels several different texts, *Fumi no shiori* (文の枝折 'A Guidebook to Letters' and *Fumi no yukikahi* (文のゆきかひ 'A To-and-fro of Letters'. See for example Noriko Itasaka (2015-09-18).

14. Isome Tsuna, *Onna shokan shogakushō*, 1690, vol.3 f.23v

To what purposes such meanings might be invoked, and how activated, is illustrated in a second calligraphy manual by Hasegawa Myōtei. *Sazareishi* (佐々礼石 "A Rock of Pebbles"), first printed in 1713, consisted of three volumes of letters, of which the four letters of volume one will be examined here.[15] There is no metalinguistic text as Fig. 6 shows. Furthermore, the letters are not useful as examples of practical letter writing skills as are Tsuna's above; nor are they apparently systematised. This book tends to be thought of as almost purely a calligraphy manual: not actually useful, but an at least linguistically pleasing text for women to copy in order to practice their feminine brush skills. In fact attention to *nyohitsu*'s indexicality problematizes that view, and I argue that it should instead be understood as an epistolary romance.



FIGURE 6. *Sazareishi* ('A Rock of Pebbles'), Hasegawa Myōtei, 1713. Vol. 1, divided into four letters arranged consecutively top to bottom (pages are read right to left). Images courtesy of Ebi Bunko.

Since *nyohitsu* has distinctive graphic qualities, an initial visual examination of the letters is instructive. Figure 7 compares the articulation of the first and second letters, and based on the stylistic and pragmatic principles outlined above, it might be supposed that the first, aligned letter could be to a less intimate addressee, affectively either cool or respectful. The second letter might be more personal, friendly or emotional, or perhaps addressed to a close friend.

Going on to read the text, the first letter is elegant and polite, reading as follows:

15. (Hasegawa, 1713) Union Catalogue of Early Japanese Books ID no. 1150089

Thinking to seek your pine sapling on this New Year's Day of the Rat, the path is uncertain in the deep snow. The mountainous drift before you is a jewelled mansion; see it as an image of a thousand years, and you can look forward to depending on its promise.



FIGURE 7. *Sazareishi*, Hasegawa Myōtei, 1713. Vol. 1, letters one and two. Images courtesy of Ebi Bunko.

With its references to snowy paths, this new year's greeting might be to a friend who is in the remote countryside. There is intertextuality with poems from classical Heian period literature which could be read as elevated diction, such as the "jewelled mansion". However this is an image of lovers divided.[16]

The second letter's scattered writing suggests a less reserved affective stance, and the text fulfils this expectation:

16. *Tama no utena* 玉の台 can be found for example in *Taketori monogatari* (late 9th or early 10th century) むぐらはふ下にも年はへぬる身の何かは玉のうてなをも見む *Mugura hau shita nimo toshi wa henuru mi no iduka wa tama no utena wo mimu.* How should I, who have lived in a weed covered hut, even look upon a jewelled palace?; *Shūiwakashū* (early 11th century) poem 110 けふ見れば玉のうてなもなかりけりあやめの草のいほりのみして *Kyō mireba tama no utena mo nakarikeri ayameno kusa no iori nomi shite* When I looked today there was no splendid mansion, only a hut of iris leaves; *Ise monogatari* (late 9th or 10th century) episode iii 思ひあらば葎の宿に寝もしなむひじきものには袖をしつゝも *Omoi araba mugura no yado ni mo ne mo shinamu hijiki mono niwa sode o shitsutsu mo* If you cared for me, we would sleep in a weed-grown hut, and spread our sleeves for a bed (all my translations).

> So overgrown is the garden that no drop of moonlight intrudes. Beneath the trees bloom irises, but with no-one to see them they scatter in the pond like so much rubbish. How pitiful I think them.

The writer complains of loneliness, and that nobody visits them in their overgrown garden. There continue to be intertextual references to classical Heian poetry, and in that context, a woman alone viewing her garden is an image of a woman waiting for her lover, fearing he will never come.[17] Classically irises signify the fifth month of the year, indicating that although the two letters have apparently no connection, the rules of seasonality are obeyed in the ordering of the volume.

The third letter (Fig. 8) fills 11 pages with scattered writing, and since it has a return, the full length is passed twice. This letter continues to use imagery and linguistic devices from classical literature. It's a highly emotional, even overwrought letter:

> Though 10,000 miles of mountains and rivers separate us, this heart will not change, you said as you left. Those words proved empty, and now not even a messenger do you send. Oh, I grow bitter! You are far away beyond clouds, like them your desire ever-shifting – just as the wise man of old said, you should take care. What did I expect, I ask myself, crying out for a friend to accompany me in this time of grief. This world, its people, like the kudzu leaf I should turn my back, but cannot. It must be some sin of my own I am repaying, and I think back, like a catalpa bow foolishly unstrung. Birds nestle in flowers, and tears nestle in sleeves. So it goes, the hollow promises of this world of pain.

The image is of a woman in classical literature who, having given herself over to a man who had professed his undying love, finds that his feelings have now cooled. Her overflowing despair at his desertion is expressed not only linguistically but through the articulation of scattered returning lines.

Letter three provides the tools to appropriately index features of all three letters. There is no reason other than the book's presumed female readership (and traditional expectations of calligraphy manuals) to assume all the letters are between women. The aligned writing of the first letter could indeed indicate coolness or detachment between women, but it might also, via the contested discourses around men and line articulation, point to a male writer avoiding scattered writing. The jewelled mansion, instead of being strange, then suggests a man writing to a woman, telling her that she can be certain of him, as his love will

17. See for example Izumi Shikibu's poem (late 10th century), no. 158 in *Shikiwakashū*: まつ人のいまもきたらばいかがせんふままくをしき庭の雪かな *Matsu hito no ima mo kitaraba ikaga sen fumamaku osiki niwa no yuki kana* If the person I am waiting for comes now, what to do? How sad if the snow in the garden is trodden. (My translation)



FIGURE 8. *Sazareishi*, Hasegawa Myōtei, 1713. Vol. 1, letter three. Images courtesy of Ebi Bunko.

last for a thousand years, even though snow prevents their seeing each other.

The second letter's complaint of unseen irises in an unvisited garden can now be read in light of the first: someone who finds her summer flowers wretched instead of charming might be the woman addressed in the previous letter, months after his promises in the spring. The third letter then generates in the reader's mind an image of the same woman, now distraught at his faithlessness: her distress is described both linguistically and formally, in her scattered writing with long return.

The final letter is scattered and has two returns, while the linguistic tone is soft and calm (Fig. 9):

> With your compassionate heart, pity people above insects and beasts and spare a drop of mercy. As the willow sways in the wind, soften, and repair your suspicious heart. Please keep this in mind. I will come soon, and I will tell you the details when I see you.

Surely this is someone telling the distraught woman to compose herself. Be less suspicious. They intend to visit her to talk in person. Who is it who is attempting to comfort her? The lexical item "willow" offers a clue. The text uses *yōryū* (楊柳), a Sino-Japanese, *kan* word, where in *nyohitsu* linguistic style the "wa" term *yanagi* (柳) would be expected. This invokes the *wakan* dialectic, pointing to the intellectual and erudite, and is therefore masculine-coded. While the lexical choice then indexes a male writer, the two returns suggest a soothing warmth and sincerity. The letter reads in a man's voice, perhaps authoritative, but also gentle, heartfelt and soft.



FIGURE 9. *Sazareishi*, Hasegawa Myōtei, 1713. Vol. 1, letter four. Images courtesy of Ebi Bunko.

This series of four letters form a romantic narrative, but one that a purely linguistic analysis obscures. It is the paralinguistic information in the calligraphy, and its indexicality, that enables a more satisfactory, narrative reading of the slim volume: there are characters, an evolving situation, and a fragment of a plot.

6. Conclusion

Returning then to the very first text examined above, *Wakamidori*'s description of the capital is linguistically almost identical to the later version, but it uses very different calligraphy.

> ... Higashiyama, of which many have heard. It may have been Yoshida who, starting with the goddess Amaterasu, brought here the gods of the more than sixty provinces of this land from where the sun rises: it is a sacred place.[18]

This is a potentially colourless list of sites, but uses a lyrical diction which is difficult to express in English translation. This linguistic expression is further heightened by the script form, an effect which is impossible to reproduce typographically.

> On the left the high mountain is Hieizan, unrivalled in Yamato, where, through the founding by Dengyō Daishi, [the teachings of] Mount Tendai were brought from China.[19]

---

18. (Hasegawa, 1707, f. 44-5^{r})... 東山吉田とかやはあまてらす御神を始として日の本六十餘州の御神を勧請ありし霊地なり

19. (ibid., f. 5^{r}-6^{r}) 弓手に高き御山は和国無双の比叡山伝教大師の開基にてもろこしの天台山をうつされたり

The two texts may relate to each other textually, and typographically presented as above are indistinguishable. As literature however, they operate very differently. *Wakamidori* draws on the refined elegance of *nyohitsu*, its warmth and sense of intimate direct address balancing the dryness of content. The later iteration *Miyako ōrai narabini kunizukushi* does not impart this kind of a reading.



FIGURE 10. First pages of various descriptions of the capital. L-R: *Wakamidori*, Hasegawa Myōtei, 1707. *Miyako ōrai narabini kunizukushi*, anon., 1779. *O-ie edo meisho hōgaku rakuyō ōrai*, Rinsendō, 1818. *Rakuyō ōrai narabini bunshō*, Rinsendō Yōshō, 1846. Untitled, Helen Magowan, 2022. Images: Wakamidori from Suzuran Bunko, remaining from Tōsho Bunko under CC except author's own.

In fact, *Wakamidori* had many iterations, and continues to generate new ones when I transcribe it in order to analyse it for my research, or format it for presentation (Fig. 10). The transposition of the handwritten into typography—a process of re-mediation—is often necessary, but the losses entailed tend to be treated (if considered at all) as minor collateral damage. In the case of *nyohitsu*, apparently superfluous aesthetic qualities of text are in fact fundamental to a text's meaning. The dominance of typography has served to obscure practices of meaning-making using non-typographic technologies of writing: attention to the brush as an instrument not only of art but of writing reveals not only a *nyohitsu* text's meanings but also typography's limitations.

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Semanticity in the Chinese Graphic System

Modeling and Assessing Its Consistency

Pierre Magistry & Yoann Goudin

Abstract. Beyond the dominant representation regarding the Chinese characters (sinograms) and its supposed "ideography" among the general public, learners, and (still many) teachers, this paper addresses the semanticity of the Chinese graphic system. We tackle this assumption and investigate the consistency of semantic clues embedded in the sinograms compositions. After a brief overview of principles of the economy of the Chinese graphic system, and the typology of the different functions of components, it is reported how probabilistic and graph-based models were designed in order to assess the semantic contribution of the 214 canonical "radicals". Results show that if *some* semanticity cannot be denied, it concerns a few among not the more frequent components. Discussion then addresses the relevance of the consistency of the semanticity of the system and what is at stake with such a focus for learning and teaching sinograms.

In Memoriam Zhitang Yang-Drocourt & Georges Antoniadis.

1. Introduction

This paper follows a previous publication (Magistry, Fabre, and Goudin, 2017), where we advocate the relevance of crafting phonological-based linguistic resources for learning languages related to the Chinese script (Sinitic languages and other languages written with sinograms). Based on a litterature review in cognitive science and the question of granularity in writing systems, we then demonstrated how grapho-phonological correspondences were helpful for the machine and hopefully—beyond dominant speeches and representations—useful in class for learners of these related languages : Sinographic languages. For this paper, after phonological cues and their reliability, we want to challenge our

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previous statement by tackling the reverse question and the hypothesis of the semanticity of this graphic system. This later view is mostly shared by sinologists, language teachers and consequently their learners. Thus, it perpetuates the representation according which at least in the West and especially here in the French context, since Jesuites figurism and Leibniz, sinograms would directly note ideas and not according the way in which phonological informations are embedded in these signs among the components they are combined with and their different functions. We hence intend to seek in which extend an array of functions—discriminant component, key for indexation, phonological or semantic clues and even autonomous sinograms or just graphical sub-component—of the modern canonical 214 components referred as "radicals" in English convey—or not—semantic information. We do so by designing probabilistic models which relate form to meaning, and we rely on such models to define odd ratio of semantic contribution. Finally these odd ratio enable us to provide a graph-based analysis and visualisation of *some* semantic contribution of a few radicals, but this semanticity remains marginal compared to our previous findings on the grapho-phonological relations.

This paper is organized as follows: in Section 2, we firstly describe the context and the practices at the origin of the graphic system originated from what became China, to introduce what is at stake for learning and teaching sinograms and related lexicons of the sinogramic languages. Section 3 presents different strategies to model *radicals* reliability as semantic clues. We compare two different distributional models (Skipgram and Bert) and two different languages (Mandarin and Taiwanese). In Section 4, we apply the model to build a network of radicals able to capture *some* semantic effect among a subset of most relevant *radicals*. Follows a discussion of possible applications and perspectives.

2. Chinese Graphic System: Historical Context, Evolution and Practices

In this section, our point is to shed light on very long term and still running paradox between in one hand, the observable evolution of the sinographic system and its fundamental principles among those phonetism; and on the other hand, the cultural practice of focusing on components initially designed for discrimination, institutionalised as key of indexation and since mainly reinterpreted as reliable at least for semantic purposes if not for ideography. We finally propose a five component functions typology and discuss the relevance to consider a sixth one further in this paper.

2.1. Early Evolutive Facts: Discriminant Components

Our position is strongly grounded on works such as those—already classical—by Karlgren (1923), Boodberg (1939)—*vs* Creel (1938)—and after them among other Boltz (1994) and Baxter and Sagart (2014); such as in the French academic field, Sagart (2006) again—*vs* Vandermeersch (1994)—and in the field of teaching and learning (Yang-Drocourt, 2022); or of course Chinese scholars such as (Qiú, 1988) and (Zhèngzhāng, 2003). For our brief historical sketch here, we mainly rely on Boltz's three steps of development to whose we add a fourth one after the normalization and institutionalization of the Chinese script. After him, we vigorously state in class as in our papers that, firstly the main development principle is phonetism as early as the very first step of oracle-bones available remains, and did not change later on as documented by Li (1986) until the Song period *Guǎngyùn* 《廣韻》 rime dictionary and then until modern and contemporary times (DeFrancis, 1989). Technically, after a first *zodiographic* step during which graphs already were not pictograms and referents could not be recognized. See "elephant" and "mouth" as examples in Figure 1. Quickly, antic practitioners had to face different problems of ambiguity as soon as the sentences went longer and more complex: the *multivalence* step. Indeed some zodiographs were ambiguous because they both noted words such as "elephant" or homophonic "statue" (cf. A in Fig. 1); or were polyphonic for related concept such as the "mouth" and "to call" (cf. B in Fig. 1). In order to disambiguate these situations, practitioners started to add a set of components in order to discriminate the different meanings, the *discriminative* step. As a result, a component nowadays referred to as "man" was added to the homophonic "statue," and the conventionally called "dawn" component was added to our polyphonic representative.

Finally, beyond the scope of Boltz's study, we added a fourth step of development during which neology was designed on the same principle of "neography" all along the exponential development of sinograms through History and the compilation of bigger and bigger dictionaries.

2.2. Key of Indexation and Beyond?

As a result of the increasing of literary corpus over time and the evolution of the script itself for notating and archiving, after thematic ordering works such as *Ěr yā* 《爾雅》 or *Jíjiùpiān* 《急就篇》, a major game changer arose with the earliest lexicographic masterwork by Xǔ Shèn 許慎's *Shuōwén Jiězì*《說文解字》(CE 121). Despite the fact that its 1,900 years of presentation to the Emperor three years ago was notably uncommemorated, its influence is still at the chore of our representation of the Chinese writing system and the invention of the "radical". The interesting

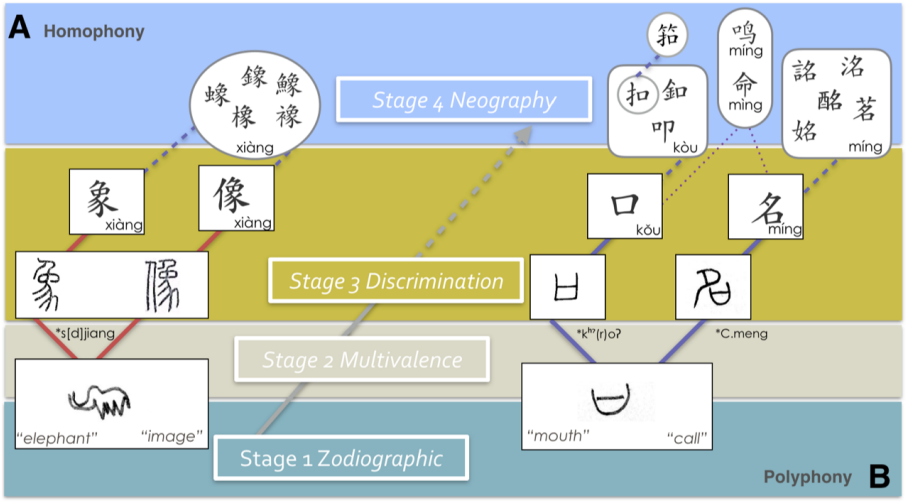

FIGURE 1. The different steps of evolution of the Chinese script after Boltz (1994, p. 64). Archaic Chinese (5th. c. BCE) reconstructions indicated with "*" by Baxter and Sagart (2014). Source: (Magistry, Fabre, and Goudin, 2017), Figure designed by Murielle Fabre.

things are that firstly, the observation between the emic designations of "radical", as it is translated in English. Initially referred as 部 *bù* "part" in the postface of *Shuowen Jiezi*, and later 部首 *bùshǒu* as the combination of 部 "part" determining the second sinogram 首 "head": "head of category". We are quite far from the Latin grammatical reference "radical," and so the changing desinence counterpart[1]. The second observation is that this proposal of indexation took centuries to become the reference system and dominant but not before the late Ming and above all Qing dynasty and the *Kangxi Dictionary* 《康熙字典》*Kāngxī Zìdiǎn* (1716) as presented by Bottéro (1996). The third is that the number for radicals did considerably vary through time, in number—but also in types—from 540 in the *Shuowen Jiezi* to 214 in the *Kangxi*, and since in contemporary times (Wèi, 2015): to 189 in *Xiàndài Hànyǔ cídiǎn* 《現代漢語詞典》first published in 1958 and 王竹溪's *Xīn bùshǒu dà zìdiǎn* 《新部首大字典》in 1988 dealing with 51,100 entries but 56 *bushou* only (Wáng, 1988). As a key of indexation, it is significant when we observe that it was chosen in the Diderot et d'Alembert's *Encyclopedia* for representing the Chinese writing system as "Clefs chinoises" in the dedicated volume of "Alphabets anciens et

1. In French, let's note that the direct reference to indexation through the use of "clé" or "clef" (cf. in Fig. 2) of an index as early as the first attempt of dictionary in the mid-18th century.

modernes" relying on the *Kangxi Dictionary* ordering and its 214 radicals. Except for those possibly used as sinograms as such, in this representation, these unautonomous components were presented as the equivalent of a character used for indexation in dedicated books as it is observable in conventionally alphabetic ordered dictionaries.

The other point is the—now past—extensive practice of training in Chinese philology, and nowadays sinographic languages learning: search in paper dictionaries for reading and translation purposes. Even if the last two decades relegated these artifacts to History with the successive raising of electronic devices and online resources, the fact is that the way of teaching, and consequently learning sinograms have mainly not changed yet, and still rely on the same practice of fundamental "radical" identification of any unknown sinogram, and then strokes counting and ordering, again because it is—was?—part of the main process for searching a sinogram in dictionaries. This practice is so deeply embedded that even computer resources do rely on it. Indeed, even for Unicode, sinograms are ordered by radical and complementary strokes number as we can observe it by activating the function "alphabetic ordering" in any spreadsheet for columns filled with sinograms.

2.3. Six Component Functions?

Relying on the previous two subsections, underlining the contradiction between in one hand, the principle of the development of the script—phonetism—and on the other hand, practices and representations focusing at least on the radical, we distinguish at least five different component functions and do question about the relevance of a sixth one, with examples provided by the sinograms already seen above:

- autonomous sinogram attested in the general lexicon such as 口 *kǒu* in Mandarin meaning "mouth, entrance, gate";
- phonological clue or *phonophore* after Budberg and Boltz such as in previous examples 象 in 像 or 口 in 名, respectively read *xiàng* and *míng* in Mandarin meaning "image" and "name, title, position," when they are in right side position in combination with the discriminant component 亻 "man" or 夕 "dawn" on the left;
- discriminant component such as in the different characters here above in a paleographic perspective with 亻 in 像 or 夕 in 名;
- key of indexation, *radical*, such as 口 in 台 read *tái* in Mandarin, "platform, unite" as early as the *Shuowen Jiezi* classified under the《口部》for lexicographic practices. It overlaps with the previous category as for 亻 in 像 but not systematically, such as in 名 for which the conventionalized radical is 口, and so as early as in the *Shuowen Jiezi*;
- subpart of a component with just graphic relevance as 口 in the phonophore 台 such as in 颱 *tái* "typhoon" or in 始 *shǐ* "start";



FIGURE 2. Chart of "Clefs chinoises" (Chinese radicals) in the second volume "Recueil de planches," "Alphabets anciens et modernes" part of *L'Encylopédie ou dictionnaire raisonné des sciences, des arts et des métiers* (1751-1772) p. 193.

To these five functions, we question the existence and the relevance of a sixth one:

– semantic clue? as we propose to tackle in this paper and the following sections.

In this section, through this historical sketch, we just saw how the evolution for more than two millennia, both embedded and competing different practices designed our representations and speeches about sinograms from classical exegesis to contemporary academic speeches, in classrooms then and nowadays, and even in the way sinograms are ordered in Unicode. If once, we proposed a modelisation of phonetic clues (Magistry, Fabre, and Goudin, 2017) for teaching and learning purposes, it is now time to investigate the consistency of the semantic clues.

3. Modeling Semantic Clues

3.1. Related Works

In this section, we present our attempt to provide computational models able to capture the semantic contribution of so-called radicals with a purely data-driven approach.

Some solutions have already been proposed in the literature. Among the most noticeable we can distinguish two different approaches to the question of the *semanticity* of the radicals. The first one addresses it in a lexicographic fashion, drawing from ontologies or the Generative Lexicon, esp. Hantology and HanziNet (Chou and Huang, 2006; Hsieh and Huang, 2006). The second one adopts a more task-based NLP strategy to show that the inclusion of information on radical can be helpful in semantic-related tasks such as text classification (Haralambous, 2013) or subjectivity classification (Xu and Huang, 2014). All these works make the hypothesis that there is some kind of *semanticity* in the radicals, which can be either described or relied on in practical applications. The main specificity in our present work is that we aim at detecting and assessing the reliability of potential *semantic clues*. Like the task-based approaches, we take into account all the sinograms and radicals found in our corpora, contrasting with publications on ontological approaches, which tend to cherry-pick most reliable examples for a more fine-grained description. On the other hand, we aim at producing a graphematic resource to describe the contribution of the radicals (complementing our previous work on phonetic clues). It will be more coarse-grained than ontologies but it contrasts with task-based approaches which can only show a global effect.

In our own previous work (Magistry, 2015), we proposed a model closer to the present paper. Both are based on a model of (coarse) mean-

ing similarity, which enables us to compute semantic clue reliability indices. Our first attempt was to rely on synonymy networks handcrafted by lexicographers and random walks. They have been shown to be reliable models of meaning similarity for psycholinguistics experiments and various NLP tasks. Unfortunately, such models rely on synonymy resources that are not easily available for most languages. Here we replace synonymy networks with distributional semantic and language models.

3.2. A More *Data-Driven* Approach

In this paper, we turn to distributional models which are trained from raw texts in an unsupervised fashion. We compare *Transformers*-based (Devlin, Chang, Lee, and Toutanova, 2019) models with more simple Skipgram models (Mikolov et al., 2013).

Bert models are considered the state of the art of distributional models, but are expensive and energy-intensive to train for a new language. Skipgram models on the other hand present the benefit of being easily and quickly reproducible. They can thus be tried on different corpora to obtain estimates for different languages or account for different situations of learners exposure (with learner corpora).

In this section, we report on experiments in which we compare Bert and Skipgram models trained on Mandarin corpora and two skipgram models trained on Mandarin and Taiwanese corpora.

3.3. Sinograms Embeddings Approaches

Both Bert and Skipgram are vector-space models and provide a mapping function from sinograms to high dimensional vectors in spaces where semantically similar sinograms are expected to be close to each other (so-called *embeddings* esp. when used in the context of neural neworks). The main difference between the two types of models is that the Skipgram model yield a single vector for each sinogram (type-wise) where Bert compute "contextual embeddings" and yield a different vector for each occurrence of each sinogram (token-wise), depending on the context in which the sinogram occurs.

Putting aside this distinction, and mathematical formulation to go from sinogram vectors to semantic clues estimate are very similar in the two cases. The main intuition is that these models are good at providing good substitution candidates in a semantically consistent way. Our hypothesis is that if a radical acts as a reliable semantic clue, then its substitutes should be more likely to have the same radical. To compute

our reliability score, we first turn the sinogram vector space into probability distributions (of a sinogram being replaced by other sinograms by the model) and then compute the following odd-ratio to measure the effect of the radical:

$$R_r = \frac{P(s = r \mid o = r)}{P(s = r)},$$

where R_r is the ratio computed for a radical r, $s = r$ stands for substituted radical being r, and $o = r$ stands for original radical being r. In other words, we compare the probability of selecting a sinogram with a radical r to replace a sinogram with the same radical with the probability of selecting such a sinogram in the general case. A high R means that the radical tends to be preserved accross the substitutions, which is expected if there is some kind of semantic field associated with the radical. On the other hand, a low value (esp. 1 or less), correspond to cases where the radical has no observable semantic effect.

3.3.1. *Corpora*

To compute the odd-ratio described in the previous section, we rely on two text corpora. For Mandarin, we used the *Academia Sinica Balanced Corpus of Modern Chinese* (ASBC, 中央研究院漢語平衡語料庫)[2]. For Taiwanese, we used the *Digital Archive Database for Written Taiwanese* (DADWT, 台語文數位典藏資料庫)[3] (Iunn, 2007).

3.3.2. *Assessing Semantic Clue Reliability With Bert*

Due to the high cost of training a Bert model, we rely on a pre-trained model readily available on HuggingFace[4]. This model was trained on Wikipedia data in Mandarin as a *masked language model*, which learnt to guess "masked" sinograms in a given context (a sentence). We use the same procedure and apply a *softmax* function on its output to obtain the probabilities of possible substitutions of every sinograms in the ASBC corpus (we exclude the substitutions of a sinogram by itself).

We replace every sinogram with its radical according to the information provided in the Unihan database[5] from Unicode.

We then aggregate the probabilities corresponding to all the occurrences of each radical to obtain a single probability distribution of radical substitutions for each radical. With these values, we can apply the odd-ratio and obtain an R_r value for each radical r.

2. http://asbc.iis.sinica.edu.tw/
3. https://github.com/Taiwanese-Corpus/nmtl_2006_dadwt
4. https://huggingface.co/google-bert/bert-base-chinese
5. https://www.unicode.org/charts/unihan.html

3.3.3. *Assessing Semantic Clue Reliability With Skipgram*

A Skipgram model is trained by trying to predict co-occurrences of sinograms. It produces a single vector per sinogram, based on all the contexts of its occurrences in the corpus. According to the distributional hypothesis, this vector space can be used as a model of semantic similarity.

We use *gensim* (Řehůřek and Sojka, 2010) to train a model on each corpus (ASBC for Mandarin and DADWT for Taiwanese), we obtain a vector-space for each language in which we can compute distances between sinograms.

We then compute substitution probabilities by looking at the closest neighbors of each sinograms, using the "cosmul" similarity from (Levy and Goldberg, 2014) as a the weight to be normalized. The main difference with the Bert approach is that we obtain a probability distribution for each sinogram in the vocabulary rather than one distribution for each occurrence in the corpus. This slightly changes the aggregation but it is also possible to perform the same replacement of each sinogram by its radical to compute a ratio R_r similar to the one described in the previous sections.

To distinguish between the different models to produce various probability ratios, we adopt the following notation:

$$R_{<l,m,r>},$$

where:

- l is the language (*mdn* for Mandarin or *tw* for Taiwanese),
- m is the model (*tf* for Bert Transformer and *sk* for Skipgram), and
- r is one of the radicals.

In the following experiments, we compare $R_{<mdn,tf,r>}$ with $R_{<mdn,sk,r>}$ and $R_{<mdn,sk,r>}$ with $R_{<tw,sk,r>}$.

3.4. Results

The results obtained with the described methods are shared as three CSV files corresponding to the three models $R_{<mdn,tf,r>}$, $R_{<mdn,sk,r>}$ and $R_{<tw,sk,r>}$.

The raw values are available for download on Zenodo[6] along with the code to generate the figures discussed in the present section. Visualisation of the following figures with tunable parameters is also possible online through an R-Shiny interface[7].

6. https://doi.org/10.5281/zenodo.11223724

7. https://analytics.huma-num.fr/Pierre.Magistry/Grafematik2022/

TABLE 1. Spearman rank correlation coefficients between R values from different models. It shows a very strong correlation between the two skipgram models and a strong correlation between skipgrams and transformer models.

	$R_{<mdn,tf,r>}$	$R_{<mdn,sk,r>}$	$R_{<tw,sk,r>}$
$R_{<mdn,tf,mdn>}$	1	0.609	0.606
$R_{<mdn,sk,r>}$	0.609	1	0.754
$R_{<tw,sk,r>}$	0.606	0.754	1

3.4.1. *Spearman Correlations*

A first question is whether the ranking we obtain in the three cases are consistent. To address it, we compute Spearman rank coefficients and present the results on Table 1. As we can see, there are *strong* (around 0.61) or *very strong* (0.75) correlation between the rankings obtains by the different models. Interestingly, the difference between Skipgrams and Transformer models seems larger than the difference between the two languages. This allows us to argue that the Chinese graphic system shows properties that are language independent (Mandarin and Taiwanese are far from being mutually intelligible as spoken languages).

3.4.2. *Choosing Skipgrams Models Over the Transformers*

Considering the correlations from Table 1, and more importantly, the computational costs in time and energy, we decide to focus our analysis on the Skipgram models. The cost of transformer based models makes it difficult or impossible to address new languages beside Mandarin or to conduct future experiments based on training corpus selection (especially to reproduce our results on learner corpora). Even the decoding step to compute the substitution probabilities from the pre-trained model was significantly slower compared to the training of a Skipgram model from scratch[8].

3.4.3. *Semantic Clues Ranking*

We can now confidently study the rankings obtained by our method.

The decomposition from the Unihan database follows the convention of the *Kangxi Dictionary* to divide the sinograms between 214 radicals.

In our corpora, only 205 radical are attested. In Mandarin, 74 are never realised in substitution ($R_r = P(s = r) = 0$) and 128 have $R_r > 1$. In Taiwanese the respective figures are 84 for $R_r = 0$ and 108 for $R_r > 1$.

8. Our code could easily be optimized, so exact figures are not very relevant but it took 2 days with a RTX 3090 GPU, when a skipgram model takes less than an hour to train on high end CPU.

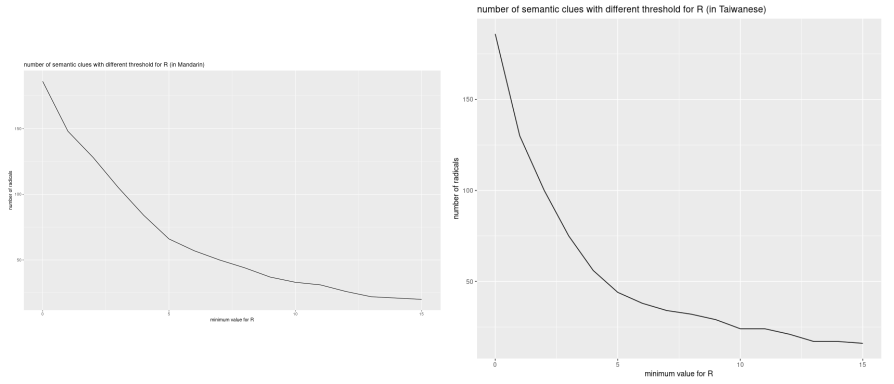

FIGURE 3. Number of r with $R_r > x$ in Mandarin on the left and Taiwanese on the right

It is not easy to define a clear cut on the R_r value to distinguish between reliable and unreliable clues. In Figure 3 we plot the number of radicals r with $R_{<l,s,r>} > x$. The graphic on the left is based on Mandarin (ASBC) data and the one on the left is based on the Taiwanese (DADWT) data. As we restrict the list to more and more reliable R, we can see that the number of radicals more likely to be kept quickly drops under 50.

3.4.4. *Comparing Taiwanese and Mandarin*

We can visualize the correlation between $R_{<mdn,s,r>}$ and $R_{<tw,s,r>}$ on Figure 4. The radicals that appears on the top right corner are the most reliable as a semantic clue.

4. Graphs of Semantic Clues

One limitation of our R metric when used as described in the previous section and especially when compared to the ontology-related approaches, is that we take the supposed meaning of each radical in isolation. We only consider substitution of a radical by itself (vs. by any radical) and our computation ignores the possibility for two different radicals to have related meanings. This is not ideal as related radicals are easily noticeable and discussed in the literature such has body parts or animals. For example, (Huang, Yang, and Chen, 2008) chose to discuss four different radicals related to "Four Hoofed-Mammals" (羊 *bovid*, 鹿 *deer*, 牛 *cattle* and 馬 *horse*).

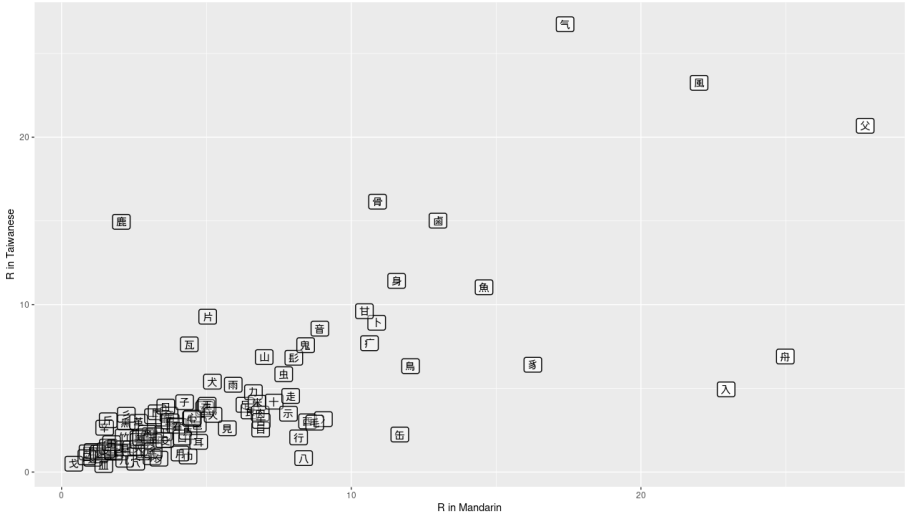

FIGURE 4. Scatter plot comparing R values in Mandarin and Taiwanese for each radical.

To explore this possibility, we propose another experiment. Firstly we compute odd ratio similar to those in the previous section, but to answer the question "what are the odds to go from radical a to radical b with a substitution following our skipgram model?" We do so for all possible pairs of radical (a, b). Secondly we build a graph in which nodes are radicals and edges are the ratio values (using the ratio as weights and cutting the edges out under a threshold). Then we apply Fruchterman-Reingold layout algorithm for spacialization (Fruchterman and Reingold, 1991) and Infomap clustering (Rosvall and Bergstrom, 2008) to color the nodes and produce Figures 6 and 7. In the printed figure, we set the R threshold to 4. It corresponds as a good balance to keep a large number of radicals while obtaining a graph with a good level of clustering modularity (hopefully creating semantic clusters). We show the modularity as a function of the R threshold on Figure 5.

The reader can experiment with different values of the threshold on our R-Shiny interface[9].

Clusters appear clearly from both Mandarin and Taiwanese datasets. These clusters indeed correspond to animals, bodypart, meteorology or food. We can thus argue that we were able to see some semanticity of the radical emerging from the data. Our measures seems consistent to the semantic classes typically discussed in the literature, with some lit-

9. https://analytics.huma-num.fr/Pierre.Magistry/Grafematik2022/

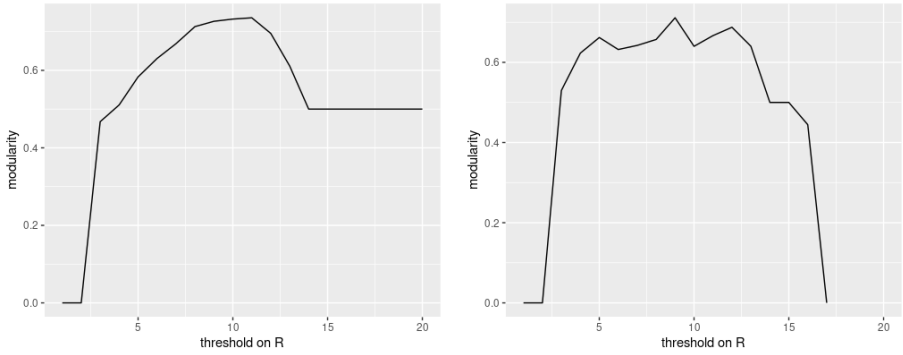

FIGURE 5. Clustering modularities as a function of the threshold on the value of R for the Mandarin (left) and Taiwanese (right) graphs

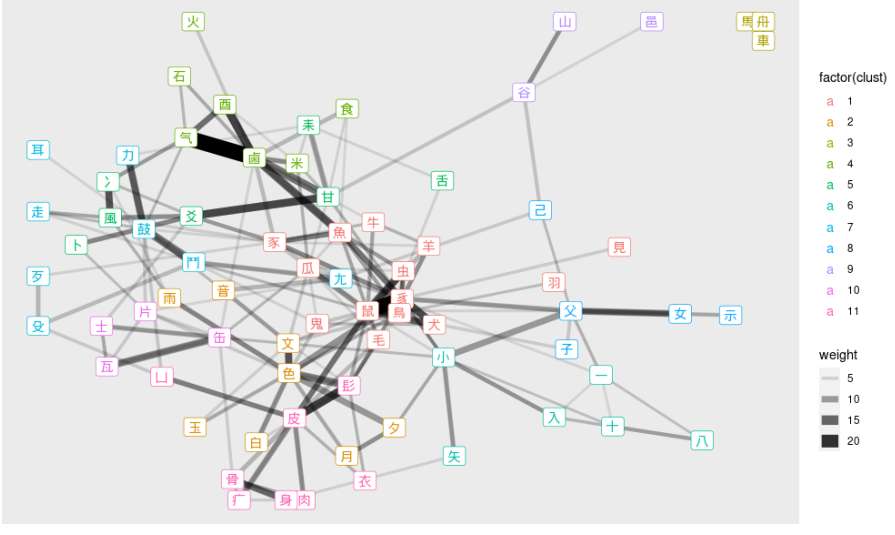

FIGURE 6. Graph of semantic clues in Mandarin with a cut at $R > 4$ with Infomap clustering and Fruchterman-Reingold layout

tle discrepancy that seems understandable as well (for example, we can observe that the radical 馬 *horses* is more related to carriages than it is to other mammals).

However, this semanticity is only observed for a few dozen of radicals. As far as our model can tell, we provide no evidence that the ontological description can be extended beyond those few components.

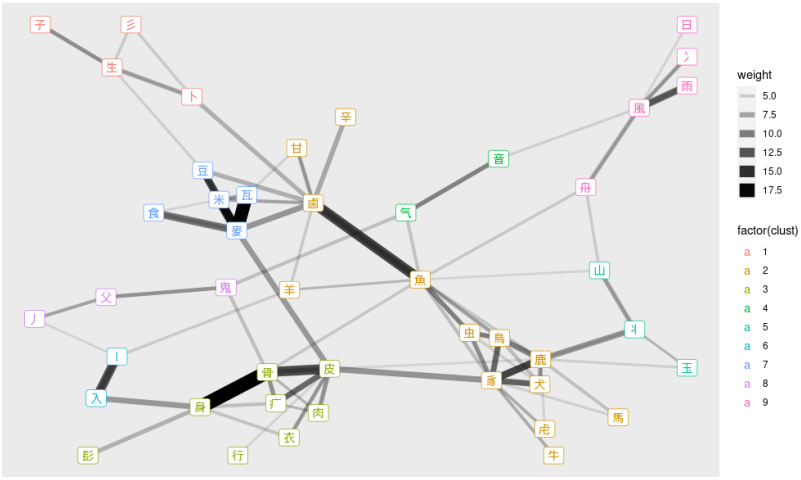

FIGURE 7. Graph of semantic clues in Taiwanese with a cut at $R > 4$ with Infomap clustering and Fruchterman-Reingold layout

5. Discussion and Future Work

Despite our initial position which is to advocate for the importance to study and teach the grapho-phonological correspondences in the Chinese Script, we wanted to provide a fair treatment of a possible semanticity effect that could emerge from the data. We were able to propose a computational model which capture some semanticity in some of the radicals. However, only a very small minority of the 214 traditional radicals can be considered as reliable *semantic clues*, much less than the *phonetic clues* we were able to detect in our previous work (Magistry, Fabre, and Goudin, 2017).

The method proposed in this work was experimented on both Mandarin and Taiwanese data. We observed a strong correlation in our rankings between the two languages. As the Chinese script is or has been used to write a variety of languages, it is interesting to observe that some properties seems to hold cross-linguistically, but it would also be relevant to describe the discrepancies. This goes beyond the scope of this paper and would require a more diverse dataset. Currently we can only compare ASBC and DADWT, but drawing robust conclusions to compare the two languages would also require some comparison between different corpora for the same language. In other words, if the correlations observed on Table 1 advocate for the robustness of our models, we can not say if the differences we can spot come from differences between the languages or simply between the two corpora. More investigations using the proposed measures are required.

For the same reason, we hope that the code and data which come with this paper[10] can foster further discussions on the Chinese script and help in teaching languages written with sinograms, but the precise rankings are to be considered as estimates and work in progress. We invite the readers to experiment on a variety of corpora of their own.

Another expected extension of this work is to run the same computation for all possible graphical component without restricting ourselves to the canonical 214 radicals from the *Kangxi Dictionary*.

6. Conclusion

In this paper, through the probabilistic models we designed, we are able to propose a graph-based analysis and visualisation of *some* semantic contribution of a few radicals, but this semanticity remains marginal compared to our previous findings on the grapho-phonological relations. It is the same for a semantic function of these graphic components. If we do not reject it, we lower it as a side function of the discriminant component. This conclusion inspires us a last question and a final statement: beyond our community of graphematicians, may this paper be relevant and used for pedagogical purposes? Indeed, our readers do not stand for themselves and do stand in order also to be read by teachers and ideally by—with—learners themselves, aiming so at to make these communities to come aware of what is at stake with general representations and dominant speech about Chinese graphic system. Thus, we firmly call for a definite shift of speeches and practices in the field of Chinese learning and teaching, from paper and radical (or alphabetical) ordered dictionaries to dynamic online open resources: a paradigmatic and radical shift.

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Zheng Qiao's Grammatology

Elvin Meng

Abstract. This paper begins by examining Chinese grammatology's complex relationship with empirical, epigraphic research and questioning to what extent it is—or should be—an offspring of traditional *liushu* studies, conventionally but ahistorically traced back to Xu Shen's *Shuowen* postscript. But instead of answering these questions in the context of current academic debates in their respective disciplines, this paper returns to the philological writings of Zheng Qiao (1104–1162) whom many consider to be the progenitor of later *liushu* studies, and demonstrates that these writings contain multiple currents of thought that do not lend themselves easily to be recruited by a single, coherent research program.

1. Introduction: Pluralizing Chinese Grammatology

1.1. The Case of 急〈㣺為心〉

The third sentence of the "first" Guodian *Laozi* manuscript (generally known as Guodian *Laozi* A or 郭店老子甲) had to be interpreted multiple times by some of China's most erudite philologists.[1] The sentence corresponds to—and therefore finds itself read against—the second sentence in chapter 19 of the *Laozi* 老子 text as we have received it through Han-dynasty (202 B.C.E.–220 C.E.) editors, which reads

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1. My exposition in this paragraph follows that of Shaughnessy (2006, pp. 23–28). The Guodian Chu Slips were unearthed in 1993 just north of the ancient capital of the State of Chu, and are dated to the second half of the Warring States period (c. 475–221 BCE). Images, transliterations, and translations of the Guodian text are available in a number of Chinese and English language publications (Allan and Williams, 2000; Cook, 2012; Henricks, 2000; Jingmen shi bowuguan, 1998). It should be noted that the bulk of the disagreements revolved around the interpretation of the fourth character of the manuscript, while I describe here, for the sake of simplicity, the multiple possible interpretations of the second.

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絕仁棄義、民復孝慈。

Cut off humaneness and discard propriety, and the people return to filial piety and parental love.[2]

The Guodian text, also composed of eight characters, differs from the received text at several points, one of which is the graph that replaces 仁 as that which is "cut off": 急〈⿰為心〉 (Jingmen shi bowuguan, 1998, pp. 3, 111).[3] The character assembles familiar significs ("action" 為 and "heart" 心, respectively) but, as a composite, does not appear in any received texts and is certainly not used in modern written Chinese. The idiosyncratic graph therefore was given the customary treatment by the Jingmen Museum editors preparing a transcription of the bamboo slips for publication: following the reading of Qiu Xigui 裘錫圭 who reviewed the manuscript for Beijing University Press, the editors interpreted the graph as a variant of a known character, in this case *wei* 偽, or "artifice" (ibid., pp. 111, 113). Under this and another similar interpretation, they transcribed the line inscribed on the bamboo slip as

絕偽棄詐、民復孝慈。

Cut off artifice and discard deceit, and the people return to filial piety and parental love.[4]

The problem of this interpretation, as Edward Shaughnessy suggests, is that "by forcing the script of the Warring States period to correspond to the script of the Han and later, [it is] possible that we lose some of the nuance of the original" (2006, p. 27). The habitual practice in Warring States epigraphy of seeing the unruly script forms of bamboo slip inscriptions as variants of the more legible Han forms epitomized by Xu Shen's 許慎 *Shuowen jiezi* 說文解字 dictionary (ca. 100 C.E.), a procedure already underway in the Han dynasty, leaves unexamined the formation of the very conceptual categories it necessitates.[5] Namely, the naturalized notion of a "standard form" of characters and with it, a weakened definition of graphic variant as always already that of a character in such a standard form. "Is not another reading possible?" asked the late historian Pang Pu 龐樸, who took the heart signific 心 in the

2. Translation modified from Shaughnessy (2006, p. 24).

3. For this and other difficult-to-represent sinoform graphs, I follow the conventions of Ideographic Description Sequences (The Unicode Consortium, 2011, §12.2).

4. Jingmen shi bowuguan, 1998, p. 111. Translation modified from Shaughnessy (2006, p. 24).

5. This editorial tendency enacts, in effect, only the first of the four methods Tang Lan 唐蘭 (2015, pp. 163–277) proposes for the decipherment of unknown graph forms, the remaining three being: deducing the meaning of a graph from context, identifying the meaning of its components, and positioning the graph in a larger context of graphic transformations.

Guodian manuscripts to be semantically significant, even if it appears in composites unattested in later texts. Could 憸 not have been a now-lost term, evanescent though it may have been in the first place, that meant an action of the heart, or emotional (as opposed to physical) activity?[6]

Reading from, or reading into? Haun Saussy's (2021) question regarding the challenge posed by the recently published bamboo slip *Classic of Poetry* (*Shijing* 詩經) can also be posed to the study of writing in general.[7] To what extent could an unexpected graph in manuscript culture be made intelligible without assuming that it is only a familiar graph, veiled by orthographic idiosyncrasies that are identified merely to be discarded?[8] More specifically, where does "graphical variation" end and "lexical variation" begin?[9] (An especially important question given the disparity of exegetic significance conventionally attributed to the two.) While the interpretation of 憸 itself is a matter of disagreement among a relatively small set of experts, their process of making sense of the graph, which is typical of the laborious and difficult endeavor of reading pre-Han inscriptions in general, betrays aspects of Chinese grammatological thinking underdeveloped in generic descriptions thereof.

1.2. The Problem with *liushu*

By generic descriptions of Chinese traditional grammatological thinking, I mean those articulated by historians as well as grapholinguists which, for various reasons, take as their chronological or conceptual (often both) anchor the "Six Modes of Character Formation" (*liushu* 六書) paradigm most famously described in the *Shuowen Jiezi*.[10] It is not my aim

6. For a more detailed summary of Pang Pu's position and Qiu Xigui's response, see Shaughnessy (2006, pp. 26–28).

7. Saussy is commenting on the Anhui University manuscripts, whose first batch was published in 2019 (Huang, 2017; Huang and Xu, 2019). A number of English language studies of the Bamboo *Classic of Poetry* already exist and can be found in the 2020 issue of *Bamboo and Silk*, in which Saussy's essay appears.

8. It is not that the process of epigraphic interpretation forecloses the encounter with the new. Qiu Xigui (1980) pointed out decades ago that excavated texts may contribute to our understanding of received texts. However, with a few welcome exceptions, in practice the linguistic or referential content of the text, and in particular its "original" form reconstructed by processing the manuscripts through grammatological and hermeneutic procedures, tends to be the preferred subject of investigation rather than the logistics of graphic or textual variation *per se*.

9. To borrow the (in my view problematic) distinction in Boltz (1994, p. 159).

10. For a summary of the "Six Modes" in English, see Boltz (ibid., pp. 143–155) and Qiu (2000, pp. 151–162). More detailed surveys of the historical context as well as the evolution of the paradigm in later intellectual history can be found in Boltz (2017), Bottéro (1998), and Wang (1979).

here to survey the traditional paradigm or its various proposed modifications (e.g., Chen, 2006; Myers, 2019; Qiu, 2000; Tang, 2015). Neither do I reiterate the familiar thesis that the *Shuowen Jiezi*'s component-based analysis of characters, which is related but irreducible to the *liushu* paradigm that only briefly appears in the dictionary's postscript, provided perhaps a far more influential framework of character analysis than *liushu* itself in the history of Chinese lexicography.[11] Rather, by pointing out and then bracketing the central position *liushu* occupies in our understanding of emic theorizations of Chinese characters, I want to draw attention to different modes of grammatological thinking necessitated by the constant encounters with apparent neographisms such as 慾 in epigraphy. Modes of thinking which foreground graphic variance, for which the *liushu* theory, which treats characters as a closed set of graphs whose standardization is a *fait accompli*, has proven time and time again to be inadequate.[12]

An instructive example is the published Ph.D. dissertation of the epigraphist Liu Zhao 劉釗, who professes a graph-oriented approach to the study of earlier character forms (2011, pp. 228–234).[13] Liu studies patterns underlying the various graphic variations within oracle bone and bronze inscriptions, and identifies the following operating "rules" that might explain the diversity of graph forms in oracle bone inscriptions specifically:

1. graphic inversions, which may be subdivided into the inversion of strokes, components, or full graphs;
2. ornamental strokes;
3. simplification or linearization of contour;
4. omission of strokes or components;
5. multiplication of strokes, components, or a full graph;
6. substitution of significs with those having similar meanings;
7. replacement by a visually similar graph;
8. other types of allography that are more challenging to explain (perhaps to be attributed to periodization or the style of the scribe);
9. unique graphs of proper names;

11. For the component-based organization of the *Shuowen Jiezi*, see Bottéro and Harbsmeier (2008). For a study of its legacy in medieval Chinese lexicography, see Bottéro (1996).

12. On the prescriptive nature of the *Shuowen Jiezi*, and *a fortiori* that of the *liushu* paradigm, see Boltz (1994, pp. 145–146) and especially Galambos (2004).

13. *Xing* 形, as opposed to sound (*sheng* 聲) or meaning (*yi* 義). This trichotomy is conventional in characterizations of Chinese classical philology, historically termed "Lesser Learning" (*xiaoxue* 小學, in contradistinction to what may be termed "philosophy"). It can be traced back to the division between hermeneutics, phonology, and graphology drawn in the *Yuhai* 玉海 encyclopedia compiled by Wang Yinglin 王應麟 (1223–1296) of the Southern Song dynasty (Tang, 1969, pp. 4–6; Tang, 2015, p. 356 ff.).

10. adaptation of character form to the specific textual context.[14]

Liu identifies similar, but not identical, patterns in early and Western Zhou bronze inscriptions, before discussing even more general patterns of graphic transformation including intra- and inter-graphic assimilation and the becoming-semantophonetic of syssemantographs. In other words, in early Chinese inscriptions, the fundamental multiplicity of graph forms, crisscrossed by a plethora of mutational trajectories that cannot be simplistically predicted by a teleological view of script evolution (*pace* Gelb, 1963, pp. 190–205), meant that every instance of writing was less a citation of a predetermined repertoire than a moment of that repertoire's own continuous transformation.[15] It is therefore unsurprising that, in the methodological reflections near the end of his book, Liu criticizes those modern scholars whose veneration of the *liushu* as the fundamental means of character analysis verges on "superstition" (2011, pp. 226–228). Even a generous reading of *liushu*, in which *shu* is taken as a verb such as "scribal act" (Bottéro and Harbsmeier, 2008, p. 252), is undoubtedly insufficient given the variational complexity at play in a corpus such as Liu's.

While Liu may have been deliberately polemical in his criticism of *liushu*, it is undeniable that, for any scholar who works in a hands-on manner with historical Chinese inscriptions, knowing how to make sense of graphic variance (which would have become familiar to such a scholar early in their training) is just as useful, if not more so, than *liushu* or similar taxonomic theories that presume a standardized corpus of characters and a standardized way of using them. But such forms of knowledge are sometimes presented as merely supplementary to *Shuowen Jiezi*-style speculations about the nature of Chinese writing, even in the writings of those scholars who know the former to be equally indispensable forms of grammatological knowledge. Qiu (2000) exemplifies this tension in the organization of his book's chapters: chapters 7, 8, and 9 explicate his "three-principles" theory that continues the revision of *liushu* in the footsteps of Tang (2015) and Chen (2006), but the substantive nouns that comprise those chapters' titles ("semantographs," "phonograms," and "loangraphs") are subverted in the subheadings by the proliferation of verbal nouns ("addition," "alteration," "replacement," "abbreviation," "interchange," "deformation," "borrowing," and so on) whose logic is continuous with the earlier and later chapters—-chapters that deal not with "classification" (the title of chapter 6 which frames chapters 7, 8, and 9) but with processes of graphic

14. See Liu (2011, pp. 9–67) for the detailed demonstration of these patterns.

15. Analogically, this relationship between "repertoire" and "graph" recalls reinterpretations of the relationship between *langue* and *parole* (Saussure, 1986) as one of autopoiesis in the sense of Maturama and Varela (1980); see, e.g., Thibault (2011).

change along various timescales.[16] Returning to earlier scholarship, Tang (2015) displays a similar internal differentiation of grammatological knowledge, with his version of "three-principles" being placed under "the origin and evolution of writing" (文字的起源和其演變) while the more complex and heterogeneous patterns underlying graphic variance are described under "how to recognize ancient characters" (怎樣去認識古文字). Within these organizations of knowledge, the grammatology of variations becomes the epigraphical *mētis* (practical wisdom) from which categorizing projects struggle to distinguish themselves as better-codified ways of seeing, not least because they can never fully leave the former behind without risking the collapse of their own practical efficacy.[17]

What, precisely, is the relationship between epigraphy and grammatology in the Sinographic context? This is by no means a simple question, and the answer one gives will likely depend on one's own disciplinary affinities.[18] It is not uncommon, especially in the West, for those who research the grammar of Chinese characters in the last few decades to follow Ferdinand de Saussure's (1986) suggestion that the study of language can be separated along the lines of synchronic and diachronic inquiries—the modern science of linguistics on the one hand and the old-fashioned tradition of philology on the other (e.g., D. K.-W. Wang, 1979, pp. 32–38).[19] What Qiu Xigui the epigraphist has to say about writing, if we were to follow this train of thought, would be of limited import to the interlocutors of Qiu Xigui the grammatologist, and to insist otherwise would be to commit a category mistake.

But delimiting the object of linguistic research in this way comes with its sacrifices. A particular legacy of the Saussurean distinction in linguistics, as philosopher Frederik Stjernfelt notes, is that studies of

16. The "three principles" are followed by chapters 10 and 11, dealing respectively with "allographs, homographs, and synonymic interchange" and "graphic differentiation and consolidation," whose placement outside chapters 4 and 5 ("the evolution of the shapes and styles of Chinese characters") suggest that they, like the "three principles," are more general patterns of graph formation rather than processes specific to an earlier stage in the history of Chinese writing.

17. Cf. Scott (1998, pp. 309–341). For the notion of *mētis* in Ancient Greece (which Scott invokes), see Detienne and Vernant (1974).

18. The question is especially complex when one takes into consideration the fact that many prominent twentieth-century Chinese epigraphist-grammatologists were also tasked with a third commitment: writing reform. The empirical or historical study of ancient inscriptions, the scientific categorization of a panchronic inventory of character forms, and the reinvention of writing in light of modern political and technological concerns were therefore interlinked, each informing the others. For a sketch of this complicated history, see Hou (2021), Tsu (2022), and Zhong (2019).

19. It is noteworthy that the disciplinary-specific definition of "language" in modern linguistics, with its emphasis on synchronicity and speech, was also repeatedly invoked in earlier polemics around the "ideographic myth;" see Lurie (2006).

meaning tend to "see static structures as having ontological prominence over their transformations" and to be "interested primarily in 'codes' seen as stable relations between content and expression," which in turn has "hindered the insight into the centrality of the concept of transformation" (Stjernfelt, 2007, p. 120). "The place of synchronous description in the middle, between diachronous linguistic development on the one hand and linguistic use on the other," Stjernfelt continues, "has split this structuralism into two concepts of time without mutual contact and both ontologically underweight, with the often-noted implication that diachronous system change as the result of changes in use tends to become invisible" (ibid., p. 120). Such a differentiation of differences is already at work in aforementioned bifurcations of grammatological knowledge: the distinction between lexical and graphical variations, for example, or that between variations of script forms falling under "evolution of writing" and those that are merely circumstantial and therefore inconsequential.[20]

The difficulty that scholars such as Tang Lan and Qiu Xigui had in trying to fully separate taxonomic grammatology from empirical epigraphy can therefore be interpreted as a symptom of the synchrony/diachrony distinction's maladjustment to the study of Chinese character formation. Recent developments in grammatology in China, of which Liu (2011) is just one example, demonstrates the benefit of sidestepping this distinction through a new, non-teleological approach to the "evolution of character structure," which creates a richer description of the formation of characters by deemphasizing their structure at any given historical moment to focus on the pluralized materially-, aesthetically-, and pragmatically-conditioned transformative processes in which they are involved (see, e.g., Zhang, 2008; 2012). Nevertheless, the emphasis of these scholars tends to land on the early history of Chinese writing, which creates its own set of problems.

One needs only note that the productivity of any Chinese character-grammatical rule is best observed through the introduction of neographisms into the inventory of characters, although the exponential growth of this inventory is a sedimentary (rather than evolutionary) process that takes centuries to unfold (Myers, 2019, pp. 3–6). In fact, the vast majority of character forms in use today came about not in what is usually thought of as the "formative period" of Chinese writing—that is, up to the Han dynasties—but in the roughly two-millennium gap between the *Shuowen Jiezi* and *The Unicode Standard*, an interval often ne-

20. The distinction between lexical and graphical variation underlies Martin Kern's (2002) otherwise erudite discussion of textual variants and hermeneutics in the context of the *Classic of Poetry*, which nevertheless remains useful as an introduction to the topic in a Western language.

glected in studies of the formation of Chinese characters.[21] What is one to do with the proliferation of neographisms in manuscript and print culture of this long temporal span—neographisms not all of which have survived to the twentieth century?[22] A leading scholar of medieval Chinese manuscript culture points out that "we need a mechanism for interpretation of the structure of a character in its existing state, the way it appeared to contemporary readers of manuscripts or inscriptions. In the process of being used, characters continue to change and this change is often governed by rules that may be largely independent of the principles that had been at play during the formative stages of the writing system" (Galambos, 2014, p. 55).[23] Imre Galambos is understating the stakes of his article here, as he writes a few pages later that "[he] believe[s] that the principles underlying [his attempt at formulating empirically determined, non-*liushu* strategies of character formation] are theoretically valid for any time period that produced texts written with Chinese characters," and that his is a list that, not forming "a closed set with a specific number," will instead "grow as new categories are identified and we will not have to force every character form into one of the existing categories" (ibid., pp. 57–58).[24] If these statements seem to echo those of the epigraphists cited earlier in the introduction, it is because early and medieval Chinese practices of writing, though separated by the monumental transformations of the Qin and the Han empires, might have more in common at a fundamental level than what received wisdom otherwise imparts. Commonalities that demand a rethinking of what the study of Chinese character structure should take as its empirical objects, and of the presuppositions about the ontology of characters underlying various types of analysis.[25]

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21. A specific consequence of this neglect is that the syssemantograph category (*huiyi* 會意) of the *liushu* is sometimes considered a "myth" by twentieth-century linguists (see, e.g., Boltz, 1994, pp. 147–149, 153–154), but those who study medieval manuscript culture closely observe that, to the contrary, characters with such "folk-etymological" structures are widely attested in preserved manuscripts, even if some of those graphs are no longer in use today (Branner, 2011; Galambos, 2011; 2014, pp. 62–64).

22. For useful inventories of variant graph forms in medieval and early modern Chinese manuscript and print culture, see Huang (2019), Zeng and Chen (2018) and Zhao (2019).

23. Scholars of medieval manuscript culture have made great process on this topic in recent years, but their insights regarding the nature of graphic variation remain, so far, confined to the specialized field despite those insights' relevance for the study of writing at large. For a snapshot of recent developments, see Van Cutsem (2022).

24. Galambos' (2014) short list of proposed formation principles are the following: archaized structures, folk-etymological structures, taboo characters, ligatures, and assimilated forms.

25. An exemplary precedent in redirecting the study of Chinese characters in this direction through the examination of manuscript evidence and considering the impe-

1.3. The Goal of the Paper

These tensions between the observable productivity of graphic variation and the paradigm set forth by Xu Shen, between descriptive and prescriptive modes of thought when confronted with the proliferation of variant characters in historical practices of writing, call for a reconsideration of the data and method of Chinese grammatology. It is in response to these concerns that this paper critically engages and reactivates ways of thinking from an earlier moment in the history of the discipline. Typically, instead of attending to the operating concepts and methods in medieval scholarship on their own terms, early modern and modern grammatologists prefer to think of the history of their discipline as—in the words of a historian of science—"a chronicle of errors overcome and currently accepted doctrines anticipated" (Daston, 2017, p. 137). This retrospective tendency often leads to highly distorted narratives of the discipline's history, attributing great importance to the postscript of the *Shuowen* and other early texts while neglecting millennia of scholarship between Xu Shen and the twentieth-century epigraphists. But this scholarship is invaluable not only for understanding how Chinese grammatology became what it is but also for seeing what it could have been. This is not only because they established early modern interpretations of the *Shuowen* model as the canonical mode of character analysis but also, and more importantly, because they experimented with many other methods for analyzing the structure of characters that presuppose a different understanding of the nature of writing.[26] And my introduction to this study took the form of a prolonged examination of the contemporary legacy of the *liushu* paradigm because excavating those earlier modes of thought are of contemporary relevance.

This paper takes as its main point of reference the medieval grammatological treatise "Compendium on the *Liushu*" (*liushu lüe* 六書略) written by the historian-encyclopedist Zheng Qiao 鄭樵 (1104–1162) during the

rialist legacy of Han fictions of writing is Galambos (2006), who, by carefully studying variance in recently unearthed Warring States manuscripts, concludes that "one could imagine the totality of individual character forms visually as a 'cloud' of potential forms, as opposed to one discrete form" (ibid., p. 2). However, it should be noted that this cloud still presupposes the autonomy of *logos*. Jacob Reed points out to me that Galambos' metaphor resembles the "cloud of exemplars" model of phonetic variation proposed in Pierrehumbert (2001), which "probably says more about the growth of 'probabilistic thinking' in the humanities than anything else" (2022, personal communication).

26. For a brief but insightful history of Chinese grammatology, see Tang (1969, pp. 12–25). For a more extensive history that decenters the *liushu* paradigm, see the two-volume Hu (1965).

Southern Song, one of the most vibrant periods for Chinese thought.[27] Traditionally, Zheng Qiao is known to be the first scholar to convert the *liushu* paradigm from a paragraph-long commentary on an opaque term in the *Rites of the Zhou* (*Zhouli* 周禮) to a full-fledged taxonomic framework systematically applied to tens of thousands of characters, initiating what later become "*liushu* studies" (*liushu xue* 六書學), the precursor to modern Chinese grammatology.[28] But treating Zheng Qiao's writing as a heterogeneous corpus—that is, acknowledging that it moves along different threads that may branch out in different ways—this paper explores other aspects of the work that may supplement, recontextualize, or even undermine his conventional legacy, while at the same time indexing other possibilities for conceptualizing Sinography that center around the problem of variance.

Such possibilities begin with a reexamination of the purview of the study of writing in the Chinese context, which will be the topic of the next section, followed in the section after by a summary of Zheng Qiao's theory of writing.

2. The Fuzzy Boundaries of Sinography

2.1. Un-knowing "Chinese Writing"

What is Chinese Writing? In response to this question—which any exposition of Zheng Qiao's grammatological thought will have to think

27. In this paper I use the two-volume 1995 Zhonghua Shuju 中華書局 edition of the *Twenty Compendia to the Comprehensive Treatise* (*Tongzhi Ershi Lüe* 通志二十略), in which the compendium in question is included. This edition is based primarily on Wang Qishu's 汪啟淑 (1728–1799) edition printed in Qianlong 14 (1749), itself revising the Ming-era xylograph edited by Chen Zongkui 陳宗夔 (1522–1566) (Zheng, 1995, p. 6). The *Twenty Compendia* originally circulated in manuscript form, often alongside the remainder of the 200-*juan Comprehensive Treatise* (*Tongzhi* 通志), and as such its original text can be difficult to ascertain from extant xylographic editions. Nevertheless, according to the philological glosses of the Zhonghua Shuju edition, textual variations in the sections I discuss in this paper is relatively insubstantial. Translations from the *Compendia* mine unless otherwise noted.

28. Zheng Qiao, in other words, was less an 'author" than a "founder of a discursive practice," to use Michel Foucault's useful distinction (1979). Unfortunately, while Zheng's unconventional claims that heavily influenced second-millennium scholarship on the *Classic of Poetry* have rightfully received attention in Western scholarship (see, e.g., Mittag, 1993a,b; 2010), studies of his grammatological writings are few, even in Chinese, and tend to follow the presentist mode of historiography mentioned above. For selected previous scholarship on Zheng Qiao's grammatological writings, see Bo (2009, pp. 15–68), Bottéro (2004), Han (2008), and Shi (1974). Bottéro's short article is, to my knowledge, the first to realize the significance of non-Sinitic writing systems for Zheng Qiao's grammatological thought at large.

anew—stand in eagerness a series of familiar answers, provided for us by figures from Athanasius Kircher (1602–1680), Gottfried Wilhelm Leibniz (1646–1716), and Nicolas Fréret (1688–1749) to Ernest Francisco Fenollosa (1853–1908), Herrlee G. Creel (1905–1994), and John DeFrancis (1911–2009). It is not insignificant that to trace a chronicle of these answers would involve recounting the histories not only of Sinology and linguistics as we know them but also of Western philosophy, literature, and a range of other disciplines from the early modern period to the present.[29] But the familiarity of the question—and the assumptions it carries—obscures the instability of its terms in historical Chinese grammatology.

Typical assumptions that make the question legible for us tend to fall under two categories. First, Chinese writing conventionally meant the writing system that has more or less stabilized in form by the end of the Han dynasty, and as such is conveniently tied to the historical moment at which "China" itself became a meaningful sociopolitical entity.[30] It is routinely admitted that this script further became a "scripta franca" of a larger world, but one with a distinct center or origin, fixed not only in space but also in time (one speaks, even today, of *hanzi* or *kanji* or *hanja*).[31] Second, there is usually a glottocentric bias in the study of Chinese writing, that is to say an overemphasis on the correspondence (or lack thereof) between writing and the spoken utterance which is even thought by some to be the primary task of writing.[32] These biases have, among other things, resulted in the negligence of non-glottographic

29. The bibliography for this history is far too enormous to present even in abridged form. For reader unfamiliar with the early history, an excellent introduction is the monograph of Madeleine V.-David (1965), complemented by Bruce Rusk's (2007) article tracing the thoughts of Kircher and others to early modern Chinese contexts.

30. For a short introduction to this script transformation process, which is often narrated as one of "modernization," see Schindelin (2019).

31. For a typical articulation of this view, see Holcombe (2001, pp. 60–77). Note that the idea that Sinographs enabled "worlds without translation" (Denecke, 2014) was already familiar to Europeans in the 16th century, and was one of the reasons Chinese writing became a key inspiration for universal language schemes such as that of John Wilkins (1614–1672) (Knowlson, 1975, pp. 15–27).

32. I acknowledge but do not follow the distinction between "semasiographic writing" and "glottographic writing" introduced by Geoffrey Sampson (1985) and has been adopted by scholars of Mesoamerican archaeology (e.g., Colas, 2011) as a more inclusive framework than that of Gelb (1963). By the glottocentric bias I do not mean a bias toward glottographic writing within this dichotomy, of which critiques have been plenty, but rather a more general approach to the study of meaning that takes spoken language as the privileged point of comparison and reference for meaning-making in general (Petrilli, 2014). Furthermore, I find it misleading to make substantialist taxonomies of writing systems in this way, as the same graphs very often afford multiple modes of meaning-making even within one, albeit heterogeneous, linguistic environ-

uses of Sinoform writing both inside and outside geographical China, as well as the customary classification of Sinoform writing systems by way of spoken languages, despite the value "Sinoform writing" already holds as an analytic frame for understanding writing in ways other than the recording of language (cf. Handel, 2019; Osterkamp, 2017).

These presuppositions accompanying the phrase "Chinese writing" in its usual sense create a tunnel vision before any inquiry even begins, privileging a *de facto* closed, internally homogeneous, already-standardized inventory of characters, fully and solely determined by their Sino-glottographic functions, as the default—if not only—subject of analysis.[33] This circumscription, however, does not necessarily reflect how a historical Chinese scholar theorizing writing as they knew it would define the purview of their study. To the contrary, just as in European intellectual history, the understandings of speech, language, and writing derive their complexity—however misguided this complexity appears in retrospect—from encounters with peoples, artifacts, and cultural practices different from one's own ("the becoming-legible of non-Western scripts," as Jacques Derrida memorably puts it; see Derrida, 2016, p. 82), Chinese theories of writing emerge from the knowledge that writing—be it under the character *wen* 文, *zi* 字, *shu* 書, or others—is a densely heterogeneous field rich with historical, cultural, stylistic, or pragmatic differences, and that "ordinary" Sino-glottographic writing can only be understood, if not constructed, through an organization of this heterogeneity.

2.2. Graphic Heterogeneity in Xu Shen

Viewed in a different way, just as the history of Chinese writing constitutes a history of variance, so is the history of Chinese grammatology the history of a preoccupation with these differential relations among and between graphs, meanings, and sounds. We should recall that grapholinguistic heterogeneity already saturate Xu Shen's depiction of writing in the postscript to the *Shuowen Jiezi*. The postscript begins with an account

ment, with "glottographic" graphs taking on "semasiographic" significance and vice versa (Osterkamp and Schreiber, 2021).

33. On open and closed writing systems, see Küster (2019). While Küster correctly notes that in Chinese writing "signs can be added to l_s if a need is felt to do so" and it is difficult to make an exhaustive inventory thereof (ibid., p. 19), it is important to note that the script users' ability to do so is heavily dependent on the technological infrastructures of inscription. It would have been much easier for me—or any other ordinary user of the script—to use a graph like 急 in manuscript or woodblock printing (two predominant inscriptional media in historical China). In the absence of the possibility of *ad hoc* neographisms in everyday script use, a finite inventory, regardless of size, should be considered a closed writing system.

of an "evolution of scripts" that traces the beginning of writing to Fuxi's hexagrams, Shennong's knotted cord, and Cangjie's imitations of bird traces. It then moves on to a more abstract genealogy from *wen* to *zi* to *shu*, followed by the *liushu* principles which allegedly formed part of the Zhou curriculum for the prince.[34] But notably, Xu Shen's hasty account of these legendary diachronic and synchronic diversities of writing—to momentarily revert to the Saussurean division—is quickly followed by other, more problematic (for Xu Shen and his imperial audience, anyway) types of diversity that followed the Zhou's disintegration:

> 其後諸候力政、不統於王、惡禮樂之害己而皆去其典籍。分為七國、田疇異晦、車涂異軌、律令異法、衣冠異制、言語異聲、文字異形。
>
> [Thereafter], the various marklords warred with one another; they were not unified under one king. They considered the "harmful" effects of the rites and music to be bad and in all cases discarded their canons and records. The realm was divided into seven states. Agricultural field divisions had different measures, carts and road-ruts different axle-widths, laws and commands different rules, ritual garb different sumptuary regulations, spoken words and language different sounds, and writing different graphic structures (O'Neill, 2013, pp. 432–433).

Xu Shen is not simply narrating the history of writing here, of course, but presenting the state of affairs from the point of view of the Chancellor to the first emperor of China, with a tacit suggestion of what needs to be done about land measurements and graph forms alike. But while one of the products of Li Si's 李斯 (c. 280–208 B.C.E.) project "to homogenize these things, so as to remove what did not conform to the Qin pattern of culture," namely the Small Seal (*xiaozhuan* 小篆) form of characters, plays a central role in the *Shuowen* itself, Xu Shen is not entirely satisfied with the Qin empire's linguistic reform (ibid., p. 433). What the burner of books and murderer of scholars failed to see, and what Xu Shen's addressee does, was that imperialism without philology will always remain an incomplete enterprise (ibid., pp. 437–438). "Writing systems and their offspring characters," after all, "are the root of the classics, the origin of kingly government, what former men used to hand down to posterity, and what later men use to remember antiquity" 蓋文字者, 經藝之本, 王政之始, 前人所以垂後, 後人所以識古 (ibid., pp. 435–436). There is an noticeable anachronism in Xu Shen's use of contemproary

34. A full English translation of Xu Shen's postscript can be found as the appendix of an excellent article by Timothy O'Neill (2013), which helpfully bridges Xu Shen's rhetorical and political gestures with his grammatological method at large from the perspective of early modern Chinese philologists. In what follows I quote directly from O'Neill's transcription and translation, which use the Song woodblock text edited by Xu Xuan 徐鉉 (916–991), known in Chinese scholarship as "Da Xu ben" (大徐本), as base text.

graph forms to illustrate the *liushu* principles upheld before writing itself entered into the state of disarray, but the very purpose of his project, which highlights rather than hides this discrepancy, is to at once affirm this anachronism (i.e., the way of the ancients can no longer be taken for granted) and to announce its overcoming (i.e., the merit of Han standard character forms lies precisely in their inheritance of those bygone principles). And so Xu Shen carved out a space for others like himself in the "empire of writing": his function is one of (diachronic) organization that supplements (synchronic) homogenization, a matter of folding graphic variation into a coherent historical narrative whose origin is once again accessible, and of simultaneously disavowing and justifying the eradication of difference *per se* through force (cf. Lewis, 1999).

It is unclear whether Xu Shen's project of script organization and standardization was, as some scholars have recently speculated, a reaction to the pressing cultural rivalries (and with them, anxieties) of his era, namely "the Chinese encounter with Indo-Iranians and the cultural invasion of Buddhism they brought with them" (Zhang and Mair, 2020, p. 29). Regardless, for those theorizing the structure of "Chinese writing" after Xu Shen, those "letters from the West" were to become much more difficult to ignore.[35] Recent Anglophone scholarship has brought attention to the roles played by Sanskrit, Tibetan, Mongolian, and Manchu writing systems (which are variably derived from Gupta and Old Uyghur scripts) in grammatology of the Ming (1368–1644) and Qing (1644–1912) periods (e.g., Söderblom Saarela, 2020; Vedal, 2022), whereas the study of Sanskrit in medieval East Asia is generally situated in the histories of Buddhism or phonology (e.g., Van Gulik, 1980). Together with Sinoform musical notations (predominantly studied by musicologists)[36] and aforementioned "vernacular character forms" (predominantly studied by epigraphists), the peripheral status of non-Sinoglottographic writing systems such as various Brahmic abugidas in the historiography of Chinese grammatology is misleading: it retroactively projects early-modern and modern disciplinary divisions such as phonology, grammatology, musicology, religious studies, "ethnic studies" (as opposed to the study of "Chinese tradition proper"), and so on onto historical modes of thought wherein such specializa-

35. What is much more often discussed is the role of Sanskrit learning on the development of Chinese poetry and phonology, which is not dissimilar to the related story in Japan. For medieval Chinese poetry, see Mair and Mei (1991). Chinese "rime tables," which play an important part in the phonological scholarship, is traditionally (in part due to Zheng Qiao's influence) taken to be of Buddhist origin; for recent studies see the introduction to an essay collection edited by David Branner (2006).

36. For surveys of traditional Chinese musical notation, see, e.g., Wang (2006) and (in English but less detailed) Zang (2002).

tions were either yet to assume relevance or would be articulated differently.[37]

2.3. Graphic Heterogeneity in Zheng Qiao

This is why readers of Zheng Qiao's "Compendium on the *Liushu*" will find, perhaps to their surprise, that the concepts most crucial in his analysis of Sinographs are never specific to the set of graphs used for writing down Chinese language, but are procedures operating also in other writing systems or practices of writing within the purview of an observant medieval Chinese scholar. Contractions in Chinese (e.g., that of 之焉 [*tə ʔan] to 旃 [*tjan], Baxter's reconstruction) are compared to the formation of syllables in written Sanskrit, and so are *qin* musical notations that likewise fall under the category of Chinese writing (*huashu* 華書) (Zheng, 1995, pp. 340, 350–351). Missing are the "hard" classification of writing systems into abugida and logography, glottography and musical notation, "Chinese" and "Western;" instead, what is emphasized are character grammars shared by various zones of writing and, in relation to those commonalities, their respective specificity.

If the boundary of Chinese writing becomes fuzzy here—if, indeed, both "Chinese" and "writing" become pluralized in Zheng Qiao's encyclopedic attention and assured rejection of incommensurability—it is because, while his project to organize Sinographs according to *liushu* is explicitly framed as a more assured attempt to reactivate grammatological knowledge lost since the Zhou, this motive is conjoined, almost paradoxically, with a contrary one toward the examination of writing in general. Speaking of his earlier work on Chinese characters (now lost), he writes in the introduction to the "Compendium" that

> 今取象類之義、約而歸於六書、使天下文字無所逃、而有目者可以盡曉。
>
> Now I have taken the essence of *Xianglei*, abridged it and organized it in accordance to the *liushu*. This is so that no writing [*wen* and *zi*] under the Heaven can escape [from the purview of my analysis], and anyone with eyes can understand it thoroughly (ibid., p. 234).

Of course, there is more to "[all] writing under the Heaven" than what can be made to fit within the *liushu* paradigm, a fact that Zheng Qiao, who concludes the "Compendium" with a three-part essay on the Sanskrit alphabet, knows well.[38] And in the face of this heterogeneity of known

37. Cf. the non-differentiation of cosmology and philology in Ming scholarly culture as discussed in Vedal (2022).

38. The three-part essay, titled "On Sinitic and Sanskrit [Scripts]" (*lun Hua Fan* 論華梵) is available in English translation (Mair, 1993).

writing greatly exceeding that of Xu Shen's time, Zheng Qiao did not invoke moral corruption and expel unorthodox (or non-Sinitic) writing from his study, nor did he—following early medieval Buddhist thinkers such as Sengyou 僧祐 (445-518) and Annen 安然 (841-915) to whom he was nevertheless indebted—unite Sinitic, Brahmic, and Kharosthi scripts in an universal fraternity ultimately symbolizing the Buddha's three bodies (Skt. *trikāya*).[39] But he did inherit from the earlier Buddhist thinkers their mixture of empirical and speculative ways of thinking, of both closely studying the heterogeneous field that is "writing" beyond Sinoglottography in its concrete mechanisms and readily acknowledging those mechanisms' cosmological significance.

Understanding the tendency in Zheng Qiao's writing to reorient grammatology toward living practices of writing (be they of his own or earlier times) in all their plurality and difference is important, not only for seeing how his epistemic attitude differs from those of his predecessors (Xu Shen and the medieval Buddhists) and successors (early modern Chinese philology and modern linguistics), but also for seeing how, more concretely, this choice of sources allowed him to formulate the technical functioning of writing in an idiom that may otherwise appear idiosyncratic. I will discuss that idiom at length in the next section, while the remainder of this section will briefly outline the various corpora of writing with which Zheng Qiao was familiar, and which had profound influences on his grammatological thought.

2.3.1. *The Brahmic Analogy*

While it is difficult to overstate the importance of Sanskrit writing systems, which were abugidas with the *akṣara* as a basic unit, for Zheng Qiao's conceptualization of writing in general, this discussion sometimes fails to emphasize a key aspect (Bottéro, 2004; Mair, 1993). Zheng Qiao's staging of "Sanskrit versus Chinese" in claims such as "For the Indians, the basis of sound-distinctions lies in the sound rather than in the writing; for us Chinese, the means of distinguishing characters lies in their written form, not in their sound" (梵人別音、在音不在字、華人別字、在字不在音; Zheng, 1995, p. 351), like Xu Shen's history of writing, is not so much a disinterested description of fixed facts about language than it is a statement about temporary states of affairs that the *Twenty Compendia* is determined to mend. The interlinked parallel prose in "Preface to the Seven Sounds" (*qiyin xu* 七音序) intimates that "sound" versus "graph"

39. Sengyou's statement in *Collected Records on Producing the Tripitaka* (*chu sangzang jiji* 出三藏記集) is available in English translation (Sengyou, 2006). For the philosophical background of this claim, and in particular the religious significance of the translatability between languages in Mahāyāna Buddhism, see the discussion on Sengyou in Kin Bunkyō (2021, pp. 25–28).

was never an either-or situation even in the Chinese context alone, as both were entailed in the sages' teachings but subsequently forgotten.[40] What the Chinese can learn from Sanskrit is therefore the phonographic potential latent within Sinography itself, which is neither antithetical to Sanskrit phonography nor more advanced (in the sense of a linear progression) than Sinography as it is ordinarily practiced in his day. This is why his actual comparison between the two writing systems takes its *tertium comparationis* (the "third term" that makes the two terms in a comparison comparable) from the wide-spread practice of transliterating written Sanskrit using Chinese characters in the context of Buddhist sutras, and especially magical spells (Skt. *dhāraṇī*).

The medieval Buddhist practice of stacking Chinese characters in the same way that one stacks graphic components in, say, the Siddhāṃ abugida does not have a proper name. The phrases Zheng Qiao uses to describe it—"conjoining two [graphs]" (*er he* 二合) or "conjoining three [graphs]" (*san he* 三合)—are such generic descriptors that they could have been used to describe any situation in which a new graphical whole is created by juxtaposing multiple components, and this generality or vagueness is precisely the point. These phrases originated not in reflexive discourses about writing, however, but simply as reading instructions in transliterations of Sanskrit where such stacked characters appear. In a fragmented scroll recovered from the "Library Cave" in Dunhuang (sealed in the 11th century) on which a spell is written side-by-side in Siddhāṃ and Sinographic transliteration, we find the Sanskrit syllable *dāv*, which requires the vertical stacking of two graphs in Siddhāṃ (<dā> and <ba>), transliterated as 闥〈二怛嚩〉, two graphs whose pronunciations in Early Middle Chinese can be reconstructed as [*tat] and [*buak], respectively (Pulleyblank's reconstruction).[41] Below the compound 闥 is written, in smaller characters, "conjoining two [graphs]" as well as "prolonged" (*yin* 引), the latter meaning the vowel is to be read long. Outside the context of Dunhuang manuscripts, the prevalence of this transliteration strategy is attested by its omnipresence in the "Esoterica" (*mikkyō* 密教) section of the *Taishō Tripiṭaka*.[42]

40. For example, on how the sages' teachings differentiate humans from animals: "The seeing and hearing of humans are the same as those of beasts and fowl. The sages created patterns of sound so as to guide the auditory faculty of the ear, created graphs so as to expand the visual faculty of the eye" 人與禽獸、視聽一也、聖人制律所以導耳之聰、製字所以擴目之明 (Zheng, 1995, p. 353). Knowledge of both were lost in the subsequent centuries, Zheng Qiao continues later, as those who study graphs had forgotten the difference between simple and compound graphs, while those who study sounds had forgotten the vertical and horizontal axes of the rime table.

41. See *Pelliot chinois* 2778, digitized through the International Dunhuang Project: `http://idp.bl.uk/`.

42. Which is fully digitized: `https://21dzk.l.u-tokyo.ac.jp/SAT/index_en.html`. The "Esoterica" is vols. 18–21.

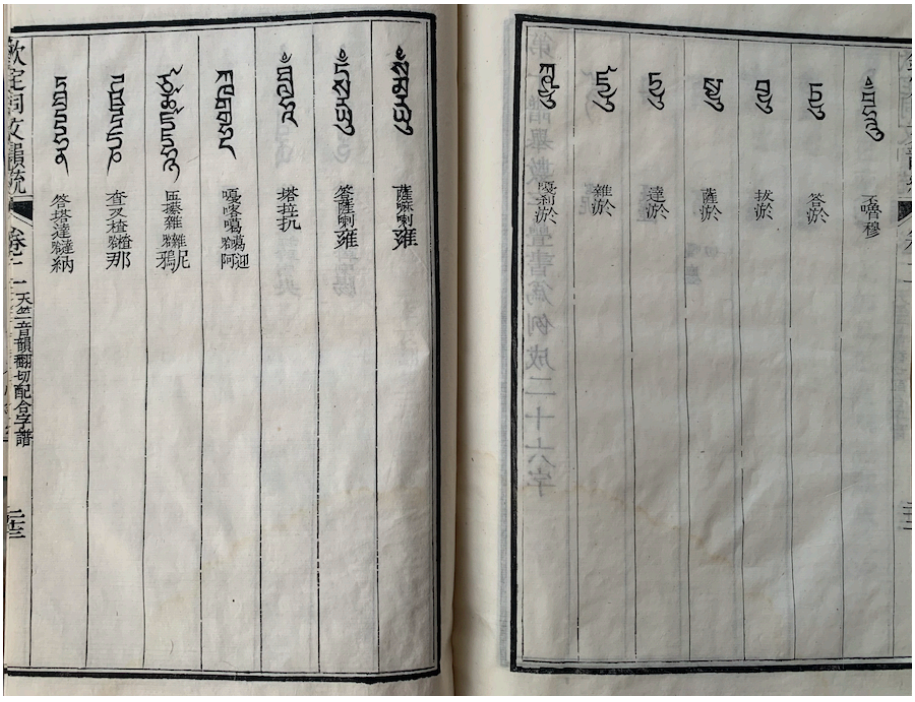

FIGURE 1. Codification of "character stacking" practice for transliterating Buddhist spells, based on the Tibetan script, in the Qing dynasty. *Qinding tongwen yuntong* 欽定同文韻統 (preface 1751, rpt. 1910). East Asian Collection, University of Chicago Library.

The later trajectory of this practice, which leads to the unexpected territories of Chinese opera theory and the Qing imperial sponsorship of Tibetan Buddhism, is beyond the scope of this paper (see Söderblom Saarela, 2016). What should be noted for now is that through typographical grids on the page which may be explicit (as in the case of the Dunhuang manuscript) or implicit (through correspondence to the Sanskrit syllables they are understood to represent), what is produced through "conjoining" becomes in some sense a single compound graph with a regular logic of composition, even if the resulting graph is not what we conventionally call a "Chinese character."[43]

43. The Ming scholar Zhao Yiguang 趙宧光 (1559–1625) famously believed a substantial number of Sinographs in his day were created in this way, under Sanskrit influence (Vedal, 2022, p. 59). In fact, such graphs are rare, and the most well-known of which is 甭 ("not to need to"), read as *béng* today as a contraction of 不用 *bú yòng* ("not" + "use") although it was originally a "vernacular" graph form of 棄 *qì* (to abandon) and was read as such (Branner, 2011, pp. 73–74).

2.3.2. *The Gestural Analogy*

Zheng Qiao is careful to explain how the product of this general operation of conjoining (which can be found in Sanskrit writing but also in ordinary Sinography such as the syssemantograph) is to be mereologically understood, stating, in the case of Sanskrit syllables, that "when a graph is called 'conjoined from two [graphs],' its sound is neither that of one graph nor that of two" 凡言二合者、謂此音非一亦非二也 (Zheng, 1995, p. 351). What he means is that a conjoined graph is neither replaceable by a single graph (i.e., its significance is derived compositionally from both of its components) nor is it simply the concatenation of one graph to another without their individual functions being thus affected. To put it positively, what conjoining entails, as a general operation that Zhen Qiao finds across multiple corpora of writing, is a twofold transformation: the specialization of component graphs into specific types of sub-graphic functions (i.e., being read only for the initial or only as the semantic signific, when by itself the graph signifies more) and the coordination of specialized components in light of the blueprint of the composite graph.

Focusing on *how* different scripts operate in practice rather than *what* they are or do (which presume a fixity of their function if not existence), Zheng Qiao thus effortlessly compares Chinese writing to Sanskrit abugidas, but also compares glottographic writing to musical notation:

> 華有二合之音、無二合之字。梵有二合、三合、四合之音、亦有其字。華書惟琴譜有之、蓋琴尚音、一音難可一字該、必合數字之體、以取數音之文。
>
> The Chinese language has sounds that conjoin two components, but does not have graphs that show this conjoining. Sanskrit has sounds that conjoin two, three, or four elements, and also have corresponding graphs. Among Chinese writing, [such multiply-conjoined graphs] can only be found in scores for the *qin* zither. This is because [the playing] of the *qin* emphasizes its sound, and yet a single graph is often inadequate for a single sound. Thus it is necessary to conjoin the bodies of multiple graphs, so as to obtain expression made up of multiple sounds (ibid., pp. 350–351).[44]

Thematically, it should hardly be surprising, given his general argument that "graph" and "sound" were equally important in the teaching of the ancients, that Zheng Qiao would turn to existing sonographic uses of Chinese scripts (such as the transliteration of Sanskrit and Sinoform musical notation) as examples of what else Chinese writing is capable of. *Qin* "shorthand" (*jianzi* 減字, literally "abbreviated graphs") notation, which Zheng Qiao references here, deserves a closer look for our purposes, not only as another example of "conjoining" but also as a species

44. Translation modified from Mair (1993, p. 336) for terminological consistency.

of Sinoform writing relatively unknown outside the field of musicology.[45]

Conventionally attributed to the Tang-dynasty (618–907 C.E.) musician Cao Rou 曹柔 (730–?), *qin* notation in the second millennium builds upon but greatly simplifies the earlier convention of describing manual gestures—the location of the left hand on the fingerboard of the instrument, the technique on the right hand for attacking the string—in full sentences for recording a piece of music.[46] Perhaps due to the aesthetic value traditionally associated with the wide timbral range produced by different fingering techniques, this new shorthand notation does not deviate far from the earlier method in that, not unlike Western tablature notations, it is the precise movements of the hands rather than the pitch and duration of musical notes that are to be recorded. Each of the aspects of left and right hand movements—or the lack thereof—are associated with a radical or stroke group (tellingly named *zimu* 字母 in early modern texts) taken from the full graph(s) denoting the technique.[47] Here is an partial list of this "alphabet" of gestures that demonstrates their graphic basis, meaning, and position in the composite graph. I have used some intuitive abbreviations (L for left, BL for bottom-left, etc.). Two notable positional absences in this chart are the right of top, where a number is usually written indicating the location on the string using the thirteen ornamental jades (*hui* 徽) as reference points, and the center of bottom, where the string number is given. A complete composite graph denoting a plucking gesture therefore would have the structure of ⿰⿰夕十⿰卜⿰勹三, which would be parsed in prose as "arrive at the tenth *hui* (十) with the index finger of the left hand (夕), after plucking inward with the middle finger of the right hand (勹), by sliding the left hand up (卜) along the string (三)." And in a musical score one will find hundreds of such graphs, alongside other shorthand graphs conveying finger movements (e.g., 犭 for 猱, vibrato), tempo (e.g., 爰 for 緩, slowly),

45. The discussion given here is cursory. For a more detailed description of this notation system in English, the *locus classicus* is Van Gulik (2011, pp. 117–139). See also Kaufmann (1972, pp. 267–295), as well as John Thompson's English translation of the third fascicle of the *Great Collection of Superlative Sound* (*Taiyin daquanji* 太音大全集, 15th century) with the original illustrations: `http://www.silkqin.com/02qnpu/05tydq/ty3.htm`. On the history, see also Wang (2006, pp. 55–68) and Zang (2002, pp. 46–48). For its importance in the comparative study of musical notation systems and recording technologies, see Chua and Rehding (2021, pp. 140–145) as well as Rehding (2021).

46. The best-known example of this earlier and scarcely-attested notation method is the "Secluded Orchid" (*Jieshi diao youlan* 碣石調幽蘭) manuscript dated to the 7th century, which has received a detailed discussion in English in Yang (2014).

47. Note that, while *zimu* refers unambiguously to "letter" in the sense of the alphabet in modern Mandarin Chinese, its meaning in early modern Chinese is much more complex. This will be discussed in the next section.

TABLE 1. An incomplete list of common components in *qin* shorthand notation.

Stroke group	Full graph	Meaning	Hand	Position
大	大	Thumb	L	L of T
亻	食	Index finger	L	L of T
中	中	Middle finger	L	L of T
夕	名	Ring finger	L	L of T
𧾷	跪	"Kneeling" ring finger	L	L of T
艹	散	Open string	L	T
卜	绰	Slide up	L	T of B
氵	注	Slide down	L	L of B
尸	擘	Thumb inward pluck	R	TL of B
毛	托	Thumb outward push	R	BL of B
木	抹	Index inward pluck	R	T of B
乚	挑	Index outward push	R	BL of B
勹	勾	Middle inward pluck	R	TR of B

rest (e.g., 省 for 少息, brief rest), and other information (e.g., 嘳 〈曲冬〉 for 曲終, end of score).

The character grammar of *qin* shorthand notation cannot be treated in full here, but a general sketch can nevertheless be attempted to better situate this practice within what is already established of Zheng Qiao's grammatology. First, regarding the formation of the *zimu* or stroke groups. Quite clearly the selection of stroke groups, which may be a radical (氵 for 注) but more often a more arbitrary (albeit distinguishing and conventionalized) graphic subset of the full graph, exceeds the purview of "idiosyncratic allomorphy" as discussed in Myers (2019, pp. 55–69) and should be compared instead to medieval manuscript ligatures observed, again, in the Dunhuang manuscripts.[48] More generally, the abbreviation process can be situated along one of the two "pathways" of Chinese character simplification identified by David Lurie (2011, p. 314 ff.), namely abbreviation (or synecdoche) as opposed to cursivization (cf. Champollion, 1836, pp. 14–18). And similar to the products of these two pathways in the case of Japanese writing (*katakana* and *hiragana*, respectively), *qin* shorthand notation may be distinguished from the roughly contemporaneous musical notation system derived through cursivization—"vernacular character notation" (*suzi pu* 俗字譜)—not just graphically but also with respect to social prestige and musical genre (Kaufmann, 1972, pp. 174–182; Zang, 2002, pp. 53–60).

48. The most well-known of such ligatures is writing *pusa* 菩薩 (Bodhisattva) as 艹〈艹艹〉. For a history of this type of ligature traditionally referred to as *hewen* 合文 or "conjoined graphs," which already appeared in oracle bone inscriptions and was perhaps most popular in early texts in general, see Galambos (2010). Note, however, that in ordinary ligation only up to two characters will be combined into one, which is not the case for *qin* shorthand notation.

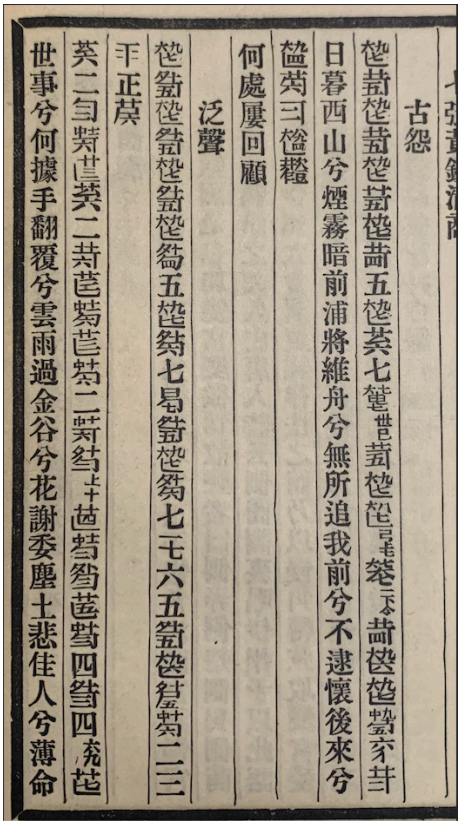

FIGURE 2. The beginning of "Ancient Lament" (*guyuan* 古怨), composed by Jiang Kui 姜夔 (c. 1155–c. 1221), with lyrics. *Baishi daoren gequ shuzheng* 白石道人歌曲疏證 (preface 1749, rpt. in *Liaohai congshu* 遼海叢書 1934). East Asian Collection, University of Chicago Library. For a modern performance, see `https://www.youtube.com/watch?v=kxT4paThVbM`.

Second, at the level of conjoining, it should be observed that, of the composite graphs created from the stroke groups in the table above, the fundamental structure is more-or-less nonnegotiable and non-recursive.[49] The composite graph can always be split into an upper and a lower portion, where (very heuristically speaking and disregarding the numbers) we can state that the upper portion communicates a

49. Only one "template" in general allows a full graph such as ⿱⿰夕十⿱卜⿰勹三 to be a component, which is structured by 早 (for 撮) and denotes two strings being plucked at the same time by different fingers. In this case, one full graph each would be placed to the bottom-right and bottom-left of 早.

steady state concerning only the left hand, while the lower portion communicates movement either to or from this state (right hand attack and left hand motions before or after the attack). On the top, the left hand fingering is always to the left, while on the bottom, the right hand technique will always conjoin directly with the string number, and it is to this composite that the left hand movement (if present) conjoins. The result is that each stroke group will always occupy the same position, and thus graphic allomorphy is reduced to a minimum. As in the case of transliterating Sanskrit syllables, conjoining in this case operates under a very stable blueprint in which each of its internal positions is functionally specialized.

2.3.3. *The Challenge of Archaeology*

One last, unusual corpus of writing that greatly affected Zheng Qiao's grammatological thought must be introduced here, although it is somewhat different in nature from the previous two. While writing practices related to Buddhism or music were for Zheng Qiao recent history or even contemporary practice, Zheng Qiao also lived shortly after the appearance of the first-ever dedicated woodblock print publications of inscriptions (both facsimile and transcription) found on excavated bronzes from as early as the Shang and Zhou dynasties, publications such as Ouyang Xiu's 歐陽修 (1007–1072) *Jigu lu bawei* 集古錄跋尾 (*Colophons from the Records of Collecting Antiquity*), Lü Dalin's 呂大臨 (1046–1092) *Kaogu tu* 考古圖 (*Illustrations for the Study of Antiquity*, preface 1092) and *Bogu tu* 博古圖 (*Illustrated Catalogue of Antiquities*, 1122) created by Huizong 徽宗 (r. 1101–1125), the last emperor of the Northern Song dynasty (Pirazzoli-t'Serstevens, 2010; Sena, 2010; Shaughnessy, 1991; Visconti, 2015).[50] These publications add to two other major works of Song epigraphy, the *Han jian* 汗簡 (*Sweating the Bamboo*) by Guo Zhongshu 郭忠恕 (d. 977) and the *Guwen sishengyun* 古文四聲韻 (*Ancient Graphs Organized by Tone and Rime*) by Xia Song 夏竦 (985–1051), both of which contain large inventories of "ancient" (that is, Warring States) graph forms taken from various inscriptions available to the authors at the time (see Galambos, 2006, pp. 15–20).

These publications, which undoubtedly partook in the *Zeitgeist* of antiquarianism of the Song dynasty, also provided specific epistemological opportunities and challenges for philologically-minded scholars who

50. It should be noted that these were not the first publications of archaeologically discovered texts after the Han dynasty, but rather the first that focus on—and accurate reproduce in print—the original inscriptions in large quantities (the two works cited describe over 200 and over 500 objects, respectively). For earlier instances of publishing excavated texts, consider the famous (and famously contentious) case of the *Bamboo Annals* (*Zhushu jinian* 竹書紀年) discovered in the autumn of 279 C.E. (Shaughnessy, 2006, pp. 185–256).



FIGURE 3. Facsimile and transcription of the inscription on a cauldron known as "Jinjiang ding" 晉姜鼎 dated to the early Spring and Autumn period. *Kaogu tu* 考古圖 (preface 1092, rpt. 14th–15th century). Harvard-Yenching Library.

read the inscriptions closely.[51] For the compiler of the *Illustrations for the Study of Antiquity*, for example, the impressive presence of excavated inscriptions serves as a reminder of what is lost when later scholars take on a more rebellious attitude toward the ancients. Taking aim specifically at a text often associated today with philosophical Daoism—the *Zhuangzi*—Lü Dalin writes in the preface:

51. On Song dynasty antiquarianism and the appreciation of ancient inscriptions, in addition to the already cited scholarship, see Egan (2006, pp. 7–59) and Sena (2019).

> 莊周氏謂儒者逐迹喪真、學不善變、故為輪扁之說、芻狗之諭。重以漁父、盜跖、《詩》《禮》發冢之言、極其詆訾。夫學不知變、信有罪矣。變而不知止於中、其敝殆有甚焉。
>
> Zhuangzi states that scholars obsess after traces [of the ancients] and lose sight of what is true, learn [from the books] but are not flexible, and therefore created [various fables and legends] that are insulting to scholars to the extreme. It may be true that it is a mistake to study [the Classics] without understanding how things have changed; but to drastically depart [from received teachings] without knowing where to stop, that is far more deleterious (Lü, 1092, *juan* 1: 1^{r}–1^{v}).[52]

And the true traces of the ancients (which Lü would insist, *contra* Zhuangzi, is not an oxymoron) that are most worth venerating are to be found in the inscribed artefacts of antiquity, of which the Han dynasty editors, who tried to restore a textual order after the Qin "burning of the books," only possessed fragments (*yibian duanjian* 遺編斷簡, literally "remnant scrolls and broken bamboo slips"). Therefore his epoch is fortunate to be in possession of the various types of bronze vessels that, "over the course of millennia and centuries, emerged in mountains cliffs, the walls of buildings, agricultural fields, and tombs" (ibid., *juan* 1: 3^{r}). But his goal in gathering these inscriptions together, the compiler hastens to add, is not merely to delight in the accumulation of antiquaries; rather,

> 觀其器、誦其言、形容髣髴、以追三代之遺風、如見其人矣。以意逆志、或探其制作之原、以補經傳之闕亡、正諸儒之謬誤。
>
> By inspecting the vessels and chanting the ancients' inscriptions, a vague glimpse of their countenance becomes perceptible. And in this way we recover the lingering customs of the Three Dynasties, as if being in the presence of the ancients ourselves. One may thus venture to speculate their intentions, and investigate why [the inscribed vessels] were created. Thus one may mend the lacunae of the received Classics, and correct the errors of various scholars [who have opined since then] (ibid., *juan* 1: 3^{v}–4^{r}).

The general gesture made here—that the outcomes of archaeological investigations challenge received wisdom about the past—is a recognizable one, as powerful then as it is today. Zheng Qiao—who like many of his age believed that a better-mediated relation with the past is possible—mirrored this rhetoric freely in his own "Preface to Bronze and Stone" (*jinshi xu* 金石序), even borrowing wholesale Lü Dalin's motif that what excavated inscriptions make available are not merely the uttered speech but the countenance of the ancients:

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52. In the interest of succinctness I have opted not to translate Lü's numerous allusions to specific passages in the *Zhuangzi*. For a comparative study of this motif in *Zhuangzi* against the veneration of written texts from ancient times, which discusses some of these "fables and legends," see Zhang (1992, pp. 1–34).

> 方冊者、古人之言語。款識者、古人之面貌 [...] 蓋閒習禮度、不若式瞻容儀、諷誦遺言、不若親承音旨。今方冊所傳者、已數千萬傳之後、其去親承之道遠矣。惟有金石所以垂不朽、今列而為略 [...]
>
> Today's codices consist of the spoken words of the ancients; ancient inscriptions consist instead of their countenance[...] [As Wang Cheng from the Jin period writes,] "studying vainly the ritual norms is much inferior to witnessing mannered demeanor in person, and chanting the remnant speech is much inferior to receiving the sound of the instruction oneself." What is being conveyed in codices today has undergone thousands if not tens of thousands of phases of transmission, and it has strayed far from what was received [by the ancients] themselves. Only bronze and stone persist without decay, and now I list them to form a "Compendium" [...] (Zheng, 1995, p. 1843).

It is often said with respect to this early period of Chinese archaeology that "complex theories were proposed to explicate the historical and ritual significance of ancient objects. As a result, historical narratives and cosmological outlooks were modified or expanded based on the revised understanding of antiquity" (Sena, 2019, p. 3). It is important that most of the terms in these claims are in the plural: what this face-to-face with the ancients meant for Zheng Qiao—the "understanding of antiquity" it results in and the modification of historical narratives that it necessitates—should be distinguished from a general antiquarian point of view represented by scholars like Lü Dalin. Lü Dalin, in his celebration of antiquity, tends to downplay the strangeness of the past (especially from a grammatological or epigraphic perspective), but the earlier epigraphist Yang Nanzhong 楊南仲, whose opinion was cited at length by Ouyang Xiu, is much more forthright in his comments on the inscription on the *Hancheng ding* 韓城鼎 cauldron:

> 其銘蓋多古文奇字、古文自漢世知者已稀、字之傳者、賈逵、許慎輩多無其說。蓋古之事物有不與後世同者、故不能盡通其作字之本意也。其不傳者、今或得於古器、無所依據、難以臆斷。大抵古字多省偏旁而趣簡易 [...]
>
> This inscription has many ancient and strange graphs, and few after the Han dynasty have known them. As for graphs with received counterparts, scholars like Jia Kui and Xu Shen have failed to give us appropriate interpretations of them. The way things were in the past differs sometimes from the way they are now; and for this reason, the original intention behind the creation of the graph cannot be fully understood. Of graphs without received counterparts, and which we have now chanced upon in ancient vessels, there is nothing upon which to base our speculations. We can roughly conjecture that ancient graphs often omit radicals and prefer simpler forms [...] (Ouyang, 1888, *juan* 1: 5^{r}).

The face-to-face with the ancients, far from confirming what is already known (the ambition of cultural conservatism), is for this experienced epigraphist instead almost humbling: it reveals how little one knows about the chronotope at the heart of "this culture of ours" (cf. Bol,

1992).[53] It is a strangeness that calls for a reevaluation of what is gained or lost in traditional scholarship, among other things.[54] Zheng Qiao's response to this challenge, which is much closer to Yang Nanzhong's than to Lü Dalin's, will be outlined below. For now, however, I will only mention that while Zheng Qiao's "Compendium on Bronze and Stone"—which contains only the list of names of inscriptions with date and location—is often cited in the history of Chinese archaeology, his much-closer analysis of the ancient graph forms as would have been available to him through print publications, which can be found near the end of the "Compendium on the *Liushu*," is rarely discussed in that or other contexts, as previous scholars have tended to focus on aspects of the latter that anticipates later "*liushu* studies."

3. Outline of Zheng Qiao's Grammatology

3.1. The Vitality of Writing

From today's viewpoint, Zheng Qiao's selection of what counts as writing is thus free from a number of "-centrisms": it takes into account both writing practices from other cultures and minor practices within one's own culture, both graphs that record speech and graphs that inform performance, and both scripts of the present and scripts of the past. This series of "both"s, furthermore, does not introduce binaries but at most a space of variation, with underlying technical continua and analogies, as we have already begun to see. In this section, I switch from an etic account of Zheng Qiao's sources (differentiating them, as I have done above, using familiar categories such as Indian, music, or archaeology) to an emic exposition of his concepts. The emphasis will fall on how Zheng Qiao created grammatological concepts, often by extrapolating and radicalizing existing ones within Chinese grammatological

53. On the multiple transliterations of the Hancheng inscription and their provenance, as well as Ouyang Xiu's suspension of judgement on their veracity, see Sena (2019, pp. 54–63).

54. Thus, after reading the transcriptions and learning about how pre-Qin character grammar differed from his own, Ouyang Xiu laments, in a sentiment that anticipates Zheng Qiao's: "The seal scripts of antiquity at times have additional [components], and at times omit [components] entirely, and [the same component] can also be move to the left, right, above, and below [of the other] in accordance to the [artisan's] desire but also limited by their skill. Since the time of the Qin and the Han, all this are limited and forced into one set of graph forms, thus [inscriptions such as this] is all we see of ancient writing. How regretable!" 古之篆字、或多或省、或移之左右上下、惟其意之所欲、然亦有工拙。秦、漢以來、裁歸一體、故古文所見者止此、惜哉！(Ouyang, 1888, *juan* 1: 6^{v}).

discourse, to structure these heterogeneous corpora of writing and render legible their intra- and inter-corpora relations.

At the conceptual borderlands of Zheng Qiao's grammatological thought, which is far enough from the formal analysis of graphs that it cannot be studied in detail here, is an anthropology that attempts to understand what makes the human (in a world peopled also by plants and animals) uniquely capable of writing, which also differentiates written texts (*shu* 書) from drawn images (*tu* 圖).[55] The latter point is particularly significant because, while Zheng Qiao makes clear that all the *liushu* are variations derived from original *xiangxing* 象形 or "pictographs," he is also clear that despite their shared point of departure, pictographs and images follow fundamentally different patterns of meaning-making, the former taking on "form" (*xiang* 象) with a tendency toward simplification while the latter takes on "shape" (*xing* 形) with a tendency toward details (Zheng, 1995, p. 234).[56]

Writing thus shares the same basis as, yet is defined by an originary departure from, pictures. Owing to its tendency toward simplicity, Zheng Qiao continues, the "pictograph" lends itself much more than does picture to variation and diversification (*bian* 變), the two processes that produce the *liushu* categories (ibid., p. 234). These transformations are not evolutionary or sequential but sedimentary, resulting in a heterogeneous field resulting from their interplay not unlike a game of *go* resulting from the minimal difference between the white and the black stone:

> 經之有六書、猶奕之有二棋 [...] 奕之變無窮、不離二色 [...] 苟二棋之無別、白猶黑也、黑猶白也、何以明勝負？
>
> That the Classics are composed of [graphs of the] *liushu* types is like the game of *go* being composed of stones of two types [...] the game has infinite variations, yet it does not depart from those two colors [...] and had there been no difference between the two types of stones, with the white being indistinguishable from black and the black being indistinguishable from white, how could one decide the win and the loss? (ibid., p. 233).

This metaphor is both elucidating and misleading. Elucidating, because it demonstrates that a mixture of multiple types of graphs (rather than a homogeneous inventory of "pictorgraphs" or "phonographs") is crucial

55. On human nature, Zheng Qiao's position essentially is that humans are at once animal-like (*dongwu* 動物, moving-things) and plant-like (*zhiwu* 植物, planted-things), capable of horizontal movement yet having a vertical corporeal orientation. This hybridity—a bipedal posture, to risk an anachronism—renders the human body something of a site of interaction between Earth and Heaven, born from the former yet receiving the Way of the latter (Zheng, 1995, p. 349).

56. On Zheng Qiao's writing on the relation between images and writing, including translations of the relevant primary texts, see Si (2008, esp. pp. 54–81, pp. 137–141).

for the function of writing; misleading, because it paints a picture of writing that is merely generated combinatorially by a finite set of types, while we have already seen that Zheng Qiao's epoch is one in which many corpora of writing challenged the millennium-old claim that the combinatorial logic of *liushu* is the origin of the creation of graphs (*zaozi zhi ben* 造字之本). Indeed, Zheng Qiao touches upon this claim but immediately moves on to two more general—and original—principles that lay the foundation of a more general grammatology, and subsumed the *liushu* categories under their operation. The two principles are:

1. The generative relation between child-graphs and mother-graphs 子母之相生; and
2. The difference between simple and compound graphs 文字之有間 (ibid., p. 233).

Just precisely what the two principles entail is the topic of this section. For now, I will note that it is here that we find the polysemic concept that, much more than *liushu*, is most general and generative for Zheng Qiao's conception of writing, and which indeed can be found everywhere in "Compendium on the *Liushu*": *sheng* 生, which translates (across a number of grammatical categories) to "to grow," "to give life to," "to live," "to produce," "to generate," "living," or "life."

It would not be an exaggeration to state that for Zheng Qiao, the most general and salient characteristic of writing in general is its vitality or generativity, its manifold engagement with growth.[57] This dependence on life is not a naïve vitalism that locates an *élan* or entelechy within material things, but a specific reference to the etymology of "*zi*" 字 (graph, or in Zheng Qiao more specifically compound graph), as given for example in the *Shuowen*:

> 字：乳也。
>
> *zi* 字 is the same as *ru* 乳.
>
> 乳：人及鳥生子曰乳、獸曰産。
>
> When human and birds give birth to offspring, it is called *ru* 乳. In the case of beasts, it is called *chan* 産.[58]

57. Yannis Haralambous points out to me that the centrality of this life metaphor in Zheng Qiao's grammatology bears resemblance to the "Chinese DNA" project developed by Chu Bong-Foo's team (2000; n.d.).

58. For Xu Shen's definitions in the *Shuowen*, I use the convenient digital edition `https://www.shuowen.org/`, which also includes the influential commentary of Duan Yucai 段玉裁 (1735–1815). The two graphs are numbered 9720 and 7665, respectively. A more complete but also more complex online philological aid that collates various *Shuowen* commentaries can be accessed at `http://www.kaom.net/book_xungu.php`.

This earlier usage of "*zi*" (which graphically decomposes to a child 子 under a roof 宀), as something akin to establishing a parent-child relation (through birth or, more often in received texts, metaphoric adoption), is attested in a number of canonical texts composed before the Qin conquests, and was clearly on Zheng Qiao's mind as he categorizes different components of compound graphs into child-graphs and mother-graphs.[59] To write a compound graph is already to bespeak a relation between its components, wherein one (the phonetic component, in today's parlance) enters into the care of the other (the determinative).

But the significance of *sheng* or life eventually outgrows its origin in the etymology of *zi*, and comes to denote a general orientation of Zheng Qiao's project, which as we have seen is committed to living practices of writing. In his own words (and referring to his earlier work that is now lost):

> 臣六書證篇實本說文而作、凡許氏是者從之、非者違之。其同乎許氏者、因畫成文、文必有說、因文成字、字必有解。其異乎許氏者、每篇總文字之成、而證以六書之義、故曰六書證篇。然許氏多虛言、證篇惟實義、許氏所說多滯於死、證篇所說獨得其生。蓋許氏之義、著於簡書而不能離簡書、故謂之死。證篇之義、舍簡書之陳迹、能飛行走動不滯一隅、故謂之生。
>
> My "Verified Chapters on the *Liushu*" were written with the *Shuowen* as their basis. I followed Mr. Xu whenever he is correct, and contradicted him whenever he is wrong. Where I followed him: because simple graphs (*wen*) have their basis in drawings, all simple graphs have an explanation; because compound graphs (*zi*) have their basis in simple graphs, all compound graphs also have an analysis. Where I contradicted him: every chapter collected graphs as we find them, and verified them with the *liushu*, which is why the work is titled "Verified Chapters on the *Liushu*." While Mr. Xu has mainly empty speech, the *Verified Chapters* have only real significance. What

59. In the *Zuo Tradition of the Spring and Autumn Annals* (*Zuoshi chunqiu* 左氏春秋, traditionally attributed to Confucius' contemporary Zuo Qiuming 左丘明), where this earlier sense of the graph is used most consistently, "*zi*" denoted something closer to an adoptive relation rather than a blood relation, a matter of "taking someone under one's wing," so to speak. Consider the following examples:

> 楚雖大、非吾族也、其肯字我乎？
>
> Although Chu is great, its people are not our kin. Will it be willing to care for (字) us? (Zuo, 2016, p. 747).
>
> 禮也者、小事大、大字小之謂、事大在共其時命、字小在恤其所無。
>
> By definition, ritual propriety means that the lesser serve the greater and the greater care for (字) the lesser. Serving the greater consists of respecting timely commands from them. Caring for the lesser consists of showing concern about the things that they lack (ibid., p. 1705).

The quotations are from the Fourth Year of Duke Cheng (587 B.C.E.) and the Thirtieth year of Duke Zhao (512 B.C.E.), respectively. This usage, rather than biological offspring, seems to be much better represented across the *Zuo Tradition*.

> is discussed by Mr. Xu is constrained by the [scheme's] being inert/dead (*si* 死), whereas the discussions of *Verified Chapters* are uniquely receptive to life (*sheng*). This is because Mr. Xu's writing is attached to inscriptions on bamboo slips but cannot be lifted therefrom, hence I say they lack life. My *Verified Chapters* leave behind the aged traces of bamboo slips and lets words move about freely without being constrained to one place, hence I call their characters "alive" (Zheng, 1995, p. 343).

The concept of life or *sheng* 生 thus operates in Zheng Qiao's "Compendium" in two, interrelated, ways. First, *sheng* denotes intra- and inter-graphic relations that his study of writing focuses on, such as the relation between different components in a compound graph or the lines of variation or diversification linking one graph to another. Second, *sheng* signals that this way of thinking about writing is both dependent on and applicable to the expanded field in which the boundary of Sinography has become fuzzy, leaving behind Xu Shen's limited corpus to include, as we have seen, other writing practices known in Zheng Qiao's time that he felt grammatology needed to take into account.

3.2. Simple Graphs

The entanglement between these two meanings of *sheng* can be seen throughout the five-volume "Compendium on the *Liushu*," where new grapholinguistic data engender new conceptual paradigms and vice versa. This interconnection between epigraphy and grammatology is especially salient in the work's fifth, most theoretical volume, which will be the focus of the remainder of this paper. I follow Zheng Qiao's second principle and present this material by establishing first a distinction between simple and compound graphs (*wen* 文 and *zi* 字, respectively). This historically contentious distinction, famously articulated as "those graphs whose body is isolated are/become *wen*, and those graphs whose body is conjoined are/become *zi*" 獨體為文、合體為字, concerns not so much what each graph *is*, as an unchanging quality insensitive to its contexts, but the trajectory of becoming or the network of relations that a graph encrypts, while alternative trajectories or networks always lurk not too far away (ibid., p. 5).[60]

The opening essay in the fifth volume of the "Compendium on the *Liushu*" is titled "The Diagram of '一' Arising and Becoming Simple

60. In the fifth volume, essays that deal with the grammar of simple graphs and compound graphs do not exhaust all the forces conductive of neographism, as Zheng Qiao also discusses contractions (Zheng, 1995, pp. 339–341), what is lost and gained between the Seal and the Cleric Scripts (ibid., p. 346), graphs created *ex novo* by specific historical persons such as Empress Wu Zetian (r. 690–750) (ibid., p. 347), and other topics. Their omission in this paper is the choice of this author, not Zheng Qiao's.

Graphs" (*qiyi chengwen tu* 起一成文圖), and it situates the formal origin of the simple graph in "一," the trace left on the inscriptional surface by a steadily moving hand.[61] The bulk of this essay follow a repetitious syntactic pattern, demonstrating the transformations of the stroke through various geometric operations, often through intermediate graphic patterns for which Zheng Qiao always provides a phonetic gloss. A representative sequence of transformation of "一" would read:

> 折一為𠃌、反𠃌 為 𠂆, 轉 𠂆 為 乚、反 乚 為𠃍。至𠃍 而窮。
>
> Bend 一 and [it] becomes 𠃌, invert 𠃌 and [it] becomes 𠂆, rotate 𠂆 and [it] becomes 乚, invert 乚 and [it] becomes 𠃍. [When this line of variation] reaches 𠃍 it is exhausted (Zheng, 1995, p. 335).[62]

The stable quadri(grapho)syllabic syntax here gives a sense of regularity or recursivity: [變]A 為 B, or [transform] A and [it] becomes B, to be followed by C (from B), D (from C), E (from D), etc. This phrase structure dominates both the first essay (wherein five different, diverging lines of variation from "一" are given) and the second essay. The verbs denoting the transformation proliferate as the essays go on. It is therefore informative that, at the beginning of this procession or cascade of becomings, this syntax is altered slightly:

> 衡為一。從為丨。邪丨為丿、反丿 為𠂉。至𠂉為窮。
>
> Horizontal and [it] becomes 一, vertical and [it] becomes 丨. Tilt 丨 and [it] becomes 丿, invert 丿 and [it] becomes 𠂉. [When this line of variation] reaches 𠂉 it is exhausted (ibid., p. 335).

I have left out from the translation of the first sentence information that is not in the original (and which Zheng Qiao could have provided had he intended to). What is noteworthy here is that 一 is not, in itself, held to be the origin of the cascade, which is instead occupied by an absent "A" whose content we are left to conjecture: the movement of the hand? ink on paper? something else entirely? What Zheng Qiao does explain is that 一 is chosen for a reason, which is what differentiates the graph from two other alternatives that might, upon first sight, seem to better represent the origin or perfection, the dot and the circle:

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61. Undoubtedly Zheng Qiao is playing upon cosmological claims in canonical philosophical texts that posit the arising of all things from Oneness (the linguistic signification of *yi* 一), which arises from Nothingness, but his reference to this discourse is interesting precisely because he reformulates it—and in so doing modifies it—in grapholinguistic terms. On Oneness and the changing conceptions of coherence in (pre-Song) Chinese thought, see Ziporyn (2012; 2013).

62. Once again, we should be reminded that Zheng Qiao insists all of these graphs can be read out loud. Thus, he notes that 𠃌 should be read as 及 [*gip], and so on. However, I will not provide these readings in this paper as with other Sinographs, since they are often not attested anywhere else and are, in my view, meaningless.

> 引一而繞合之、方則為□、圓則為○。至○則環轉無異勢、一之道盡矣。丶、與一偶、一能生、丶不能生、以不可屈曲、又不可引、引則成丨 [...] 天地之道、陰陽之理也。
>
> Prolong 一 and close it upon itself, if squared it becomes □, if circled it becomes ○. Reaching ○, [the graph] turns in a circle and lacks the propensity for deviation, and here the Way of 一 is exhausted. The dot 丶 is the opposite of 一. 一 is capable of generating (*sheng* 生), but 丶 is not. This is because it cannot bend or form curves, and neither can it be prolonged: if prolonged it just becomes 丨 [...] Such is the Way of Heaven of Earth, the pattern inherent in *yin* and *yang* (ibid., p. 335).

"The Way of 一" is tellingly exhausted upon reaching a homogeneous curvature, when the "propensity for deviation" is expelled: that which qualifies 一 as the substitute origin of simple graphs is precisely its capacity for variance, be it in the form of bending, being prolonged, or anything else.

If this first essay in the fifth volume of "Compendium on the *Liushu*" demonstrates the proliferation of graphs generated by 一 or, in what amounts to the same thing, its propensity for deviation, the second, titled "Diagram of the Formation of Forms from Simple Graphs" (因文成象圖), displays the diversity of generative relationships or trajectories of variation among a larger repertoire of graphs, many of which epigraphic evidence found in publications such as the *Illustrations for the Study of Antiquity* and the *Ancient Graphs Organized by Tone and Rime* introduced above.[63] A total of nearly twenty types of inter-graphic relationships are suggested, although no claim is made that all such relationships are exhaustively listed in the essay. Each of these relationships is introduced with a phrase such as "there are [graphs] obtained through vertical inversion" (有到取), followed by a list of examples (less sequentialized than in the previous essay). An exemplary subset of these relationships is as follows (ibid., pp. 335–336):

With the benefit of hindsight, it is not difficult to see that Zheng relies, without discrimination, on graphs from a variety of sources to make his points, some more reliable than others.[64] But thinking through the

63. Other significant sources for graphs analyzed in this essay are the Seal Scripts given in the *Shuowen*, graph forms of his own day, as well as the *Classic of Changes* (*Yijing* 易經) hexagrams, which are analyzed as the origins of some later glottographic graphs.

64. We know, for example, that 三 is a common form of "four" in oracle bone and bronze inscriptions, and only became replaced by the "modern" form 四 *en masse* in Warring States manuscripts. The ligature 廿 is likewise familiar to any student of Chinese even today, and the calligraphic differentiation of 毋 and 母 is a textbook example in Chinese paleography for the reduction of a polysemic graph's lexical load (Qiu, 2000, pp. 325–326). On the other hand, the form 𠂇 for "left," while clearly taken from the aforementioned *Sweating the Bamboo* lexicon, is only attested among excavated materials in oracle bone inscriptions, which neither Zheng Qiao nor his prede-

TABLE 2. Selected transformations/relations of simple graphs.

Transformation	Zheng's Term	Example
Vertical inversion	到	𠂤 (up) to 𠂆 (down)
Horizontal inversion	向	 (left) to (right)
Back to back	相背向	 (to do) to (north)
Taking from what is near	近	☷ (the *kun* trigram) to (earth)
Reduplication	加	二 (two) and 二 to 三 (four)
Subtraction	減	二 and 十 (ten) to 廿 (twenty)
Changing the middle	中	毋 (do not) to 母 (mother)

internal logic of the text rather than evaluating his arguments against the yardstick of epigraphic accuracy, the point of the essay becomes clearer: simple graphs are generated from each other through graphical operations, and it is first and foremost through the invisible threads left behind by these operations that we should understand their forms. Thus the cascade of variance that Zheng Qiao traces back to the horizontal stroke 一 continues through a much larger corpus of graphs, past and present, through plural yet specific patterns that have little to do with the radical-based system of the *Shuowen* or any of the *liushu* principles. A cascade that flows through the world of simple graphs until the appearance of a different type of relationship fundamentally different from everything discussed so far—the bending, adding, subtracting of strokes, the geometric manipulation of components, and so on. This relationship is the intra-graphic relationship of conjoining.

3.3. Compound Graphs

In the texts available to Zheng Qiao and in his own writing, the term *zimu* 字母 (mother-graph) meant something more intricate and intriguing than letters in an alphabet. The term can be traced to its specialized use in Buddhist scriptures or commentaries, where it signified the initial consonant (with an inherent vowel) in the Brahmic writing systems known in China since the third century C.E., while intermittently designating the basic unit of Brahmic writing systems, the *akṣara* (Mak, 2014,

cessors likely had knowledge of. The more common form in bronze inscriptions and later manuscripts is in fact the one given in the *Shuowen* (similar to the "modern" form 左), while in the Chu manuscripts the 工 signific is often replaced by the 口 signific. For epigraphic aid and the images of graphs in excavated inscriptions, I refer to the *Open Ancient Chinese Characters Glyph Database*: `http://www.ccamc.co/cjkv_oaccgd.php?`.

p. 215).[65] Its more general usage, which Zheng Qiao relies upon, derives from the Sinographic *zimu* attributed to the late-Tang monk Shouwen 守溫, who selected thirty-six graphs, in imitation of the phonological organization of Sanskrit syllables, that represent the thirty-six initials of the Chinese language.[66] Zheng Qiao's praise for these *zimu*, which form the backbones of phonological rime tables, is unreserved:

> 華僧從而定之、以三十六為之母、重輕清濁、不失其倫、天地萬物之音、備於此矣。雖鶴唳風聲、雞鳴狗吠、雷霆驚天、蚊蚩過耳、皆可譯也、況於人言乎。
>
> The Chinese monk followed [Indian phonology] and established the mother-graphs with thirty-six graphs, which preserved the distinctions between accented and unaccented, voiced and voiceless sounds. In these [written characters] are the sounds of all the myriad things of heaven and earth. Though it be the cry of a crane, the voice of the wind, the crow of a cock, the bark of a dog, the crash of thunder which startles heaven, the buzz of a tiny insect passing by your ear, all can be rendered [through these graphs]. How much more so [can it render the sounds of] human speech![67] (Zheng, 1995, pp. 353–354)

Zheng Qiao's fascination with the use of Sinographs in phonology likely informed the vocabulary he uses to discuss grammatology, where the becoming-initial of a graph in *fanqie* 反切 spelling or the becoming-consonant of a Sanskrit *zimu* when a vowel mark is added becomes a blueprint for how the becoming-component of a graph is conceptualized. Zheng Qiao was not the first to notice the grammatological analogy between the Sanskrit abugida and compound graphs in Chinese writing, as Buddhist writers such as Sengyou had carried out similar analyses half a millennium earlier; but his systematization of this vocabulary connects component-based analyses of compound graphs to his general concept of life and enables a reformulation of the *liushu* theory (Bottéro, 2004).

It is safe to conjecture that Zheng Qiao's concept of the child-graph (*zizi* 字子) is his own (or otherwise contemporary) invention, reassessing *zimu* as being only half of the vocabulary necessary to describe compound graphs. Unlike the operation of conjoining, which as we have seen is shared across various writing systems that Zheng Qiao discusses,

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65. The Tang dynasty monk Huilin 慧琳, in a widely-referenced lexicon of Buddhist terms titled *Sound and Meaning of All Sutras* (*Yiqiejing yinyi* 一切經音義, c. 807), described Sanskrit *wenzi* 文字 as having twelve vowel markers (*fanzi shengshi* 翻字聲勢), thirty-four mother-graphs (*zimu*), and four "helping sounds" (*zhusheng* 助聲). See Jao (1990, pp. 113–117).

66. On the history of Chinese traditional phonology, including discussion of key terms such as the rime table, *fanqie* spelling, and the thirty-six *zimu*, see Branner (2006) and Pulleyblank (1999).

67. Translation modified from Mair (1993, p. 339).

the idiom of child- and mother-graphs is primarily reserved for compound Sinographs. At the most basic level, Zheng Qiao defines them in the following way:

> 立類為母、從類為子。母主形、子主聲。
>
> That which establishes a category is the mother-graph, and that which follows an established category is the child-graph. The mother-graph prioritizes its shape, while the child-graph prioritizes its sound (Zheng, 1995, p. 344).

There is an echo here to Xu Shen's organization of the *Shuowen* here, however critical Zheng Qiao is of Xu's actual categories that sometimes file graphs under their child-graphs instead of mother-graphs.[68] Zheng Qiao is careful to establish that, while the mother-graph in this context is fully analogous to the *zimu* of phonology, their difference can be accounted for by the different meanings "category" (*lei* 類) assumes when different organs of perception are in play. The visual identity of the *Shuowen* "radical," which Zheng Qiao takes to be the more important in the "learning of the eye" (*yan xue* 眼學, that is, grammatology as opposed to phonology; cf. (Zhang and Mair, 2020)), establishes a category under which is gathered various adopted children, components that are now under its care (*zi* 字).

Of the six categories of the *liushu*, only two consist of compound graphs that can definitionally be analyzed through this new idiom: the syssemantograph (*huiyi* 會意) and the phonetic compound (*xiesheng* 諧聲). Of which, "[the conjoining of] two mother-graphs form the syssemantograph, [the conjoining of] a mother-graph and a child-graph form the phonetic compound" 二母為會意、一子一母為諧聲 (Zheng, 1995, p. 233). Nevertheless, Zheng Qiao uses these two terms as the main anchors for his analyses of graphs falling under those categories as their numerous subcategories. These numerous subcategories have been studied in previously-cited scholarship that situate Zheng Qiao in the context of *liushu* studies, and therefore will not be examined here.

68. For example, Zheng Qiao criticizes the 句 category in the *Shuowen*. in which are included graphs 拘 and 鉤. Zheng Qiao argues that 拘 should be subsumed under the hand radical and 鉤 the metal radical, and the 句 category is pointless because 句 is a child-graph, not a mother-graph (Zheng, 1995, pp. 344–345).

4. Conclusion: Time and Variations

> Instead of condemning or excluding, one consigns a certain thing to antiquity, to archaism. One no longer says "false" but, rather, "out-of-date," or "obsolete." In earlier times people dreamed; now we think. Once people sang poetry; today we experiment efficiently. History is thus the projection of this very real exclusion into an imaginary, even imperialistic time. The temporal rupture is the equivalent of a dogmatic expulsion.
>
> Serres, 1995, p. 50

> It is the variation itself that is systematic, in the sense in which musicians say that "the theme is the variation."
>
> Deleuze and Guattari, 1987, p. 93

This paper began by examining Chinese grammatology's complex relationship with empirical, epigraphic research and questioning to what extent it is—or should be—an offspring of traditional *liushu* studies, conventionally but ahistorically traced back to Xu Shen's *Shuowen* postscript. But instead of answering these questions in the context of current academic debates in their respective disciplines, I returned to the philological writings of Zheng Qiao—whom many considers to be the progenitor of later *liushu* studies—and demonstrated that these writings contain multiple currents of thought that do not lend themselves easily to be recruited by a single, coherent research program. The "Compendium on the *Liushu*" certainly contains an attempt to categorize a standard repertoire of glottographic Sinographs according to the *liushu*, but it is also something different and more. Zheng Qiao's grammatology, when read along the lines sketched out in this paper, exemplifies an explicit interconnection between grammatological and epigraphic modes of thinking: by drastically expanding the purview of what is included in the study of writing, the basic concepts and operating underlying formal theorizations of writing are also continuously transformed, resulting in deep analogies between different repertoires of writing and provisional lists of operations that are never fully finalized. All of the methodology and results that emerge along these lines—the commitment to living practices of writing, the centrality of inter- and intra-graphic relations, the recognition of the propensity for deviation as the originary force of neographism—are encapsulated in the term *sheng* 生, which Zheng uses to align the realm of writing with its immanently productive or generative forces. Seen in this light, the term "grammatogenetics" as opposed to

"grammatology" is perhaps more fitting for the nature of his endeavor, since the invention of writing is no longer a rarefied event of the distant past but a continual, only derivatively signifying process central to the nature of writing itself.[69]

It goes without saying that Zheng Qiao's study of grammatogenesis is at once linguistic and philosophical, and I will not further summarize its details beyond what is already given above. A further dimension of this grammatogenetics is its politics. It has sometimes been observed that, in the context of twentieth-century Chinese archaeology, "the transformation of archaeology into the virtual handmaiden of antiquarianist historiography coincide with an increasingly reactionary political climate" (Von Falkenhausen, 1993). We have already seen how such a dynamic was already at play in the Northern Song, with Lü Dalin's preface heralding an elimination of difference and a return to antiquity, whose glory in part derives from a presumed homogeneity and unity. But Zheng Qiao's antiquarianism, if we can call it that, imagines that the archaeology of writing and writing-related concepts alike will open up another possible relation with the past, not establishing a dichotomy of orthodoxy and deviation but a relation of kinship in diversity.[70] His patience for and attention toward the graphic heterogeneity of his own time is echoed by what the study of excavated texts enabled him to confirm: that the scripts of the ancients had variance and deviation as a core element, and that instead of an imagined teleological orthography that later scholars so eagerly project backward in time what prevailed were local habits and sensibilities.[71] Zheng Qiao's response to such antiquarian tendencies within paleography in the "Compendium" proceeds in four essays, the first three being lists of examples while the fourth developing a focused argument.

The first three essays are titled "Diagram of Variant Graphs Across Time" (*gujin shuwen tu* 古今殊文圖), "Diagram of Variant Graphs Within a Single Era" (*yidai shuwen tu* 一代殊文圖), and "Diagram of Variant Graphs in Various States" (*zhuguo shuwen tu* 諸國殊文圖), and they enumerate examples of what, in today's parlance, amounts to the diachronic change as well as synchronic variability of graph forms (cf. Galambos, 2006). In the first essay he chooses commonly appearing graphs such as 泉, 貨 (both meaning "currency") or 惟 (a common particle at the beginning of texts) and traces the various forms they take in inscriptions dated from

69. I am inspired in this formulation by Brian Massumi's distinction between "ontology" and "ontogenetics" in philosophy, one prioritizing positions and entities while the other emergence and becoming (2021, pp. 1–23).

70. Zheng Qiao's position in this regard, as is perhaps clear by now, is also taken by this author.

71. I use the term "orthography" strictly in the sense of a normative standard of graph forms.

the time of the legendary Yellow Emperor to the Shang and the Zhou dynasties.[72] The second essay focus on local corpora such as "the coins of Fuxi" and the money and inscribed vessels of Shang to demonstrate that even under one sovereign, the "same" graph can be written with a considerable degree of variance. Finally, in the third essay, Zheng Qiao turns to the same graph inscribed on vessels attributed to various dukes of the Zhou, and once again finds considerable variance in how graphs such as 文 and 公 are written. Neither of the three essays are particularly long, although they each end with a sentence that states that graphic variation of the type described are too many to list, and the examples given in the essays should provide a general idea of the phenomena (Zheng, 1995, pp. 337–339).

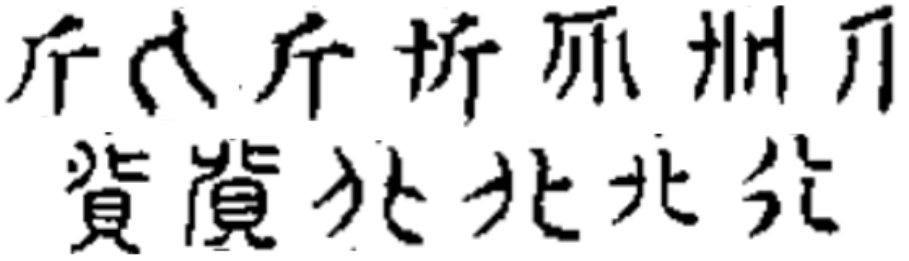

FIGURE 4. Variants graphs of 貨 Zheng Qiao gives in "Diagram of Variant Graphs Across Time" (*gujin shuwen tu* 古今殊文圖), attributed to money dated from the Yellow Emperor's time (top left) up to the Zhou.

All this, Zheng Qiao concludes, is evidence of the arrogance of the Qin conquerors who "unified" China, that is to say, homogenized it, and also of later scholars who attempted to legitimize the imperialistic installation of the "modern" orthography. How could the intent of the ancient sages be tied to this or that specific graph form (which, according to Xu Shen, the Clerical Script of his day inherits) when there were no fewer than thirteen ways of writing a graph like 貨 in inscriptions dated to their era? Thus the hermeneutic attitude in the study of a privileged set of graph forms—an attitude that focus on the graphs' original intent or inherent meaning (*yi* 義)—is a futile endeavor misguided from the

72. In this and the following essay, Zheng Qiao references many graphs found on ancient money, but I have been unable to locate the source of those inscriptions in any received text. Ming scholars cite Zheng Qiao's now-lost work *Quanpu* 泉譜 or *Catalogue of Coins* as a paleographic authority, therefore it is likely that Zheng Qiao is referring to inscriptions included in this work, inscriptions that he perhaps played an active part in collecting.

start.[73] In this way, Zheng Qiao recovers the intention of the ancients by suggesting, paradoxically, that the very idea of such an intention that can be discerned from graph forms is a later fantasy:

> 後人之書、附義成文、古人之書、舍義成文。文而無義者、皆古聖人之書也、附義成文者、皆是依緣意想而取象、舍依緣則其意無所繫者、此後人之用心也。
>
> Later scholars graft "meaning" to their writings, while the ancients write by leaving "meaning" behind. All writings that are without inherent intention or meaning are the writings of the ancient sages. The formation of graphs with "meaning" attached to them, on the other hand, are dependent upon mental speculations and are meaningless without them. Such are the artifices of later scholars (Zheng, 1995, p. 339).

But what is without "meaning" in this strong sense created by Han scholars is not arbitrary or disorderly, as the Xu Shen postscript portrays; rather, what differentiates between the writing practices of pre- and post-Qin China is that in the former, the source of meaning is not legitimated by the authority of the origin, but rather by various local habits of reading and writing:

> 觀諸國殊文、則知三代之時、諸國之書、有同有異、各隨所習而安、不可彊之使同。秦人無知、欲使天下好惡趨避盡狗於我、易天下之心而同吾之心、易天下之面而同吾之面。
>
> Beholding the various graphs of each nation, we see that at the time of the Three Dynasties [Xia, Shang, and Zhou] the writings of each state had their similarities but also their differences. They were each content with what was habitual for themselves and did not territorialize writing to enforce homogeneity. The Qin regime was ignorant and wanted to forcibly make the preferences of all under the Heaven follow its own preferences, to change the heartminds of all under the Heaven to be the same as its own heartmind, to alter the countenance of all under the Heaven to be the same as its own countenance (ibid., p. 339).

Or worse: it may have eradicated the heartmind (*xin* 心) of others entirely through the mutilation of their senses (cf. Dean and Massumi, 1992, pp. 26–39). It is perhaps fitting to conclude this conclusion by citing at length a recent study by Liu Baojun 劉寶俊 of the use of the 心 signific across three corpora of bamboo inscriptions from the Chu state (namely the Guodian, Shanghai, and Tsinghua manuscripts), and in particular his discussion, in light of Chu heterographic practices in

73. The polemical argument against the overemphasis on "meaning" strongly echoes his famous argument against the exegetical tradition surrounding the *Classic of Poetry*, claiming that the songs therein should not be read for their implicit moral messages—as has been done since the influential *Mao Tradition* of the Han dynasty—but were edited by Confucius primarily on the basis of their appropriateness for various ritual occasions as musical compositions (Mittag, 1993a).

general, of the 急 graph with which this paper began. Citing the opinion of Pang Pu and echoing the sentiment of Zheng Qiao, Liu Baojun writes:

> "急" is a specialized graph created by the people of the Chu state to emphasize "an action of the heart," and in fact appears earlier than "偽" [...] The correspondence between the Chu graph "急" to graphs in the Qin lineage "偽" is the same as that between the Chu graph "息 〈⿰身心〉" [body-heart] and graphs in the Qin linage "仁," and seems to contain an implicit pattern of correspondence that intimates the oppositional difference between the systems of thought of the Chu and the Qin peoples. The Chu "急" graph emphasizes not the external, artificial action of "偽" (人為之偽) but the internal, mental action of "急" (心為之 急): it is the mental state of action or an action of the mind, not physical activity but a mental action (不是行為而是心為). In the later competition between the Qin graph "偽" and the Chu graph "急," following Qin's unification of all under the Heaven, the homogenization of writing, and the eradication of all that is different from Qin graphs, "偽" became the orthodox, standardized form that is promoted through governmental power and have survived to this day. And the Chu graph "急" has disappeared following the Chu state's demise at the hands of the Qin. It is fortunate that due to archaeological excavations some two thousand years later, the mental traces (心跡) of the Chu people once again see the light of day, and the efforts of their mind are at last no longer in vain (Liu, 2020, p. 84).

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The Chinese Script as a Self-Regulating System

Applying Köhler's Basic Model of Synergetic Linguistics to Simplified Chinese Characters

Cornelia Schindelin

Abstract. Köhler's basic model of synergetic linguistics endeavors to show language (sub-)systems as dynamic systems the units (of various levels) of which interrelate directly or indirectly. These relationships are controlled by needs or constraints which interact in complex ways. This study adapts and applies Köhler's basic model to modern simplified Chinese characters and tests the hypotheses it provides about the direct and indirect relationships between character frequency, graphical complexity, and functional complexity. The hypotheses are tested on data from a large corpus study published in the People's Republic of China in 1986.

Three hypotheses about direct relationships and three about indirect relationships between the three systemic features were operationalized and tested. While all three hypotheses about direct relationships could be accepted based on goodness of fit, this was not the case with all three hypotheses about indirect relationships. Here, the model or at least its adaptation—including the operationalization of "functional complexity"—seems to need improvement. Further study is needed.

1. Introduction

Modern Chinese characters seem to show some systemic features which correspond to those already examined on the lexical level of various languages.[1] For example, there are differences in text frequency (token frequency) among Chinese characters just as some words of any language are more frequently used than others. And just as more frequent words are shorter on average than less frequent ones, more frequent Chinese

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1. Including modern Chinese, see (L. Wang, 2011), (Lu Wang, 2014b), and (Lu Wang, 2014a).

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characters also seem to be, on average, graphically and/or structurally simpler than less frequent ones.[2]

Synergetic linguistics views language (sub-)systems as self-regulating systems[3], somewhat like ecosystems, and endeavors to model them as dynamic systems the units (of various levels) of which interrelate in certain ways, directly or indirectly. These relationships are controlled by needs or constraints which interact in complex ways.[4] For example, writers would want characters to be easy to write and thus tend toward a minimization of the coding effort while readers would want them to be easy to differentiate and thus prefer a minimization of the decoding effort. Both readers and writers would want the whole inventory to be limited in size so they would not need to learn endless numbers of graphical signs. However, at the same time, they would want each graphical form to be as unambiguous and specific as possible which would require graphically different forms for different morphemes of their language and thus result in an expansion of the character inventory. These conflicting needs and interests can push the system to develop in one or another direction.

Quantitative linguistic research has already identified and described, in mathematical or statistical terms, relationships between variables like unit length, its text frequency and frequency rank, its complexity, its breadth of usage, and so forth. These relationships or dependencies can be formulated as a "hypothesis" or even a "law" of quantitative linguistics and may be given a name which often honors the first person to describe the respective relationship, like "Zipf's law".[5] A further step would be to integrate the various hypotheses and "laws" into one model which considers the direct relationships already explored but also allows to derive, operationalize, and test indirect relationships.

Köhler's basic model of synergetic linguistics (Köhler, 1986) is such an attempt at formulating an integrated model.[6] The hypotheses that can be derived from it have been tested on data from various languages.[7]

In this study the attempt was made to apply the model to Chinese characters and find out if the relationships described by the model also hold for Chinese writing. So, a corresponding formulation of the model

2. For reasons of space we shall not go into the question of what a "word" is. For a discussion pertaining to modern Chinese, see (Duanmu, 2017). For a summary of studies on word length in Chinese see (Schindelin, 2017c).

3. This idea has been picked up in China as well, cf. (Wáng, 1995).

4. Cf. Altmann and Köhler (1996).

5. See Zipf (1932), for one of Zipf's seminal publications. For information on research done on the validity of Zipf's law for Chinese, see Schindelin (2017d).

6. For an introduction in English see Köhler (2005).

7. See Köhler (2004), for some examples.

was constructed and examined, and the results of this endeavor are presented here.[8]

If in the following simply the word "characters" is used, it is intended to mean "Chinese characters". After all, the principle of least effort presumably is an universal principle.

2. The Chinese Script

Modern Chinese writing, that is, the characters being used by the speech community to record modern Chinese language utterances, is best described as a morpho-syllabic writing system.[9]

Nearly 90 percent of the characters within the modern Chinese character inventory represent morphemes, approximately each half representing free and bound morphemes, respectively. The remaining 11 percent either stand for unique morphemes ("cranberry morphemes") or representations of submorphemic parts of disyllabic or polysyllabic morphemes which need two or more characters to be written down completely (cf. DeFrancis, 1984, p. 185). A certain number of Chinese characters may (as types) be employed to represent different morphemes and also have different pronunciations or readings which, however, does not mean that every morpheme has its own reading for the character concerned.[10]

A character in a text is read, when read out loud carefully, as one syllable, with a few minor exceptions which can be disregarded here.[11] The overwhelming majority of words in the lexicon (i.e., the word inventory) are disyllabic and thus are written down using two characters (tokens).[12] Chinese words, if the remark is allowed, do not have inflectional endings because grammatical relationships between words and between clauses are expressed mainly through their positioning within the sentence ("word order") and by lexical means.

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8. This article is largely an English version of Menzel (2004).

9. For a well readable treatment, take DeFrancis (1984). Schindelin, 2007, pp. 6–7, presents the viewpoint of the Chinese scholar Qiú Xīguī 裘锡圭 who argues that the system should be described as one whose characters are made up of signific components, phonetic components and purely mnemotic components and thus argues for a Chinese term for it which can be translated as "semanto-phonetic writing" (意符音符文字 *yìfú yīnfú wénzì*, cf. Qiú, 1988, p. 18 and Qiú, 2000, p. 26).

10. For the distribution of number of readings per character among the commonly used characters, cf. Schindelin, 2007, p. 166.

11. The most obvious exception is the character 儿 which in many cases is used to write out the rhotacized version of a syllable.

12. Again I would like to refer the reader to DeFrancis, 1984, pp. 177–188, this time for his treatment of the "Monosyllabic Myth".

As for the size of the modern Chinese character inventory, various frequency counts conducted in the second half of the last century arrived at different numbers of currently used characters ranging from about 4,500 to more than 7,500 character types. The last number, however, was found by just one count which examined a corpus of nearly 12 million characters (tokens) in size. Two other research projects which examined corpora of around 21 million and around 40 million characters (tokens) in size, found 5,991 and 6,001 different characters (types), respectively. The character dictionary *Xīnhuá zìdiǎn* 新华字典 which up until the age of the smartphone could be found in nearly every household of the People's Republic of China (PRC) lists around 11,100 character entries, and when multiple entries resulting from characters having more than one reading are discounted, there are still over 8,000. People having mastered 1,500 frequently used characters are regarded to be officially "semi-literate" in the PRC while having mastered 3,000 frequently used characters makes one officially "literate". There is an official list of 2,500 most frequent characters and one of the next 1,000 frequent characters. Having mastered these, in sum, 3,500 frequent characters should enable one to recognize 99.48 percent of all the characters in ordinary texts, that is, non-specialized, everyday texts. The next 1,000 characters on the frequency list would add another 1.51 percent to that. If one were to take one thousand more characters, the added percentage contributed by these would be even lower. (Schindelin, 2005b; 2017a)

In the 1950s the government of the PRC implemented a language reform[13] aimed at making reading and writing easier for the broad masses of its people. During this reform 2,264 traditional character forms were replaced by 2,236 simplified ones. In most cases, character components occurring in a number of characters were simplified in (nearly) all characters they are a component of, which in effect simplified a lot of characters at once.[14] The simplified forms more often than not were forms which had been used in handwriting for a long time already, so they were familiar vulgar forms which now rose up to be standard ones.[15] Other methods of simplification were the renewed uptake of graphically simpler archaic forms,[16] the replacement of complicated components by simpler symbols[17] and sometimes by simpler phonetic components

13. For a short introduction to writing reform in the PRC see Chen, 1999, pp. 148–159.

14. For an introduction in English with further examples, see Yin and Rohsenow, 1994, pp. 103–112.

15. The traditional character 書 *shū*, book, was replaced by 书, a form already popular in handwriting. The component 言 (as in 說, *shuō*, to say) was replaced by the handwriting form 讠 (说) in all the characters containing it on their left, and so forth.

16. Trad. 雲 *yún*, cloud → 云.

17. Trad. 難 *nán*, difficult → 难.

which may or may not reflect current pronunciation better than the traditional ones,[18] the discarding of graphical components while keeping the overall contour or a salient component of the character,[19] and the creation of new associative compounds.[20] A combination of methods may have been applied to a traditional character in order to get a simpler form. The difference between the number of abolished characters and the number of simplified characters is the result of the reformers' merging characters for several morphemes which earlier had had their "own" character each to be represented by into just one resulting character with several meanings, i.e., able to represent more morphemes than before, although the morphemes were at least nearly homophonous and usually the original characters had had some similarity, like sharing a certain component.

Before the advent of the digital age, every printed text in China had had a hand-written original as its predecessor, so the need to reduce the required writing effort could understandably lead to differences between hand-written and printed versions of the same character, the latter conforming to the standard orthography. In a sample of 152 characters in their printed and hand-written form, about a third had the same number of strokes in both forms. 43 percent only had one stroke less in their hand-written form than in their printed form. So nearly three thirds of the characters examined were only very slightly or not at all "shorter" (counting their number of strokes) than their printed counterparts.[21] In other words, the number of strokes of printed simplified characters quite closely reflects the number of strokes of the handwritten form, which is helpful as we want to take number of strokes as an indicator of the effort it takes to write a character.

The first frequency count of characters of contemporary texts in China was done in 1927. In the last century the motivation for such research was mostly inspired by goals of writing reform or pedagogy. The size of the corpora examined has grown immensely with the development of modern computerized tools. Quantitative linguistics may not be a household name in China—and China in this respect is not different from other countries—, but quantitative research on language and writing, including on corpora, has grown quite a bit in recent decades. (Cf. Schindelin 2005a,b)

18. Trad. 畢 *bì*, to finish → 毕. However, to improve phoneticity obviously was not a priority.

19. Trad. 廠 *chǎng*, factory → 厂. Trad. 開 *kāi*, to open → 开.

20. Trad. 塵 *chén*, dust → 尘.

21. Unpublished study by this author.

3. The Corpus

The corpus at the bottom of the frequency data used for the present study consisted of texts written in simplified Chinese characters as used in the PRC. It encompassed texts of 1,808,114 character tokens or about 1.31 million running words altogether which turned out to use an inventory of 4,574 character types. The corpus had been put together by the original researchers with didactic purposes in mind. Their aim was to reflect contents and text types which an inhabitant of the PRC of average education would read. Thus, it consisted of factual prose (about 40 percent), drama, fictional prose and essays as well as folk-tales. The counting only considered Chinese characters while punctuation marks, non-Chinese numbers, Latin letters and such were ignored. The resulting data were compiled and published in a frequency dictionary[22].

The *Frequency Dictionary* contains word lists as well as a list containing each character found along with its absolute and relative frequency and its rank[23]. The list furthermore contains data on the number of words the respective character is part of in its written form in the corpus, how many different words it can be found in, in how many cases—in di- and polysyllabic words—it appears at the beginning, in the middle or at the end of the word or whether it can only be used to write monosyllabic words. The distribution of these cases is as follows:

- 217 characters (= 4.7 percent) only write monosyllabic words;
- 1,620 characters (= 35.5 percent) only occur in di- or polysyllabic words, of these 519 characters only ever occur at the beginning of words, 39 exclusively in the "middle" (which is not further specified) of words, 433 exclusively at the end of words, and 168 can appear in all three positions;
- 2,737 characters (= 59.8 percent) appear in texts as representations of monosyllabic words as well as parts of longer words.

This data set was chosen for the present study because it seemed sufficiently big in size and because the *Frequency Dictionary* provided more data than just frequencies and ranks. In light of the facts reported above about corpus studies and inventory sizes that have been variously published it appears that an inventory of 4,574 character types should be able to yield meaningful results.

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22. Simply called *Frequency Dictionary* here which refers to 现代汉语频率词典 *[Frequency Dictionary of the Modern Chinese Language]*, Beijing, 1986.

23. More precisely: its ordering number, as characters of the same frequency and thus rank still have different numbers in this list.

4. The Basic Model and the Chinese Script

The underlying assumption of the following adaptation of Köhler's basic model for application to the Chinese character system is that this system has a structure with respect to its properties and processes which corresponds to that of the lexical system, which is why a similar behavior is expected for the relationships between corresponding variables. As far as the functional dependencies of the system variables are concerned, the same differential equation is used as a mathematical model which Köhler used for his basic model. The solution of the differential equation and its linearized form are taken over as well.

The "language" examined in the following sections is, to be clear, the Chinese character system and *not* the "Chinese language" or its lexicon.[24] Any findings or conclusions, therefore, should not simply be also applied to the "language" as a whole nor to its "lexicon" in the sense of its inventory of words.

"Inventory size" in the adapted model corresponds to Köhler's "lexicon size". The need[25] to encode a message (Cod) is the desire to graphically encode syllables of the Chinese language using characters which are different for each morpheme (as there are homophonous morphemes). The higher the number of syllables and morphemes which need to be written, the bigger the character inventory has to be.

There is another need running counter to the need to encode which is the need to minimize inventory size (minI) because the capacity of the brain to memorize characters is limited; this need is served by the fact that many character types can be used for various morphemes and their corresponding syllables. Inventory size is operationalized as the number of different characters (types) which were found in the corpus.

Number of components[26] in this adaptation of Köhler's basic model corresponds to number of phonemes in his original version. It is the number of character components or minimal component graphemes identified through minimal pair analysis. The size of the component inventory is influenced by the need to minimize the coding effort (minC) on part of the writer and the need to minimize the decoding effort (minD) on part of the reader. "minC" demands the inventory to be as small as possible and its elements to be as simple as possible, so the components can be executed swiftly without having to make many different

24. Lu Wang (2014b) undertook a study of Chinese word lengths confronting Köhler's model with a corpus of texts taken from the newspaper *People's Daily* (人民日报 *Rénmín Rìbào*). As the present study is concerned with writing and character complexity, Wang's study is not discussed here.

25. In Fig. 1 below, the needs which "pull" at the systemic features are represented by abbreviations in oval shapes.

26. Or: component graphemes.

movements. "minD" on the other hand demands the elements to be well distinguishable from one another in order to make characters easy to identify.

To test the hypotheses suggested by the adapted basic model, the component inventory which resulted from Bohn's minimal pair analysis was used (Bohn, 1998, pp. 12–14). So "number of components" in this study refers to the components Bohn found as they occur in the character types of the corpus used here.

"Graphical complexity" here corresponds to the length of lexical units in the original model. As elaborated above, Chinese characters when written by hand demand different amounts of effort. Characters consisting of more strokes require more effort than those with fewer strokes. Characters consisting of more components also require more effort to write down than those with fewer components even though the latter may in fact have fewer strokes than the former. As ibid., pp. 20–24 has shown, Menzerath's law holds for the relationship between the average number of character components and their average number of strokes, which means that characters which have more components on average consist of components with fewer strokes than those characters which consist of fewer components.[27] However, the arrangement of several components on paper within a small hypothetical rectangle is more difficult than having to arrange just two components which is why graphical complexity shall be measured both in number of strokes and number of components.[28]

Even finer measurements of the effort it needs to write Chinese characters by hand can be thought of but they would be relatively laborious to operationalize. What can be accomplished, though, is considering the different types of strokes which can be assigned different values of effort according to whether or not they change direction and if so, how many times. So Bohn's measures of stroke complexity (ibid., p. 15) were also used to measure graphical complexity with a finer grain.[29]

Inventory size and number of components affect character complexity in the same way lexicon size and number of phonemes affect word length in the original model.[30] The need for redundancy (Red) strives

27. For a summary of Bohn's study in English see Schindelin (2017b).

28. Wang and Chen, 2015, p. 238, also studied the question whether number of strokes or number of components is a better measure of character complexity. They come to the conclusion that both are "proper measurements".

29. For suggestions on how script complexity can be measured, see Altmann (2004).

30. Inventory size affects the microprocesses responsible for unit length globally, as Köhler, 1990, p. 184, points out; it does not determine the length of individual lexical units.

to avoid the appearance of characters which are too similar and thus has an effect on graphical complexity.

In this research we shall use the term "functional complexity" to refer to the fact that in many cases the same character can be used for various morphemes and words. There is a relationship between graphical complexity and functional complexity which is influenced by the need for specification (Spc). Diachronically speaking, "Spc" had the effect that characters which were used to represent different morphemes in different contexts were made more complex by adding a component to yield a more specific character for a certain meaning. To give an example: This process caused the character for the word *lái* "wheat", originally written 來, which was borrowed to write the homophonous word *lái* "to come" for a while, to be made more specific and at the same time more complex by adding the component 艸[31], called the "grass component", at its top to express that the resulting combination, the descendant of which is now written 萊[32], specifically meant the grain and not the motion verb. Thus, "Spc" has the effect of enlarging the inventory which in this modeling is contained within the need to encode, "Cod". Synchronically, "Spc" refers to the need to write more complex characters in order to achieve less ambiguous expressions, given the inventory at hand.[33]

The historical process which led to new characters lets us presume that within the present character inventory, characters with more components on average have a lesser functional complexity than characters consisting of fewer components.

The needs "minC" and "minD" also have effects on functional complexity and need to balance one another out. "minD" strives for lower functional complexity as readers would like to quickly and effectively decode which morpheme is represented by the character they are seeing. "minC" on the other hand strives for higher functional complexity because having fewer characters which can each be employed for more meanings or morphemes allows writers to comfortably utilize fewer character types.

Functional complexity helps the need "minI" as the inventory can be smaller when each of its elements, the characters, on average has a higher functional complexity.

A comparison of the adapted model with Köhler's original basic model shows functional complexity to be the integration of a part of the structure which models the relationship between properties Köhler called "polylexy" (the number of meanings of a word) and "polytexty"

31. Its modern simplified form is ⺾.

32. I give the traditional full form characters for the two words here because the addition happened long before the writing reform of the last century.

33. In China as elsewhere orthography is largely standardized and leaves the individual little space to choose signs according to their own whim.

(number of cotexts a word can be used in) and the needs affecting them in the original version. Simplifications like this are possible and allow for the calculation of more complicated systems (Köhler, 1986, pp. 48–49). In the original basic model, polytexty is a function of polylexy (ibid., p. 67), and frequency is a function of polytexty (ibid., p. 68). Apart from this, it could be shown for the basic model that frequency indirectly is a function of polylexy (ibid., p. 74). Thus, simplifying the model in the way done here should not damage it. The practical reason for this choice is that for the characters of the inventory we only know how many word types contain them in this corpus but we do not know in how many different texts they occur.

The relationship between graphical complexity and functional complexity in the linearized model can be expressed through the equation

$$\text{L-functional complexity} = Q_2 * \text{minC} - Q_1 * \text{minD} - T * \text{L-graphical complexity}.$$[34]

To test this hypothesis the functional complexity of each character was operationalized as the number of the various mono-, di- and polysyllabic words (i.e., word types) it appears in within the lexical inventory of the corpus.

Characters with higher functional complexity presumably appeared more often in the corpus than those with lower functional complexity. This means, their frequency would be a function of their functional complexity, as the need to use a certain character (Use) would have an effect on its frequency. This relationship is modeled as a directly proportional dependency in the model:

$$\text{L-frequency} = R + \text{Use} + K * \text{L-functional complexity}.$$

It is known for each character how many times it was used in the corpus.

Back to graphical complexity once more. It is known that within the character system there is a relationship between the text frequency of characters and their graphical complexity similar to that between the text frequency of words and their length. The need to minimize the effort of production (minP) of each character can be seen to manifest itself in simplifications and abbreviations of characters that need to be written often. One can even say that "minP" has driven Chinese characters to evolve from their ancient forms to their modern forms as well as various swiftly executable handwritten forms which are still in use today for private or semi-official use. When the people responsible for script reform in the 1950's declared a large number of simplified characters already in use to be the new standard forms, they acknowledged

34. An "L-" signals the use of the logarithmized (linearized) form of the equation and its variables.

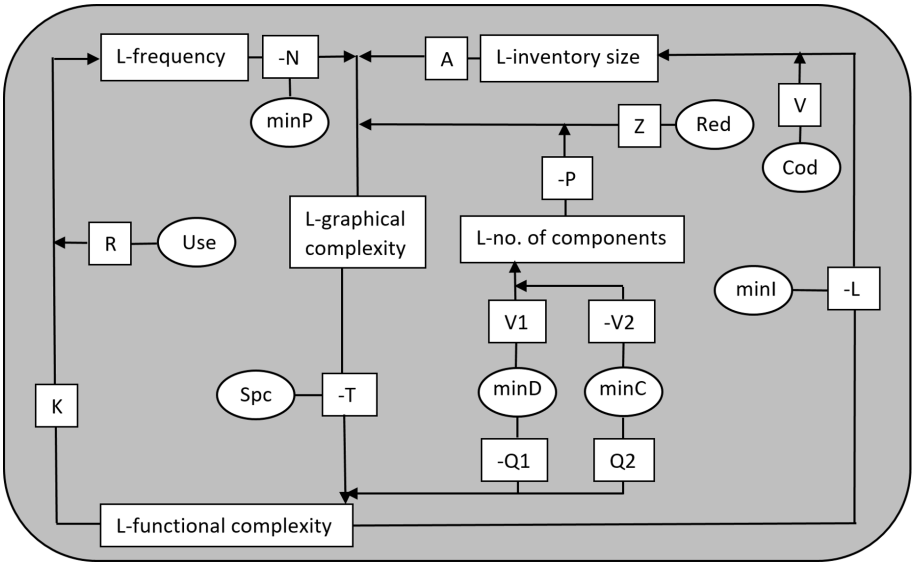

FIGURE 1. Adapted basic synergetic model of the Chinese character system, linearized (i.e., logarithmized)

the results of this "natural" development. And when one examines Chinese characters synchronically, it is quite evident that frequently used characters are "shorter," that is, less complex than characters which are used more rarely.[35]

Graphical complexity is modeled in this equation:

$$\begin{aligned}\text{L-graphical complexity} = {} & A * \text{L-inventory size} + Z * \text{Red} \\ & - P * \text{L-number of components} \\ & - N * \text{L-frequency}.\end{aligned}$$

The complete adapted model is shown in Figure 1.[36]

4.1. The Hypotheses

The adapted model enables us to derive three hypotheses about direct relationships and another three hypotheses about indirect relationships

35. Cf. Schindelin (2017a).

36. Of course, Köhler's model has not remained without criticism. See Hammerl and Maj (1988), and Maj (1990), for instance. The debate, during which replies by Köhler were also published and discussed in turn, somewhat continued through the volumes of *Glottometrika* in the following years.

between systemic features. The direct functional relationships are (in their non-linearized forms):

$$H_1 : \text{functional complexity} = A_1 * \text{graphical complexity}^{B_1}$$
$$H_2 : \text{frequency} = A_2 * \text{functional complexity}^{B_2}$$
$$H_3 : \text{graphical complexity} = A_3 * \text{frequency}^{B_3}.$$

Insertion yields the following three hypotheses about indirect functional relationships:

$$H_4 : \text{graphical complexity} = A_4 * \text{functional complexity}^{B_4}$$
$$H_5 : \text{functional complexity} = A_5 * \text{frequency}^{B_5}$$
$$H_6 : \text{frequency} = A_6 * \text{graphical complexity}^{B_6}.$$

The six hypotheses were verified using the linearized model with the help of the statistics software package SPSS. Multiple linear regression was performed using the method of least squares fit. For all relationships examined there were replicated responses. Therefore, the means of the replicated responses weighted with the number of values was used for the independent variable. Data points with a weight of 5 or less were in general excluded from regression. When no such exclusion was made, it shall be mentioned below. To measure the quality of the fit, the determination coefficient R^2 was used, below abbreviated as D (for coefficient of determination). A fit was considered good when D reached at least the value 0.9.

4.2. Direct Functional Dependencies (H_1–H_3)

4.2.1. *Functional complexity as a function of graphical complexity*

The functional complexity of Chinese characters is directly a function of their graphical complexity. It is lower when their graphical complexity is higher. In the linear model, the equation is

$$\text{L-functional complexity} = \ln A + B * \text{L-graphical complexity}, \qquad (H_1)$$

where B is expected to be negative.

Graphical complexity was measured in three ways: (a) number of strokes, (b) number of component graphemes, and (c) sum of the effort values of each stroke of the character counting their change of direction when being executed manually, called "writing effort" below. Regression was applied to each of these data sets including the data of all characters.

(a)	No. of strokes:	$D = 0.956$	$A = e^{5.59} = 268.12$	$B = -1.373$
(b)	No. of components:	$D = 0.953$	$A = e^{3.666} = 39.09$	$B = -1.133$
(c)	Writing effort:	$D = 0.95$	$A = e^{6.086} = 439.72$	$B = -1.44$.

As expected, the value of B is negative and in addition has very similar values in all three kinds of measuring. The values of A differ as the values of the entities counted are very different in absolute numbers.

Figures 2 through 4 show the data points as well as the curve of the respective function in non-logarithmic form.

The quality of the fit as well as the visual appearance of the curves in relation to the data points suggest that the first hypothesis can be accepted.

4.2.2. *Frequency as a direct function of functional complexity*

The text frequency of Chinese characters is a function of their functional complexity. It is higher for characters with a higher functional complexity. In its linearized form, H_2 is expressed as

$$\text{L-frequency} = \ln A + B * \text{L-functional complexity}, \qquad (H_2)$$

and a positive value is expected for B.

Regression was performed on the complete data set. The fit was very good: D = 0.958. Figure 5 shows the data points and the curve of the derived function in non-linearized form. For he sake of graphical resolution, only data points with weights >5 were included in drawing the figure. As functional complexity gets higher, the data points are more widely scattered around the curve. The curve seems to reflect the tendency of the relationship nonetheless. This and the quality of the fit leads us to accept the second hypothesis as well.

4.2.3. *Graphical complexity as a function of text frequency*

The graphical complexity of Chinese characters is a function of their text frequency. Graphical complexity is on average lower when text frequency is higher. In linearized form the equation is

$$\text{L-graphical complexity} = \ln A + B * \text{L-frequency}. \qquad (H_3)$$

Again, a negative value for B is expected.

Text frequency is measured as the absolute number of occurences of each character in the corpus. Possible values are very disparate. Especially among very frequent characters there are hardly any two with the same frequency. So in order to use frequency values feasibly as the independent variable they were condensed into frequency classes. The resulting classes were weighted with the number of data points in them. Two class widths were chosen: 50 and 100. Frequency classes which contained only five data points or less were excluded from regression. The central value of the class was chosen as the value of the independent

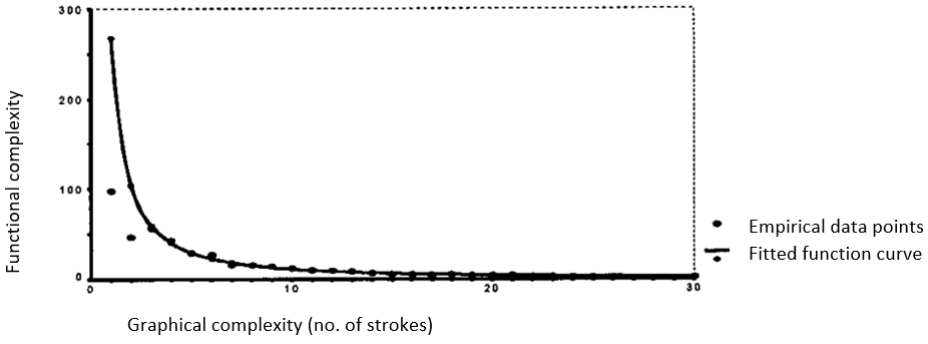

FIGURE 2. Functional complexity as a function of graphical complexity, measured in number of strokes

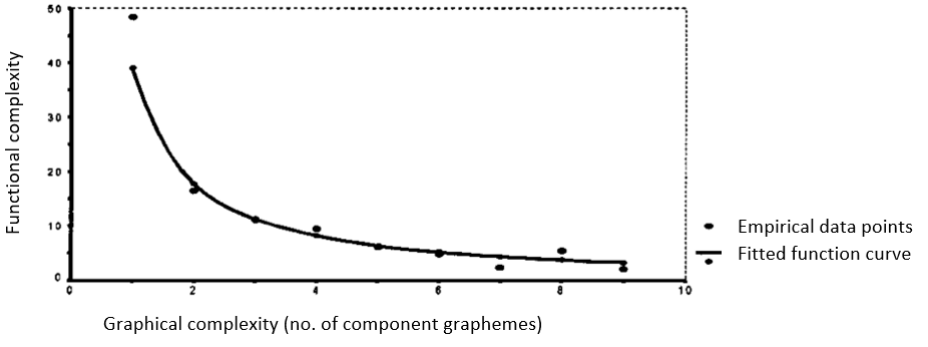

FIGURE 3. Functional complexity as a function of graphical complexity, measured in number of component graphemes

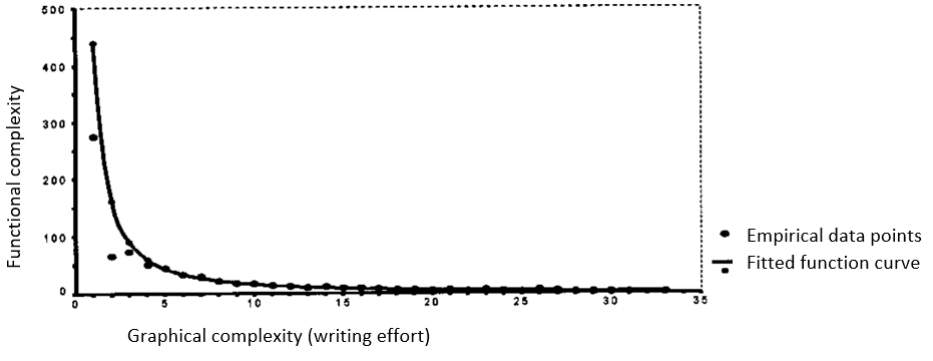

FIGURE 4. Functional complexity as a function of graphical complexity, measured in writing effort

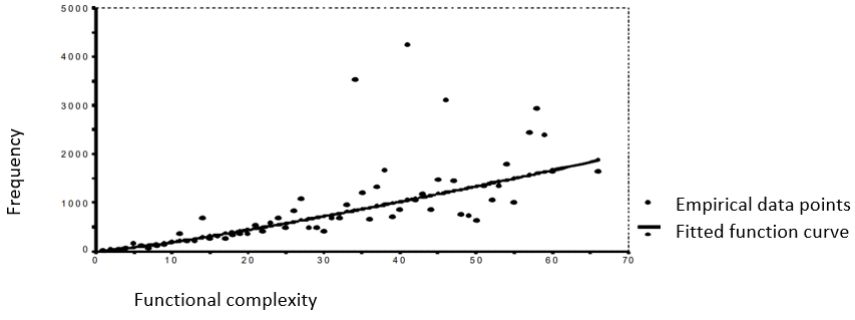

FIGURE 5. Text frequency as a direct function of functional complexity

TABLE 1. Results for H_3 for both class widths and three ways for measuring complexity

	Measure	Class width 100	Class width 50
(a)	No. of strokes	$D = 0.94$	$D = 0.93$
		$A = e^{2.846} = 17.22$	$A = e^{2.72} = 15.18$
		$B = -0.114$	$B = -0.094$
(b)	No. of components	$D = 0.95$	$D = 0.897$
		$A = e^{1.51} = 4.53$	$A = e^{1.4} = 4.066$
		$B = -0.0958$	$B = -0.078$
(c)	Writing effort	$D = 0.946$	$D = 0.92$
		$A = e^{3.057} = 21.28$	$A = e^{2.94} = 18.88$
		$B = -0.11$	$B = -0.09$

variable. Regression was performed for each of the three ways graphical complexity was measured in this study. The results are shown in Table 1.

B has, as expected, a negative value and is quite close to -0.1 in five out of six cases. The differences between the values is a little bigger for the grouping in classes of width 50. Again, as the absolute values of the three kinds of measures vary quite a bit, so do the values of A, but variation for the same kind of measurement is only very small between the two classes.

Figures 6 through 11 show the data and curves for class width 100 and class width 50, respectively, in non-linearized form. In each case the data points scatter more widely around the curves as frequency gets higher.

The fits were very good and the curves do seem to reflect the relationship quite convincingly, so this hypothesis is also accepted. The criterion to include only classes with more than five data points, however, led to a substantial reduction of the data points to be considered in the regression. Especially characters with very high frequencies were

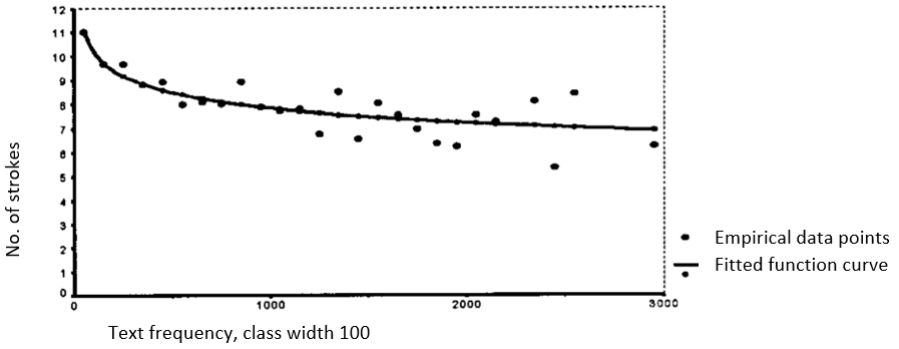

FIGURE 6. Graphical complexity measured in number of strokes as a function of text frequency

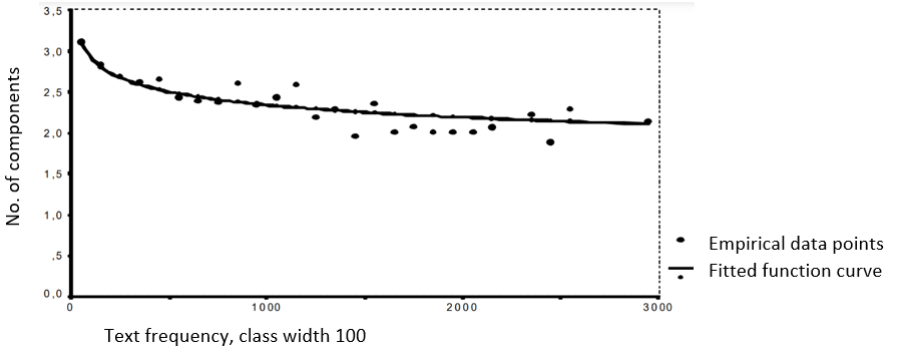

FIGURE 7. Graphical complexity measured in number of component graphemes as a function of text frequency

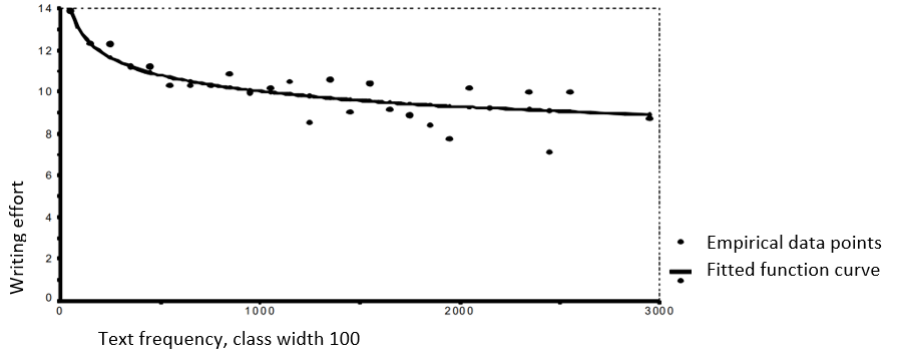

FIGURE 8. Graphical complexity measured in writing effort as a function of text frequency

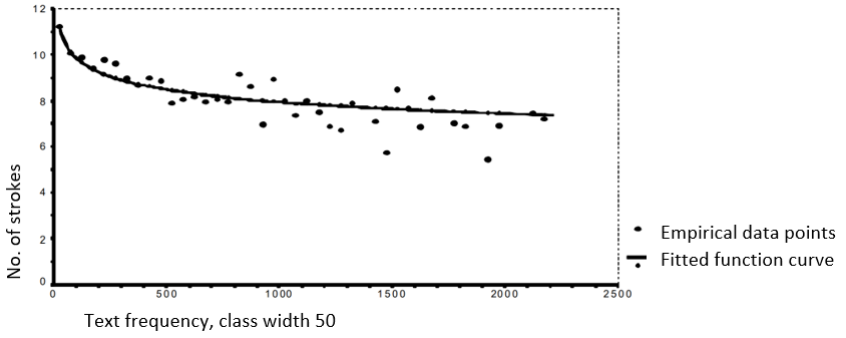

FIGURE 9. Graphical complexity measured in number of strokes as a function of text frequency

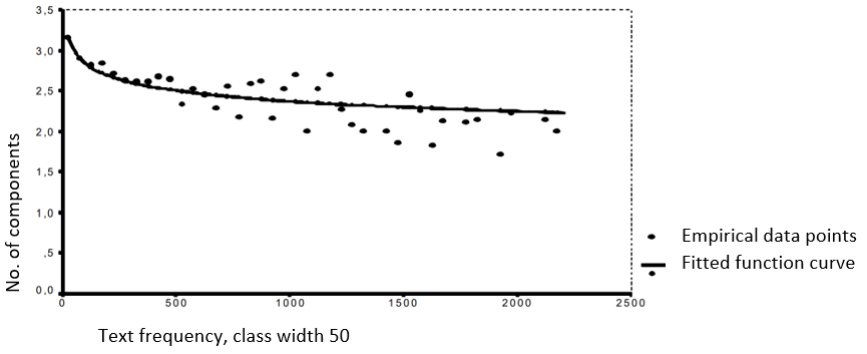

FIGURE 10. Graphical complexity measured in number of component graphemes as a function of text frequency

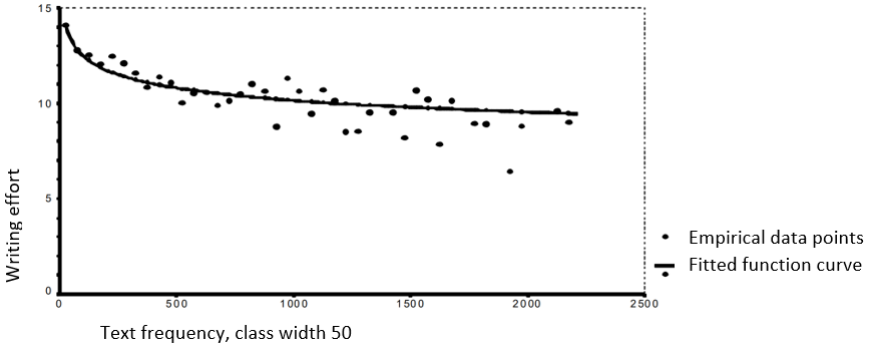

FIGURE 11. Graphical complexity measured in writing effort as a function of text frequency

excluded because among the very frequent characters, each class contained only very few data points. Thus, this relationship mainly is valid for medium and low frequency characters which, on the other hand, make up the vast bulk of the entire inventory.

Regression was also performed on the unfiltered data, that is, including all data points. The fit was not very good: $D = 0.76$ through $D = 0.85$. The parameters A and B estimated from the unfiltered data were very close to those reported above.

4.2.4. *Conclusion for the Direct Functional Dependencies*

All three hypotheses about direct functional relationships can preliminarily be accepted as their verification yielded good to excellent results. The non-linearized curves among the data points also seem very reasonable to the eye. On this basis, the indirect hypotheses are tackled next.

4.3. Indirect Functional Dependencies (H_4–H_6)

Regression on the data for the direct functional relationships have yielded estimates for the parameters. By inserting them into the equations, the indirect functional dependencies can now be modeled theoretically. Thus, it is possible to compute what the curve should theoretically look like and compare it with the curve arrived at by regression on the data. Statistical testing is applied to find out whether differences between the theoretical model and the data are statistically significant. If such a difference is not statistically significant, an indirect hypothesis can also be accepted. If the difference is statistically significant, however, it has to be rejected.

4.3.1. *Graphical complexity as an indirect function of functional complexity*

The graphical complexity of Chinese characters is indirectly a function of their functional complexity, mediated by frequency. The linearized equation is:

$$\text{L-graphical complexity} = \ln X + Y * \text{L-functional complexity}. \qquad (H_4)$$

As graphical complexity was measured in three ways and there were two class widths for frequency, we get six theoretical models:

a) Graphical complexity measured in number of strokes

$$\begin{aligned}\text{L-graphical complexity}_{a_1} &= 2.72 - 0.094 * (2.444 + 1.215 * \text{L-functional complexity}) \\ &= 2.49 - 0.114 * \text{L-functional complexity}\end{aligned}$$

and

$$\begin{aligned}&\text{L-graphical complexity}_{a_2}\\&\quad = 2.85 - 0.114 * (2.444 + 1.215 * \text{L-functional complexity})\\&\quad = 2.57 - 0.138 * \text{L-functional complexity.}\end{aligned}$$

b) Graphical complexity measured in number of component graphemes

$$\begin{aligned}&\text{L-graphical complexity}_{b_1}\\&\quad = 1.4 - 0.078 * (2.444 + 1.215 * \text{L-functional complexity})\\&\quad = 1.2 - 0.095 * \text{L-Functional complexity}\end{aligned}$$

and

$$\begin{aligned}&\text{L-graphical complexity}_{b_2}\\&\quad = 1.51 - 0.096 * (2.444 + 1.215 * \text{L-functional complexity})\\&\quad = 1.277 - 0.116 * \text{L-functional complexity.}\end{aligned}$$

c) Graphical complexity measured in effort of execution (writing effort)

$$\begin{aligned}&\text{L-graphical complexity}_{c_1}\\&\quad = 2.94 - 0.09 * (2,444 + 1,215 * \text{L-functional complexity})\\&\quad = 2.72 - 0.109 * \text{L-functional complexity}\end{aligned}$$

and

$$\begin{aligned}&\text{L-graphical complexity}_{c_2}\\&\quad = 3.06 - 0,109 * (2,444 + 1,215 * \text{L-functional complexity})\\&\quad = 2.79 - 0.13 * \text{L-functional complexity.}\end{aligned}$$

The results of regression on the actual data were:

(a)	No. of strokes:	$D = 0.73$	$A = e^{2.55} = 12.82$	$B = -0.116$
(b)	No. of components:	$D = 0.60$	$A = e^{1.25} = 3.49$	$B = -0.092$
(c)	Writing effort:	$D = 0.75$	$A = e^{2.78} = 16.19$	$B = -0.114.$

The following figures (Fig. 12 through Fig. 14) show the curves estimated from the data and the data points.

D did not come out very good. The values of the parameters arrived at by regression seem, at first glance, to get quite close to those expected on the basis of the theoretical equations, as Table 2 shows.

It seems that the parameters of the first theoretical function in each case agrees better with the function parameters arrived at through regression. As for case (a), Figure 15 shows that the two curves intersect at about functional complexity = 24. The first theoretical function generally keeps the same distance from beginning to end from the empirically estimated function curve while the curve for graphical complexity$_{a_2}$

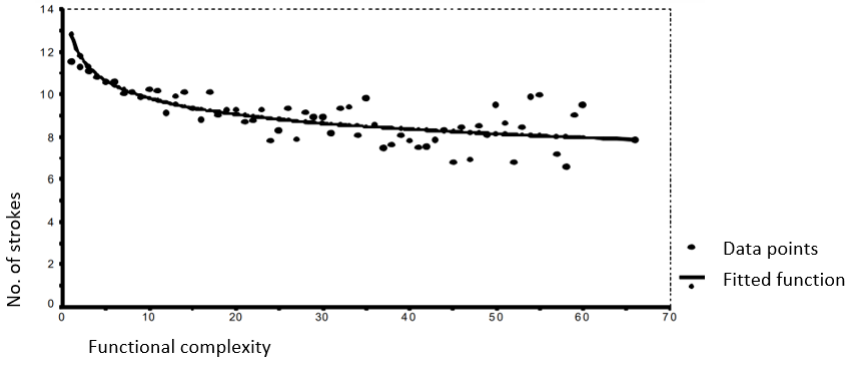

FIGURE 12. Graphical complexity measured in number of strokes as an indirect function of functional complexity, empirical fit.

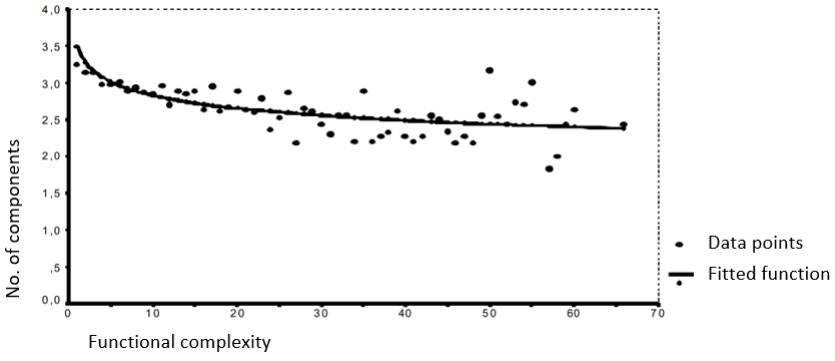

FIGURE 13. Graphical complexity measured in number of component graphemes as an indirect function of functional complexity, empirical fit.

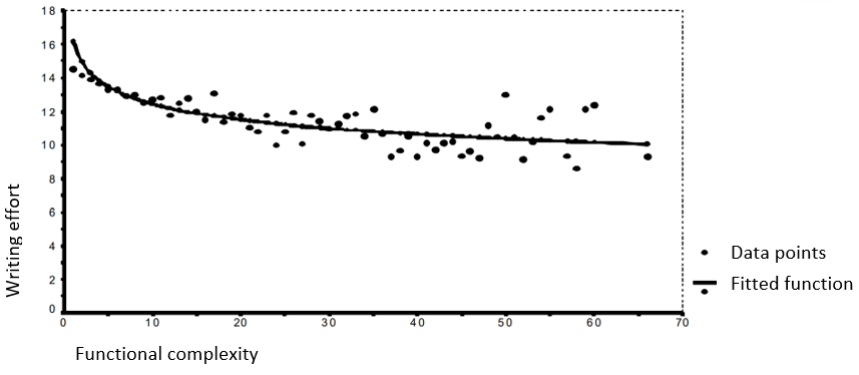

FIGURE 14. Graphical complexity measured in writing effort as an indirect function of functional complexity, empirical fit.

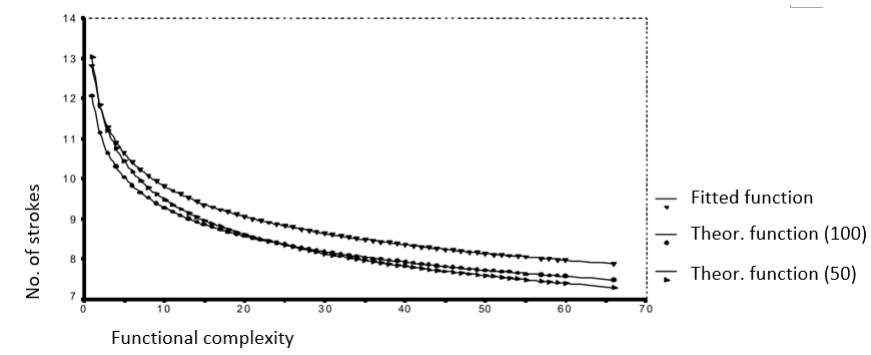

FIGURE 15. Graphical complexity measured in number of strokes as an indirect function of functional complexity, fitted function curve and theoretical function curves.

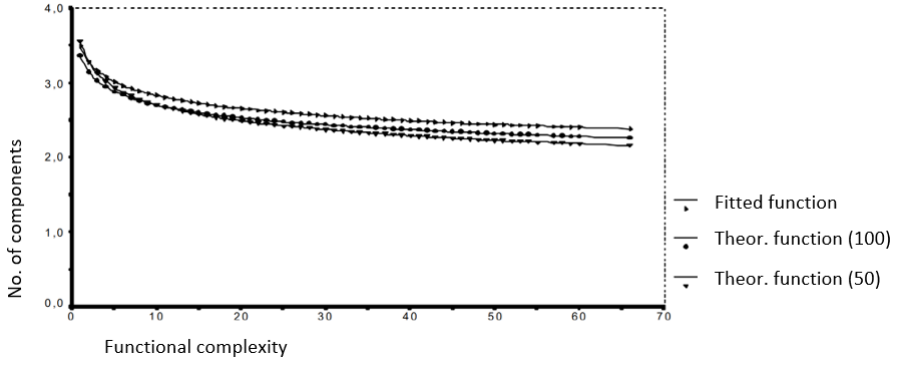

FIGURE 16. Graphical complexity measured in number of component graphemes as an indirect function of functional complexity, fitted function curve and theoretical function curves.

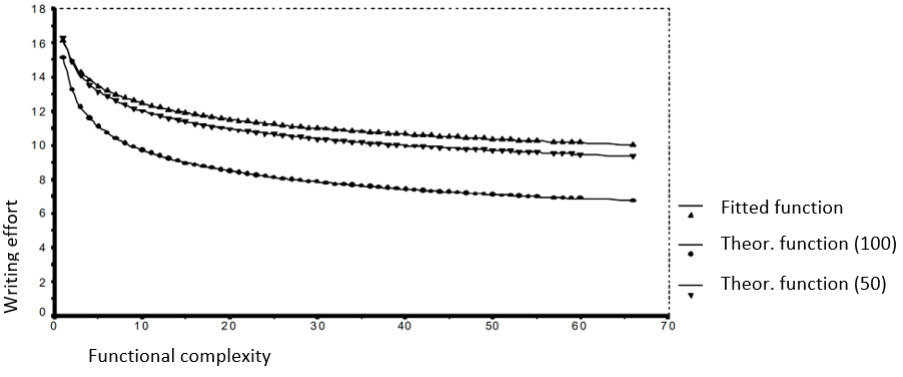

FIGURE 17. Graphical complexity measured in writing effort as an indirect function of functional complexity, fitted function curve and theoretical function curves.

TABLE 2. Results of the regressions for H_3. "fc" stands for "functional complexity."

	Measure	Function Type	Function
(a)	No. of strokes	Theoretical	$\text{Graph.comp.}_{a_1} = 12.06 * \text{fc} - 0.114$
		Theoretical	$\text{Graph.comp.}_{a_2} = 13.04 * \text{fc} - 0.138$
		Empirical	$\text{Graph.comp.}_{a_e} = 12.82 * \text{fc} - 0.116$
(b)	No. of components	Theoretical	$\text{Graph.comp.}_{b_1} = 3.36 * \text{fc} - 0.095$
		Theoretical	$\text{Graph.comp.}_{b_2} = 3.59 * \text{fc} - 0.116$
		Empirical	$\text{Graph.comp.}_{b_e} = 3.49 * \text{fc} - 0.092$
(c)	Writing effort	Theoretical	$\text{Graph.comp.}_{c_1} = 15.16 * \text{fc} - 0.109$
		Theoretical	$\text{Graph.comp.}_{c_2} = 16.3 * \text{fc} - 0.13$
		Empirical	$\text{Graph.comp.}_{c_e} = 16.19 * \text{fc} - 0.114$

gradually swerves away as functional complexity gets higher. Similar observations can be made for case (b) in Figure 16. Figure 17 shows that the curve for graphical complexity$_{c_2}$ is farther away from the empirically estimated function curve than that of graphical complexity$_{c_1}$.

Köhler (1986) used the *t-test* to evaluate the differences between the theoretically expected function values and the empirical function that was fitted to the empirical data. The *t-test* is a statistical test to compare means. This study follows his choice.[37]

The individual results of the *t-tests* shall not be reported here. They showed significant differences for all six comparisons, so the hypothesis has to be rejected on these grounds for the time being. The fit of the function to the empirical data was not satisfactory, so this subsystem of the model seems to require improvement.

The graphs of the linearized function fit to the logarithmized data (not shown here) showed the straight line suggested for the second theoretical function (lower index 2) in all three cases to run nearly parallel to the function fit to the data which was not the case for the first suggested theoretical function (lower index 1). This seems to indicate that grouping the data in frequency classes of width 50 yields better results than grouping them in classes of width 100. In addition, the nearly parallel run of both lines may indicate that there is a factor (maybe a constant?) not yet considered in the model which is responsible for the discrepancy between the theoretically expected and empirically determined parameters.

Although this hypothesis has to be rejected in its present form, a future revision of it will contain it to some degree, which is why it is seen as a step into a promising direction at this point.

37. Köhler's choice of this statistical test has also been criticized, cf. Grotjahn (1992), and more sophisticated testing would certainly be desirable.

4.3.2. *Functional complexity as an indirect function of text frequency*

Functional complexity indirectly is a function of text frequency, where graphical complexity mediates the dependency. The equation in linearized form is

$$\text{L-functional complexity} = \ln X + Y * \text{L-frequency}. \qquad (H_5)$$

There were three ways employed to measure graphical complexity and frequencies were grouped into classes of two widths in order to make regression feasible, so there are once more six theoretical functions possible. The same types of abbreviations and indices as above are used here again.

(a)

$$\begin{aligned}\text{L-functional complexity}_{a_1} &= 5.59 - 1.373 * (2.85 - 0.114 * \text{L-frequency}) \\ &= 1.68 + 0.156 * \text{L-frequency}\end{aligned}$$

and

$$\begin{aligned}\text{L-functional complexity}_{a_2} &= 5.59 - 1.373 * (2.72 - 0.094 * \text{L-frequency}) \\ &= 1.85 + 0.13 * \text{L-frequency}.\end{aligned}$$

(b)

$$\begin{aligned}\text{L-functional complexity}_{b_1} &= 3.666 - 1.133 * (1.51 - 0.096 * \text{L-frequency}) \\ &= 1.95 + 0.108 * \text{L-frequency}\end{aligned}$$

and

$$\begin{aligned}\text{L-functional complexity}_{b_2} &= 3.666 - 1.133 * (1.4 - 0.078 * \text{L-frequency}) \\ &= 2.076 + 0.088 * \text{L-frequency}.\end{aligned}$$

(c)

$$\begin{aligned}\text{L-functional complexity}_{c_1} &= 6.086 - 1.441 * (3.06 - 0.109 * \text{L-frequency}) \\ &= 1.68 + 0.157 * \text{L-frequency}\end{aligned}$$

and

$$\begin{aligned}\text{L-functional complexity}_{c_2} &= 6.086 - 1.441 * (2.94 - 0.09 * \text{L-frequency}) \\ &= 1.85 + 0.13 * \text{L-frequency}.\end{aligned}$$

Frequency was the independent variable, so the data was once more grouped into frequency classes of widths 100 and 50, respectively, and the center of the class was used to compute the regression.

The results of the fits were as follows:

Class width 100:	$D = 0.969$	$A = e^{-1.649} = 0.192$	$B = 0.804$
Class width 50:	$D = 0.97$	$A = e^{-1.173} = 0.31$	$B = 0.74.$

The fitted curves are shown in Figures 18 and 19. The empirical data points begin to scatter below the curves at about the frequency of 800.

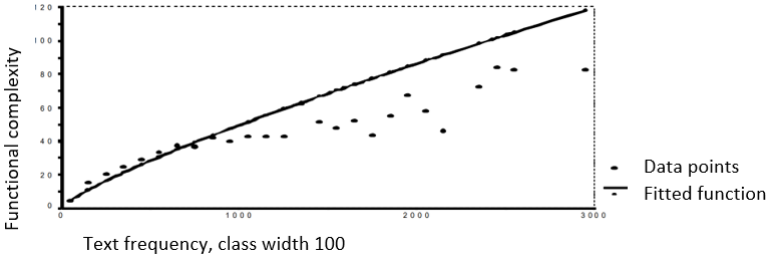

FIGURE 18. Functional complexity as an indirect function of text frequency, class width 100.

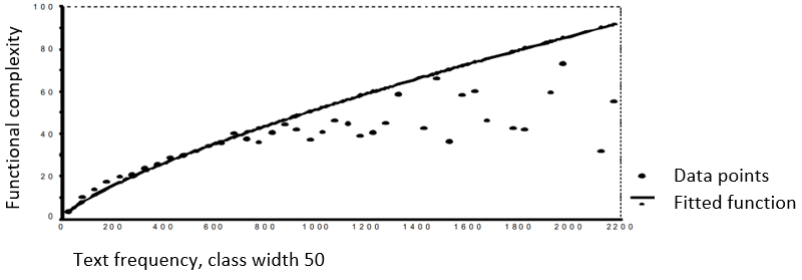

FIGURE 19. Functional complexity as an indirect function of text frequency, class width 50.

For greater ease of comparison, the theoretically expected and empirically estimated parameters are shown in Table (3).

While the parameters of the theoretical functions look similar as to their magnitude, there is still a visible discrepancy between the expected values and the empirically determined parameters of the functions.

Figures 20 and 21 show the curves of the function fits and the three curves of the theoretically expected functions. The curves of the three theoretical functions in both cases are all close together while the curve resulting from the fit to the empirical data is much steeper.

TABLE 3. Functional complexity as an indirect function of text frequency (H_5), comparison of theoretically expected and empirically estimated parameters.

C.w.	Theoretical functions	Empirical function
100	$\text{funct. comp.}_{a1} = 5.37 * \text{freq.}^{0.156}$ $\text{funct. comp.}_{b1} = 7.05 * \text{freq.}^{0.108}$ $\text{funct. comp.}_{c1} = 5.36 * \text{freq.}^{0.157}$	$\text{funct. comp.}_{e1} = 0.192 * \text{freq.}^{0.804}$
50	$\text{funct. comp.}_{a2} = 6.36 * \text{freq.}^{0.13}$ $\text{funct. comp.}_{b2} = 7.98 * \text{freq.}^{0.088}$ $\text{funct. comp.}_{c2} = 6.36 * \text{freq.}^{0.13}$	$\text{funct. comp.}_{e2} = 0.31 * \text{freq.}^{0.74}$

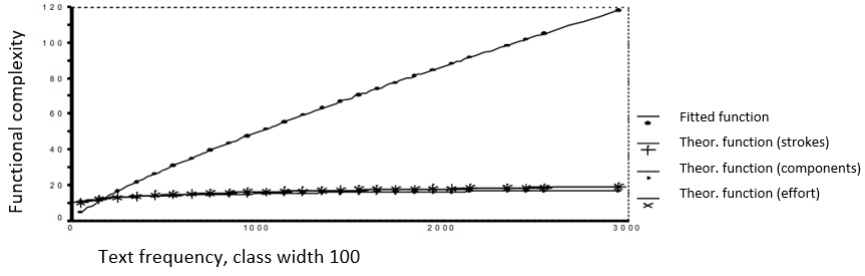

FIGURE 20. Functional complexity as an indirect function of text frequency, class width 100, fitted function curve and theoretical curves.

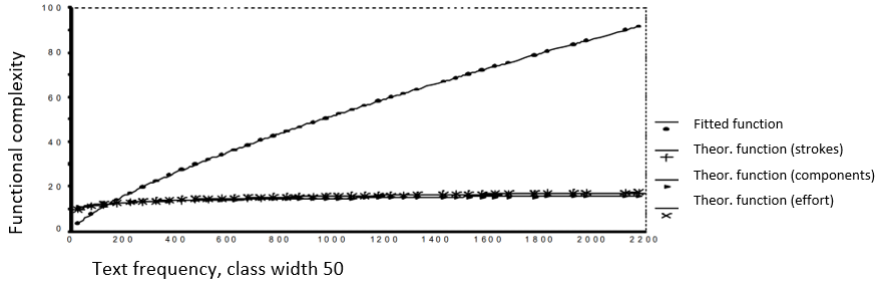

FIGURE 21. Functional complexity as an indirect function of text frequency, class width 50, fitted function curve and theoretical curves.

The *t-test* was employed again and, unsurprisingly, once more showed significant differences between the means of the various functions. The empirical fit to the data had been very good, so there seems to be a functional relationship, however, the theoretical model does not describe it well, so the hypothesis in its present form has to be rejected.

The data points had been filtered according to their weight when the dependency of graphical complexity from text frequency (hypothesis

H_3) had been modelled, but this should not be responsible for the enormous discrepancy between the expected function and the one estimated from the data because, as mentioned above, when all data points were included to test H_3 the fit had not been as good, but the parameters arrived at had varied only very little from those found when performing regression on only the data points carrying enough weight.

4.3.3. *Text Frequency as an Indirect Function of Graphical Complexity (H_6)*

The model allows the text frequency of Chinese characters to be seen as being indirectly a function of their graphical complexity, functional complexity mediating the dependency:

$$\text{L-frequency} = \ln X + Y * \text{L-graphical complexity}. \qquad (H_6)$$

As graphical complexity had been measured in three different ways, three theoretical functions are possible:

(a) No. of strokes
L-freq$_a$ = 2.444 + 1.215 * (5.59 - 1.373 * L-graph. comp.)
= 9.24 - 1.67* L-graph. comp.
(b) No. of comp.
L-freq$_b$ = 2.444 + 1.215 * (3.666 - 1.133* L-graph. comp.)
= 6.9 - 1.377* L-graph. comp.
(c) Writing effort
L-freq$_c$ = 2.444 + 1.215 * (6.086 -1.441* L-graph. comp.)
= 9.84 - 1.75* L-graph. comp.

Regression on the empirical data yielded the following results:

(a) Number of strokes
$D = 0.93 \quad A = e^{11.077} = 64{,}690.26 \quad B = -2.466.$
(b) Number of component graphemes
$D = 0.955 \quad A = e^{7.63} = 2{,}058.5 \quad B = -1.98.$
(c) Writing effort
$D = 0.88 \quad A = e^{11.675} = 117{,}557.75 \quad B = -2.47.$

In case (c) the fit was not entirely satisfying.

Figures 22 through 24 show the data points and the curves fit to them. The deviations where stroke numbers, component numbers and effort weights are low can be explained by their low weights.

The following overview shows the power functions with the theoretically expected parameters and the parameters estimated from the data (*Freq* stands for text frequency and *Comp* for graphical complexity):

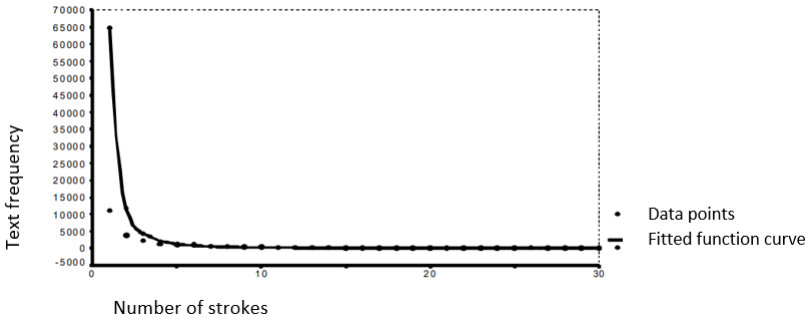

FIGURE 22. Text frequency as a function of graphical complexity, measured in number of strokes.

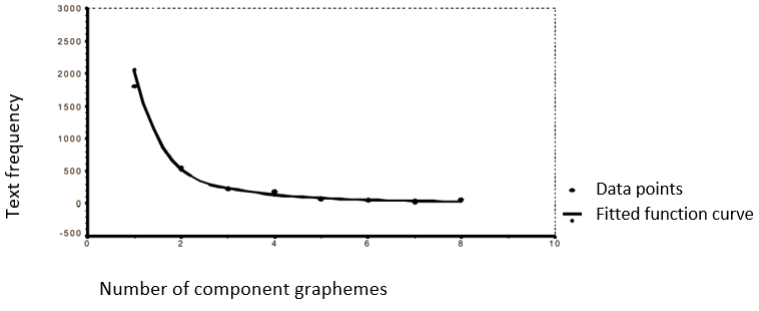

FIGURE 23. Text frequency as a function of graphical complexity, measured in number of component graphemes.

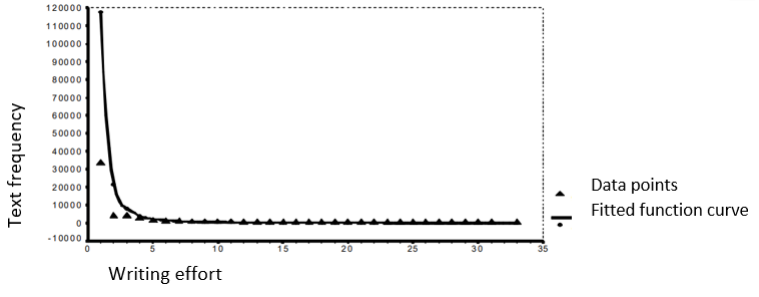

FIGURE 24. Text frequency as a function of graphical complexity, measured in writing effort.

	Theoretically	Empirically
(a)	$\text{Freq}_a = 10,287.14 * \text{Comp}^{-1.67}$	$\text{Freq}_{e_a} = 64,690.26 * \text{Comp}^{-2.466}$
(b)	$\text{Freq}_b = 992.27 * \text{Comp}^{-1.377}$	$\text{Freq}_{e_b} = 2,058.5 * \text{Comp}^{-1.98}$
(c)	$\text{Freq}_c = 18,797.89 * \text{Comp}^{-1.75}$	$\text{Freq}_{e_c} = 117,557.75 * \text{Comp}^{-2.47}$

Theoretically expected and empirically estimated values of the exponents are similar to one another to a certain degree but the empirical values are higher than the theoretical ones by about 0.6 to 0.7. The differences in magnitude between the values of the multipliers are especially eye-catching. The differences between the various theoretically expected multipliers are much smaller than those among the empirically estimated ones. The latter deviate from the theoretical values by magnitudes. However, when graphical complexity is measured in number of component graphemes, this discrepancy is lowest (case b).

The quality of the fit for graphical complexity measured in number of strokes (a) and number of component graphemes (b) suggests that frequency indeed is dependent on graphical complexity. It is possible, though, that the model needs to be refined here as this dependency perhaps should not be modelled as mediated by functional complexity or possibly other sources of influence need to be considered as well which are not yet contained in the model.

Figures 25 through 27 show the function curves. The theoretical curve and the empirical one start to overlap very early. Comparisons of cases (a) and (c) with Figures 10a and 10b show that the theoretical curves reflect the data points better than the empirical ones which can be explained by the fact that the data points for low graphical complexity carry only little weight.

In this case, as above, the *t-test* was be used to evaluate the differences between theoretically expected and empirically estimated parameters. It showed for all three comparisons that there were no significant differences. Thus, this hypothesis can be accepted.

4.4. Some Conclusions

In contrast to the three hypotheses about direct relationships two of the three hypotheses about indirect dependencies have to be rejected. Only hypothesis H_6 withstood testing.

H_4 had to be rejected but there are indications that an improvement of the model and thus a refinement of the hypothesis could yield better results. For this reason, the model is seen here as a step into the right direction.

For H_5, which modeled the indirect dependency of functional complexity from text frequency, the theoretical expectations and empirical

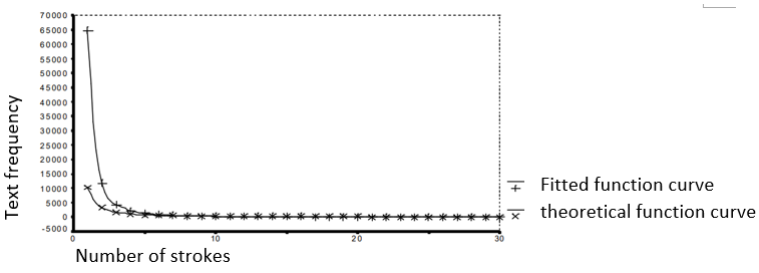

FIGURE 25. Text frequency as a function of graphical complexity measured in number of strokes; fitted function curve and theoretical function curve.

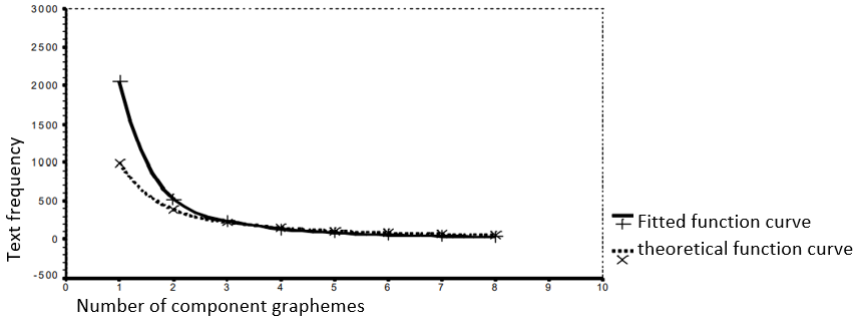

FIGURE 26. Text frequency as a function of graphical complexity measured in number of component graphemes; fitted function curve and theoretical function curve.

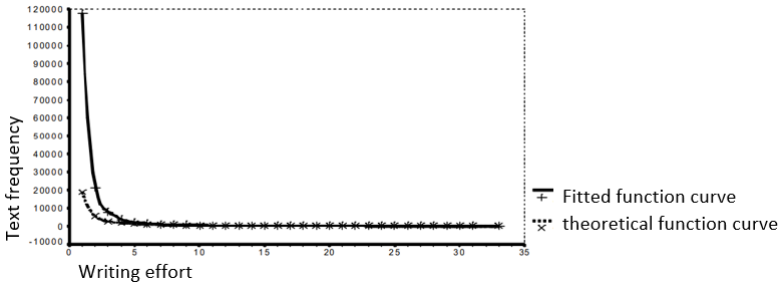

FIGURE 27. Text frequency as a function of graphical complexity measured in writing effort; fitted function curve and theoretical function curve.

data deviated widely from one another. Here, the model has definitely to be improved and there is a certain possibility that this will not be limited to additionally considering more factors.

5. Closing Remarks

The adaptation of Köhler's basic model has been, at least in the eyes of this author, a rewarding experiment. The verification of the three hypotheses about direct dependencies has shown that these dependencies also exist in the Chinese character system. For these the model seems to be adequate.

For two of the three hypotheses about indirect dependencies the predictions based on the model were not sufficiently adequate. The way functional complexity was operationalized may be one of the sources of the problem because the number of lexemes for which a character is used in the texts of the corpus may be too inaccurate a measure for the answer to the question how many different morphemes a given character may actually serve to represent. The results for hypothesis H_5 ("functional complexity is indirectly a function of text frequency"), however, probably did not just only for this reason deviate so evidently from the predicted values. The model may be incomplete here.

As a specific manifestation of human linguistic ability and behavior, the Chinese character system shows certain relationships between its systemic features which also can be found in other subsystems of language, like the vocabulary. To show that this is the case was the aim of the present endeavor.

Furthermore, the author hopes to have demonstrated, by examining aspects of a language that seems distant to many and its script rather inaccessible, that Köhler's basic model can be employed to examine other levels of analysis and that by doing so new discoveries about the model itself as about the object domain under inspection can be gained

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Does Korean Grapho-Phonemic Systematicity Enhance Spontaneous Learning?

Hana Jee, Monica Tamariz & Richard Schillcock

Abstract. I investigate whether such a systematicity is spontaneously intuited and whether it then enhances learning. During the experiment, the participants had to learn Korean letters by themselves without any instruction. All participants had the opportunity to learn the correct phoneme-grapheme associations and randomly paired, fake phoneme-grapheme associations. It was hypothesised that participants would learn better and faster when the association was the veridical one. However, the performance was not significantly different between the two conditions. The participants repeated less in learning consonants than vowels. Nasals were the easiest consonants to learn. The participants had difficulties in learning vowels when jaw movements were not involved. Those whose first language was Chinese showed comparatively poorer performance in general.

1. Background

Hangeul, the orthography of the Korean language is renowned for the availability of knowledge surrounding its origins. It is also the only orthography that a king himself designed for the illiterate among his people. The 28 letters were completed in 1444, promulgated in 1446 and named *Hunmin Jeongeum*, the Standard Sounds for the Instruction of the People. Until recently, it was believed that King Sejong the Great (reigned 1418–1450) ordered a group of scholars from the Jiphyeonjeon ('Hall of Worthies') to create hangeul, but more and more evidence indicates that it was Sejong who studied the phonology, linguistics, oral

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anatomy, and foreign writing systems to design the letters. The creation of hangeul was an important paradigm shift from logograph to phonograph and from knowledge as privilege to knowledge for equality.

Korean phonemic system is basically alphabetic like English, in which a letter is linked to a phoneme (either consonant or vowel) but specifies phonological features (Sampson, 1985). For example, tensed phonemes are distinguished from tenseless phonemes: /p/ - /p͈/; /t/ - /t͈/; and /k/ - /k͈/. Along with the tensed phonemes, Korean consonantal sounds consist of sets of three: lenis, aspirated and tensed. In hangeul, these phoneme sets are visually consistent letters. In general, adding a stroke makes the lenis aspirated (e.g., ㄱ /g/ - ㅋ /k/) and duplicating the letter makes it tensed (e.g., ㄱ /g/ - ㄲ /k͈/). Overall, a set of the phonemes that share an articulation point have visually similar letter-shapes (e.g., ㄱ /g/ - ㅋ /k/ - ㄲ /k͈/).

Meanwhile, the vowels of hangeul reflect the prevalent philosophy of the times. The basic three vowel ㅡ, ㅣ, and ㆍ respectively symbolizes the earth, a person and the heaven. The combination of these three components means the harmony between human beings and the nature. For example, ㅗ /o/ combines ㅡ and ㆍ on the top, and ㅏ /a/ combines ㅣ and ㆍ on its right. Despite its philosophical background, diphthongs are systematically distinguished from monophthongs by an additional stroke (e.g., ㅏ/a/ - ㅑ /ja/).

The systematic relation between hangeul letters and their sounds was recently quantified and defined as 'grapho-phonemic systematicity' (Jee, Tamariz, and Shillcock, 2021; 2022; 2023). The pairwise distances between letters and their corresponding pairwise distances between phonemes were measured by a few computational techniques. As expected, hangeul returned the highest grapho-phonemic systematicity amongst other phonographs such as Arabic, Cyrillic, Greek, English and Hebrew.

The systematic letter-sound relation of hangeul is expected to lead to efficient learning. Inji Jeong (1397–1478), one of the scholars who got involved in the hangeul creation project even mentioned that the clever would learn it in a day and even fools, in ten days (Preface of Hunmin Jeongeum, 1446). The current paper investigates if the systematic letter-sound relation like hanguel is picked up and exploited by new learners and if it indeed leads to faster and easier learning compared to non-systematic letter-sound relations.

We let the participants spontaneously learn the consonants and vowels of hangeul in the two settings: real letter-sound association and fake letter-sound association, and measured their learning processes and reaction times.

2. Experiment

2.1. Participants

11 male and 50 female participants were recruited from the University of Edinburgh. 42 were postgraduates and the rest were undergraduates. Their ages ranged from 18 to 34. All of them were at least bilingual. They were told that they would learn Korean consonants and vowels. After a 40-minute experiment, they were paid £8 each.

2.2. Stimulus

19 Korean consonants and 18 out of 20 vowels were used for the experiment (Table 1). The vowel ㅔ /e/ and ㅖ /je/ were excluded due to the high confusability of the sound with ㅐ /ae/ and ㅒ /jae/, respectively. I included diphthongs to maximise the systematic visual relation among the vowels.

The visual stimuli were designed on PsychoPy (Ver. 3.2.4). Each letter in white sans-serif font (맑은고딕) was displayed on a black background for 6 seconds in random order. At the same time, the corresponding phoneme was also played over headphones. For the consonants, the phoneme was heard in C-C-CV form (e.g., /g-g-ga/) and for the vowels, V-V form (e.g., /ah-ah/)

TABLE 1. The 19 consonants and 18 vowels used for the experiment

Consonants				Vowels			
ㄱ	/g/	ㅊ	/tɕʰ/	ㅏ	/a/	ㅑ	/ia/
ㄴ	/n/	ㅋ	/k/	ㅐ	/ɛ/	ㅒ	/iɛ/
ㄷ	/d/	ㅌ	/t/	ㅓ	/ʌ/	ㅕ	/iʌ/
ㄹ	/l/	ㅍ	/p/	ㅗ	/o/	ㅛ	/io/
ㅁ	/m/	ㅎ	/h/	ㅜ	/u/	ㅠ	/iu/
ㅂ	/b/	ㄲ	/k*/	ㅚ	/ø/	ㅘ	/oa/
ㅅ	/s/	ㄸ	/t*/	ㅟ	/y/	ㅝ	/wʌ/
ㅇ	/ŋ/	ㅃ	/p*/	ㅡ	/ɯ/	ㅢ	/ɯi/
ㅈ	/tɕ/	ㅆ	/s*/	ㅣ	/i/	ㅙ	/oɛ/
		ㅉ	/tɕ*/				

2.3. Experiment Design

A mixed design was employed. Because the consonant-vowel distinction in Korean orthography is widely recognized as a clear source of

systematicity, I focused on the potential effects of orthographic systematicity within the consonants and within the vowels. Half participants learned correct consonants and fake vowels, the other half learned fake consonants and correct vowels. The correct set of letters was always presented first. There was a 3 to 5-minute break between the two sessions. 29 participants learned correct consonants and the randomly associated vowels and 32 learned the correct vowels and the randomly associated consonants.

For the fake condition, the letter stimuli were displayed with the wrong sounds. The participants did not know that they were learning the wrong association at that moment. They had a short lesson to debrief them after the experiment. A 5-minute post-experimental interview was also conducted to investigate the learning strategies they used.

2.4. Procedure

The experiment consisted of a few training phases followed by the test phase. During the training, each letter-sound pair was exposed twice in random order. After the training, the participants took the test with 9 letters only. The letters were displayed altogether, and the participants were required to click the appropriate letter according to the sound played. Letters could be chosen multiple times.

If they failed to score 70%, they had to go back to the training, which repeated a maximum of 4 times. Thus, if a participant failed to pass the test 4 times in a row, the experiment went directly to the final test. During the final test, all the letters (19 consonants or 18 vowels) were displayed altogether, and the participants were required to click the correct letter according to the sound. Letters could be chosen multiple times. In both tests, participants' reaction times as well as answers were recorded.

3. Results

Did the naïve learners learn the Korean alphabet better with the correct letter-sound association? I predicted a difference in performance between the correct association and the random association. However, participants were able to learn letter-sound associations, regardless of condition. The proportion of correct answers and the mean reaction times were not significantly different between the two groups (Fig. 1), confirmed by a Mann-Whitney U test ($U = 356$, $p = .16$ for consonants; $U = 405$, $p = .40$ for vowels). Performance in learning consonants ($M = 61.98$, $SD = 16.20$) was slightly better than vowels ($M = 58.26$, $SD = 12.96$), but the difference was not significant ($U = 402$, $p = .39$).

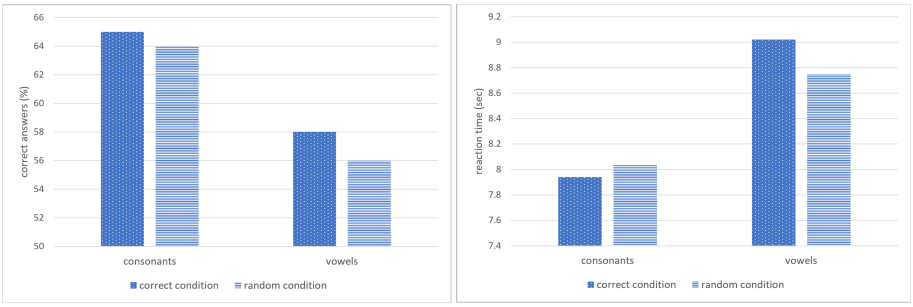

FIGURE 1. The percentage of correct answers (left) and reaction time (right). $SD = 16.20$ (correct consonants); $SD = 16.44$ (random consonants); $SD = 12.96$ (correct vowels); $SD = 17.12$ (random vowels)

Fig. 2 shows the number of tests the participants repeated in each condition. They generally needed more training to learn random letter-sound association, but the difference was not statistically significant ($U = 7$, $p = .44$). Rather, the difference was found between learning consonants and vowels ($U = 2$, $p = .04$). Compared to vowels, the consonants required less training, as shown by the number of tests taken. During the interview, many participants mentioned that the consonants were easier to learn, regardless of the condition.

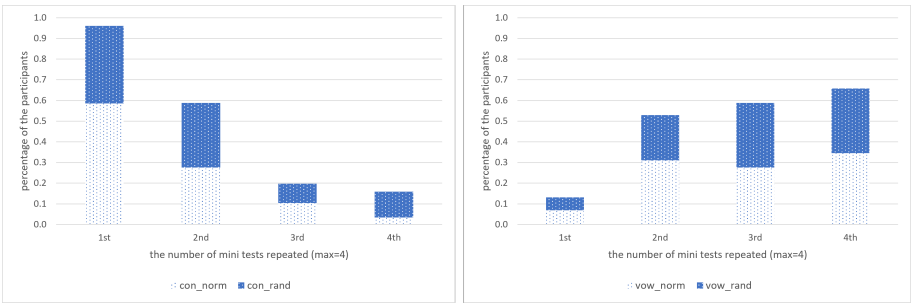

FIGURE 2. The number of the tests the participants repeated for consonants (left) and vowels (right): Many participants passed the first test when learning consonants but had to repeat multiple times for vowels.

The reaction time during the test phase was inversely proportional to the scores (Fig. 3). Taking longer time did not enhance decisions. It rather indicated incomplete learning. This implies that the letter-sound association requires an instant, intuitive judgement rather than thoughtful, comprehensive reasoning skills.

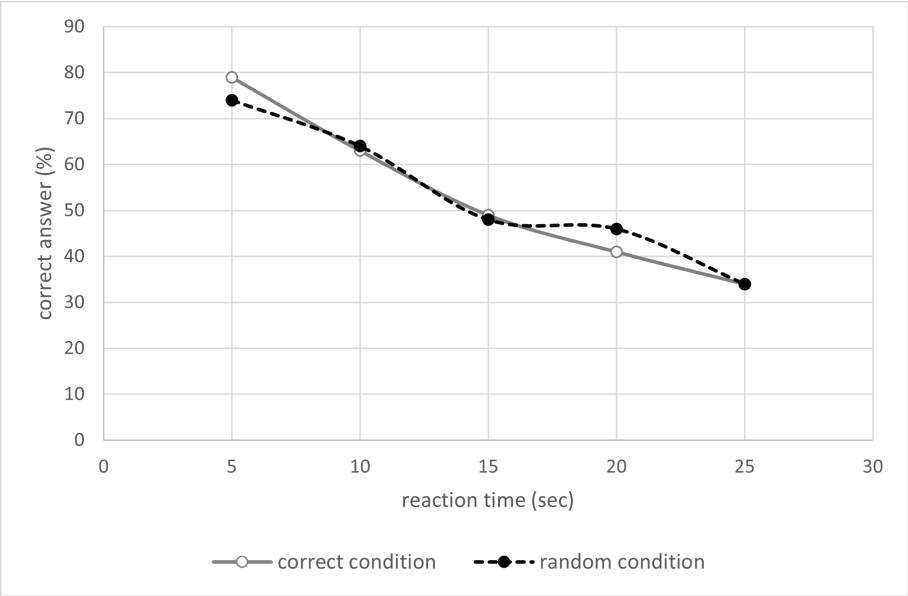

FIGURE 3. Relation between score and reaction time

The easiest consonants to learn were nasals (Fig. 4): they were considered 'special' letters according to the post-interview. When asked about their learning strategies, the participants often answered they began with those nasals and extended from them. In contrast, the most difficult consonants to learn were those for tensed phonemes mainly due to the difficulties in distinguishing sounds. One participant said that she eventually managed to notice the difference between lenis and tensed sounds, but it was too late. This implies that such a fine distinction among Korean phoneme sets requires substantial time to be accustomed to.

Fig. 4 also shows that those vowels accompanied by opening jaw were better learnt than the vowels with closed-jaw. The participants had difficulties in understanding the phonemic boundaries of back vowels (e.g., ㅜ /u/ and ㅡ /ɯ/). Lack of visual information presented such as lip shapes can be a reason for the failure in distinction between ㅗ /o/ and ㅜ /u/. In fact, these vowels were confusable even for a native when heard in the identical setting.

Meanwhile, the participants readily noticed the combination rules for Korean diphthongs. One participant pointed out that ㅚ /ø/ does not sound /oi/ as it is supposed to. According to the general diphthong rule—where basic monophthongs compose diphthongs with their original sounds intact—she was right.

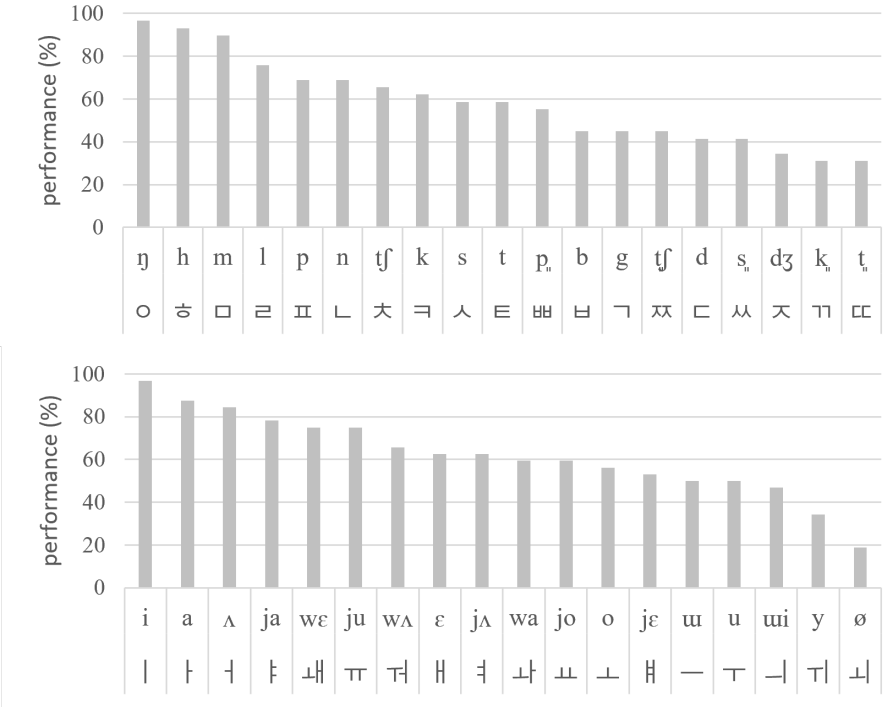

FIGURE 4. The fulfilment of each letter based on the final test

In terms of learning strategies, the participants in general showed very active attitudes. They tended to apply a strategy and if it failed, applied another. Partly due to the experiment design, where they were exposed to the veridical grapheme-phoneme association first, the participants expected and looked for systematicity in the random (fake) condition, too. They explicitly tried to find a pattern, even when there was no pattern to find.

The interview also demonstrated that participants tended to exploit existing knowledge. Most of the participants strategically associated the stimuli with sounds or characters they already knew. For example, they connected Japanese 口 /ku/ with ㅁ /m/, ancient letter H /ae/ with ㅐ, Greek Λ /l/ or Chinese 人 /ren/ with ㅅ, and Cyrillic Г with ㄱ. Sometimes conflicting knowledge helped: Chinese 口 sounded different from Korean ㅁ; Greek Π /p/ sounded the same as ㅈ but looked different (in the random condition); and ㅌ should sound like /e/ as in the participant's name, but sounded different.

Some participants generated particular *meanings*. For example, letter ㅍ /p/ reminded a participant of 'prison' or 'papa who always uses stairs'.

Some others used the vocabulary from their first language to memorize associations. Interestingly, in most cases, this lexical association was related to family: mom, dad, aunt, and even sister-in-law. The vowels were frequently connected to the sound 'yes' in different languages: French /wi/, German /ja/ and Swedish /jʌ/.

Meanwhile, a large proportion of poor performers spoke Chinese as their first language (Fig. 5). Korean consonants rather than vowels seemed more difficult for Chinese participants to learn. Further research is required, however, to investigate whether this was induced by their logographic experience.

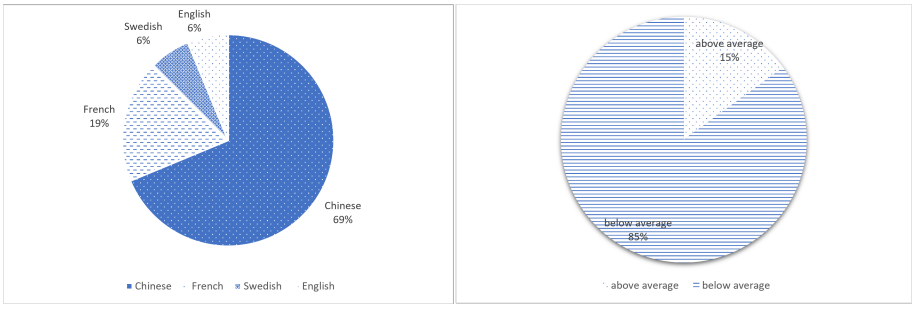

FIGURE 5. The distribution of the first languages of the performers who scored below average (left); and the scores within Chinese participants (right)

4. Discussion

People seem to successfully learn any kind of orthography. It did not matter at all whether it was the real Korean letter-sound association, which maximized audio-visual systematicity, or whether it was randomly paired, fake letter-sound associations. Even learning efficiency, as approximated by the number of repetitions, showed no difference between the two conditions. The results show more differences between learning consonants and vowels. Korean consonants were significantly easier to learn than vowels.

The nasals elicited the best performance, which is attributable to two reasons. First, nasal sounds seem to occupy a special position in human perception. The ratio of obstruents and sonorants is found to be constant across languages (Lindblom and Maddieson, 1988). In addition, nasals, approximants, and laterals are closer to vowels than plosives and fricatives are (Monaghan and Shillcock, 2003; 2008). For example, a trained neural network (Monaghan and Shillcock, 2003) demonstrated

that a vowel-layer lesion damaged nasal consonants more than plosives and fricatives (see their Table 2). Therefore, it seems plausible that one of the Korean followed by plosives, aspirated and tensed (Sogang University, 2004). The current data in fact demonstrated the aspirated letters may be easier than plosive letters. Second, the reason for the better performance on nasals may lie in the letter shapes. Due to its special position in the phonemic inventory, nasals may be easily connected to visually canonical figures (e.g., ㅇ, ㆁ, and ㅁ).

Whereas the perception of consonants can be categorical, that of vowels is more continuous. Fry et al. (1962) argued that there is no categorical effect for vowels. In fact, vowels show a much weaker categorical effect (Kronrod et al., 2012) that is more fluid than that of consonants (Toro, et al., 2008): for example, in the latter experiment where the pseudo-word 'cebra' was given, people tended to change vowels (e.g., cobra) rather than consonants (e.g., zebra). This may explain why learning vowels was more challenging than consonants, which can be made more difficult by the similar letter shapes of Korean vowels. For the participants, round back vowels were especially difficult to discriminate. Recorded mouth movements, for instance, are expected to increase the performance.

It is interesting, however, that the participants did not experience any difficulty in learning ㅓ /ʌ/, which hardly exists as an independent phoneme and is usually realized as one of allophones. This can be explained by a 'perceptual magnet effect', where people tend to be sensitive more to non-prototypical vowels than typical ones: the 'poor examplars' are ironically better distinguished than 'good examplars' (Iverson and Kuhl, 2000).

In summary, the current experiment demonstrated that people are very good at learning arbitrary letter-sound association and they do so by exploiting the relations between letters. The merits of hangeul's systematicity is only potentially observed in consonants in connection with learning efficiency. The current findings suggest the inherent difficulties of back phonemes and implies the necessity of additional visual aids in educational settings.

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Concevoir une fonte pour la transcription des *mouth actions* en langue des signes : le système typographique Typannot

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Résumé. Le projet Typannot a pour objectif l'élaboration d'un système typographique complet pour l'intégralité des paramètres des langues des signes. Si les configurations manuelles ont été très largement étudiées par la communauté linguistique, on ne peut pas en dire autant des *mouth actions* : aujourd'hui les recherches sur ces dernières restent rares en comparaison des travaux effectués sur les autres paramètres. Pourtant le bas du visage, et plus spécifiquement la bouche, transmettent des informations linguistiques majeures. Dans cet article, est introduit notre travail d'élaboration du système typographique pour la transcription des *mouth actions*. Après avoir présenté le contexte, seront énoncés les objectifs, notre approche et nos méthodologies pour mettre en place la structure du système. Sera présenté ensuite nos processus d'expérimentation et de design typographique avant d'évoquer les usages présents et futurs de la fonte.

Designing a font for the transcription mouth actions in sign language: the Typannot typographic system

Abstract. The Typannot project aims at creating a complete typographic system to transcribe all sign language parameters. If handshapes have been widely studied by the linguistic community, the same is not true for mouth action. Research on mouth actions is still scarce in comparison with other parameters, yet the mouth carries extensive meaningful linguistic information. In this article, we will introduce our work to set up a comprehensive typographic system for

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mouth actions. After setting the context, we will present our goals, approach and methodology to structure the typographic system as well as explain our processes to design the typeface.

1. Introduction

Les langues des signes (LS), plus d'une centaine dans le monde, constituent une partie centrale de l'identité culturelle des personnes (majoritairement sourdes) qui les pratiquent. Traditionnellement elles sont décrites comme des langues visuo-gestuelles, qui permettent de communiquer à travers le mouvement des mains, et c'est sur ces dernières que se concentrent la plus grande partie des études linguistiques. Mais les LS ne se limitent pas aux mains, toute la partie supérieure du corps – les avant-bras, les bras, les épaules, le buste et les différents articulateurs présents sur le visage – est engagée dans la production du sens. Les LS sont aussi des langues considérées exclusivement orales : elles semblent en effet résister aux représentations graphiques symboliques, c'est-à-dire à l'écriture. Que cela soit pour un usage courant (écrire) ou pour faire de la recherche (transcrire), le développement d'une écriture des LS se heurte systématiquement à la difficulté de représenter le mouvement des différentes parties du corps. Mettant de côté l'étude des mains, cet article va se focaliser sur le contexte et les enjeux associés au développement du système de transcription Typannot Mouth Action, qui permet de décrire les gestes buccaux (section 2.1). L'article commence par un bref état de l'art qui permet de se situer au sein des systèmes de représentation des *mouth actions* existants et de leur histoire (section 2.2). Le cadre théorique (section 3.1) et le modèle graphématique (section 3.2) mobilisés dans le système de transcription Typannot sont ensuite exposés. Vient une description des étapes de conception qui sont nécessaires pour créer un système qui soit à la fois fidèle à notre approche et facilement utilisable (section 4). Cette question de l'appropriation est réfléchie depuis la perspective du design et de l'ingénierie typographique, de la conception d'interfaces de saisie (section 5) et des besoins des linguistes. Enfin, un cas d'usage concret permet de présenter les perspectives de recherche ouvertes par Typannot Mouth Action (section 6). L'ensemble de ces réflexions ont pour enjeux de proposer un nouvel outil de représentation des LS, complémentaire aux solutions existantes, permettant de prendre en compte les structures corporelles qui régissent les productions gestuelles signifiantes.

2. Les *mouth actions* dans la littérature

Les recherches concernant les paramètres non manuels en LS se sont principalement concentrées sur les gestes de bouche. Dans la littérature

sur les LS, on distingue deux types de *mouth actions* : les *mouthings* et les *mouth gestures*.

2.1. Mouth gestures et mouthings

Les mouthings ont tendance à reproduire la partie phonétique la plus pertinente des mots de la LV environnante. Il s'agit le plus souvent d'un nom ou d'un adjectif (Fontana et Fabretti, 2000). Leur présence serait le résultat d'une éducation orale et/ou d'une situation de contact avec la communauté entendante. En effet, la LV parlée fait partie de l'économie communicative de la communauté sourde signante qui est en contact permanent avec la LV. En outre, les mouthings peuvent avoir une valeur sémiotique car ils indexent le mot ou l'expression qu'ils accompagnent comme signifiant, non pas pour son propre contenu sémantique, mais pour son contenu pragmatique de discours. Les différents mouvements de la bouche sont utilisés conjointement avec la LS, tout comme les gestes co-verbaux le sont avec la parole.

Au contraire, les mouth gestures en LS ne sont pas liés ou influencés par la LV environnante. Au sein des mouth gestures, les différents mouvements de bouche peuvent soit changer, soit rester constant pendant l'articulation du signe. Différents chercheurs (Crasborn et al., 2008 ; Woll, 2001) s'accordent sur le fait que les mouth gestures impliquent diverses configurations de la mâchoire, des lèvres, des joues et de la langue et impliquent des mouvements d'air. Les gestes de bouche reflètent également le rythme du mouvement du signe. Ils jouent différents rôles allant de la fonction lexicale à celle morphémique (adjectivale ou adverbiale). Un exemple du rôle lexical est donné par la paire minimale [ADORER] et [CONFIANCE] en LS Française (LSF) (Figure 1).

Ces deux signes sont des homonymes manuels et sont notamment désambiguïsés (hors contexte) par le geste de la bouche : dans le signe [ADORER] (Figure 1a) la bouche est ouverte et les sourcils sont levés ; alors que dans le signe [CONFIANCE] (Figure 1b) le visage est relativement neutre. En reproduisant des mouvements rythmiques, les mouth gestures semblent également fournir des informations onomatopéiques supplémentaires. Ces dernières semblent être liées aux signes comme les gestes le sont à la parole : *les mains sont la tête de la bouche* (Boyes-Braem et Sutton-Spence, 2001). L'application de cette métaphore se retrouve, par exemple, dans la vibration des lèvres, lors de la production du signe [ABEILLE] ; ou lors du gonflement de joues accompagné d'une expiration de l'air, exprimant à lui-seul d'exprimer l'ennui.

Différentes études montrent l'importance des mouth gestures en LS, mais pour parvenir à étudier efficacement leurs différentes fonctions, il est indispensable de disposer d'un système de transcription adapté.



(a) [ADORER] (b) [CONFIANCE]

FIG. 1. Exemple de paire minimale en LSF – corpus EVLS-MOCAP (THOMAS, 2019)

2.2. Notations des *mouth actions*

Depuis plus de 5000 ans, l'Homme a développé des systèmes graphiques voués à représenter le langage humain : les écritures. Au cours des siècles, des facteurs linguistiques, historiques, culturels et politiques ont menés à la naissance de nombreuses typologies d'écritures (DANIELS, 1990) – qui partagent le fait d'être des représentations graphiques d'une langue à travers un ensemble de symboles conventionnels (caractères) inscrits sur un support en suivant des règles, elles aussi, conventionnelles.

Née pour garder la trace des échanges commerciaux et/ou des rites religieux (GADOTTI, 2012), l'écriture est aujourd'hui partie intégrante de la vie quotidienne d'une grande partie de la population mondiale[1]. Pour les locuteurs des langues où le développement d'une écriture n'a pas été imposée par les récentes politiques d'alphabétisation globale[2], celle-ci n'est pas uniquement une manière de transmettre des informations, elle est une partie intégrante du bagage culturel des locuteurs.

Si les écritures « historiques », dans leurs grandes diversités typologiques, sont le fruit de l'histoire et de la culture d'un peuple, il est aussi

1. Selon les données fournies par la Banque Mondiale (`https://donnees.banquemondiale.org`), en 2020, 87% de la population mondiale est alphabétisée, ce taux atteint presque 100% dans les pays de l'Union Européenne.

2. Ces politiques se limitent souvent à proposer l'apprentissage d'une langue (souvent européenne) écrite en créant des situations de diglossie entre la langue parlée et écrite. Toutefois, elle mènent parfois à l'adaptation d'un système d'écriture existant (souvent alphabétique) pour coder la langue locale.

vrai que toute LV peut être décrite de manière phonographique, c'est à dire en associant à chaque phonème un caractère. Le recours à l'écriture phonographique permet aux linguistes de transcrire les textes, c'est-à-dire de représenter graphiquement (plus ou moins) fidèlement la forme signifiante des mots ou une phrase ayant été prononcés oralement.

Une typologie de langue résiste à la possibilité d'être écrite phonographiquement, les LS : langues visuo-gestuelles, elles ne peuvent être décrites par des caractères représentant des sons ; langues multilinéaires (puisque plusieurs articulateurs concourent simultanément à la création du sens), elles ne peuvent être écrites à travers des systèmes graphiques conçus pour représenter la linéarité des LV. Les LS sont donc non seulement des langues purement de face-à-face, mais aussi des langues, du moins pour l'instant, non scriptibles (Bianchini, 2021).

La non-scriptibilité des LS impacte tant la capacité des locuteurs de LS à écrire leur langue au quotidien (pour établir une liste de course, prendre des notes en cours ou écrire un livre en LS) que celle des chercheurs d'analyser les formes signifiantes des LS. Depuis plus d'un demi-siècle, de nombreuses solutions ont été mises en œuvre pour pallier ce manque. Certaines – comme SignWriting (Sutton, 1995) – visent à créer pour les LS une écriture courante et quotidienne, d'autres – comme HamNoSys (Prillwitz et al., 1989) – avaient comme objectif la création d'un système de transcription permettant aux linguistes de représenter les formes signifiantes des LS.

Le premier système de transcription développé dans le but de permettre l'analyse linguistique des LS (notamment la LS américaine – ASL) est la Notation de Stokoe (1960) et Stokoe, Casterline et Croneberg (1965). À partir de 1960, Stokoe dégage un ensemble de chérèmes qu'ils regroupent en paramètres formationnels (emplacement, configuration, mouvement et orientation). À la différence des phonèmes dont la segmentation dans le discours est séquentielle, les chérèmes se combinent spatialement et simultanément dans le signe. Dans sa version originale (1960), la Notation de Stokoe compte 55 symboles et, ni dans sa version originelle ni par la suite, ce système ne permet la description des paramètres non manuels.

D'autres systèmes ont émergé par la suite, tirant inspiration de cette Notation de Stokoe : HamNoSys (Prillwitz et al., 1989), la Notation d'Hohenberger et Happ (2001), le système de transcription d'Ajello, Mazzoni et Nicolai (Ajello, Mazzoni et Nicolai, 2001). Permettant de décrire les composantes non manuelles des signes, ils nécessitent d'une présentation plus détaillée.

Le système de transcription HamNoSys (Prillwitz et al., 1989) est une évolution de la Notation de Stokoe. Malgré la grande finesse descriptive de HamNoSys, Prillwitz et collaborateur ont porté peu d'attention à la représentation des paramètres non manuels

> Les composants non manuels ne sont pas suffisamment développés pour HamNoSys. Jusqu'à présent, les mouvements d'autres parties articulées que les mains doivent être décrits avec l'inventaire des mouvements connus de HamNoSys. La description détaillée nécessaire ne peut pas être faite actuellement. (Hanke, 2004)

La Table 1 représente les différents éléments pour annoter les *mouth actions*, nous relevons 6 articulateurs de la face (menton, bouche, langue, joue, lèvres et dents) et 10 valeurs.

Tab. 1. Notation des *mouth actions* dans le système de notation HamNoSys

Articulateur	Représentation	Articulateur	Représentation
Menton		Joue	
Sous le menton		Lèvre supérieure	
Bouche		Lèvre inférieure	
Langue		Dents supérieures	
Dent		Dents inférieures	

La Notation d'Hohenberger et Happ (2001) a été développée spécifiquement pour décrire les *mouth actions* en LS allemande (DGS). Ce système apparaît possède une granularité assez fine. En effet, il comporte 6 articulateurs de la face (sourcils, yeux, bouche, lèvres, joues et nez) et propose 11 valeurs pour les décrire. La Table 2 regroupe les articulateurs avec les positions correspondantes. Ce système propose en surcroît des caractères pour annoter le pluriel, les termes qui sont exprimés avec un seul signe et les changements de rôle.

Pour finir, la transcription d'Ajello, Mazzoni et Nicolai (2001) a été élaborée dans le cadre d'une recherche sur les mouthings en LS italienne (LIS). Ce système possède un grand nombre d'éléments permettant d'annoter un ensemble de position de la bouche. Effectivement, il se compose de 27 valeurs réparties sur 4 articulateurs de la face (la mâchoire, les lèvres, les joues et la langue). Contrairement aux autres notations présentées jusqu'ici, ce système ne propose pas de représentation graphique. La Table 3 regroupe l'ensemble des articulateurs avec les valeurs correspondantes.

Les systèmes présentés ci-dessus décrivent, en utilisant une granularité et une terminologie distincte, des postures de la bouche telles qu'elles sont perçues par le récepteur du signe. Bien qu'ils figurent par-

Tab. 2. Notation des *mouth actions* dans la Notation d'Hohenberger et Happ (2021)

++	M Marqueur du pluriel
-	Trait d'union : permet de relier les termes qui sont exprimés avec un seul signe
∩∩	S Sourcils levés
∪∪	S Sourcils froncés
OO	Yeux grands ouverts
⟷	Bouche en forme de bar
V	Reconnaissance des gestes de la bouche : lèvres inférieures légèrement avancées, bouche fermée de manière triste
Θ	Lèvres fermées en « O » en dégageant de l'air comme si elles soufflaient doucement
<...>	Changement de rôle : le signataire prend le point de vue de l'agent dans l'histoire
∩	Bouche inclinée vers le bas
∞	Joues gonflées
≅	Nez froncé
≈	Lèvres légèrement plissées
◊	Bouche en forme [∫] avec les joues légèrement gonflées

mis les systèmes les plus complets pour représenter les *mouth actions*, ils n'arrivent pas à associer une description articulatoire fine à une représentation graphique efficace. Depuis 2012, Typannot, un nouveau système de transcription typographique des LS propose une description alternative basée sur une description articulatoire et intrinsèque des signes. Son objectifs est de représenter l'intégralité du corps du signeur, donc aussi ses mouth gestures.

3. Système de transcription Typannot

3.1. Approche Typannot (modèle linguistique)

L'étude linguistique des LS repose en partie sur la description des phénomènes gestuels à un niveau sous-lexical. Initiée par les travaux de Stokoe (1960), une approche descriptive a progressivement vu le jour en identifiant des paramètres essentiels pour représenter ces phénomènes : la forme de la main, sa position et son orientation dans l'es-

Tab. 3. Notation des mouthings dans le système de transcription d'Ajello et al. (2001)

1 Ouverture de la mâchoire	2 Position des lèvre	3 Position des joues	4 Position de la langue	5 Utilisation de l'air	6 Direction du mouvement
a) fermée	a) neutre	a) deux gonflées	a) protrusion de la pointe de la langue	a) bouffée	a) ouverture
b) semi-fermée	b) courbées vers le haut	b) une gonflée	b) contact avec la zone alvéolaire supérieure	b) flux	b) fermeture
c) semi- ouverte	c) courbées vers le bas	c) deux aspirées	c) contact avec la zone alvéolaire inférieure	c) inhalation	
d) ouverte	d) étirées		d) contact avec l'arc dentaire supérieur	d) vibration	
	e) contractées		e) contact avec la partie interne de la lèvre inférieure		
	f) avancées		f) contact avec la lèvre supérieure		
	g) aspirées				
	h) lèvre inférieur étirée				
	i) lèvre inférieure s'appuyant sur l'arc dentaire supérieure				
	j) étirées vers le haut				
	k) étirées vers le bas				
	l) contractées vers le haut				
	m) contractées vers le bas				
	n) avancées et contractées				

pace, son mouvement, et – bien plus tard – l'expression du visage. On va retrouver ce découpage dans les différents types de systèmes de représentation existants (section 2), qu'ils servent à écrire les LS comme SignWriting ou à les transcrire comme HamNoSys.

3.1.1. *Une tradition visuo-spatiale*

Cette approche descriptive paramétrique a pour particularité d'être dominée par une conception visuo-spatiale des signes. En effet, les descriptions rendent compte des phénomènes gestuels depuis un point de vue externe, c'est-à-dire que l'on va décrire ce que l'on voit du geste – les effets que celui-ci produit dans l'espace – depuis la perspective d'un observateur. La configuration de la main est ainsi représentée par des *figures* (une moufle, un doigt crochet, un bec de canard) qui relèvent d'organisations spécifiques des doigts et du pouce (Figure 2). Sa position et son orientation sont déterminées par un référentiel spatial (devant soi, vers l'avant, etc.). Le mouvement est représenté par des indices

sur la façon dont la main se déplace dans l'espace, la plupart du temps des flèches montrant une trajectoire. L'expression du visage, elle, repose sur un ensemble limité de traits distinctifs (voir les systèmes présentés en section 2.2). Ce mode de représentation est très économe et efficace car il donne à voir des formes constituées et explicites, une sorte d'empreinte de l'activité du signeur qui permettrait d'identifier des unités signifiantes dans la langue. Par exemple, dans la représentation du signe [MAISON], la forme de la main, sa position, son orientation et sa trajectoire rendent clairement compte d'une motivation iconique : l'image schématique d'une maison (dans la tradition architecturale occidentale). Cet ancrage des signes dans la *réalité* du locuteur, sa façon d'éprouver le monde, est une caractéristique de la manière dont les LS fonctionnent et que les chercheurs nomment *iconicité*. On peut donc comprendre que la tradition représentationnelle des chercheurs en LS traduit l'importance des critères visuo-spatiaux dans la construction de la langue[3].



FIG. 2. Transcription du signe [MAISON] utilisant SignWriting (centre) et HamNoSys (gauche). Code couleur : vert = configuration de la main, violet = indications sur son orientation dans l'espace, rouge = trajectoire de la main, bleu = contacts entre les mains, noir = symétries du mouvement

Il est incontestable que cette approche visuo-spatiale soit d'une grande utilité dans la description des LS, mais force est de constater qu'elle ne permet pas de s'interroger sur une dimension implicite de ces formes, celle de l'organisation corporelle qui les sous-tend (DANET, THOMAS et al., 2022). En effet, la forme de la main, sa position et son orientation, ou même sa trajectoire dans l'espace sont les produits d'une

3. Rapport qui va être très différent dans d'autres formes de productions gestuelles comme la danse et qui donnent lieu à d'autres approches descriptives.

organisation corporelle particulière qui n'est pas systématiquement[4] explicitée actuellement. Les modèles de description actuels ne permettent pas de renseigner comment le corps produit ces formes et par conséquent il n'est pas possible de s'interroger sur le rôle du corps dans la structuration de la langue. Caractériser les LS au travers d'un modèle proprement corporel permettrait aux chercheurs d'articuler deux niveaux de structuration qui sont intrinsèquement liés :

- un niveau corporel décrivant la façon dont les possibilités articulatoires du corps sont dynamiquement organisées ;
- un niveau linguistique[5] décrivant comment ces organisations corporelles peuvent à chaque instant former des structures signifiantes.

3.1.2. *Un modèle kinésiologique*

Ce modèle corporel doit donc permettre de représenter et d'étudier scientifiquement le mouvement du corps humain. Cela correspond à un domaine d'étude existant qui s'appelle la kinésiologie (Boutet, 2018). Cette dernière cherche à décrire et à comprendre les principes et les mécanismes du mouvement à un niveau anatomique et biomécanique, entre autres. Cette démarche nous permet de modéliser le corps en tant que système articulatoire complexe et ainsi de décrire des processus gestuels à un niveau sous paramétrique. Dans le cadre de ce projet, nous avons choisi de modéliser l'activité corporelle à partir de deux composante, une composante *articulatoire* et une composante *actionnelle*.

Dans la composante articulatoire nous décrivons les différents segments corporels impliqués dans la production des gestes et caractérisons pour chacun d'eux des degrés de liberté (DdL). Elle permet donc de représenter l'état du système articulatoire en prenant en compte les liaisons et les contraintes entre les segments (Chevrefils, 2022). Dans le cadre de l'étude des LS, cette composante regroupe 3 grandes structures articulatoires (GSA) : la main, les membres supérieurs, le visage. Chacun d'eux possède des segments distincts qui peuvent être aménagés selon différents DdL. Par exemple, pour les membres supérieurs nous avons 3 segments : le bras, l'avant-bras et la main qui offrent en tout 7 DdL. Avec ces quelques variables élémentaires, nous pouvons décrire un très grand nombre de configuration articulatoire locale et globale. L'approche kinésiologique permet ainsi de développer des analyses qui ne sont plus uniquement centrées sur la main (Chevrefils et al., 2021). Nous voyons que la position et l'orientation de la main dans l'espace découle d'aménagements spécifiques des DdL des membres supérieurs.

4. HamNoSys propose une représentation articulatoire corporelle de la main uniquement.

5. Ce niveau d'analyse serait par exemple utile dans les recherches portant sur la prosodie ou la sémiogénèse.

Aux côtés de cette composante articulatoire, nous sommes en train de définir une composante actionnelle qui doit rendre compte de la façon donc ces structures articulatoires peuvent se transformer. L'idée est de pouvoir caractériser les différents modes de mobilisation des parties et de leur DdL dans le temps. Ainsi, cette dernière composante nous permettra d'aborder le geste comme une « phase » ou un ensemble de « phases » regroupant des configurations articulatoires et des actions dans le temps.

Cet article se focalisera sur la conception de Typannot Mouth Action, un système de transcription qui porte sur une des 3 GSA que nous venons de présenter.

3.2. Modèle grapholinguistique

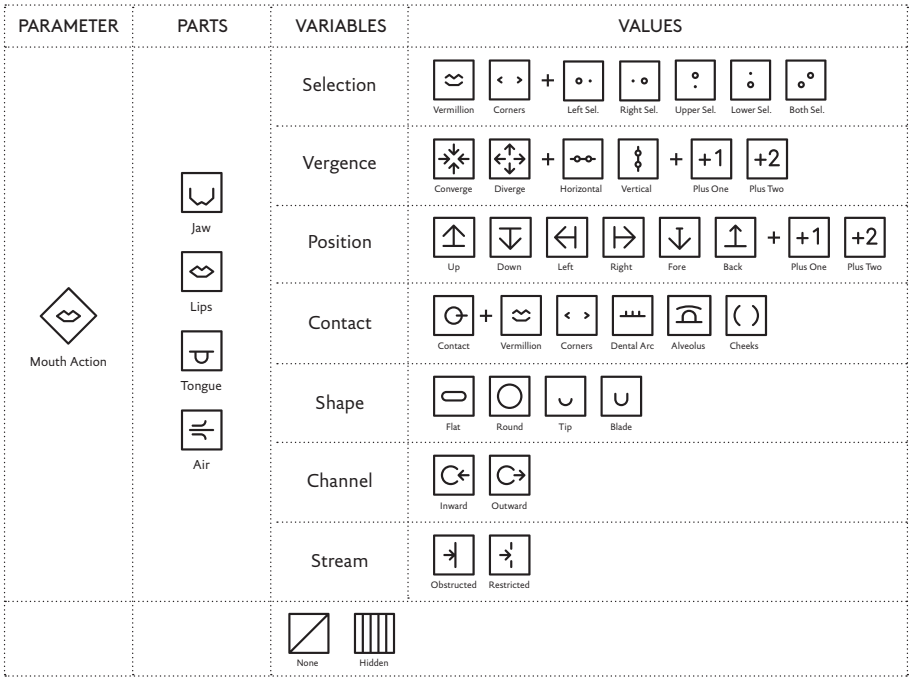
L'objectif de Typannot est de proposer un outil de transcription qui mette en œuvre les principes de ce modèle articulatoire corporel. Concrètement, il s'agit de développer un système typographique ainsi que les interfaces de saisie permettant son utilisation par les chercheurs. Un des enjeux a donc été de concevoir les conditions de l'appropriation d'un modèle qui repose sur une perspective interne du geste et qui est donc à première vue opaque.

Comme décrit plus haut, le système typographique, en cours de développement, sera composé de 4 polices de caractères, 3 pour les GSA et une pour décrire les caractéristiques actionnelles. Elles transposeront sous la forme de symboles graphiques le système graphématique permettant de représenter chacunes de ces composantes. Pour décrire Mouth Action, nous utilisons un modèle graphématique qui est commun aux autres GSA (Doan et al., 2019) et qui articule 3 niveaux d'information (Table 4) :

- la partie ou segment (bouche, sourcil, etc.) ;
- le DdL (converge/diverge, up/down, etc.) ;
- la valeur du DdL (++, +, 0, etc.).

Ce registre de quelques symboles permet de systématiquement coder et décoder une très grande variété de gestes sous la forme de séquences obéissant à une syntaxe précise. Au travers de cette forme de transcription de type phonétique articulatoire, les chercheurs peuvent opérer des analyses à un niveau articulatoire du signe et partager leurs corpus sans être limité par les barrières d'un codage utilisant leur LV respective. Dans un souci d'appropriation et d'utilisation plus large, nous avons voulu introduire une autre forme de représentation qui puisse faire l'inverse de la décomposition en unité minimale. En effet, chaque transcription utilisant une suite logique de symboles génériques renvoie à une organisation particulière du corps, qui vue de l'extérieur va

Tab. 4. Répertoire des glyphes génériques Mouth Action



être perçue comme une figure. Nous avons donc développé un second registre glyphique que nous avons nommé *composed* qui fait la synthèse visuelle des transcriptions et permet d'afficher une représentation simplifiée de la figure produite (Figures 3 et 4).

4. Étape de conception Typannot Mouth Action

La complexité de la structure musculaire et morphologique du visage et notre capacité à identifier et à interpréter les plus infimes mouvements et changements d'expression font de la transcription du visage – *via* un système typographique – un réel défi. À l'opposé de la flexibilité du visage humain, une typographie est par nature structurée et rationalisée. Les caractères qui la composent doivent être séquencés selon une logique précise et leurs formes typographiques doivent être parfaitement intelligibles. Comment, donc, réunir le visage et la lettre dans une typographie qui respecte les principes généraux du système Typannot ? Les éléments de réponse à cette question peuvent diffici-

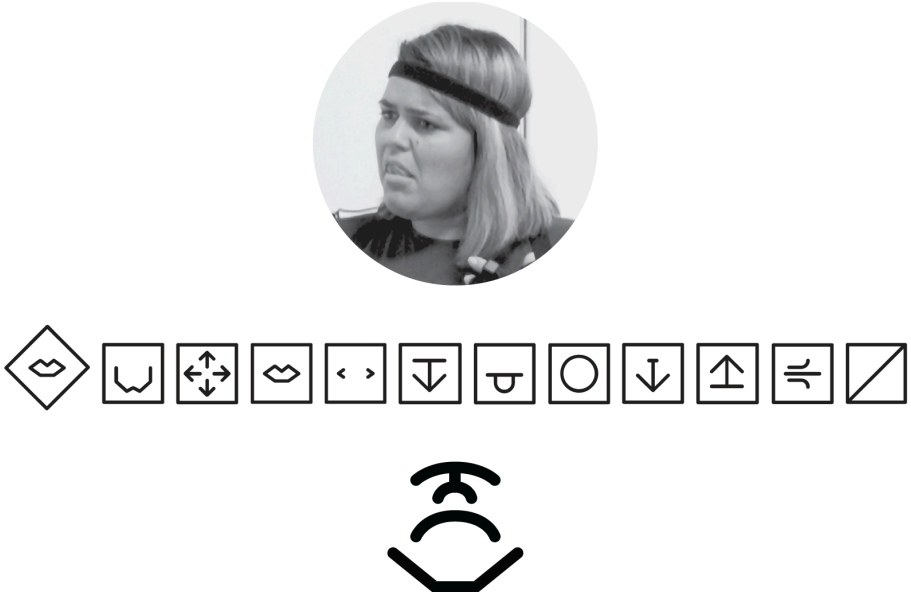


FIG. 3. Exemple de transcription d'une *mouth action*, présenté dans la forme générique et la forme composed de la fonte Mouth Action

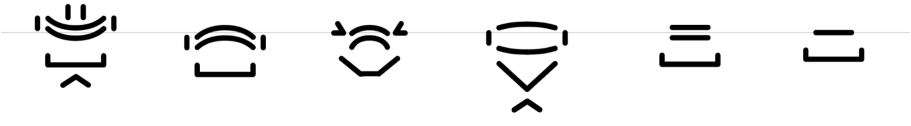


FIG. 4. Série de glyphes composed de la fonte Mouth Action

lement être trouvés dans une réflexion purement théorique. En effet, le cheminement nécessaire à la résolution de cette problématique invoque conjointement réflexions, méthodologie et expérimentation formelle. Au travers des paragraphes suivants, seront exposées les étapes clés et les prises de positions qui ont permis la structuration et le design du système typographique Mouth Action de Typannot.

4.1. Formule graphématique

La première nécessité pour concevoir un système typographique des *mouth actions* est d'avoir une formule graphématique efficiente. Cette formule est la fondation, sans laquelle le système typographique ne serait

qu'une liste plus ou moins arbitraire de glyphes représentant des expressions faciales. Elle se doit d'être adroitement réfléchie, car elle constitue la structure descriptive sur laquelle vont s'appuyer les caractères typographiques. Sans une formule efficace, structurée et compréhensible, il est impossible de concevoir un système typographique intelligible. Une formule graphématique qualitative pour les *mouth actions* doit répondre à 3 exigences principales. La première est évidente, les composantes de cette formule doivent permettre la codification de toutes les *mouth actions* existantes. La deuxième, est qu'elle doit pouvoir réaliser cette tâche en étant le plus économique possible et en invoquant un nombre limité d'éléments pour maintenir un niveau de complexité bas. La dernière exigence est qu'elle doit être organisée de manière logique pour permettre un apprentissage facile et une utilisation efficace.

Lors de la constitution de l'état de l'art sur les *mouth actions*, la classification des composantes morphologiques des *mouth actions* proposée par Sutton-Spence et Day (2001) a été retenue. Ces deux chercheuses proposent deux organigrammes, l'un partant de « mâchoire fermée » et l'autre de « mâchoire ouverte » qui se développent en un embranchement des possibles composantes morphologiques de la bouche. Cette approche méthodologique est particulièrement intéressante, car elle permet une représentation visuelle organisée des composantes du visage. Ces organigrammes, ayant été réalisés en vue de l'analyse d'un corpus précis en LS britannique (BSL), ne peuvent pas être exhaustifs, mais ils permettent d'imaginer la création d'une cartographie graphématique des *mouth actions* (Figure 5).

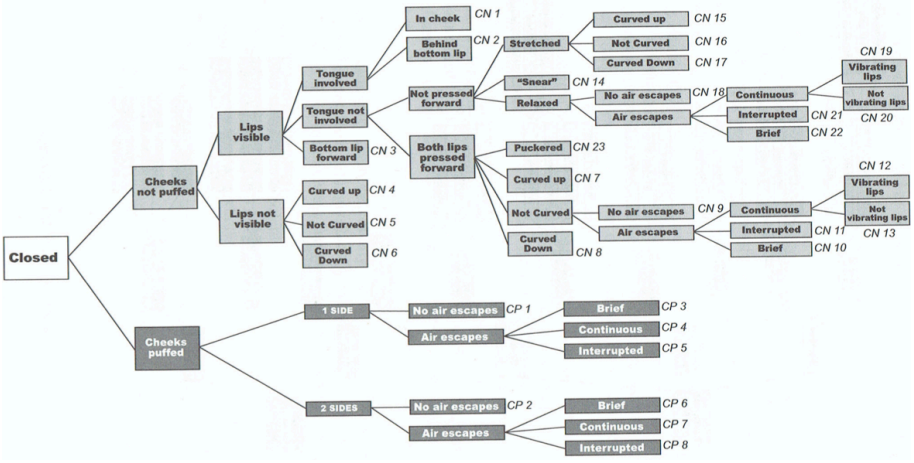


Fig. 5. Organigramme « mâchoire fermée » Sutton-Spence et Day (2001)

En s'inspirant de cette démarche, nous avons étendu la portée du travail réalisé en créant un organigramme plus exhaustif et plus universel.

Les analyses existantes sur les *mouth actions* étant très limitées en nombre, nous avons pris le parti de créer une formule graphématique qui peut transcrire « toutes » les positions morphologiques faciales. Cela revient à créer une formule basée sur la physiologie du visage humain et non sur une compilation d'occurances de visages présentes dans les corpus existant. C'est un objectif ambitieux, mais qui permet de créer une formule universelle adaptable à tous les contextes langagiers.

Baser la formule graphématique sur les capacités morphologiques du visage résout le problème lié au manque de corpus, mais apporte une nouvelle question à laquelle répondre : comment déterminer la granularité de la description morphologique si l'on ne peut pas se baser sur un corpus complet, et de ce fait, tester la juste identification d'une liste déterminée de *mouth actions* à transcrire ? Deux contraintes, l'une perceptive, l'autre fonctionnelle, nous permettent de trouver un juste équilibre entre une granularité trop grossière, qui ne permet pas la transcription de certaines composantes morphologiques, et une granularité trop fine, qui engendre une formule trop lourde dans son utilisation. C'est donc les notions de saillance visuelle des *mouth actions* à représenter et de contexte d'utilisation de la formule graphématique qui nous permettent de déterminer où placer le curseur de la granularité.

Trouver ce juste équilibre nécessite de nombreuses phases de conception et de test. Les premières versions créées avaient un niveau de granularité très fin, avec pour volonté de retranscrire un large panel de nuances. La segmentation d'une variable comme l'ouverture était alors réalisée en 5 incrémentations (fermée, semi-fermée, semi-ouverte, ouverte, complètement ouverte). Les organigrammes résultant d'une telle segmentation étaient alors extrêmement complexes et le nombre de résultats possibles exponentiel. Une telle formule ne répondait pas convenablement aux besoins liés à son utilisation. Après des tests de transcription, il s'est avéré qu'un tel degré de granularité était peu utile, car l'annotateur n'était pas en capacité de discerner avec autant de précision les composantes du visage en action dans un extrait de discours.

Une nouvelle version de la formule (Figure 6), plus économique dans la description, propose une segmentation moins fine, en 3 incrémentations pour notre variable de l'ouverture (fermée, semi-ouverte, ouverte). Elle permet une simplification substantielle et, après avoir réalisé des tests d'annotation de corpus, semble être plus en adéquation avec les capacités perceptives d'un annotateur lors de la transcription d'un corpus vidéo.

Pour valider cette formule, plus efficiente dans son organisation et répondant aux besoins de l'annotateur, un test regroupant 5 bêta testeurs fut organisé sur 4 jours (en 2017). Les résultats, très positifs en ce qui concerne la capacité de description de la formule, ont toutefois

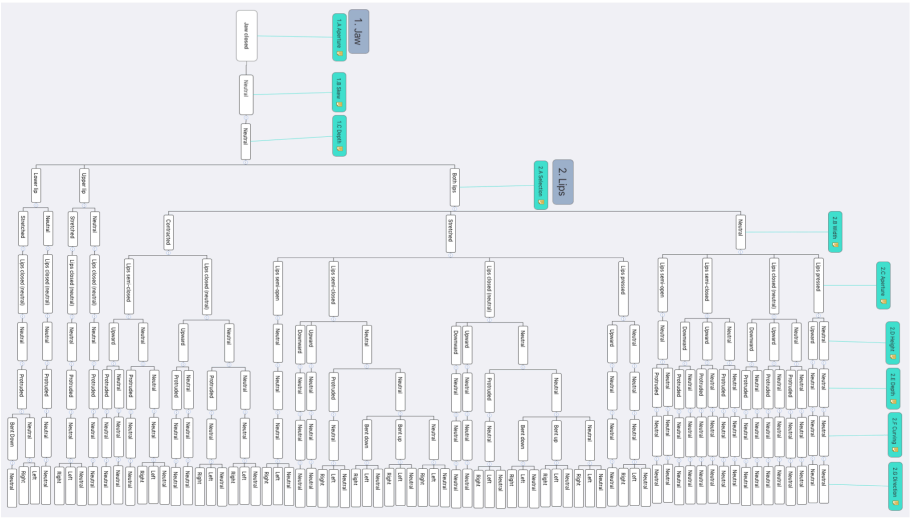


FIG. 6. Travail de complétion d'un organigramme « mâchoire fermée » pour Mouth Action

été contrebalancés d'une certaine difficulté d'apprentissage et d'utilisation liée au grand nombre de valeurs à connaître. En effet, cette formule comportait une centaine de valeurs possibles avec pour chacune un vocabulaire propre (ex : stretched, pressed, bent, puffed, sucked in, etc.). Par exemple, pour décrire un mouvement de rétractation, les lèvres sont « retroussées » alors que la mâchoire est « rentrée » ; pour décrire en rapprochement forcé entre deux sous-parties, les lèvres sont pressées alors que la mâchoire est serrée.

Pour répondre à cette difficulté de prise en main, une simplification de la formule était requise. Pour ce faire, la syntaxe a été entièrement requestionnée pour être plus objective et moins descriptive dans son vocabulaire. Dans cette recherche, il est apparu que toutes les valeurs utilisées dans la formule comportent intrinsèquement que des informations tridimensionnelles. En effet, une *mouth action* complexe peut être décrite dans son intégralité, en appliquant des coordonnées X,Y,Z aux différentes parties du visage (Figure 7). Par exemple, les lèvres retroussées et une mâchoire rentrée impliquent toutes deux un mouvement sur l'axe de la profondeur (Z-1) ; des lèvres pressées et une mâchoire serrée impliquent toutes deux une convergence sur l'axe des X (X+1;X-1). Cette description axiale des parties du visage permet une économie de vocabulaire significative et simplifie les possibilités de l'annotateur lorsqu'il doit déterminer quelle valeur attribuer aux différentes parties du visage.

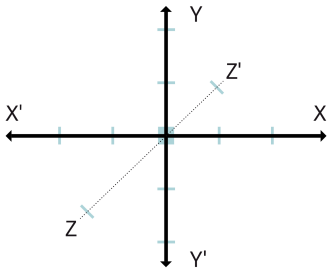


Fig. 7. Grille tridimensionnelle à la base de la formule graphématique Typannot Mouth Action

Dans cette formule (Figure 8), la bouche est décomposée en 5 parties (la mâchoire, les commissures des lèvres, le vermillon des lèvres, la langue, l'utilisation de l'air) qui ont chacune un set de position possible – ou de direction possible dans le cas de l'utilisation de l'air – sur les axes X,Y,Z. Cette économie structurelle rend la formule plus simple et plus concise : plus efficiente dans son fonctionnement, elle conserve toutes ses capacités descriptives.



Fig. 8. Syntaxe de la formule graphématique Mouth Action

Une série de tests, conduits en 2020 sur 6 participants, a permis de valider les bénéfices de la nouvelle formule graphématique, mais aussi de mettre en évidence une impression d'abstraction lors de son utilisation. En effet, le cerveau humain n'est pas habitué à percevoir ou interpréter le visage humain sur un plan uniquement spatial. Afin de faire le lien entre cette formule tridimensionnelle efficiente, et le vocabulaire plus couramment utilisé pour décrire les *mouth actions*, il a été important de réaliser un tableau de correspondance, qui lie les combinaisons de positionnement X,Y,Z à un vocabulaire morphologique descriptif. Par exemple, des lèvres en position Z+1, équivalent à des lèvres en protru-

sion ; des commissures en divergence (Y+1,Y-1) équivalent à des lèvres étirées, etc.

4.2. Recherche typographique

4.2.1. *Intentions typographiques*

En termes typographiques, l'intention première a été de créer un système typographique modulaire qui trouve l'équilibre entre ressemblance morphologique et symbolisme. La modularité permet d'utiliser au besoin les différentes composantes de la bouche, avec pour chacune un set de variantes, pour composer une *mouth action*.

Pour ce qui est de la ressemblance morphologique, elle permet une identification des glyphes intuitive, car basée sur nos capacités naturelles de reconnaissances des expressions faciales. A l'inverse, le symbolisme permet de créer des marqueurs forts et facilement identifiables, utiles là où l'aspect morphologique ne permet pas une différenciation des glyphes suffisante pour une utilisation typographique.

Le but d'un tel système, outre de faciliter la prise en main, est d'avoir une fluidité visuelle entre formule graphématique et forme glyphique. Cela induit qu'un utilisateur a la possibilité de comprendre et d'intégrer la traduction formelle – typographique – des valeurs de la formule graphématique. Dans le cas de l'utilisation d'un symbole, cela est particulièrement direct puisque chaque symbole code directement une valeur graphématique. Dans le cas d'une ressemblance morphologique, cela n'est pas aussi direct, car une valeur graphématique doit être traduite en ce qu'on pourrait appeler une expression typographique, une forme non absolue, mais s'appliquant et interagissant avec les autres valeurs graphémiques d'un module.

Dans cette réflexion, on peut noter que d'un côté la forme morphologique est simple à interpréter visuellement, mais peut devenir problématique lors de combinaisons typographiques complexes. De l'autre, le symbole est typographiquement simple et minimaliste, mais peut nécessiter un effort non négligeable de décodage dans le cas d'une utilisation excessive. C'est donc un équilibre entre ces deux principes typographiques qui permettra la mise en place du système le plus efficace.

4.2.2. *Préambule graphique*

Mettre en place un système modulaire d'hybridation morphologique et symbolique est une tâche peu commune et relevant du défi. Afin d'initier la conception de ce système, la première étape a été d'identifier les différents éléments constitutifs de la bouche (Figure 9), d'intégrer leurs formes et de comprendre leurs interactions morphologiques.

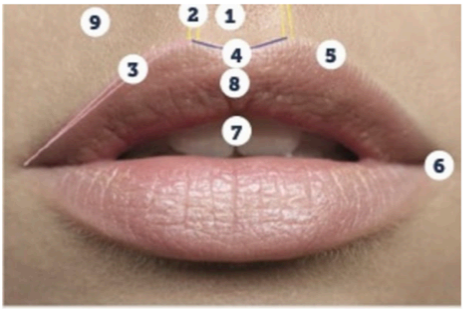


FIG. 9. Identification des composantes morphologiques de la bouche

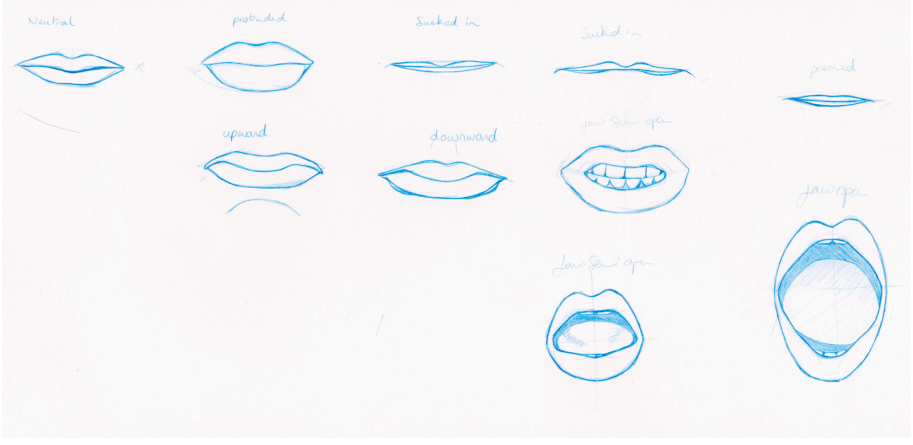


FIG. 10. Premiers croquis exploratoires de formes de bouche

Pour ce faire, des crayonnés et croquis ont permis d'identifier certains éléments physiologiques constitutifs du visage fortement représentatifs. L'acte manuel du dessin permet de questionner les courbures, les rapports de forme et de taille qui font naître chez le spectateur les liens entre l'objet réel observé et sa représentation picturale (Figure 10).

4.2.3. *Recherche*

Suite à ce travail de croquis anatomique, une série d'exercice de rationalisation des formes a permis l'émergence des premières formes filaires. Ces embryons typographiques avaient pour but de conserver l'essentiel d'un croquis morphologique en éliminant toutes les composantes formelles superflues. Après vectorisation, cette série de dessins filaires

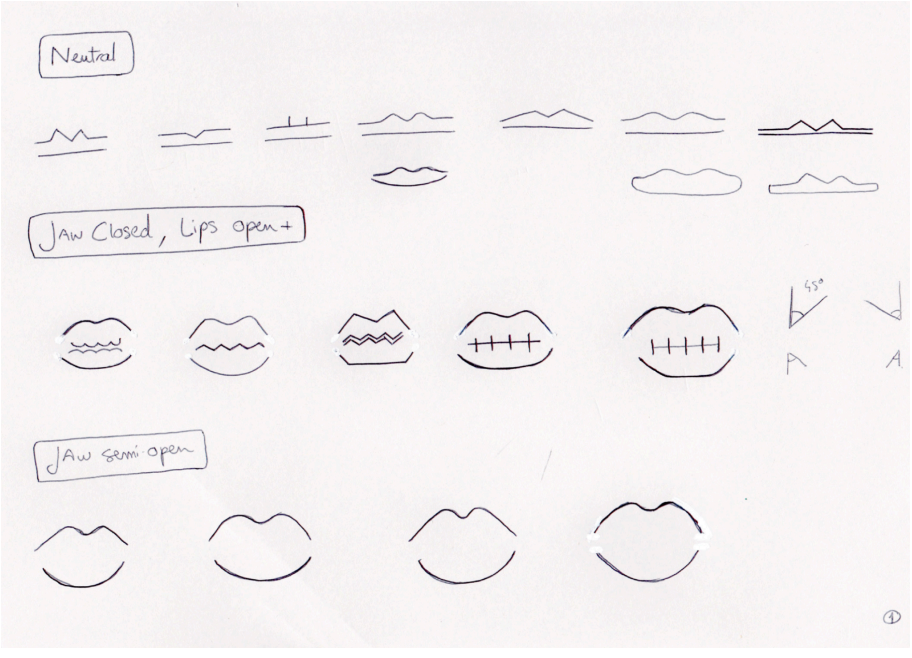


FIG. 11. Premières esquisses de formes simplifiées

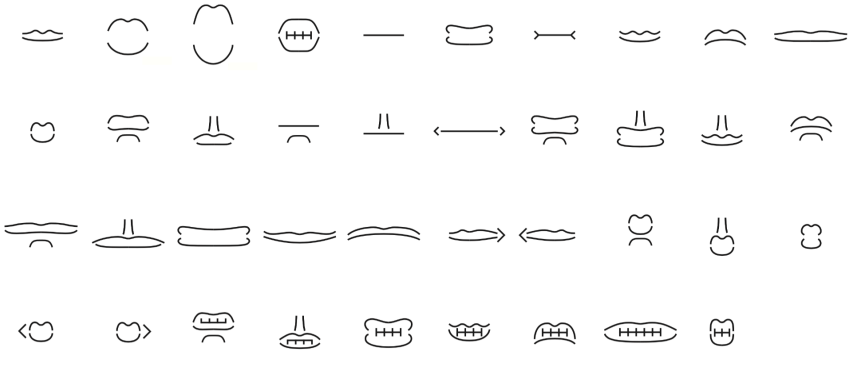


FIG. 12. Première série de formes filaires vectorisées

nous a permis de confirmer une possible identification intuitive d'un set de *mouth actions* en utilisant une forme simplifiée (Figure 11).

Cependant, une telle collection de glyphes ne représente en aucun cas un système typographique. À ce stade, les éléments qui le composent ne sont pas travaillés pour une utilisation modulaire, et leur utilisation se réduit à un glossaire de dessins vectoriels. De plus, réduit à taille typographique, les éléments constitutifs perdent leur potentiel d'identification. Enfin, des différences morphologiques subtiles sont facilement identifiables sur un visage, mais sont très loin de l'être sur un glyphe typographique. C'est à cette étape que l'adjonction d'élément symbolique permet de radicaliser le répertoire formel et confère aux tracées une bien meilleure identification à petite taille (Figure 12).

L'équilibrage entre utilisation de symboles et référence formelle à la morphologie a nécessité de très nombreuses itérations. Les éléments constitutifs du système typographique étant modulaires, ils doivent être calibrés pour différents scénarios de combinaisons. De plus, chacun des modules de ce système peut se voir attribuer plusieurs valeurs graphématiques, ces valeurs ayant des caractéristiques formelles qui leurs sont propres, elles doivent pouvoir se combiner. Le module de glyphe qui en résulte doit malgré plusieurs combinaisons permettre l'identification de tous les éléments graphémiques le constituant. Cela revient à réaliser une interpolation entre plusieurs formes, toutes permettant l'identification de chacune des constituantes dans le résultat. L'ensemble de ces contraintes demandent une approche rigoureuse et méthodique afin de construire plus qu'une typographie, un système typographique modulaire.

4.3. Rationalisation et règles

4.3.1. *Grille de construction*

Un système construit à partir de modules devant se combiner demande à ce que ces derniers aient des largeurs et des hauteurs rationalisées. Pour veiller à cela, a été créé une grille de composition (Figure 13). Celle-ci a des proportions relativement fidèles à notre visage, en accord avec l'approche morphologique et intuitive de notre proposition. Pour définir la taille du plan de travail des glyphes, il faut prendre en compte l'ensemble des modules constitutifs d'une *mouth action* et ceux qui ont la plus grande taille (Figure 14). L'impossibilité de la mâchoire à s'ouvrir vers le bas a permis de définir une ligne médiane entre les deux lèvres qui marque la différence de comportement entre les éléments au-dessus et en dessous de ce repère. Cette ligne peut être considérée comme une portée guidant la lecture et l'écriture des *mouth actions*. La largeur et la hauteur du plan de travail est divisé, par incrément, de manière concen-

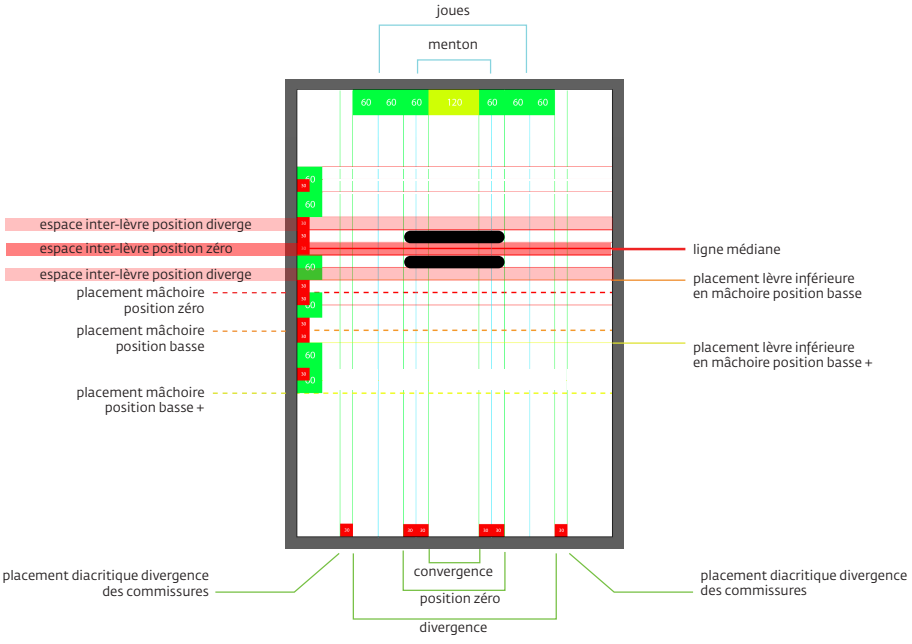


FIG. 13. Grille de composition commentée avec le placement de lèvres neutres

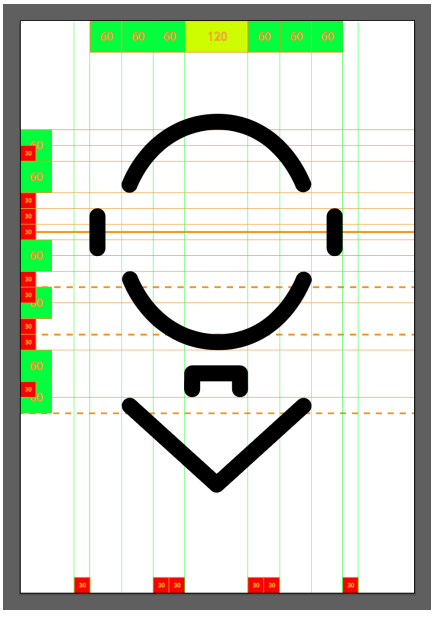


FIG. 14. Grille de composition avec le placement des deux modules les plus grands [lèvres diverge horizontales et verticales +2]

trique à partir du centre des deux lèvres, selon les différentes ouvertures (divergence horizontale et verticale) que peuvent prendre la bouche. À ceci s'ajoutent quelques repères de placements pour les modules des autres parties de Mouth Action.

4.3.2. *Répertoire de modules morphologiques et symboliques*

Un système typographique morphologique a été notre intuition première et donc notre postulat de départ. Suite à la première série de formes filaires montrées plus haut (Figure 12) et lors du développement sur ce modèle des autres modules pour compléter le système, il est apparu nécessaire de symboliser certaines informations plutôt que de les figurer. Ceci pour éviter une surcharge visuelle des glyphes et s'écarter d'une représentation illustrative. S'est alors opéré un jeu d'allers-retours d'essais de combinaisons de modules morphologiques et symboliques pour définir quelle information était pertinente de représenter à l'aide d'un code et laquelle à l'aide de sa forme visuelle. Ceci nous a permis d'arriver à placer le curseur au bon endroit pour une lecture simple et immédiate. Ainsi notre répertoire de modules se compose de deux catégories de modules : morphologique et symbolique. Les modules morphologiques sont formellement variants, ceux symboliques invariants. Les modules morphologiques des différentes variables de bouche ont une forme de base neutre et ont des déclinaisons formelles (Table 5). Il n'a pas été simple de définir les différents modules nécessaires à la représentation de toutes les formes que peut prendre la bouche. C'est à l'aide de nombreux tests de représentation de *mouth actions* (issues de notre corpus photographique) que nous avons pu le réaliser. Tous les modules sont dessinés de manière filaire, de même épaisseur, à bouts ronds.

4.3.3. *Environnement tridimensionnel*

Le système typographique Mouth Action a été conçu, à l'image de la formule graphématique, dans un environnement tridimensionnel. Ainsi, on se sert de la largeur (axe X), de la hauteur (axe Y) et de la profondeur (axe Z) pour faire varier les modules neutres de chaque « valeur ». Là aussi, grâce à ce principe graphique, nous respectons un espace, des proportions, un « mouvement » morphologique réalistes pour une lecture intuitive des glyphes créés (Figure 15).

Une difficulté s'est imposée, la représentation de la profondeur des valeurs « back » et « fore » à certain module. En effet il est complexe, au moyen d'un trait ou d'un ensemble de traits, uniquement en 2D, en noir seul, de montrer une 3e dimension. Pour cela, deux solutions ont été trouvées. Dans le cas où la forme de la partie, comme la bouche, lorsqu'elle est en avant ou en arrière, change fortement et a un potentiel

Tab. 5. Répertoire des modules de lèvres lorsque la mâchoire est neutre

Vertical \ Horizontal		Converge	Neutral	Diverge
Neutral	Converge			
	Neutre			
	Diverge			
Fore	Neutre			
	Diverge			
Back	Neutre			

iconique, alors nous représentons cette forme (Figure 16a). À l'inverse, quand la forme de la partie, comme la mâchoire, lorsqu'elle est en avant ou en arrière, se modifie subtilement et n'a donc pas de potentiel iconique, alors a été créé un signe symbolique (Figure 16b). Celui-ci est utilisé tel un diacritique en accompagnement du module principal.

4.3.4. *Règles de composition*

Nous avons montré que l'ensemble des composantes du système, les modules (forme, taille, comportement) et leur espace de composition ont été définis en amont (section 4). Pour entrer sereinement dans la phase de production de la fonte, il est nécessaire de rédiger les règles de composition des modules au sein d'un document centralisé, à l'image d'un manuel. C'est un document de travail, entre les différents membres de l'équipe, permettant une bonne compréhension et pérennisation des informations. Il est également à destination de nos collaborateurs, notamment à l'ingénieur typographique qui réalise la composition des modules. Ce document garantit ainsi de rester fidèle aux intentions de départ grâce à une bonne transmission des informations. Celui-ci contient :

- le rappel de la formule graphématique ;
- les impossibilités morphologiques ;

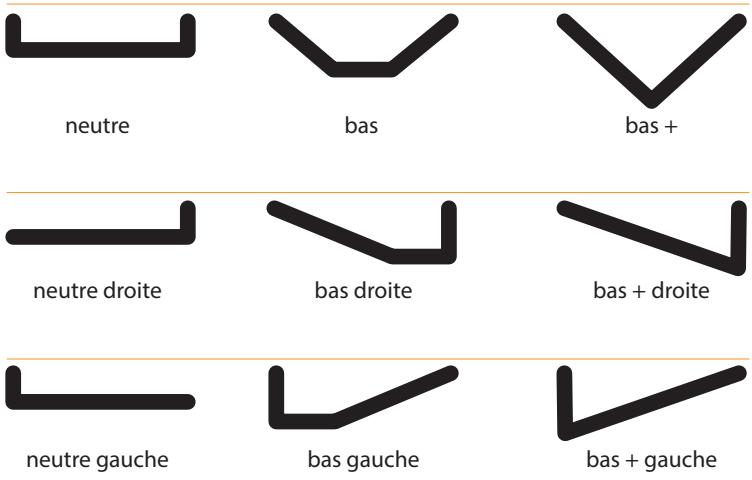


Fig. 15. Les différents modules de mâchoire

- la correspondance entre les informations à représenter et les modules appropriés ;
- le placement et les espaces à respecter entre chaque module ;
- les informations non représentées car non saillantes ;
- les cas particuliers.

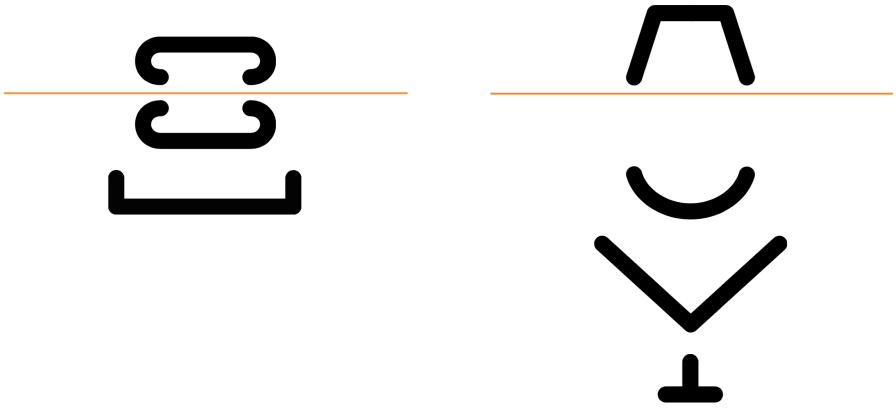
5. Design & ingénierie typographique : perspectives

5.1. Ingénierie typographique

5.1.1. *Composition de glyphes automatisée*

Le nombre de combinaisons de *mouth actions* et donc de glyphes possibles, même en y soustrayant les impossibilités morphologiques, se compte en centaines de milliers. Par conséquent, composer ces glyphes un à un, manuellement, n'était pas envisageable. Profitant de la possibilité de créer aisément des outils d'automatisation, nous avons collaborer avec Mathieu Réguer (ingénieur informatique) afin de développer une extension appelée « Control Center » pour le logiciel de création de caractères Robofont®[6]. Cette extension, développée à l'origine pour Ty-

6. Robofont® est un éditeur de fontes. Il fourni un environnement simple à utiliser pour créer des caractères. Contrairement aux autres éditeurs de fontes, il est extensible, c'est-à-dire que si une fonctionnalité n'existe pas dans le logiciel, elle peut



(a) Une *mouth action* comprenant les modules de lèvres « avant » [Fore]

(b) Une *mouth action* comprenant le symbole « avant » [Fore] associé à la mâchoire

FIG. 16. Solutions glyphiques : forme iconique (a) et ajout d'un signe symbolique (b)

pannot Handshape (DANET, BOUTET et al., 2020), est aujourd'hui utilisée pour Mouth Action.

Ce processus de création de glyphes est composé de plusieurs étapes clés. Tout d'abord, sont rédigées les règles de composition des glyphes. Ainsi sont listés les modules et leurs rôles, leurs positionnements et leurs distances les uns par rapport aux autres, du comportement général à l'exception. Ensuite, sur chaque module dessiné, sont ajoutées des « ancres ». Une ancre est identifiée par un nom et représente une position dans l'espace (Figure 17). Elles sont utilisées comme points de référence pour attacher des composants à un glyphe de base. Elles permettent également de créer une interpolation de formes entre deux modules.

Enfin, l'extension susnommée combine les modules et génère les glyphes automatiquement (Figure 18). Au préalable, ont été renseignés dans l'extension : la formule graphématique, les noms des génériques et des modules ainsi que les règles de composition écrites sous forme de scripts en Python. Une fois l'extension implémentée dans Robofont®, il suffit de téléverser les formules des glyphes souhaités dans la barre déroulante. L'extension lit une formule, indique les génériques qui la composent, les modules associés et visualise le résultat. L'affichage permet

être ajoutée par l'utilisateur, ce qui lui permet d'adapter le logiciel à ses besoins réels. Robofont® a été gratieusement mis à disposition du projet Typannot par son développeur, Frederik Berlaen.



(a) Positionnement d'ancres « left » [gauche] et « right » [droite] sur un des modules de base « stretched » [étiré]

(b) Positionnement des modules sur les ancres du module de base « stretched » [étiré] pour former le glyphe streched

FIG. 17. Positionnements d'ancres (a) et de modules (b)

au dessinateur de caractères de contrôler le résultat avant de compiler pour génération des glyphes.

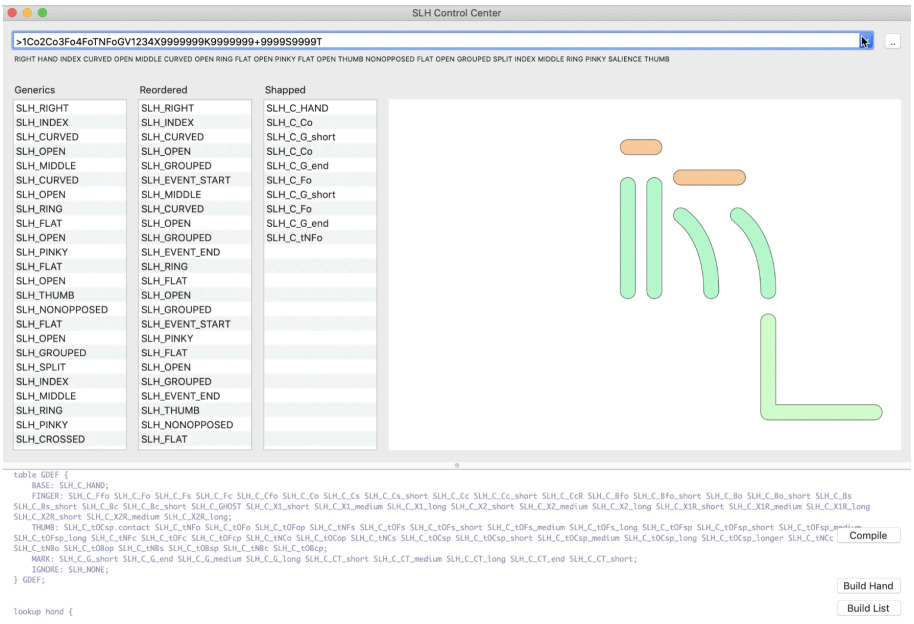


FIG. 18. Capture d'écran de l'extension de création automatique de glyphes « Control center » version Handshape

5.1.2. *Unicode et nomenclature*

Afin de garantir une pérennité et une transférabilité des données typographiques, il est fondamental d'intégrer le standard informatique Unicode®. Il permet des échanges de textes de différentes écritures à un niveau mondial. Il permet d'encoder des caractères de n'importe quel système de notation ou d'écriture en donnant un nom et un identifiant numérique unifié (n° Unicode), quels que soient la plateforme informatique ou le logiciel utilisé.

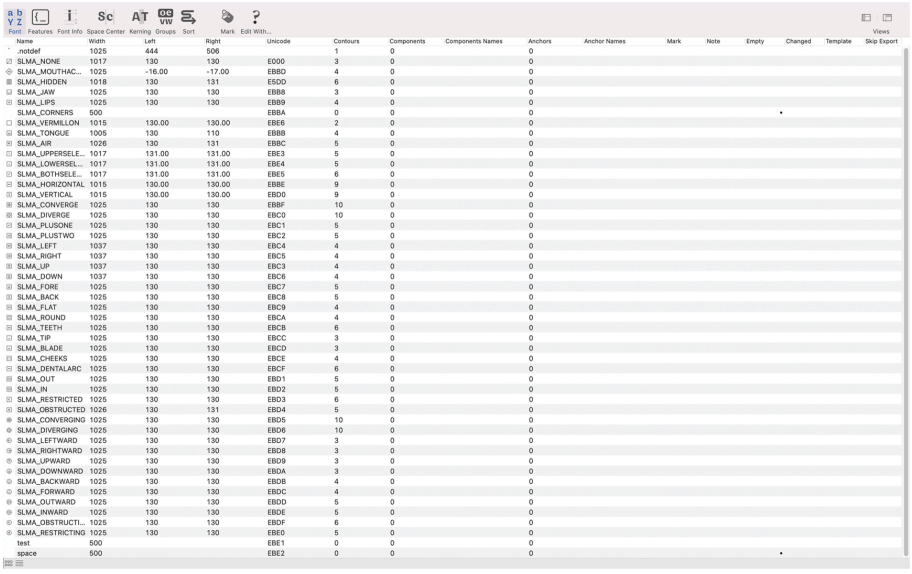
Le processus d'acceptation d'une nouvelle écriture de la part du Consortium Unicode® ne peut pas débuter avant la stabilisation complète d'un système graphique, ce qui n'est pas encore le cas pour Typannot. Pour cette raison, et afin de pouvoir utiliser nos caractères dans tous logiciels et plateformes, nous les encodons, pour l'instant, dans une des plages de numéros Unicode laissés libres (Private Use Area) pour qui a besoin d'un jeu spécial de caractères à des fins personnelles. Cela nous permet, dès à présent, de construire la structure de notre système de notation de manière compatible avec les attentes du Consortium, facilitant ainsi une future intégration de Typannot à Unicode® (Figure 19). Pour cela, sont mis en place :

- une fonte au format OpenType (.otf) par paramètre (6 au total) regroupées en une famille de caractères ;
- un rangement pertinent des caractères les uns après les autres (définition du charset [jeu de caractères]) ;
- un nom pour chaque caractère (nomenclature).

5.2. Clavier virtuel

Le système Typannot ne peut pas se suffire à lui-même. Malgré un système typographique qui s'appuie sur une formule graphématique efficiente, un fonctionnement organisé pour une compréhension et prise en main aisées, des glyphes typographiques conçu pour une lisibilité sans effort (et ce même à petite taille), la fonte Typannot Mouth Action n'en reste pas moins un système entièrement conçu sur mesure et un tel système ne peut s'appuyer sur les outils et les interfaces de saisies existantes. En effet, une interface de saisie ne peut être fonctionnelle qu'en étant adaptée d'un côté au système utilisé et de l'autre à son contexte d'utilisation.

Pour répondre à ces besoins, une interface de saisie spécifique est en cours de développement pour le système Typannot. Son fonctionnement et son ergonomie ont été développés au regard de la structure du système Typannot et des scénarios de sa future utilisation. À terme, le clavier Typannot disposera d'une interface par fonte (doigts, visage,



Name	Width	Left	Right	Unicode	Contours	Components	Components Names	Anchors	Anchor Names	Mark	Note	Empty	Changed	Template	Skip Export
.notdef	1025	444	506		1	0		0							
SLMA_NONE	1017	130	130	E000	3	0		0							
SLMA_MOUTHAC...	1025	-16.00	-17.00	EBBD	4	0		0							
SLMA_HIDDEN	1018	130	131	E0DD	6	0		0							
SLMA_JAW	1025	130	130	EBB8	3	0		0							
SLMA_LIPS	1025	130	130	EBB9	4	0		0							
SLMA_CORNERS	500			EBBA	0	0		0					•		
SLMA_VERMILLON	1015	130.00	130.00	EBE6	2	0		0							
SLMA_TONGUE	1005	130	110	EBBB	4	0		0							
SLMA_AIR	1026	130	131	EBBC	5	0		0							
SLMA_UPPERSELE...	1017	131.00	131.00	EBE3	5	0		0							
SLMA_LOWERSEL...	1017	131.00	131.00	EBE4	5	0		0							
SLMA_BOTHSELE...	1017	131.00	131.00	EBE5	6	0		0							
SLMA_HORIZONTAL	1015	130.00	130.00	EBBE	9	0		0							
SLMA_VERTICAL	1015	130.00	130.00	EBD0	9	0		0							
SLMA_CONVERGE	1025	130	130	EBBF	10	0		0							
SLMA_DIVERGE	1025	130	130	EBC0	10	0		0							
SLMA_PLUSONE	1025	130	130	EBC1	5	0		0							
SLMA_PLUSTWO	1025	130	130	EBC2	5	0		0							
SLMA_LEFT	1037	130	130	EBC4	4	0		0							
SLMA_RIGHT	1037	130	130	EBC5	4	0		0							
SLMA_UP	1037	130	130	EBC3	4	0		0							
SLMA_DOWN	1037	130	130	EBC6	4	0		0							
SLMA_FORE	1025	130	130	EBC7	5	0		0							
SLMA_BACK	1025	130	130	EBC8	5	0		0							
SLMA_FLAT	1025	130	130	EBC9	4	0		0							
SLMA_ROUND	1025	130	130	EBCA	4	0		0							
SLMA_TEETH	1025	130	130	EBCB	6	0		0							
SLMA_TIP	1025	130	130	EBCC	3	0		0							
SLMA_BLADE	1025	130	130	EBCD	3	0		0							
SLMA_CHEEKS	1025	130	130	EBCE	4	0		0							
SLMA_DENTALARC	1025	130	130	EBCF	6	0		0							
SLMA_OUT	1025	130	130	EBD1	5	0		0							
SLMA_IN	1025	130	130	EBD2	5	0		0							
SLMA_RESTRICTED	1025	130	130	EBD3	6	0		0							
SLMA_OBSTRUCTED	1026	130	131	EBD4	5	0		0							
SLMA_CONVERGING	1025	130	130	EBD5	10	0		0							
SLMA_DIVERGING	1025	130	130	EBD6	10	0		0							
SLMA_LEFTWARD	1025	130	130	EBD7	3	0		0							
SLMA_RIGHTWARD	1025	130	130	EBD8	3	0		0							
SLMA_UPWARD	1025	130	130	EBD9	3	0		0							
SLMA_DOWNWARD	1025	130	130	EBDA	3	0		0							
SLMA_BACKWARD	1025	130	130	EBDB	4	0		0							
SLMA_FORWARD	1025	130	130	EBDC	4	0		0							
SLMA_OUTWARD	1025	130	130	EBDD	5	0		0							
SLMA_INWARD	1025	130	130	EBDE	5	0		0							
SLMA_OBSTRUCTI...	1025	130	130	EBDF	6	0		0							
SLMA_RESTRICTING	1025	130	130	EBE0	5	0		0							
test	500			EBE1	0	0		0							
space	500			EBE2	0	0		0					•		

FIG. 19. Capture d'écran du jeu de caractères de la fonte Mouth Action

membres supérieurs, mouvement), spécifiquement adaptée à la formule graphématique du paramètre en question. Aujourd'hui, Handshape est le paramètre le plus avancé (DANET, BOUTET et al., 2020), pour lequel une interface fonctionnelle complète a été développée et est en cours de finalisation (Figure 20).

L'interface du paramètre Mouth Action aura un grand nombre de points communs avec l'interface Handshape (Figure 21). Cependant, certaines spécificités devront être questionnées pour garantir la meilleure expérience utilisateur. Un élément fondamental du clavier Typannot est de créer un point d'entrée intuitif dans l'utilisation du système typographique. L'idée est que l'utilisateur se familiarise avec le fonctionnement du système typographique ainsi que ses règles d'utilisation par l'acte même de la transcription via l'interface. Pour ce faire, l'affichage du clavier offre une visualisation conjointe de la formule graphématique et du résultat glyphique.

Les boutons et curseurs avec lesquels est amené à interagir l'utilisateur ont un impact direct sur d'un côté le glyphe, et de l'autre, la syntaxe de la formule. Cette double lecture, outre son avantage didactique, offre une extrême clarté dans les mécanismes qui sont à l'œuvre dans la composition des glyphes et permet à tout moment de vérifier les données entrées et les résultats correspondants.

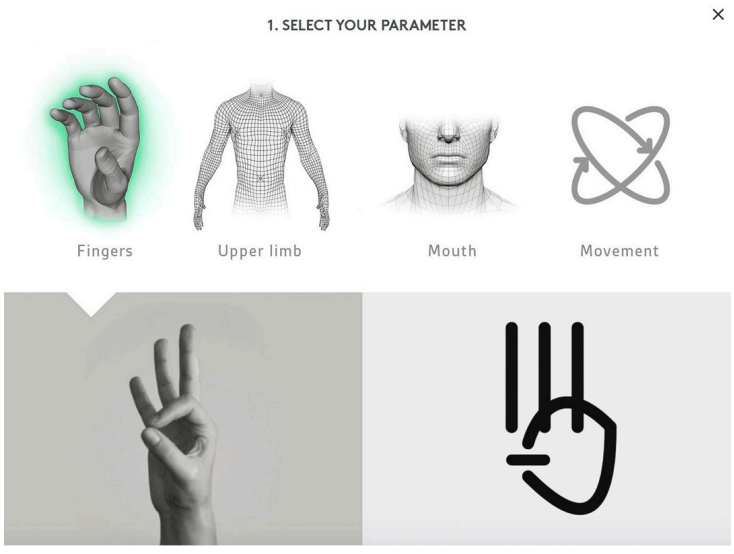


Fig. 20. Interface pour sélectionner la fonte du clavier Typannot

Un point en particulier différencie la formule Mouth Action de la formule Handshape : sa structuration autour de valeurs tridimensionnelles. Son interface, devra donc, pour correspondre au standard du clavier Typannot et à ses objectifs fonctionnels et didactiques, adapter ses fonctionnalités afin d'aligner ses éléments d'interaction avec la formule Mouth Action. En pratique, cela reviendra à créer une interface de saisie qui communique, de par son affichage, la nature tridimensionnelle des valeurs saisies. Grâce à cela, le lien entre les actions entreprises par le transcripteur, l'affichage du glyphe correspondant et la formule graphématique sur lequel il se construit seront entièrement fluides. En terme opérationnel, cela nécessitera a minima une réinterprétation des curseurs utilisés dans l'interface Handshape et une adaptation de l'affichage de l'avatar et des glyphes. Toutes ces modifications devront par la suite être testées et affinées jusqu'à l'aboutissement complet de l'interface.

6. Usages et perspectives pour Typannot

Bien que la fonte Mouth Action ne soit pas compète avec les glyphes composed et l'interface de saisie pour y accéder, une première fonte des génériques du système Facial Action comprenant Mouth Action et Eye Action a été utilisée et testée.

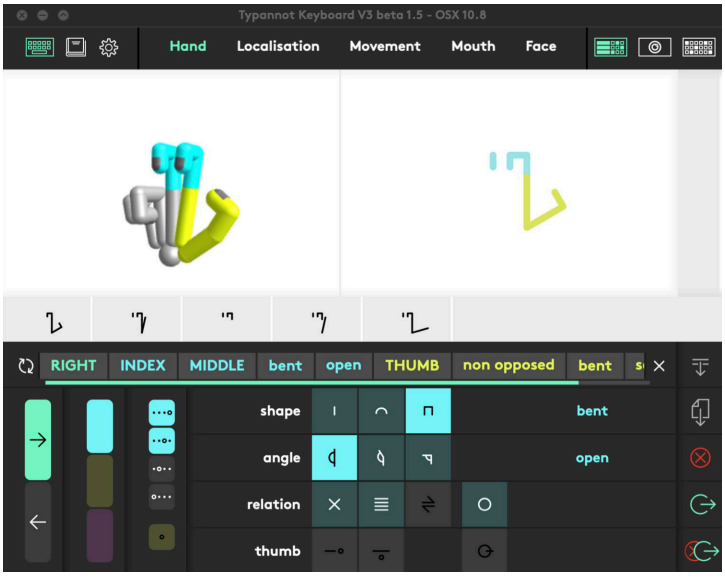


FIG. 21. Interface de saisie Handshape

6.1. Cas d'utilisation

Le système de transcription Mouth Action est actuellement en phase de test au sein de la thèse de THOMAS (en cours). Elle cherche à mettre en évidence des marqueurs non-manuels au sein de différents types d'énoncés interrogatifs en LSF. De plus, elle prépare les prémisses de leur annotation semi-automatique en Typannot. Pour cela, un corpus composé de 6 signeurs sourds, âgés de 18 à 25 ans utilisant la LSF comme langue principale, a été constitué. Celui-ci a été enregistré en utilisant différentes technologies de capture de mouvement (MoCap) que sont le Perception Neuron® (mouvement du buste) et le logiciel OpenFace® (mouvement de la tête et articulateurs de la face) ainsi que du matériel de captation vidéo (4K et HD). Le système de transcription Facial Action a été implémenté dans le logiciel d'analyse du discours multimodal Elan®. La figure 22 présente un extrait du corpus annoté :

Typannot a permis d'annoter l'ensemble des articulateurs de la face (sourcils, paupières, globes oculaires, air, mâchoire, lèvres et langues) du corpus avec une granularité très fine, dans le but d'obtenir des récurrences de patrons non manuels au sein d' énoncés interrogatifs. En parallèle de l'annotation, elle a réalisé un premier essai de mise en relation entre les données issues de la transcription manuelle avec celles tirées de l'utilisation du système OpenFace®. Pour cela, a été constitué une

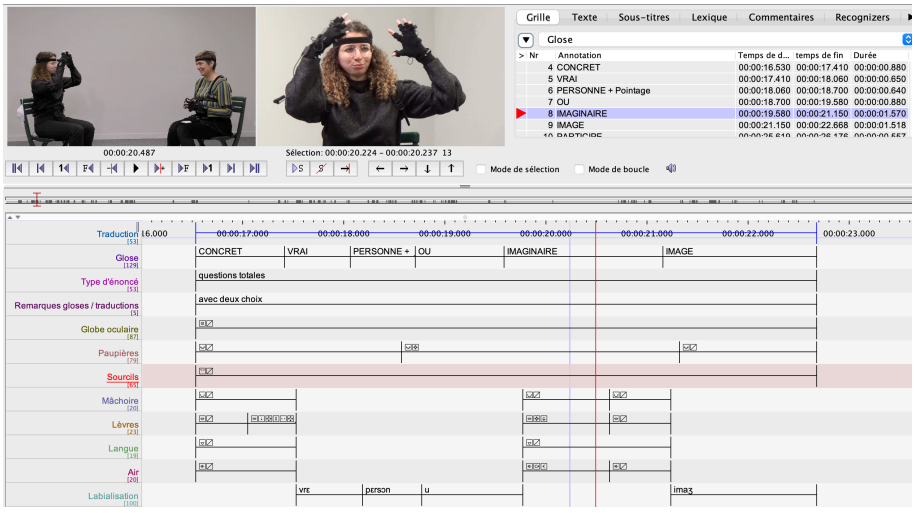


FIG. 22. Extrait d'annotation en Mouth Action (corpus EPNMLSF-Mocap2)

vidéo composée seulement de « levés de sourcils » et sans éléments venant perturber la captation (tels que des mains passant devant le visage) (Figure 23). Il a ainsi été possible de mettre en place un algorithme permettant d'identifier un « levé de sourcil » au sein des données d'OpenFace® et de lier ces données aux annotations manuelles réalisées préalablement. L'un des résultats préliminaires a été de montrer la cohérence entre les données annotées automatiquement et celles réalisées manuellement, même si les premières sont plus précises que les dernières. Désormais, il reste à tester cet algorithme sur un plus grand éventail de données ainsi que sur un corpus en LSF.

6.2. Communauté et évolution

Tout d'abord pensé pour les LS, Typannot est en réalité un système de transcription du corps dans son ensemble. En prenant également en compte les segments des membres inférieurs, le modèle proposé pour étudier les transformations corporelles fonctionne aussi bien pour les LS, la gestualité co-verbale ou pour toute autre forme d'expression corporelle.

Ce système de transcription a besoin d'une communauté d'utilisateurs pour s'adapter à leurs besoins, évoluer et démontrer son potentiel. C'est dans ce désir de partager notre outil sans attendre la fin de notre recherche que nous allons donner accès à une première version

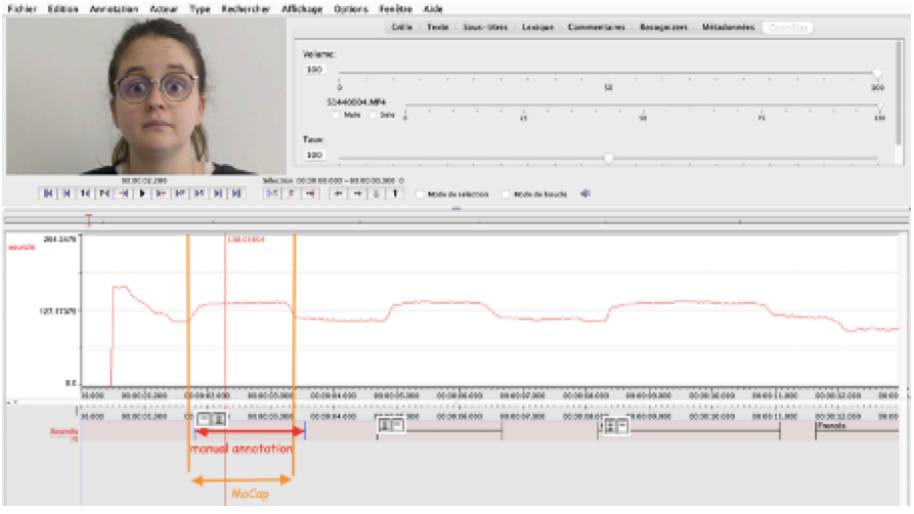


FIG. 23. Comparaison de l'annotation manuel et de la MoCap

de Typannot. Elle comprendra les glyphes génériques permettant de décrire l'ensemble des caractéristiques articulatoires et actionnelles du corps (bouche mais aussi yeux, doigts, membres supérieurs, etc.). Bien qu'étant une version témoignant de l'état d'avancement du projet à un moment T, elle sera compatible avec les versions ultérieures. En effet, les cases Unicode (sous-section 5.1.2) attribuées ne changeront pas d'une version à l'autre. Conscients que la manipulation des génériques est l'usage le plus complexe des deux registres glyphiques et que le clavier Typannot ne sera pas encore disponible, nous mettrons néanmoins à disposition d'autres outils (manuel, tutoriel, etc.) pour accompagner la prise en main du système.

La mise à disposition de cette version permettra d'ouvrir une nouvelle phase de la recherche menée sur et avec Typannot, en linguistique et en design, basée sur la collaboration avec d'autres équipes de recherche.

7. Conclusion

L'importance des *mouth actions* et la nécessité d'un système de transcription spécifique complet permettant d'étudier leur utilisations dans les LS est incontestable. Le système Typannot, de part sa perspective articulatoire basée sur une approche kinésiologique, propose un nouvel outil de transcription. Ses caractéristiques ont été définies et structurées

grâce à l'analyse de l'état de l'art des systèmes de transcription actuels et en cherchant à mettre en place un système fonctionnel, complet ayant la capacité d'intégrer et de retranscrire des informations articulatoires. Un dialogue constant entre considérations linguistiques, les perceptions typographiques et la projection de son utilisation future a été nécessaire à la construction de la fonte. Les premières mises en utilisation ont permis de valider son fonctionnement général. Reste aujourd'hui à en ouvrir l'utilisation à un plus grand panel d'utilisateurs. Un exercice de partage et de transmission qui promet d'être riche en découvertes et qui permettra d'enrichir de retours utilisateurs le travail réalisé jusqu'à présent.

La fonte typographique Mouth Action se veut logique, intelligible, et cohérente avec les autres fontes du système Typannot. Cette cohérence est nécessaire sur le plan formel comme sur le plan conceptuel. En effet, une des perspectives qu'ouvre Typannot est d'aborder les LS comme un phénomène dynamique, c'est-à-dire que la langue relève d'une interaction corporelle et cognitive du signeur dans un environnement linguistique, culturelle, social, etc., qui va contribuer à la faire évoluer. Les locuteurs communiquent, échangent et ce faisant, pratiquent leurs langues, modifient leurs outils de communication dont les langues font partie [...] (Nicolaï, 2016).

On peut alors comprendre que tout geste est à la fois une forme et un processus produisant une dynamique sémiotique au sein du langage. Au travers d'une pratique motivée par la communication et la construction de sens, le locuteur fait continuellement émerger des formes qui ne se limitent pas aux systèmes de signes stabilisés auxquels il a accès. C'est depuis cette perspective dynamique que nous pouvons mieux comprendre les enjeux associés à une représentation des gestes au niveau du corps, c'est-à-dire depuis un milieu de transformations élémentaires pouvant produire divers niveaux de structuration et donc de sens.

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