characters maximizing distinctiveness
to improve recognition & avoid tampering

UGRAPHIA

challenging legibility to tell
computers from humans apart

THE PURSUIT OF PERFECT LEGIBILITY

VLAD ATANASIU

cyborg typeface designed for
both human and machine reading

Fluxus Editions

GRAPHOLINGUISTICS AND ITS APPLICATIONS

MEDIA STUDIES | TYPOGRAPHY

FALSE

true or false? messages written in the metamorphosis typeface change with reading distance, information being encoded in distinct spatial frequency bands

IF NOT FOR LEGIBILITY WE WOULD STILL LIVE IN PREHISTORY *
this essay reflects on legibility as seen through the multifocal lens of cultural, social, aesthetic, technological, psychological, and informational constraints on progress in handwriting and typography

is perfect legibility, *ugraphia*, possible outside of thomas more's *utopia* (□⊞∟Γ⌓ȯ) ? understanding the limits of legibility is of fundamental practical relevance to typeface design and optometry, in addition to being of theoretical interest for research in human communication. drawing on a wide range of material from paleography, typography, psychology, information theory, and cinema, and supplemented with an original experiment in script design, its argument reflected in idiosyncratically writing and layout styles, this cross-cultural history of legibility explores an interlocking complex of factors affecting progress in the long-term evolution of legibility this work reveals the divergence between industrial ideals, scientific theories, and popular representations of legibility, how power games are played and aesthetic fashions develop through scripts. already loaded with heritage, scripts are being concomitantly constrained by character frequency variation between languages, visual perceptual effects, the kinematics of handwriting production, and the evolution of imaging, print and display technologies. there is limited progress found with respect to character structure, and a persistent flow and ebb in the legibility of handwriting ('bioscript') ; however, there is ample optimization of artificially produced writing ('mechascript'), as well as a potential improvement in reading performance due to script proliferation and diversification

vlad atanasiu, phd scd, is researcher in writing history, document processing, and information visualization at the university of verona in üchterland [bɛrn] · he studied arabic calligraphy in istanbul & cognitive science at MIT · now develops interfaces for the visually impairied and feeds the neighbor's cat tuna for lovely illegible scratches

* cover story: if not for legibility, we'd also struggle, at the other end of history, to distinguish between humans & machines · for this purpose, captcha technology — employing distorted texts that interfere with background motifs, such as used on the cover for the neologism 'ugraphia' — has been designed as a metaphysical, rorschach-like puzzle challenging the understanding of ugraphia's true meaning (cover pattern reproducing marbled veins on the bern casino, result of the alps' tectonics) spine : book structure by layout : right bars : pages with symmetrical layout ; middle bars : asymmetrical layout : left bars : near-empty details on p. 2058

ISBN 9782487055001

9 782487 055001

90000

Grapholinguistics and Its Applications 6

Series Editor

Yannis Haralambous, *IMT Atlantique & CNRS Lab-STICC, France*

Series Editorial Committee

Gabriel Altmann †, *formerly Ruhr-Universität Bochum, Germany*
Jacques André, *formerly IRISA, Rennes, France*
Vlad Atanasiu, *University of Bern, Switzerland*
Nicolas Ballier, *Université de Paris, France*
Kristian Berg, *Universität Oldenburg, Germany*
Chuck Bigelow, *Rochester Institute of Technology, USA*
Stephen Chrisomalis, *Wayne State University, USA*
Florian Coulmas, *Universität Duisburg, Germany*
Joseph Dichy, *Université Lumière Lyon 2 & CNRS, Lyon, France*
Christa Dürscheid, *Universität Zürich, Switzerland*
Martin Dürst, *Aoyama Gakuin University, Japan*
Keisuke Honda, *Imperial College and University of Oxford, UK*
Shu-Kai Hsieh, *National Taiwan University, Taiwan*
Terry Joyce, *Tama University, Japan*
George A. Kiraz, *Institute for Advanced Study, Princeton, USA*
Mark Wilhelm Küster, *Publications Office of the European Union, Luxembourg*
Gerry Leonidas, *University of Reading, UK*
Dimitrios Meletis, *Universität Zürich, Switzerland*
Kamal Mansour, *Monotype, USA*
Klimis Mastoridis, *University of Nicosia, Cyprus*
Tom Mullaney, *Stanford University, USA*
Martin Neef, *Technische Universität Braunschweig, Germany*
J.R. Osborn, *Georgetown University, USA*
Cornelia Schindelin, *J. Gutenberg-Universität Mainz, Germany*
Virach Sornlertlamvanich, *Thammasat University, Thailand*
Emmanuël Souchier, *Université de la Sorbonne, Paris*
Jürgen Spitzmüller, *Universität Wien, Austria*
Richard Sproat, *Google, USA*
Susanne Wehde, *MRC Managing Research GmbH, Germany*

Voiceover

Ugraphia

Empty scene.
Two chairs.
Fading din.
Silence.
Enter AUTHOR *and* READER
from facing stage sides.

/

The perfeckt language hath been loſt with the Fall from Paradise, while the vniuerſal tongue forgotten in the crrrumbling of Ye Olde Tower @ Babel. Vnder its ruins lies in like manner the primordial faultleſſneſs of the Adamic ſcript, which certain *Athanaſius* Kircher & other Baroque inquiſitors of letter myſteries ſet out to seek, not far off the iſle of Waqwaq, at forty days' ſailing diſtance from the harbors of Masqat in the country of Oman, or so we are aſſured in vnuoweled manuſcripts by ſpice merchants of Araby. That ſuch a vtopic queſt remains a mirage even in theſe days of artificious intelligence is evidenced by the inſatiable faſcination with ſcript LEGIBILITY among pſychologiſts, computer ſcientiſts, & type deſigners that only the Babel chameleon von Vgraphia may aſſuage.[§]

§ I follow sixteenth-century English orthographic conventions in the paragraph above: U* > V*, j* > i*, u* > v*, *v* > *u*, s* > ſ*, *s* > *ſ*, ss > ß. C Scragg 1974, Cassidy 2016, West 2013 ⚠ Penitent note to co-authors: you are duly mentioned in the References section. ⇾ *Tower of Babel:* In the same way as in Thomas More's (1478–1535) work *Utopia* (1516), the myth of Babel could stand as a metaphor for optimal legibility, given the doomed nature of the enterprise. C Borst 1957–63, Atanasiu 2001, Bruce 1999 ⇾ *Adamic script:* Like the question of which language Adam spoke, people have also inquired about which script he wrote in. Among European scavans, it was thought for a long time that this would be either Hebrew or the Egyptian hieroglyphs. C Eco 1995, 1998 ⇾ *Kircher:* Jesuit polymath (1602–1680), has written, inter multi alia, on language before Babel, and drew most fabulous and veridical reconstructions of the Tower. C Godwin 1979 ⇾ *Waqwaq:* A mythical island in the Islamicate world, also known to readers of Sinbad's adventures in *1001 Nights*, indeterminately located somewhere from Madagascar through Sumatra all the way to Japan, were beautiful women grow on trees like fruits, and birds speak in languages intelligible to humans. Has given rise to a rich iconography. C Tibbetts 2002 ⇾ The term *typeface* denotes a set of abstract shapes in your mind, and *font* a material instantiation of a typeface that you can touch and buy. ⇾ *Chameleon:* A companion to the Babel fish translator from *The Hitchhiker's Guide to the Galaxy*, the Babel chameleon is an instant universal transcriber & inscriber. Placed over a text, the Babel chameleon displays the words on its skin morphed into writing comprehensible by the reader and by squeezing it gently, it will write with its extended tongue exquisitely in any script and language. The Babel chameleon is the ultimate solution to perfect legibility. Purchase it now in Ugraphia! Also available as eyeshades.

Vlad Atanasiu

Ugraphia

The Pursuit of Perfect Legibility

Unabridged but for the last word
Compiled from newly discovered holographs
Translated from Continental English
Under the auspices of Swiss Xocoatl
כשר

Fluxus Editions

Achtung! If not for legibility, we would still live in prehistory, the time conventionally defined as before recordings began. Such epochal import should be reason enough to question why we pursue legibility and where it may lead us. Or, simply, what it is. Or ask, as this essay does, a fundamental question about legibility, one that should precede any attempts to improve it: namely, to what extent is the improvement of legibility possible? And is there any factual evidence of progress in legibility? Consequently, I will test the hypothesis H_0 that current scripts are perfectly legible — in other words, I aim to ascertain whether we presently live in Utopia, or more precisely, communicate in *ugraphia*. The etymological paradox of ugraphia is that it is both a script (*graphia*) and no script (*u-*), a script without shape. Mastering such an elusive form of writing is doubtless a great art, but is it legible? ⇛ To unlock this mystery, I will perform multifarious trials: theoretical, evidential, and experimental. To capture the complexity of the phenomenon under consideration, data is obtained from paleography, typography, history, psychology, information theory, & (even) cinema. As a result of these panoptic vantage points, what may be considered as 'legibility' will diffract in as many definitions thereof, twenty typographical landmarks erected along the text flow, and minor axiomatic stelae here and there. ⇛ A further aim we, your obedient author and his co-opted reader, pursue, for the benefit of the more practically minded, is to provide researchers and designers of documents, human–machine interfaces, & signage with a set of ready-made constraints on script legibility measurement and design. These establish the section topics and are listed in the table of contents. ⇛ Our work will relate the legibility goals of optimality and universality to the wider scopes of document ergonomics, information design, and communication in general, and it will highlight the cornucopia of factors that shape legibility as a psychological, scientific, technological, economic, political, cultural, historical, and aesthetic convolute. The conditions conducive to the pursuit of legibility optimization, and its implications, are also discussed. ⇛ The truism that perfection in human affairs is unattainable serves as a spirited guideline to my veridical contribution herein, the synthesis of disparate and time-and-again forgotten strands of knowledge into an original argument, non-exhaustive in its sampling and self-consciously subjective, hopefully instructive and entertaining, which, presented in an idiosyncratic format blending fabulous science with infopictography, intends to make the impossibility of universally perfect scripts manifest — or perhaps I should say, purely etymologically, that my aim is an apocalypse?[1] ⇛ As an experimental complement, a typeface minimizing redundancy is designed to (not 2) (1) investigate what happens to script design when various theoretical considerations fuse into pragmatic decisions, and to (2) [*too-too*!] test if shape distinctiveness and legibility are correlated. ⇛ You ask (ask!): Pray tell, why should we care about perfect and universal scripts? I respond: Their relevance is the nagging evolutionary question of whether one script (¿Latin?) is any better than another (¡Greek!). Depending on the Q&A's pertinence, the topic's most compelling utility could be a parable — why, a genuine psychoanalysis of human dreams and hubris. Legibility as an extension of oneself. Rumpelstiltskin in every letter.

Lorem·ipsum·Titivillus,·consectetur
adipiscing·elit.·Mauris·consequat
lorem·est,·non·pulvinar·turpis.
Nulla·scelerisque
neque·vitae
&c.

1 From Greek *apokalupsis* 'reveal'. ☞ *OED*: 'apocalypse, *n.*'

RH3T0R1C

Improving legibility is a slippery enterprise, there being many covariant & opposing forces about which too little is known. It resembles a play of shadows between the light of reason & an undecipherable chasm; a perfect subject for baroque painters. In legibility there is Bach's quasi-algorithmic art of crystalline music, Pascal's wondrous computing machine, Georges de La Tour's and Caravaggio's cheating card players, their flesh & psyche illuminated by candles, the epochal sill between the Dark Ages & the Enlightenment — to the revivalist of the French Baroque theater, Eugène Green, 'the Baroque is nothing but an infinite sequence of contradictions'.[1] Painting (surface with perceptual depth), theater (simulacrum mundi), music (allegorical), architecture (spirit made stone), gambling (game theory's inception), glory itself (princely fabrication), the Baroque is also an illusion — how fitting for a book on Ugraphia! Admittedly informed by my own predilections, perhaps inspired by the literary and visual flamboyance of typographical specimen booklets genre (phantasmagorical pangrams & sentences extending unprinted beyond the pages),[2] I sought to capture these paradoxical reflections in wording & graphic style, abundant in convolutions and allusions, onion-like layers of esoteric readings.[3] The rhetorical form of my Wunderkammer is that of an essay, larded with copious notes,[4] for the intellectual satiation of a diverse readership. Thus conditioned, let us now unfurl this electronic papyrus, and begin by framing the subject matter.

Sphinx riddle

—

Script legibility is Ariadne's thread through the invisible labyrinth of the blank page. But who is the Minotaur? © *Allegory of Science* (c. 1670), detail, Albrecht Kauw (1616 – 1681), Kunstmuseum Bern, inv. G 1889

1 Green 2001: 49 ⇝ Johann Sebastian Bach (1685 – 1750), Blaise Pascal (1623 – 1662), Georges de La Tour (1593 – 1652), Michelangelo Merisi da Caravaggio (1571 – 1610).

2 Johnston 2000

3 Don't miss note 'It is debatable...' on page 1969.

4 The initial version was a one-page affair, having sprouted no notes yet, written and laid out on a coffee shop's sunny counter, as a graphic pastiš to the daily 'Feuilleton' of the *Neue Zürcher Zeitung*. And look how weighty it became. Oh Muse!

Improving legibility is a slippery enterprise, there being many covariant & opposing forc-

Notice

What is a car? Is it an assembly of a motor, wheels, seats, a steering wheel, and so on? No! First and foremost, it is a means of transportation, a status symbol, a collector's pride, and much more. Likewise, legibility is more than one aspect of communication and a phenomenon larger than the ophthalmological problem of correctly naming characters – just as consequentially it is a sociographical instrument of power. Accordingly, this book will examine legibility from operational and functional perspectives, as both a mechanism and its usages.

dant in convolutions and allusions, often-like layers of esoteric readings.[3] The rhetorical form of my Wunderkammer is that of an essay, larded with copious notes,[4] for the intellectual satiation of a diverse readership. Thus conditioned, let us now unfurl this electronic papyrus, and begin by framing the subject matter.

1 Green 2001: 49 ◈ Johann Sebastian Bach (1685 – 1750), Blaise Pascal (1623 – 1662), Georges de La Tour (1593 – 1652), Michelangelo Merisi da Caravaggio (1571 – 1610).

2 Johnston 2000

3 Don't miss note 'it is debatable...' on page 1969.

4 The initial version was a one-page affair, having sprouted no notes yet, written and laid out on a coffee shop's sunny counter, as a graphic pacifis to the daily 'Feuilleton' of the Neue Zürcher Zeitung. And look how weighty it became. O tempora !

Sphinx riddle

—

Script legibility is Ariadne's thread through the invisible labyrinth of the blank page. But who is the Minotaur ? © Allegory of Science (c. 1670), detail, Albrecht Kauw (1616 – 1681), Kunstmuseum Bern, inv. C 1889

NB: This notice was typed by the publisher's secretary, Hermetica Frakturburga, following the resignations of the compositor & the graphic designer, exasperated by the outrageous typographical demands of the author. The notice's insertion in the book body was achieved by following the codicological paper-splitting procedure of delamination between the recto and verso in two autonomous sheets, thus obtaining a *legibility beyond the appearance* of the epidermic mask of writing. The LEGIBILITY-AS-LAYERS metaphor may be literally pulled even further by observing that papyri are made by lamination of plant fibers, parchments are skinned, and the codex is a folio stack, and by reminding ourselves of the eminently legibility effect of the palimpsest. These considerations suggest our first definition of legibility.

DEFINITION ΞΞ. Masks — ***There are layers of legibility.***

Above I have used the words 'script', 'legible', 'perfect', and 'universal'.[1] What do I mean by them? ⇛ Script has many aspects. Taking as a guide the linguistic categories of phonetics, prosody, morphology, syntax, semantics and pragmatics,[2] script is construed as the visual form of writing[3] (script system and style[4]), its encoding (writing system,[5] orthography,[6] and orthotypography[7]), content, production (manual or by artifice), & phenomenological experience. While all may impact legibility, my primary focus is the form of the visual stimulus/signal/pattern, terms peculiar to psychology, information theory, and image processing. Basic script descriptors I deem consequential for the present study are structure (inline), shape (outline), texture (pattern), layout (location), and style. Inline (skeleton) and outline (contour) are practical simplifications employed for explanatory purposes;[8] texture is the pattern of a paragraph, and layout the disposition of paragraphs. Other descriptors, beyond the geometric, are significant, ranging from the objective kinematic rhythm to the subjective experience of script and its cultural connotations. To evaluate legibility, the variability of these characteristics has to be assessed for individual scripts and populations thereof, using statistical & data representation techniques.[9] ⇛ The matters of legibility addressed are its definition (here), measurement (next), optimiza-

1 I employ 'single' rather than "double" quotes to reduce inter-word gaps and improve (perhaps) legibility. This British custom may ""startle"" ""some"" ""readers"", causing me to lose what I might otherwise have gained, which is exactly the point I wish to make throughout this work: legibility is a compromise between competing factors, ever dynamic, contextual, and subjective. C Dowding 1995: 30–32, Rafaeli 2005: 74–75

2 For the Egeria of early twentieth-century British typography, Beatrice Warde (1900–1969) of the Monotype company, '*the legibility of a typeface has an exact parallel in the audibility of a human voice.*' Equating linguistic and graphonomic concepts may procure a sense of comprehension, but one of limited utility. For example, while readability is usually described in terms of layout, it is necessary to distinguish between layout-as-texture and layout-as-logical-structure, whose linguistic equivalents are not entirely clear, being, perhaps, 'intonation', 'prosody', or 'rhetorics' (but to what corresponds 'syntax'?). C Warde 1956: 137, Wikipedia: 'Beatrice Warde'

3 *Form* is a *signifier* in Saussurean terms, defined as the abstract class of all particular *shape* instances embodying immaterial *significations*. C Arnheim 1974: 96–97, Saussure 2011: 67

4 *Script systems* helps distinguish between visible forms of communication in terms of grapheme sets, graphical rules, orthographies, and orthotypographies (e.g., English & Vietnamese are both alphabetic writing systems, but distinct script systems). *Style* (e.g., Fraktur) is a linguistically (but not semiotically) non-marked script aspect, similar to some extent to *allographs*. *Style system* is the assemblage of script styles into a coherent system of similarities, distinctions, and usages, within a continuous variability space (weight, width, and slant for the Univers typeface, as per the emblematic visualization of the concept as a cubic feature space), or a discrete space (the trinity of roman, italic, and bold; the serif–sanserif duality; and the paganism of plural typeface and handwriting style classification systems). C Osterer & Stamm 2014: 95 [Univers], Noordzij 2005 [cover]

5 *Writing systems* denotes the encoding format of thoughts & speech into visible form: alphabets, abjads, syllabaries, pictographic, {morpho|logo}{graphic|syllabic|moraic}, etc. C Coulmas 1996: 348, 520–521, Daniels 1996: 8–10, Joyce 2013 & 2013b

6 Parkes 1992 [history of Latin orthography]

7 *Orthotypography* codifies good taste in the use of typographic symbols, such as all caps, small caps, and night caps; moreover, one must never forget to accent one's French capitals (*École* yes, *Ecole* no). For magnificent specimens of orthotypography textbooks, consider the witty, poetical and erudite, the invaluable C Lacroux 2007 & Bringhurst 2004. [What more beautiful homage to their work than for it to be assembled by an impromptu team of friends and fans into a full-fledged dictionary from the scraps, notes, and drafts left over after the passing away of the first author, or for it to be dissertated on by a bus driver during a two-hour drive along the coast of British Columbia in the second case. C Lacroux 2007: 23, See 2008: 62–63]

8 *Prototype* is another possibility for character 'structure'. *Grapheme* (linguistics) or *character* (Unicode) is an abstract class, either of function or form; its realizations into instances are *graphs* (linguistics) or *glyphs* (Unicode); they are studied by *graphemics* (graphemes) and *graphetics* (graphs). C Coulmas 1996: 173–178, Pellat 1988 [lengthy list of grapheme definitions], Daniels 2018: 164–173 [con], Meletis 2022: 119–133 [pro], Unicode 2017: 6, 15–18, Haralambous 2003 [grapheme] & 2018 [graphemics]

9 Atanasiu 2016: 3 [contains a typology of handwriting variability, 'the writer bestiary']

tion (discussed throughout the book), and applications (the mutual shaping of legibility and socioculture affecting the entire argument). ⇛ The classical definition casts legibility as a classification problem, in terms of detection theory and optical character recognition:

DEFINITION 1. Recognition — *Legibility is a measure of the accuracy and speed with which written characters can be recognized under complex conditions.*[1] ⇛ Schematically, the *recognition* process comprises *detection*, that is deciding whether a pattern is script, *segmentation*, i.e., delimiting individual characters, and *identification*, which involves mapping the perceptual patterns to symbolic categories as precursor to their interpretation. Thus, the patterns {**語**, 語, 語} are determined to be script, forming three characters in no further need of segmentation, and map to the Japanese grapheme <語>, which itself maps to the concept of 'language'.[2] To the extent that a pattern is correctly attributed to a distinct symbolic class, its legibility is not conditional on knowledge of the signified entity (the reader does not need to be able to *decode* the meaning of the above Japanese character to recognize it).[3] The *conditions* are in particular *psychophysical* (including fatigue), *environmental* (e.g., angular size and contrast), and *sociocultural* (e.g., subjective preferences, social appropriateness). ⇛ I retain the term *legibility* for discussing the micro-level of characters, and use *readability* for the meso- and macro-levels of words, paragraphs, and layout, and *comprehensibility* for the content's stylistic complexity. In doing so, I follow a terminological proposal for computer screen ergonomy put forward by the International Standards Organization, along with a remark by Geoffrey Dowding in his book on *microtypography*: 'An illegible type, set it how you will, cannot be made readable. But the most legible of types can be made unreadable if it is set to too wide a measure, or in too large or too small a size for a particular purpose.'[4] ⇛ Just as words in dictionaries can

DEFINITION 1. Recognition — *Legibility is a measure of the accuracy and speed with which written characters can be recognized under complex conditions.*

1 ZACHRISSON 1965: 25, DE JONG 2016, HIGUCHI 2023

2 The nature of these categories can be conceptual ('language'), phonetical ([go] stands for 'language' in Japanese), a functional part of speech and writing (e.g., punctuation), or a host of other notations (e.g., numbers, symbols, 'spark lines' diagrams). This is of consequence for legibility insofar as these categories are processed by different brain areas.

3 Sixteenth-century gossip has it that the teenage daughter of the renowned Dutch printer Christopher Plantin (1520–1589) proofread the polyglot Bible for Philip II of Spain (1527–1598), despite knowing nada of ancient languages. During the same period, there were some equally marvelous women of Shiraz in Persia, who reputedly copied manuscripts, '*as if they were drawing*', although illiterate. C LYONS 2011: 81–82, AKIMUSHKIN 1979: 50

4 LUND 1999: 15, 19, 34, LEGGE 2014: 702, GORBACH 2020 [typographic scales] ⇛ This definition of 'legibility' is equivalent to the distinction between 'intelligible' and 'comprehensible' speech. Put differently, 'ligeblity' is what happens to handwriting after the fifth whiskey of the evening, 'readability' is equivalent to have this work typewritten by a monkey, and 'comprehension' when you try to make sense of the email you sent af-

have different meanings, so are their written forms *polycodes* of signification, endowed, beyond denotational *codes*, with a variety of *metacodes*; some are intentionally encoded, some erroneously decoded, other are intrinsic or contextual. They affect legibility, from the capitals in one's name to the rock band's blackletter to the worn-out wood block letter used as a doorstop. More specifically, legibility has both *spatial* and *temporal* dimensions, and concerns the recognition of characters by *shape* (d,o,g),[1] & maintaining recognition performance during *prolonged reading* (dogdog). Readability is influenced by the character shape assemblies that create two-dimensional *patterns* and affect the efficiency of ocular saccades during reading (d–og), and the visually marked functions of different text chunks that instantiate the *logical structure* of documents and various *navigation and processing devices* (Dog). Comprehension of the *linguistic significance* of texts ("dog") is contingent at a graphical level on the information *encoding* brought about by *writing systems* and *orthographies* (dogg). In addition to their denotational values, visual signals carry *connotations* (DOG). These and further elements describe the performance of the information machinery that are the documents, and their manipulation by readers, in respect to clarity & effectiveness, as well as aesthetic value & social relevance. As a consequence of interactions between legibility, readability, connotation, and other aspects, the perspective of this work will expand from one focused on legibility-as-recognition towards the broader issue of *ergonomy in written communication*, with rich human and technological dimensions. ⇛ The terminology contrasts *perfect* ('in a state of complete excellence; free from any imperfection or defect of quality; that cannot be improved upon; flawless, faultless') with *optimal* ('best, most favorable, esp. under a particular set of circumstances').[2] The former is absolute, unique, universal, and eternal; the latter may be circumstantial, multiple, local, and temporary. Typography historian Robin Kinross tackled the history of the idea of a *universal* typeface and the many facets of what exactly was understood by 'universal', viz. the mathematical rationality of design principles, multi-script and multi-language support, script families with multiple visual style variation axes, adaptations to technologies, readerships, and markets.[3] ⇛ The question of optimization of script legibility has likely been asked at any point at which people came in contact with writing technology; thus the gallery of my intellectual ancestors is understandably vast. Tribute will be payed to their effigies as the text progresses.[4]

ter yesterday's fifth whiskey. Similarly, concrete poetry — like Guillaume Apollinaire's (1880–1918) calligram in the shape of the Eiffel Tower, or the subtly jocular 'SERIF' and 'SANSERIF' — is perfectly legible, but its comprehension is completely dependent on its layout and script style. ⊂ Wikipedia: 'Calligrammes'

1 This is my own notation system of legibility aspects. *d,o,g* denotes recognition, here, of the three characters forming the word 'dog'. *d–og* visualizes a hyphenated word, and character spacing in general. *Dog* symbolizes the drop cap text navigation device. *"dog"* stands for the signified aspect of a communication symbol, here *Canis familiaris*, or its *n*-th level of signification, such as when this word is applied to a human. *dogg* is the notation for the impact of encoding on the decoding of written messages. *DOG* denotes the connotation of visual signals, similar to speech intonation, in this case 'shouting'.

2 *OED*: 'optimal, *adj.*', 'perfect, *adj.*, *n.*, and *adv.*'

3 Kinross 2011 [1985]: 233–245

4 On the psychological and sociocultural aspects of reading, legibility's hypertopic, you may wish to consult the following handbooks and monographies ⊂ Snowling 2022 & Pollatsek 2015b [handbooks covering models of word recognition, literacy acquisition, comprehension, multiligualism, disorders, biological and social aspects, education, policies], Reichle 2021 [anthology of computational models], Cornelissen 2010 [neural basis of reading; handbook], McGill-Franzen 2011 [reading disabilities; handbook], Johns 2023 [history of (US) reading science], Manguel 1996 [phenomenologies of reading, a classic], Hassan 2008 [impact of contemporary technologies on reading], Watling 2008 [sociocultural history of reading around the world].

One of the minutely documented scandals in the annals of typography is the apostasy of Jan Tschichold (1902–1974). At the end of the 1930s, after having made fundamental contributions in practice and theory to the rise of modern typography, the titan reverted to classical, pre-1914 typography.[1] This episode is worth recalling, since Tschichold also abandoned the sanserifs in favor of the serifs as the typefaces he most esteemed, in this way being symptomatic of the seesawing affecting the larger history of legibility research.[2] 🡻 'The study of word recognition processes', including legibility, 'is one of the oldest areas of research in the whole of experimental psychology', and 'may have the largest literature in Cognitive Psychology'.[3] It is precisely by focusing on the respective legibility merits of the serif and sanserif typefaces of import to Tschichold that the Norwegian typographer and information design scholar Ole Lund wrote a most edifying doctoral thesis about the epistemology and history of typographical legibility research.[4] Evaluating the 72 subject-matter publications identified for the period 1896–1997, and garnering a broad spectrum of critical voices, a picture of fundamental theoretical differences and doctrinal disagreements crystallizes with the turn of each page. The results of legibility research appear 'inconclusive', with the substantial claims of the prosecution being supported by independent assessors, from the satirical ('legibility research had run into a blind alley') to the stern ('Research in legibility [...] has not yet come up with anything fundamental that typographic designers did not already know — or believe — with their inherited experience of five hundred years of printing history.'). Lund concludes: 'By some arguments, we are no further than we were in 1886.'[5] His remarks echo some already made half a century before ('The trained eye of the skilled printer is more to be depended upon than all the investigations so far conducted.'),[6] and remain valid a full twenty-five years later: 'Although there are massive bodies of analysis considering typography, there is no agreement among researchers regarding legibility factors in print'.[7] Handwriting is in no better position: 'we still do not know enough about handwriting in unimpaired adults to guide therapists'.[8] In a personal retrospective on low vision research, psychologist Gordon Legge writes that 'innovations in reading technology have outstripped our knowledge about low-vision reading'.[9] A similar verdict has been reached regarding the quality of research, and the interference of ideology and vested interests, in the domain of primary education; as a history of teaching handwriting to children in the twentieth century opines: 'Looking at examples from around the world, it is surprising how little effect any of these models have on writing today.'[10] An even more curious state of affairs characterizes paleography, which for its avowed purposes — deciphering scribbles and canvasing the history

1 Through his work & book *The New Typography* (1928), Tschichold translated and codified into the domain of book design the concepts of modernism manifest in the architecture, design, advertising, painting, music, etc. of the early twentieth century, insisting in particular on the use of asymmetrical layout, sanserif typefaces, and high quality microtypography. His post-war work for Penguin Books (1947–1949), produced by printers throughout Great Britain, put him in a unique position to raise the standard of British books on an industrial scale. C McLean 1975: 87, 93, 104; Tschichold 1995, Kinross 1995, Burke 2000, Bosshard 2012

2 Tschichold 1995: 73–74; 1964; 2000: 80

3 Snowling 2005: 3, 39

4 Lund 1999

5 Lund 1999: 74, 76, 224–225

6 Rollins 1942: 28–29 🡻 This remark by a leading American typographer may also reflect the difficulty of translating theoretical knowledge into practical know-how.

7 Tarasov 2015: 1304

8 Van Drempt 2011: 327b

9 Legge 2014: 702 [meditating on Legge 2007]

10 Sassoon 1999: 108, 134–142, 181

of their shapes —, has generally found little utility in examining legibility, a core expectation from many chancellery, copy, and calligraphic hands.[1] The oldest legibility tests of which we are aware were performed by type designers in 1790s France and Germany, on typographers and children.[2] From that time on, legibility has been mentioned repeatedly in typography handbooks; when definitions and prescriptions are given, they appear to be based on the experience and traditions of the craft. The few studies on the history of typographical legibility warn the adventurous scholar that this scholarly field is something of a 'terra incognita' covered by 'moving sands' and 'pits'.[3] ⇛ The grounds for this scathing critique are many and subtend all legibility evaluation methods, such as based on continuous reading (analyzing speed, eye movements, blink rate), threshold visibility (exposure duration, distance to stimuli, other conditions), and search.[4] The validity of the research body appears deficient in respect to experimental design (e.g., unintentionally independent variables, such as the distinct x-height of examined typefaces; very limited number of stimuli, usually only a couple of typefaces, characters, or paragraphs, from which generalizations are tenuous to make) & theoretical foundations (typically absent; uncritical, in the sense of, e.g., credulous adherence to the brain–machine metaphor; and selective, such as by being primarily concerned with the Latin script). The attitude of researchers is also a cause for concern (e.g., ignorance of domain knowledge, scientism, and a sometimes blatant pursuit of mercantile goals shrouded in scientific appearances).[5] The very utility of legibility research has also been questioned (e.g., for its paucity of actionable results and the lack of a fruitful theory of legibility; or for the marginal significance of laboratory experimentation for such a complex activity as reading), and even its feasibility has been put in doubt. The list of legibility factors is indeed staggeringly multifarious and reads as if formulated by Borges himself: 'Blame [bad legibility] on the script, on its individual characters, on too long lines, on too little leading, on bad composition, on bad printing, bad lighting, translucent paper, too white or shiny paper surface, bad air, bad mood, indigestion, headache, lovesickness, arguments with the colleagues, the boss, the revenue office, a boring text, too much text on the page, generalized or specific reading unwillingness, like for filling forms.'[6] ⇛ In focusing on the empty half of the wine glass, my intent is to draw attention to a possible tendency among the general & scholarly public alike to overestimate our knowledge of legibility. To be fair, there is much related research territory that has been explored. ⇛ This overview of important areas of legibility research leads to a first remark on the impossibility of perfectly legible script: if it ever existed, we might fail to recognize it due to a lack of epistemological means. However, as we shall see next, this doesn't preclude the flourishing of legibility ideals, theories, & even mythologies!

1 Bernhard Bischoff's (1906–1991) *Latin Palaeography*, a classic textbook, indexes 'Kufic' (demotic nomenclature of an Arabic script style), but omits 'legibility', which occurs in the text once as 'legibility', once as 'clear legibility', and twice as 'clearly legible', as though further elaboration on why the matter is so 'clear' would be superfluous. ↻ Bischoff 1990 [1979]

2 König 2004: 43–44

3 Bergeron 1997: 553, König 2004: 9

4 Lund 1999: 54–79

5 A former Printer to Yale University, Carl Purington Rollins (1880–1960), noticed the tension that persists even today between typographers and psychologists regarding professional competence in the matter of legibility, contrasting practical experience and theoretical knowledge: '*It would be all right to let the psychologists have their little games if they were not so anxious to impose their tentative results on the printer.*'. ↻ Rollins 1942: 29

6 Willberg 2017: 35, König 2004 [systematization of legibility factors], Bigelow 2019 [typeface design based on legibility research] ⇛ Jorge Luis Borges (1899–1986).

Univers, Perpetua, Optima, and Neutra: the fairies playing onomastics at typeface cradles confer them the citizenship of Ugraphia. The ideal is a trope of typographical wisdom, that typography should resemble a 'crystal goblet': a transparent container of meaning rather than a distraction to reading. The words were those of Monotype's Beatrice Warde, but they characterize more generally the utilitarian credo of modernism.[1] The metaphor is potent and appears unassailable in its logic.[2] It does also define the ideal typeface: neutral, face- & characterless, anything but dazzling, the ideal script is invisible.[3] ⇛ But not everybody agreed with this vision,[4] constituent of the historical swing from nineteenth-century Romanticism & nationalism (Fraktur) to twentieth-century functionalism & internationalism (Helvetica).[5]

Eric Gill (1882–1940), himself a type designer & theoretician contemporary with the promoters of the 'new typography' (Tschichold) and 'invisible typography' (Warde), saw these new typefaces as far from 'transparent', tainted by the 'diabolical' machinations of industrialism and capable of 'deceiving' the reader into dehumanization; instead he advocated for the imperfections of 'humane typography'.[6] For another Briton, the graphic design educator Michèle-Anne Dauppe, 'the cry of "legibility" masks a reactionary attitude against progress, change or critical intervention'.[7] As for the totemized imperative of neutrality, the poet & typographer Robert Bringhurst concedes that sometimes typography just needs 'a bone in its nose' to look convincing.[8] ⇛ This consequential debate of the twentieth-century Western typography, coupled to contemporary social, cultural & scientific developments, including information theory & cybernetics,[9] illustrates the systemic and inextricable tension between objectivity & subjectivity in the history of legibility. Its extreme manifestation is a *legibility complex* pitting compulsion against aversion. With a change of costume, the debate could just as easily be staged in Renaissance Italy, when Humanists embraced the Carolingian & Roman scripts of the past, claiming to do so in the interest of better legibility, when their true aim was socio-cultural reform.[10] That is to say, the worth of prescriptive legibility definitions should be understood in the context of their functions in a specific time & place, and goals of social players.

1 Warde 1956: 11–17, Tschichold 1995: 66

2 The transparency metaphor has a remarkable longevity, occurring as an ideal of rhetoric in antiquity, as a political vision known as *glasnost*, and as the Windowpane Theory of language. Its dominion extends to the transparency of the book designer herself: '*Book design is a domain in which the designer should keep his personality out of the game*'. Literally 'crystalline' is the Chinese writing said to be, given how the repetition of radicals within a character, resembling crystal structures, transparently creates meaning using the graphical equivalent of onomatopoeia: 木 'tree' → 林 'grove' → 森 'forest'. C Eubanks 2011: 142–193 and Kretztenbacher 1995 via Spitzmüller 2019: 43, Carr 1986

3 That is, the ideal typeface has the attributes of Switzerland (in terms of its status as a neutral state). I did however find an example of typeface description that runs counter to arch-Swiss Helvetica's reputation as neutral ('*the blue jeans of typefaces*' according to late Swiss designer Adrian Frutiger [1928–2015]): one 1967 US advertisement proclaims that '*Helvetica has a certain continental flavor*'. Notwithstanding, 'Univers' (Frutiger's renowned typeface) is at least in name a better path to universalism than 'Helvetica'. C Hustwit 2007, 2015 [quote 1], Müller 2009: 57 [quote 2], Osterer & Stamm 2014: 93 [naming the Univers]

4 Spitzmüller 2019: 44 [various dissenters]

5 '**Fraktur = NATIONALISM**' is Tschichold's bold statement in *The New Typography*, as explicit as those of the opposing camp: '*The script question [Fraktur vs. Antiqua] is for us Germans no more a subject of debate, but one of Will and Might.*' Helvetica's marketing slogan is: '[*Helvetica*] *is perfect for international correspondence.*'

C Tschichold 1995: 75; Reinecke 1910: 272; 'Description' field of Linotype's digital Neue Helvetica fonts (2014)

6 Gill 1993: 69–74

7 Dauppe 1991

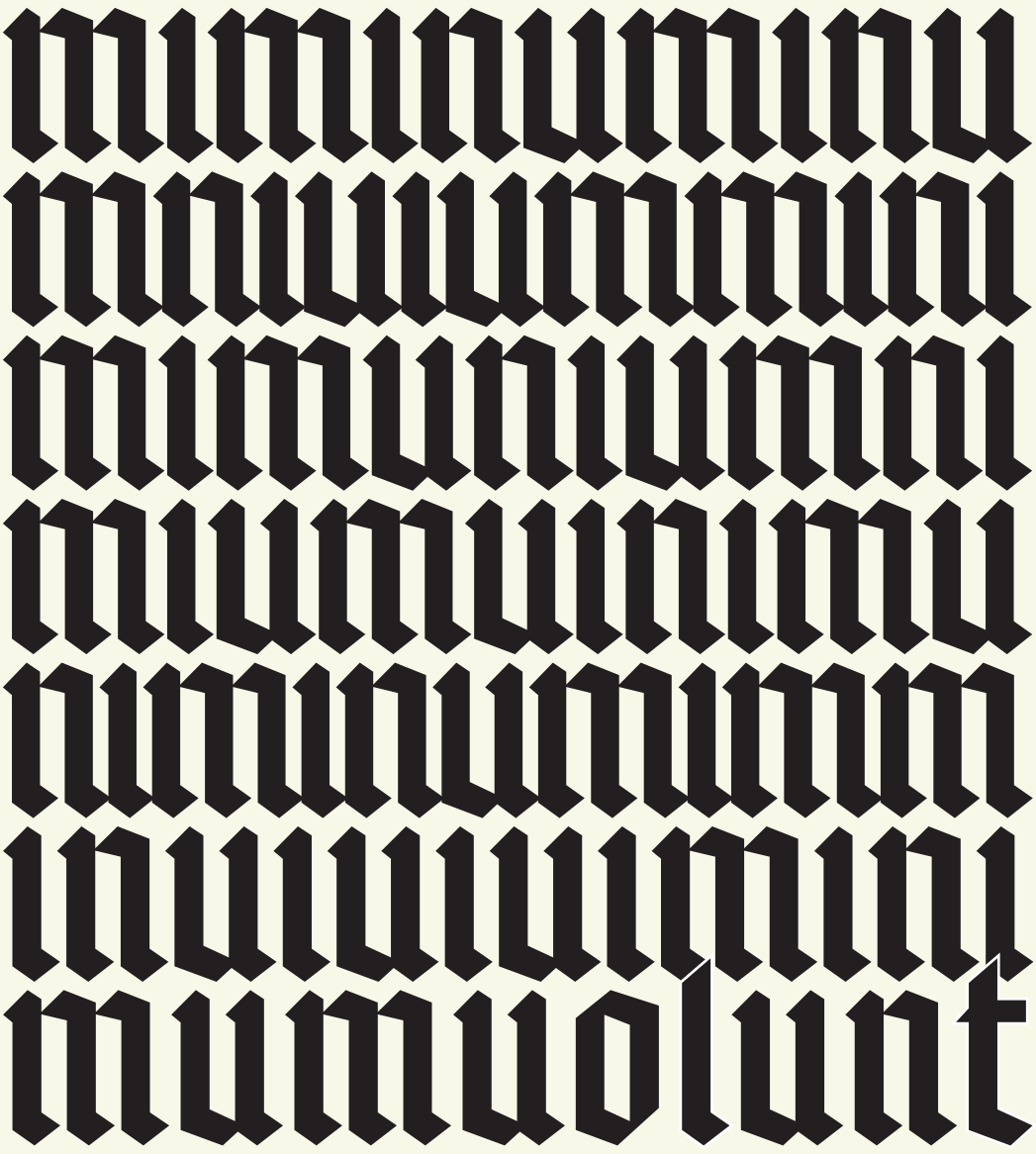
8 Bringhust 2004: 18 ⇛ Note also the parallels with the debate on interpretation transparency in classical music.

9 Spitz 2019 [case study of the Ulm design school]

10 Smeijers 1996: 43–54 [an airy hypographical cavalcade]

Data visualization, a form of graphic communication closely related to reading, is also subject to the debate on transparency. Developed during a Data Visualization Society workshop, the 'ant pen' concept is an anti-design statement challenging the myth of neutral visualization. It surrenders legibility to the unpredictable paths of ants as they emerge from the pen's hollow body, creating what might be called 'formigraphy'. C Brath 2024

Once upon a time . . .



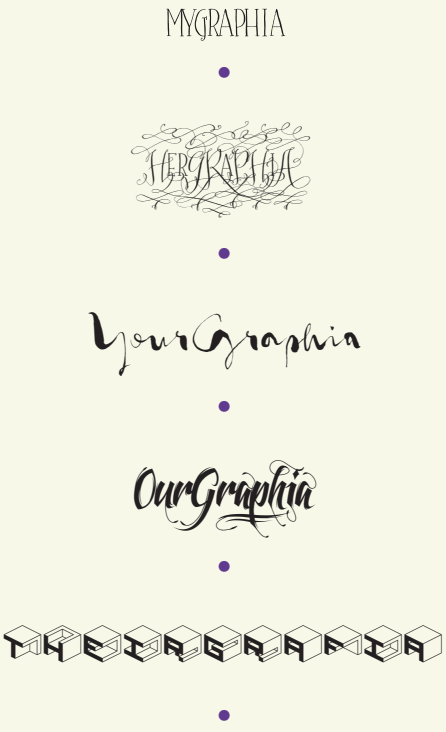
mimi numinum niuium minimi munium nimium uini muniminum imminui uiui minimum uolunt

The snow gods' smallest mimes do not wish in any way in their lives for the great duty of the defenses of wine to be diminished.

—Medieval parody in Latin on the legibility of textura, Fraktur, & other 'broken' scripts

(Meyer 1897, Crystal 2012: 104–111, Harley 2003: 274–275)

What people do (with legibility)



DE LEGIBILITATE NON EST DISPUTANDUM

— Wittgenstein (apocryphal)

The mosaic of scripts on this page is striking, not so much because of their obvious subjectivity, presumably natural legibility to their respective creators, and demonstrative mutual incomprehensibility — rather, the scripts attest to the remarkable value of diversity for a rich and lively experience of reading and writing, calling to overcome legibility research concluding in universal designs, and to incorporate comprehensive considerations of sociocultural, contextual, individual, and other factors while implicitly contributing to teeming, open thinking modes.

What people say (about this book)

I enjoyed immensely reading your spirited, wide-ranging and well informed essay.

— Ole Lund,
author of *Knowledge construction in typography. The case of legibility research and the legibility of sans-serif typefaces*

A really beautiful book that deserves to be fondled and cuddled up with as well as read.

— Aries Arditi,
author of *Adjustable typography: an approach to enhancing low vision text accessibility*

The text is creative and informal, with some eccentricities that may be intentional.

— ChatGPT.4,
known for having electronic daydreams

ADVERTISEMENT

Ideals of typography

The book typographer has the job of erecting a window between the reader inside the room and that landscape that is the author's words.

— Beatrice Warde (Warde 1956: 15)

Personally I believe that no single designer can produce the typeface we need, which must be free from all personal characteristics: it will be the work of a group, among whom I think there must be an engineer.

— Jan Tschichold (Tschichold 1995: 74)

[Times New Roman] has the merit of not looking as if it had been designed by somebody in particular.

— Stanley Morison (Loxley 2004: 134)

The typography of industrialism, when it is not deliberately diabolical and designed to deceive, will be plain. [...] All the while that the technical and mechanical good quality is increasing, the dehumanizing of the workmen is also increasing. [...] On the other hand, those who use humane methods can never achieve mechanical perfection. [...] Humane Typography will often be comparatively rough and even uncouth.

— Eric Gill (Gill 1993: 69–70)

Changing attitudes

To proclaim sanserif as the typeface of our time is not a question of being fashionable, it really does express the same tendencies to be seen in our architecture. It will not be long before not only the 'art' typefaces, as they are sometimes called today, but also the classical typefaces, disappear, as completely as the contorted furniture of the [eighteen-]eighties. [...] But it must be laid down that sanserif is absolutely and always better.

— Jan Tschichold, 1928, during his Protestant period (Tschichold 1995: 73–74)

In light of my present knowledge, it was a juvenile opinion to consider the sanserif as the most suitable or even the most contemporary typeface. A typeface has first to be legible, nay, readable, and a sanserif is certainly not the most legible typeface when set in quantity, let alone readable. [...] The classical typefaces such as Garamond, Janson, Baskerville, and Bell are undoubtedly the most legible.

— Jan Tschichold, 1959, during his Catholic period (Tschichold 1964: 16–17)

Tschichold's hagiographers explain his dogmatism and volteface within the context of a general urge for newness following the First World War, and his realization that both traditional and modern typography have their place. (McLean 1975: 35–40, 69–71)

Please refer to the colophon on pages 2128 ff. for the names of the typefaces used here, and additional rationales for their selection in conjunction with the quotes.

The Final Shape of Our Script, the Renaissance Antiqua

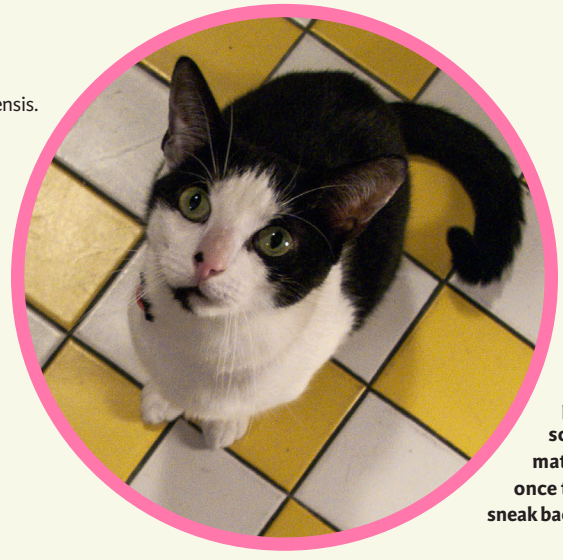
— Tschichold

Garamond's typeface, created around 1530 in Paris, is unsurpassable in clarity, legibility, and beauty. Our type is in fact an absolutely inflexible form, and offers no possibility for any but minute alternations. (Tschichold 1987: 35, 32; 1969: 53)

I don't read German books in Latin Script!

—Bismarck (Reinecke 1910: 78)

Djibou Felix Newyorkensis Parisensis.
Anno 2008. Ætatis Suæ 4.
Au jour le jour

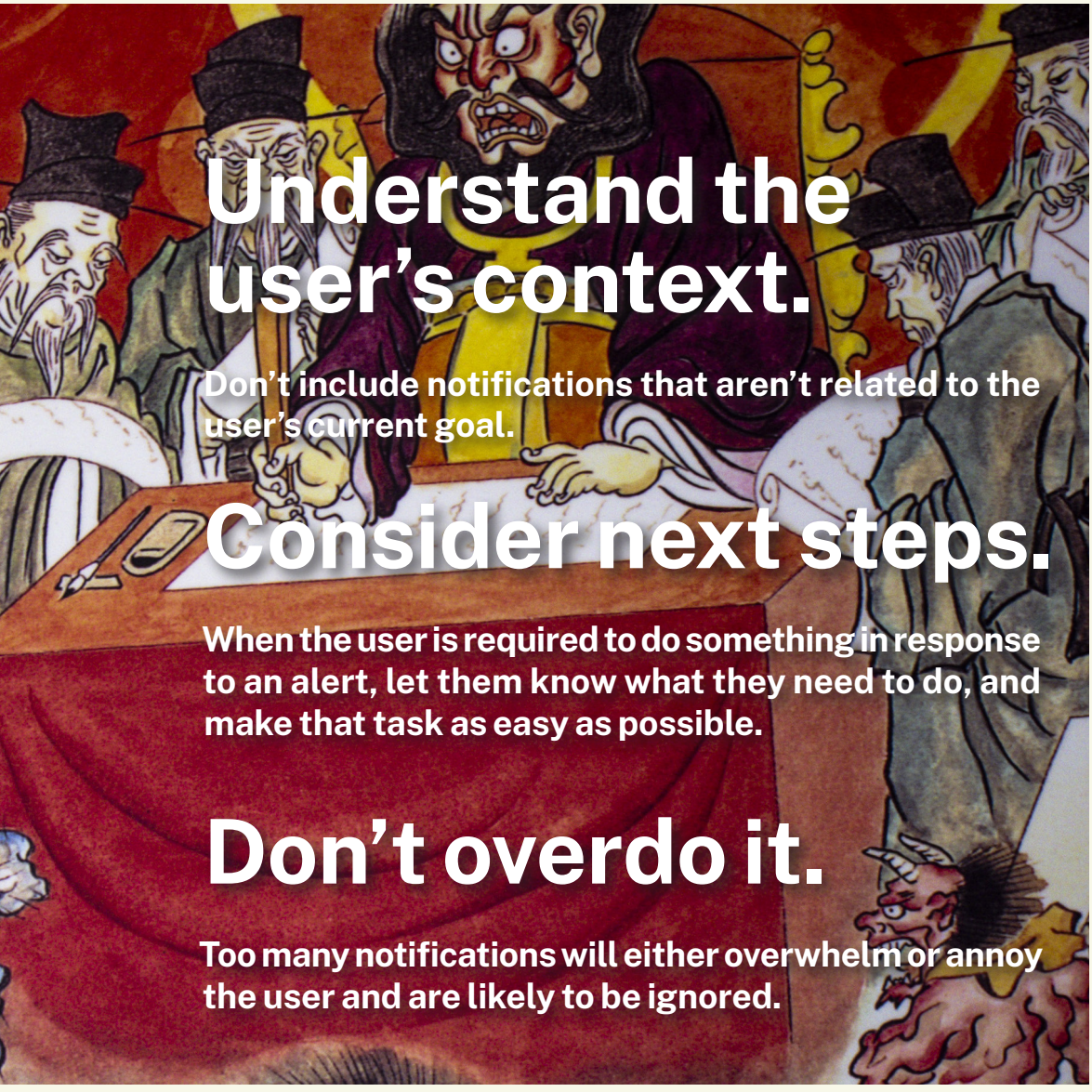


CATZ

Thus is how the Swiss typographer Jost Hochuli described the incorrigible dogmatics of typography, which, once thrown out the front door, sneak back in through the rear. (Hochuli 1991: 24)

Legibility manners & realism

It is possible to elude the dictate of neutral typography without sliding into excesses of graphical narcissism and abstruseness either. As an example, the typeface Public Sans was designed for the US government for its hundreds of websites to provide a ‘*clear and consistent*’ user experience during the average one and a half billion monthly views. Public Sans avoids impersonality & bureaucratic grayness by combining legibility with style (notice the rounded ‘l’ gracefully avoiding confusion with upper case ‘I’), in other words, it has affable manners, a desired hallmark of the public service. This aura is instilled into the type by developing it from the familiar, quintessential American face of Franklin Gothic (1902), exuding informality & modernity in its seriflessness, and being democratically accessible as open-source font. ⇛ Supra, Public Sans is used to set quotes from the federal US Web Design System guidelines, which read as digital avatars of manuals from finishing schools (in France, they would have been set in Civilité, the type extensively used in civility & manners books of the 18th & 19th centuries), with the difference of an avowed realism fitting an organization having adopted the principle of ‘*Strive to be better, not necessarily perfect*’. (‘Realist utopianism’ may be said to be a core tenet of Americanism, a semantic paradox proclaimed in the US Constitution itself, devised ‘*in order to form a more perfect union*’.) © USWDS 2024, Keegan 2024, Jimenez 2009



Vitrolegibility

One could draw a typology of legibility from metaphors of glass. Legibility as *transparent glass* is a dominant ideology, as opposed to legibility as *tinted glass*, of the 'polite public service' philosophy. Writing, the preeminent medium through which bureaucracies see individuals & represent themselves (a pity 'legislate' & 'legibility' aren't cognates), is intimidating & mysterious when the code is not shared, and legibility becomes a *one-way mirror* instrument of power. But the glass can be *shattered* by counter-cultural forces through the use of scripts illegible to the establishment. In any case, script is never neutral (even neutral is a characteristic), 'accent-free', and its usage reflects its user; thus, legibility acts as a *mirror*. Being not perfect, each script is also a *distorting mirror*, raising questions about truthfulness. ⇗ In the above painting of the Buddhist Purgatory, modeled on the imperial Chinese bureaucracy, the King of Heaven reads from the recorded deeds of a newly arrived mortal and rules over his fate in the afterworld. Note the crucial role of legibility, its consubstantiality with bureaucracy:

DEFINITION ☲. Revelation — *Legibility is an X-ray machine.*

© Fresco by Jien Takada, 2009, Daiou temple, Takayama, Japan

Ya Latin characters (...) are like a pleasure garden belonging to aristocrats, where only people
[The Latin characters … are like a pleasure garden belonging to aristocrats, where only people
with stars and ribbons are let in. Our German letters resemble the Prater in Vienna, where
with stars and ribbons are let in. Our German letters resemble the Prater in Vienna, where
Emperor Joseph let it be written: 'For all people!'
Emperor Joseph let it be written: 'For all people!']

Katharina Elisabeth (1731 1808), Goethe's (1749 1832) mother, 1798 (Kapr 1993: 64)

I am a pitiless enemy of the Latin script, mainly for physiological, that is psychoperceptual reasons. I consider it among all scripts known to me [...] as the most unreadable and unsightly. It looks almost as if a reward has been put out to invent a script that would satisfy its function to the least amount, that is to be read and not spelled letter by letter, and the first prize awarded to the Latin script. [...] I consider the German print script to be one of the best physiological solutions to the script question that has been yet found and I consider the Greek script (as shown by our schoolbooks) as much clearer and capable of being read faster than the Latin. [...] I furthermore have the intention, by advertising a physiological contest, to obtain at long last factual verdicts, on the basis of impeccable comparative experiments, on the script question.

– Prof. Dr. rer. nat. Theodor Jänsch (1860 – ?), 1910 (Reinecke 1910: 93–95)

We saw aesthetic models in industrial products and, believing the sanserif to be the simplest face (wrongly, as it turned out), we declared it to be *the* modern face. At the same time we, a group of artists, attempted to use asymmetry to oust symmetrical design. […] Everything symmetrical was unthinkingly assigned to the propaganda methods of political absolutism and declared obsolete. […] *But it seems to me no coincidence that this typography was practiced almost exclusively in Germany and found little acceptance in other countries. Because its intolerant attitude conforms to the German bent for the absolute, and its military will to regulate and its claim to absolute power reflect those fearful components of the German character which set loose Hitler's power and the Second World War.* I saw this only later, in democratic Switzerland. Since then I ceased publicizing the New Typography.

—Jan Tschichold, 1946 (Burke 2000: 73)

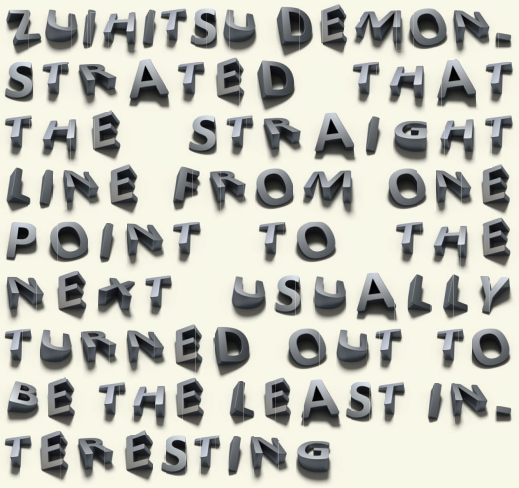
Our Fraktur is dying of natural causes, since due to the consequences of the war it became impossible to renew and complement the stock of printing matrices that are subject to continuous downwearing. [. . .] Unaltered remains the spirit that governs the principles, writing, and design of the 'Neue Zürcher Zeitung'. Tradition needs not be preserved in both appearances and essence. Thus, the shift from Fraktur to Antiqua will in no way be unfaithful to the key messages of our newspaper; it will also not hinder at times **'to talk Fraktur'** in Antiqua, where and when it may be necessary . . .

—Editorial board, Neue Zürcher Zeitung, August 1, 1946 (Maissen 2005: 149)

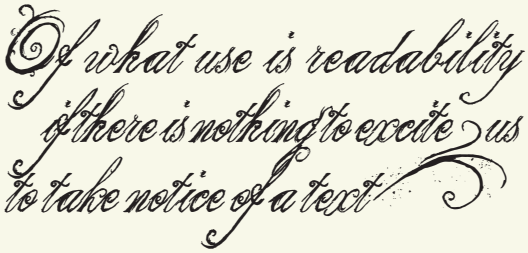
Legibility = Consumerism ≠ Satisfaction

[Adobe Garamond] is the kind of perfection that has been striven after for five centuries. But now that we have reached that point, something seems to have been lost.

— Erik van Blokland (Middendorp 2018: 211)



— Gerald Groemer (Groemer 2019: 36)



— Wolfgang Weingart (Friedl 1986 (1): 41)

Technologies of legibility

Hermann Zapf could not have designed the Optima typeface using only a screen

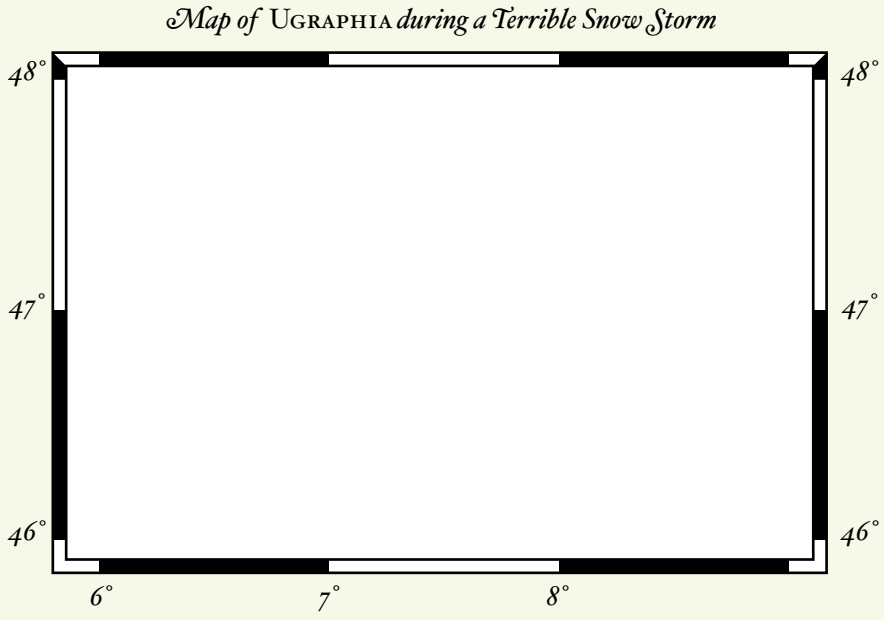
— Peter Karow

Karow, co-founder of the German typeface software company URW, refers here to the geometrical distortions of computer displays of the 1970s and 1980s. He also comments on the autotracing method of typeface outlines digitization: '*The more difficult the degree of construction, the more likely we are to digitize by hand*'. While software is limited in its knowledge of human intentionality, there have been in the intervening half-century such technological and practice developments that many type designers create typefaces directly on screen. These elements reflect the evolving contingency of script production on material factors. (Karow 1994: 92, 96)

*

8×8-pixel Atari is a typeface that forgot to become obsolete – the Helvetica of videogame fonts.

— Toshi Omagari (Omagari 2019: 45)



What is essential is invisible to the eye.

— Antoine de Saint Exupéry, *The Little Prince* (de Saint Exupéry 1995: 139)

Quote set in B612, an 'aeronautical typeface' designed for improved legibility of cockpit instruments on Airbus airplanes, and named after the asteroid of Saint Exupéry's *Little Prince* story — not after the legendary page 51 of *Tristam Shandy*, and neither after a work by Kazimir Malevitch (1879 – 1935). (intactile 2017, 2021, Sterne 1760, Wikipedia: 'Kazimir Malevich')

Cats have 9 lives · Fonts can become immortal

— Akiem Helmling, Bas Jacobs, Sami Kortemäki

There are subtle graphical differences between the first part of the above quote, set in Macho Moustache, and the second part, set in Macho Modular. They embody the principle to which the quote alludes: that '*while all things exist to perish, fonts have the ability not only to live eternally, but even to grow forever*'. Their 'immortality' is due to the additions and transformations to which they are subjected by new generations of designers and technologies, perennially reviving the typographical legacy. This metaphysical perspective defines a three-dimensional typeface space: '*One we are actually working and designing in. One we wanted to enter but could not succeed in entering. And one we are not yet aware of.*' — Read more at fontfiction.com. (Underware 2018, Gonzato 2018)

TRAJIC NOTROMAN ··· RELIES ON OUR *subconsicous* PERCEPTION OF THE ALPHABET ··· ITS LETTERFORMS APPEAR BOTH *alien* AND FAMILIAR ··· ADDING A DISTINCT AURA OF *mystery* ··· CREATING A TRULY *enigmatic* EFFECT, REMAINING READABLE NONETHELESS

— Hrant Papazian (Elnar 2016)

The San Franciscan mystic type designer Hrant Papazian is exploring in his typeface Trajic notRoman (1998) the reduction of the Roman capitals (referenced via Times New Roman & Trajan) to essential strokes. Above is the Janus script that Papazian's intransmutable concept inspired me. The discovery of architypes is a recurrent topic in type design (Frutiger used the technique of translucent letter superposition to compare typefaces, and determine the most familiar shapes as indicative of the best legibility), as well as in visual psychology & computer science (to model the emergence of categories, including for text recognition purposes).

(Frutiger 1980: 64–69 & Osterer & Stamm 2014: 255–256, 259, 408–409 [Frutiger], Biederman 1995 [geons], Hofstadter 1995 [parameterizable fonts])

Window reflection of people over the San Francisco skyline · 2016.02

Legible urbanism

'Our language can be regarded as an ancient city: a maze of little streets and squares, of old and new houses, of houses with extensions from various periods, and all this surrounded by a multitude of new suburbs with straight and regular streets and uniform houses.' — Ludwig Wittgenstein (1889 – 1951) 🡅 'Although clarity and legibility is by no means the only important property of a beautiful city, it is of special importance when considering environments at the urban scale of size, time, and complexity. To understand this, we must consider not just the city as a thing in itself, but the city perceived by its inhabitants. [...] What we seek is not a final but an open-ended order, capable of continuous development.' — Kevin Lynch (1918 – 1984) 🡅 The lifework of contemporary British artist Paul Nobel is manifested, by pencil and paper and in sprawling panoramas, in the minute details of the world of Nobson Newtown, a gray, decaying, lifeless settlement, sort of Piranesian SimCity après la lettre, whose building blocks are Lego-like edifices shaped as letters and constitute the Nobson font, illustrated on the facing page by the word Ugraphia, with a touch of optimism conveyed by the signature Bauhaus color scheme. 🡅 Nobson Newtown is also a literal incarnation of the metaphor of language as an organically growing city, archaeological strata upon strata, as expressed by Wittgenstein, himself a punctilious architect and tormented philosopher of language. 🡅 The correspondence of script and architecture has a long history, epitomized by the profusion of alphabets in architectonic form (a Victorian antiquarian highlight with echoes during the Art Deco era) and, less common but no less impressive, letter-shaped edifices (e.g., Fortunato Depero's [1892 – 1960] futuristic pavilion of the books for the 1927 International Exhibition of Decorative Arts in Monza). The concept of 'legibility' itself has been applied to urbanism in the sense of the ease, or difficulty, with which people orient themselves in cities, identifying landmarks and organizing them in a coherent mental map. Based on studies conducted at the Massachusetts Institute of Technology in the 1950s on the cities of Boston, Jersey City, and Los Angeles, urban theorist Kevin Lynch developed practical methods to assess urban legibility, using anthropological and visualization approaches, to account for factors such as navigation, shared identities, security, emotions, mystification, and the observer's active role, thereby demonstrating the similarity of issues faced in both urban and scriptural legibility, including Euclidean vs. fractal geometries, Rome's Cartesian and Baghdad's circular layout vs. the random maze of casbahs and favelas, and elegant serifs vs. funeral Gothic scrypt vs. rational sanserif. Moreover, the appropriation of the legibility concept by Nobel, Wittgenstein, and Lynch for the purpose of thinking metaphorically in artistic, linguistic, and urbanism domains reveals the fundamental function of legibility and decipherment in human life, predicated upon successful 'hermeneutics' of the natural and sociocultural ecosystem. 🡅 The bibliographical domain (in the disciplinary sense) is traversed like a marble's vein by preoccupation with legibility: understanding the scriptures for Luther (Martin, 1483 – 1546), rediscovering the classical past for Manutius (Aldus, 1449/52 – 1515), deciphering hieroglyphs for Kircher and Champollion (Jean-François , 1790 – 1832), and interpreting bookish physiognomies for Arcimboldo (Giuseppe, 1526 – 1593) and ink blots for Rorschach (Hermann, 1884 – 1922). After all, fear of being bitten by a book is not far-fetched, as we speak of letters having eyes and books featuring heads, spines, and tails, especially when they are made of parchment. C Noble 1998 [booklet], 2018 [videolet], Wittgenstein 2009: §19 [quote], Lynch 1960: 2 – 6; Depero 1927: 97 [biblioarchitecture], Tavares 2024 [architects' books' architecture] , Wikipedia: 'The Librarian (Arcimboldo)'

Parisian sky · 2011.04.23 15:44

AFTER ALL WHAT DO WE SEE EXACTLY AND IS IT WHAT WE SEE PERHAPS ALSO THE RESULT OF WHAT WE WOULD LIKE TO SEE

— Frank Blokland (Blokland 2022: 14)

The word 'Imagine' calls to mind John Lennon's (1940 – 1980) song, and 'Think!', IBM's slogan. Both urge us, in quite a Buddhist manner, to look beyond the veil of appearances and deceptive legibility, beyond our own propensity for autosuggestion. (Balcetis 2006)

no ornament, no emotion,
just clear presentation of information

—advertisement for Neue Helvetica (Linotype 2019)

Information that is difficult to obtain is better memorized. This principle was applied in the development of Sans Forgetica, a typeface deliberately made to be difficultly legible. (RMIT 2018)

Delia Dumitrașcu or Vlad Atanasiu

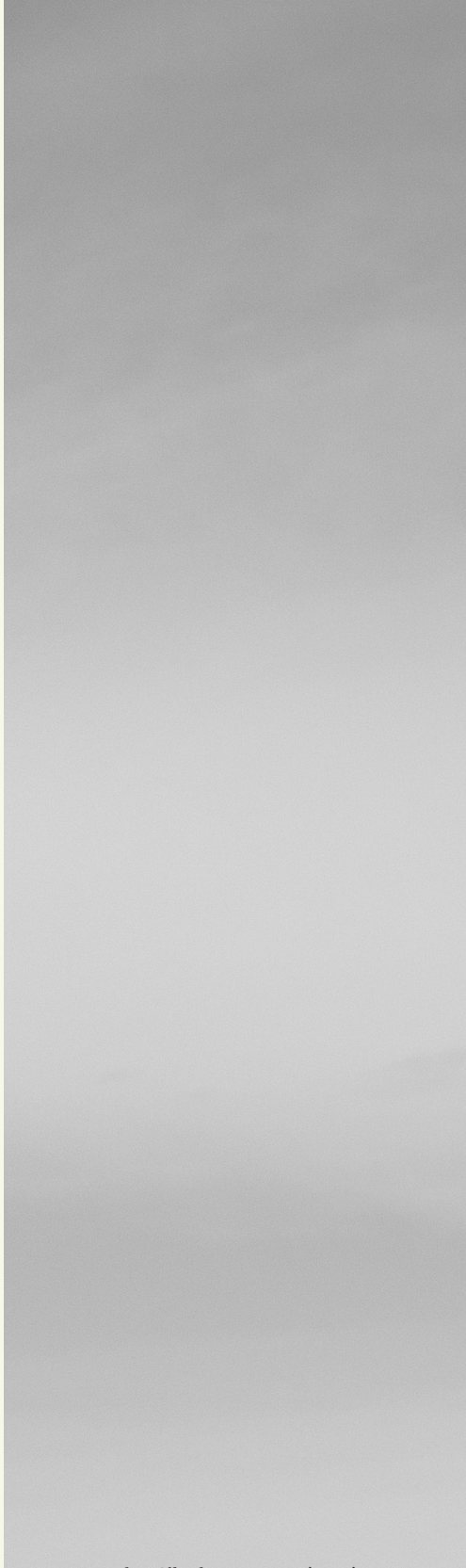
IF HE FEELS CONCERNED, THE MENSCH WILL READ ANYTHING

— Erik Spiekermann (Spikermann 1982: 46)

Please use anaglyph glasses to appreciate this quote in 3D.

—

See? You didn't put on anaglyph glasses, while still managing to read the text above, as its author surmised. The 'concern' theory of legibility has been articulated by many (including type designers, such as Wim Crouwel, who made the following historical observation on the conviviality between scientists and artists: '*It's just whatever you put in front of people. If they're interested in reading it, they read it.* [...] *Sometimes I say if you redid that legibility research from the fifties now, you would have completely different results. And nobody is interested in readability and legibility research anymore. You never, at any of these conferences* [*such as the Alliance Graphique Internationale*]*, see these people anymore.*') While this point may hold true for book typefaces, it may not be valid in all circumstances. When you drive a car, you don't have time to 'get interested' in reading signage, as milliseconds count; idem in aviation, medical, and other 'critical' contexts, be they as simple as a tired bank teller reading endless numbers on a screen. (Hustwit 2017, 2015)



Hercules, Gibraltar macaque (2010)

Social considerations

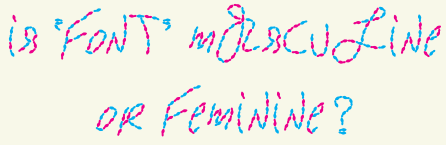
A versatile Latin typeface, such as Times New Roman, knows no national frontiers, *but its over-all appearance will never be quite the same in any two languages. It will* be conditioned partly by the existence of certain accented characters and by differences in fre*quency of individual letters, and partly by the national aesthetic approach to character forms.*

— The Monotype Recorder (Monotype 1956: 14)

The first four lines of the quote are set in Times Europa, the surprising successor of Times New Roman (next lines) for the London *Times* newspaper, designed by Walter Tracy in 1972, in time for United Kingdom's joining of the precursor organization of the European Union one year later.

Typefaces have no gender.

— Kris Sowersby (Sowersby 2021)



The aphorisms are in Epicene ['indeterminate gender'] (2020) by Kris Sowersby, & The Goddess Bunny (2023) by the queer artist Nat Pyper, a holographic homage to the eponymous transgender diva (1960 – 2021), a tap-dancer despite her poliomyelitis disability (the font's dots represent left & right feet shapes). The question refers to a discussion among Italian linguists & typographers as to whether one should say *il font* (using the masculine gender) or *la font* (feminine); this is a non-issue in English, which uses the neuter *it*. Thus, whichever quote is correct is also a matter of language. (Pyper 2023, CAST 2017)

Marketing guidance

There is no more appalling spectacle than that presented by an innocent but bewildered customer thumbing the pages of a type specimen book in an endeavor to select a type he thinks he likes, while the equally ignorant printer guides him through its pages with apparent sapience ! If the printer is really wise in his craft, he has a selection of only the best types in his office, and will not yield to the customer's request that he use Bodoni Bloated for display. The wise printer does not have a type specimen book open to public inspection.

— *Purington Rollins* (Rollins 1942: 28)

During the nineteenth century, the clash of worldviews between Industrialization and Romanticism played out, also, through the differing concepts of legibility as practiced in typography and penmanship. It was a time when the bold and upright Bodoni typefaces, like womens' corseted black gowns and men's top hats, ruled the mechanical reproduction of language, while the handwritten scripts were bedecked with Spencerian lace. Nevertheless, both shared the underlying principle of contrast between thin and broad letter strokes, as the graphical marker of a social and technological attitude diagnosed as 'double-mindedness' by Kierkegaard (1813 – 1855) and portrayed in such popular novels as Stevenson's (1850 – 1894) *Strange Case of Dr Jekyll and Mr Hyde* (1886). The august *Manuale Tipografico* (1818), the typeface specimen book published by Bodoni's widow, reflects this dichotomy through a section devoted to 'Chancery, Financial, and English' types, in addition to his trademark 'Latini'. Scripts were not only scrutinized as mirrors of national dispositions (the genre of 'local types' was gaining popularity in both painting and literature during the inception of mass tourism), but were also used by graphologists to judge, for example, marital compatibility, while typographers refined the art of typeface 'matchmaking'.

(Bodoni 1818 (1): 145 – 169, Thornton 1986: 111, Smitshuijzen Abifarès 2012)

The costs of legibility

If you want a detailed account of it, let me tell you that the work is heavy: it makes the eyes misty, bows the back, crushes the ribs and belly, brings pain to the kidneys, and makes the body ache all over.

— Florentius, monk scribe, Spain, 945 C.E., colophon
(Brown 2011: 270, 272)

All of my [type design] work is done with true renewable energy. — It's only been a year and a half since Pangea was first released but thanks to the ongoing donation of a quarter of all designer royalties, over 75,000 trees have been planted and at least 2,600 tonnes of carbon dioxide has been offset.

— Christoph Koeberlin (Koeberlin 2023, Fontwerk 2021)

CSTM *Xprmntl* 02	Instant	①
DTL Fleischmann	Years	②
ADOBE TRAJAN	Infinite	③

Comparative Font Production Duration

While producing highly legible codices in dark and cold monastic scriptoria took a toll on the health of past scribes (Florentius' colophon seems to have resonated with many a scribe, having often been recopied), using networked computers to sire a deluge of more (or less) legible typefaces is not without environmental impact, especially if the design process is streamed online (① *'CSTM Xprmntl 02 was created in real time at the CSTM Fonts Telegram channel, and its subscribers could watch the process online.'*), is lengthy (② four years for the revival of this Baroque typeface), or the scripts are immortal (③ the Roman capitals have been persistent sources of inspiration throughout the centuries).

(1. CSTM 2019; 2. Caflisch 2000: 6; 3. Stock-Allen 2016 & Shaw 2015; also: Havelková 2024 [work-related bone diseases of ancient Egyptian scribes])

Enough is enough!

Out of thousands of typefaces, all we need are a few basic ones, and trash the rest.

— Massimo Viggnelli

With the typical radicality of his time, the graphic designer Max Burchartz (1887–1961) demanded in 1926 that all fonts, except for sanserifs, be molted, & proclaimed *'One typeface for all!'* For the Swiss/German typographer Wolfgang Weingart (1941–2021), 'a few' typefaces meant four. Four like fondue, Rösti, pizzoccheri, polenta, and da capo. Quote set in Times New Roman, Helvetica, Courier, Zapf Chancery, and da capo. Quite an unpalatable diet, would suggest his compatriot Frutiger, who knew how to appreciate a wine card *'featuring sixty different Médocs all of the same year. All of them were wines but each was different from the others. It's the nuances that are important.'*

(Cahalan 2007: 63, Friedl (1): 23, Osterer & Stamm 2014: 33)

It is no secret that there is no ideal type face.

— Purington Rollins (Rollins 1942: 27–28)

Of course legibility is important, but it is not everything.

— Friedrich Forssman
(Forssman 2012: 34)

Now please turn the page.

Pavement slab and trapdoor to the netherworld. Yungang Buddhist grottoes, Cathay ▶

3LU51V3N355

Like the Cheshire cat's smile, the essence of legibility is elusiveness: legibility may be situated within the writing or in the reader, in the environmental context or even outside space, as a temporal phenomenon. Through the experiments of this double page, the overarching theme of elusiveness will serve to introduce our next section on theories of legibility. It will also resurface in subsequent places.

⇛ Consider the above image, which you may fancy to read as the Chinese or Japanese (first indeterminacy!) sign for the digit 'one', but is just a haphazard scratch that attracted my author-of-a-book-on-legibility eye, an instance of pareidolia and proof of legibility's deviousness to produce clearly detectable, segmentable, and identifiable shapes in which we see what is not there. Or is it? Was my calligraphic stimulus perhaps a divine sign that I overlooked in my materialistic folly, oblivious to the enchantment permeating the world? Mephistopheles, add magic to the list of legibility definitions!

⇛ Consider also the time factor in the ebb and flow of legibility: the evanescence of messages due to the fading of ink and their resurrection by scientific artifice. While the level of legibility fluctuates with its materiality, time can be a proxy for knowledge change. What the scholar of 1906 saw in the Greek papyrus as the word 'Hippocrates', became 'Socrates' to another papyrologist a century later. In fact, so common are temporal legibility artifacts that a dedicated publication series, the *Berichtigungsliste*, was created by papyrologists to record Popperian falsifications of erstwhile reading certainties.[1]

The cult science-fiction novel *Snow Crash* (1992) by Neal Stephenson describes how mind control is exerted via messages delivered in Sumerian language as images of random-looking black & white pixel configurations ('white noise' or 'visual snow'). From a similarly Ugraphic perspective, the antidote may be a perfect typographical gray prepared from the statistically Latin-looking 'Lorem ipsum' nonsensical filler text.

Lorem Ipsum Gray™ Elusive Legibility™ recipe

—

Ingredients

- ***lorem ipsum* ad libitum**
- **snow-white paper**
- **pixie blackletters**
- **typesetting paraphernalia**

Concoction

- **compose the text (careful with the kerning!)**
- **stir vigorously the page white with the text black until you obtain a homogeneous gray**
- **serve fresh from the press**

The cherry on top

- **stare at the above blue cat emoji for about three seconds**
- **now fixate a spot of your choice on the left-hand page: you should glimpse Doctor Schrödinger's heretofore invisible yellow Cheshire cat**
- **repeat to discover her siblings all over the page**

[This instance of Lorem Ipsum Gray™ is made from 30% black and 70% white pixels.]

1 Schubert 2011: 212–213

TH30R13$

One way to learn if perfect legibility is attainable, is to envision it through various lenses. Here I will define legibility according to an expanded version of Claude Shannon's (1916 – 2001) information-theoretical ontology and communication schema.[1]

DEFINITION 2. System — *Legibility is modulated by script (signal), writer (emitter), implements (medium), reader (receiver), and environment (noise).*

DEFINITION 3. Variability — *Legibility fluctuates according to changes in the communication system.*

DEFINITION 2. System — *Legibility is modulated by script (signal), writer (emitter), implements (medium), reader (receiver), and environment (noise).* It cannot be sufficiently stressed that legibility is a systems problem. This outlook guides the present study. As a straightforward example, the most legible typeface is useless if you have misplaced your eyeglasses, or if the paper is so thin that the front and backside texts overlap. The distractor may be the script itself, as when a typeface and its layout are so alluring to look at that you forget to read what the author has to say — a 'typographical impertinence' on behalf of the book designer, according to Frederic Goudy (1865 – 1947), auto-declared designer of 113 typefaces plus one 'Goudy 30'.[2]

DEFINITION 3. Variability — *The legibility of a script fluctuates according to changes in the communication system.* This leaves room for objective optimization, if not concurrently across all dimensions of legibility — hence the limited optimality attainable for a short duration, a *dynamic optimality* at most, never *perfection*. Maybe the great variety of hands and typefaces populating the history of writing are precisely such transient quasi-optimal states, in addition to being a manifestation of aesthetic gluttony and commercial acumen.[3]

[1] Variations of this epistemic approach can be found throughout the legibility literature, e.g., in the form of the metaphor SCRIPT-IS-A-PNEUMATIC-TUBE, in reference to the Victorian technology for sending an encapsulated message from point A to point B. Its simplistic use has been criticized as conductive to produce '*neat history*', which ignores '*messy*' and different realities, often serving to exert social power. Another legibility model, yielding similar results to mine, uses the five *w*-s inculcated in journalism: '*To try to make text legible, the designer should consider the following: what is to be read; why it is read; who will read it; when it will be read; and where it will be read.*' ⊂ SPITZMÜLLER 2019: 44 ['tube'], SCOTFORD 1994: 371 ['messy'], CAHALAN 2007: 26 ['*w*-s']

[2] Reputed to have '*such an itch for publicity*', he should knew best what he was speaking of: not with some pinch of irony, Goudy's typefaces themselves have been chided as '*precious*', while '*the curves of the* [*Goudy Old Style*] *letters — individually graceful — set up a circular, whirling sensation that detracts somewhat from legibility*'. ⊂ FRIEDL 1986 (1): 39 [impertinence], UPDIKE 1990 [itch], UPDIKE 1922 (2): 234 – 235 [precious], NYTIMES 1942 [Goudy 30 is named '*after the newspaper symbol meaning the end*']

[3] CAHALAN 2007, EISENSTEIN 1979: 83 – 85

Definition 4. Conditioning — *What is legible depends on what, and the conditions, one is accustomed to.*[1] To convince yourself of this claim, try to read this text holding it upside down.[2] A

Definition 4. Conditioning — *What is legible depends on what, and the conditions, one is accustomed to.*

similar situation was experienced daily by Roman chariot drivers and pedestrians passing under the Arch of Titus in Rome, inscribed with lines of decreasing height to appear equal from below,[3] just like the 'STOP' painted on the nearby tarmac is perfectly legible to contemporary car drivers at a given distance and angle but appears distorted from other perspectives. Inscriptions such as 'EMBULANCE' and 'POLICE' displayed on car hoods are also designed to improve legibility in a specific context, namely that of alerting motorists looking in the rear-view mirror (oh how mathematics makes illegibility vanish).[4] Consider also how the physician's handwriting is typically unintelligible to the patient but usually results in the correct drug being dispensed by the pharmacist.[5] Even something as conventional as text typefaces can be optimized for specific applications due to a variety of technical and perceptual factors; for example, large sizes for the display of titles and small sizes for footnotes differ in many respects, such as the amount of affordable detail, stroke thickness, ascender and descender length, and inter-character spacing.[6] The result is not necessarily typefaces that look the same at all sizes: title faces may be made to be attractive (from afar), footnote faces to simply maintain legibility, and body faces to be a mix of both. Script *pragmatics* (i.e., the influence of intent and context on script semiotics) play a further role in legibility: Fraktur and **sanserif** might be appropriate for lettering a hairdresser's shop window to mimic the 'before' and 'after' states of patrons but wholly inappropriate for car number plates in 1916 Great Britain, as claimed by two legibility researchers of the era.[7] Therefore, two ques-

1 My concept of 'conditioning' is a hypothesis that has been much debated under the names 'habituation' and 'familiarity', recorded as long ago as 1916 in the typographic legibility literature, and ultimately related to the question of nature and nurture. It perpetuates with obstinacy; e.g., in the words of Frutiger: '*I think legibility is solely a matter of habit.*' C Lund 1999: 67–70, 73

2 A classic example in the psychology of visual perception, used for all sorts of fascinating theories. C Pinker 1997: 275–289

3 Corbier 2006: 42–45

4 The cyclopean vision of gastropods is a wonder of nature considering the feat of making sense of topsy-turvy moving images from their two serpenting ocular tentacles, to say nothing of insects integrating signals from kaleidoscopic eyes!

5 Atanasiu 2014: 35

6 Beier 2017

7 I made up the 'hairdresser' part of the sentence, but in Bern, Switzerland, I saw this: '[*Hairdresser*] FOR BEAUTIES **AND MONSTERS**'. Help! Helvetica is a monster! and sweet surryphs morph Bodoni into a Venus! Note how, in 1916, the legibility of sanserifs was considered inferior to that of serifed typefaces, a meta-example for understanding legibility as changing with context (as, nowadays, it is serifed typefaces that are considered inadequate for car numberplates, with sanserif dominating). C Lund 1999: 100; on contemporary connotations of Fraktur, see Buschinger 2013 and Paoli 2006; on Fraktur in general, Kapr 1993 & Schalansky 2008; on script connotation theory, Van Leeuwen 2006; for typeface psychology and its wondrous applications, Hyndman 2016; an early '*graphology of printing types*' is Ovink 1938: 127–177; ÉCAL 2017: x and Koop 2012: 250,

tions to ask when assessing legibility are 'Legible by who?' and 'Under what circumstances?' ⇛ Once the stimuli and conditions change beyond a certain threshold, scripts become difficult or even impossible to read. The textura of Gutenberg's (c. 1400–1468) Bible ~~is quite challenging to modern eyes~~, but when Enea Piccolomini (1405–1464), the future Pope Pius II, saw samples of it in Frankfurt in 1454, he thought they were executed in a 'highly clean and correct script, nowhere faulty', and could be read 'without pain and spectacles'.[1] Thus, legibility is eminently an impermanent, subjective, and contextual phenomenon.[2] Additionally, a spectrum of interacting factors is at play. IF nonetheless the perfect script could somehow be designed, THEN (1) it would make the world a uniform typographical gray (i.e., attain maximal entropy, complete chaos); AND (2) rebellion would sooner or later overthrow its tyranny; OR (3) the discord between art critics, scientists, and theologians would result in its fall; XOR (4) if all else fails, natural evolution would see that it eventually splits into 'visual dialects'.[3]

DEFINITION 5. Convenience, Tolerance, and Novelty — *That which is readily available, even if inconvenient, becomes legible, before novelty is sought.* ⇛ Scientific conference attendees are routinely asked to set their papers in Times New Roman, not solely due to the valiant efforts of Stan-

DEFINITION 5. Convenience, Tolerance, Novelty
— *That which is readily available, even if inconvenient, becomes legible, before novelty is sought.*

264–265 illustrate experiments in document perception by substituting the original typeface with various others; a collection of opinions on type connotations by type designers and critics if found in CAHALAN 2007: 69–86; SPIEKERMANN 2014 dispenses an eminently entertaining collection of typeface and layout connotations. ⇛ To experience firsthand the suggestive power of typefaces, look at the Numbers (2018) typeface by Jonathan Hoefler, inspired by digits typical of various contexts. The Revenue subset (`$0.123456789`) reproduces the style of typography seen on receipts of cash registers so strikingly that one can almost hear the ringing of the opening drawer and the beat of Pink Floyd's 'Money' from *The Dark Side of the Moon* (1973) album. ☇ HOEFLER 2018, WIKIPEDIA: 'Money (Pink Floyd song)'

[1] MEUTHEN 1982: 110, 116

[2] Miles Tinker (1893–1977), central figure of legibility research with over 30,000 study participants, conceded that '[*legibility*] *findings are not necessarily good for all times*'. ☇ LUND 1999: 13, 25

[3] Legibility research has been criticized as a form of scientism for its willful ignorance or contempt of domain knowledge and practitioners (typographers, calligraphers, historians), or for stifling creativity. Anticipating another Pink Floyd song ('The Wall', from the 1979 album of the same name, which opined that *'We don't need no education'*), Cambridge letterer David Kindersley (1915–1995), a pupil of typeface designer Eric Gill, declared in the counterculture spirit of the 1960s that *'We don't want standards, because they prevent evolution. We need, above all, by continuous experiment, to avoid fossilization.'* Against the same *pensée unique* spoke with self-critique and out of bitter experience, a monumental instigator of modern typography, Jan Tschichold, who fled from the Nazis to Switzerland in 1933: '*To my astonishment I detected most shocking parallels between the teachings of [my book of 1928] The New Typography and National Socialism and fascism. Obvious similarities consist in the ruthless restriction of typefaces, a parallel to Goebbels's infamous Gleichschaltung (enforced political conformity) and the more or less militaristic arrangement of lines.*' ☇ LUND 1999: 75, 226–227, 247–248, DE JONG 2008: 21, WRIGHT 2021 [Kindersley & British street signs]

ley Morison (1889 – 1967) and Victor Lardent (1905 – 1968) to produce a legible typeface for the *Times* newspaper in 1932, but because, being a default Apple & Microsoft typeface, it became a universal visual idiom due to the market dominance of these companies.[1] While Times is beautiful upon close inspection, its nauseating ubiquity and abuse through mindless composition makes one yearn for fresh faces.[2] Adobe, seeing a business opportunity for its fonts division, put out the following advertisement: 'Man does not live by Helvetica and Times Roman alone'.[3] As a reminder, in the pre-computer world, it was Caslon that ruled as a model of legibility, with the printers' bon mot advising: 'When in doubt, use Caslon.'[4] ⇛ In-

1 Wikipedia: 'Times New Roman'

2 Parodying the purist bibliophile, Morison described his own Times New Roman as *'bigoted and narrow, mean and puritan'*. The type designer Erik Spiekermann called it the *'Suppenhuhn'* (soup chicken) of the typeface court yard for its unassuming productivity. ⊂ Morison 1973: 107, Spiekermann 1982: 16

3 Adobe 1987

4 From the American printer's lore, we report a Rhapsody to Caslon's Legibility, of 1908, of which an extract is included here: '*Great kings, who in great battles met, / Court ladies, versed in etiquette, / All, all, have scanned the pages set / In Caslon*'. Remember that Caslon is the typeface of the US *Declaration of Independence* (1776). Its glory perdures into the twenty-first century, e.g., perpetuated as main typeface in the pages of *The New Yorker* (but the magazine did not to succumb to a second adage, even for its headings: '*With Helvetica you can't go wrong!*'). Caslon is furthermore among the few script samples to leave the solar system as part of the Voyager Golden Record message to extraterrestrials. ⊂ Singer 1908, Walker 2013, Lawson 1992: 169 – 183, Wikipedia: 'Contents of the Voyager Golden Record'

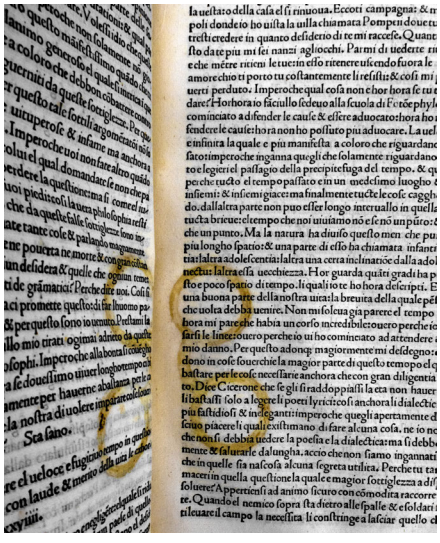
formation theory subsumes convenience, tolerance, & novelty in the form of 'dynamic efficiency': the least effort should be expended to gather necessary information (note the subjectivity of 'necessary'); redundancy, errors, & omissions should be tolerated (communication pragmatism); and, once the utility of information is exhausted, new information is to be sought (optimization to new conditions).

Definition 6. Correction — *Error correction is part of the legibility process.*

Definition 6. Correction — *Error correction is part of the legibility process.* ⇛ Legibility may be conceived as a *property* (of writer performance, script inter-character confusion, reader proficiency, and contextual noise level), as well as a *process*, such as error correction, which is integral to every stage of written communication. Reading, more generally, is a process of testing a hypothesis about the nature of visual stimuli, hence, it is an error correction feedback loop within the human and the machine. Error correction procedures are inherent to data storage and transmission to maintain their legibility, e.g., the restoration of decayed documents through image enhancement or the algorithmic code correction of corrupted digital data. The acquisition and maintenance of writing know-how (from handwriting to keyboards and other text input methods), may also be viewed as an incessant visuo-motor process of correcting legibility errors due to issues such as inattention and stress. ⇛ Eyeglasses are prized and ubiquitous error correction aids and proof of the technological optimization of legibility. Even humble stationery materials have undergone

positive evolution — or at least adaptation to new information media — from steel scrapers to rubber erasers of various hardness levels to chemically complex whiteout correction fluids. In respect to methods, error correction has even spawned a profession, that of the proofreader. As communication technologies complexified, so did the error correction mechanisms, among them the human–machine symbiotic autocorrect functionality of text processors and the mathematically sophisticated code correction algorithms indispensable to the modern digital ecosystem. ⇛ It is certain that error correction mechanisms have diversified & complexified, and they have fundamentally improved the legibility of otherwise degraded or inaccessible information for both humans and machines. To play devil's advocate, while on higher clouds, we don't dwell yet in the gardens of Ugraphia. First, error correction only restores legibility to at most its previous level but not beyond (otherwise, the procedure would have a different ontological status, such as of 'augmented reality' or graphical hermeneutics). Second, information media evolve and errors don't cease to occur, making error correction a perpetual Manichean process of victories and defeats. We will encounter this *dynamic equilibrium* characteristic of legibility at other points in our study.

Optional Definition 6 ½. Hypotheses — *Legibility is integral to formulating hypotheses about the signification of written symbols.* ⇛ Reading & understanding written connotations are categorization processes of assigning signification to written symbols in which the strength of belief in the validity of hypotheses and the speed at which connotations are created & reconsidered are an integrated descriptor named legibility. This is a recasting of Definition 1, with the flavor of Bayesian theory, in the context of the role of legibility in error correction, hence its intermediary serial number and optional status.



Oneiric legibility

—

When naughty books don't want to be read, they make you nap and snitch your spectacles, proclaiming: '*Move on, there is nothing to see here!*' To which you answer by quoting the Bard (1564–1616) on legibility, from *King Lear* [1.2]: '*Let's see. Come, if it be nothing, I shall not need spectacles.*' Alas, too late, this incunabulum kept for posterity the trace of a pair of medieval eyeglasses forgotten for too long. The last words read through them were '*Stay healthy!*' What happened next, is another story, for another night. C Seneca, *Epistolae*, Venice: Benalius, 1494; University Library Bern, Bongarsiana, Bong IV 874, fol. 43v°–44r°; Burgerbibliothek 2012 [on the life and library of the former book owner, the humanist & diplomat Jacques Bongars (1554–1612), who just returned from a voyage to Transylvania when he was called out of his study by [*unreadable*] and then [*page missing*]]

Psst! Are you still stirring? Then either this book is not somniferous enough (others are explicitly designed for such purpose) or the typeface keeps you awake. (Designers hark! Riches await those who devise a sleep-inducing font, and more fame for a sweet-dreams font.) C Adel 2020 [stories to fall asleep, set in slab serif, with sanserif headings]

C0NS3QU3NC3S

If some means were found to define legibility, could we fathom what properties perfect legibility would entail? [1] Certainly, these would extend beyond perfect accuracy and instant recognition under all conditions, wouldn't they? ⇛ The criterion stipulated by French Renaissance Humanist and engraver Geoffroy Tory (c. 1480 – 1533), representing a long tradition of anthropomorphic scripts, was that letters should mirror human proportions, and thus God's own image (OMG, Modulor!).[2] This is, barring heretic thoughts, undeniably the most perfect + legible form of writing, 'truth itself before the eyes', declared Albrecht Dürer (1471 – 1528).[3] ⇛ A perfect script would furthermore allow unbiased thought transfer. In the past, people of repute, with none other than the presumptive father of the scientific method, Francis Bacon (1561 – 1626), among them, claimed that 'ideograms' (variously identified as Egyptian, Chinese, & Mayan) and Hebrew letters possessed such characteristics (purportedly depicting the vocal tract in action, the design principle of anatomorphic scripts, such as Korean [1443] and Alexander Melville Bell's Visible Speech [1867]).[4] ⇛ The modern mind succumbs to other reflections. The philosopher, linguist, logician, mathematician, aeronautics engineer, architect, schoolteacher, gar-

Here, the author took a writing pause.

Which means what is said: a pause away from writing for writing: a nested note to footnote 4 on the dextral column.

4 bis If this book were about the perfection of writing systems rather than that of scripts, the historians would need to answer the riddle of just how two neighboring countries, Korea and Japan, developed writing systems at the opposing ends of the complexity spectrum. The first is widely praised in terms such as the following: '*Most experts agree that it will be a long time before another writing system comes along that will match han'gŭl's simplicity and efficiency and its elegance and intelligence.*'[a] On the latter, it is not unusual to read portrayals similar to these: '*Portuguese missionaries who visited Japan in the sixteenth century came to the conclusion that the Japanese language was the invention of the Devil, having been devised so as to hinder the spread of the Gospel; no doubt in forming this view, the missionaries also had in mind the Japanese writing system with its myriad intricacies.* [...] *even so written Japanese still has the dubious distinction of being the most complicated system of writing in use in the modern world.*',[b] or, to quote a quote: '*Sir George Sansom (1928), who was a British ambassador to Japan and scholar, observed: "One hesitates for an epithet to describe a system of writing which is so complex that it needs the aid of another system to explain it."*'[c] Perhaps the rationality perceived in the Korean writing system simply appeals to the modern mind more than the assumed impracticality of the Japanese script's baroque chiaroscuro logic, and thus critics err due to anachronistic judgment.[d] C [a] Kim-Reynaud 1998: ix, [b] Seeley 2000: ix, [c] Taylor 2014: 292, [d] Lurie 2011: 353 – 357, * Similar critique has been voiced about Chinese: Taylor 2014: 128 – 129

1 Kinross 2011: 233 – 245. For the influence of writing on cognition and society C Olson 1994, 2016; Ong 2002: 77 – 134.

2 The idea that the perfect letter is inscribed in an overlapping circle and a square — in a manner resembling Leonardo da Vinci's (1452 – 1519) *Vitruvian Man* — originated with Italian Renaissance artists, before crossing the Alps into Germany (Dürer) and France (Tory). It was Tory, however, who integrated geometrical figures, letters, and humans into his *Champs Fleury*, printed in Paris in 1529. Much later, Le Corbusier (1887 – 1965) invented Modulor, a method for deriving architectural proportions from those of the human body. C Meiss 1969, Deprouw 2011, Tufte 1997: 113, Wikipedia: 'Modulor'

3 Dürer 1965: 2, Baines 2008: 323 – 334 [on revealed scripts]

4 Van Helmont 2007: 169 – 202, Eco 1995: 82 – 83, 211 – 213, 1998, Kim-Reynaud 1998, Wikipedia: 'Hangul', 'Visible Speech'

dener, aspirant monk, hospital porter, and decorated soldier Ludwig Wittgenstein famously stated that 'The limits of my language mean the limits of my world'.[1] We may interpret this as meaning that language shapes how we think. Similar ideas were advanced by the linguists Edward Sapir (1884–1939) and Benjamin Lee Whorf (1897–1941): e.g., the time perception of North American Hopis appeared through their language as continuous, as opposed to the discretization imparted to speakers of English ('one night', 'two nights').[2] Aymara, a Bolivian–Peruvian language, was identified as a possible pivot language for use in automated translation, given that it operates by default with ternary logic.[3] Further examples of the 'spirit of languages' can be found at will conveying Sapir's contention that 'human beings [...] are very much at the mercy of [their] particular language'.[4] ⇛ What matters here in connection to the perfect script is *what if* we were to map Wittgenstein's and Sapir's statements from the domain of linguistics to that of grammatology,[5] and reason that if language shapes the mind, so must its visual form, writing.[6] We obtain the following paraphrases:

'The outlines of script mean the limits of my mind' and 'Human beings [...] are very much at the mercy of [their] particular script'. No surprise here, since the film *The Matrix* (1999) revealed that reality is nothing more but streams of programming code in Japanese script. What sort of thinking, then, does the perfect script enable? To begin with, there would be no more Helvetica Men, or folks lost in Times, and we would love each font equally. I further suspect that such an omnipotent instrument would allow anyone to think anything, in any way. *Hologic* would reveal the unimaginable from all perspectives at once.[7]

1 Wittgenstein 2018: 86 (proposition 56)

2 Sampson 1980: 81–102, Crystal 1997: 15

3 Eco 1995: 346–347

4 Sampson 1980: 82

5 *Grammatology* [a] is the science of writing, *graphonomics* [b] is the science of handwriting, and *graphology* [c] is psychological analysis via handwriting analysis; these disciplines link to linguistics, paleography, typography, computer science, psychology, education, &c. 'Writing studies' & its branches have various definitions (e.g, extending graphonomics to all writing [d]) & names, including the silent 'γ-etics',[e] the parsimonious 'graphonmy',[f] the alluring 'neography',[g] & the exuberant 'chirogrammatomancy'.[h] This mushrooming nomenclature warrants a sociocultural investigation. *À bon entendeur salut!* [i] ☾ [a] Gelb 1963: v; [a, c] Coulmas 1996: 173, 176–8; [b] IGS; [d] Watt 1994: vii, xii; [e] Haralambous 2018: 103; [b, d, f, g, h] Atanasiu 2014: 93, 120; [i] Meletis 2024

6 This idea seems self-evident to the more than one million subscribers of *The New Yorker* magazine: *'Did I read The New Yorker? This question had a dangerous urgency. It wasn't any one writer or article he was worried about, but the font. The meaning embedded, at a preconscious level, by the look of the magazine; the seal, as he described it, that the typography and layout put on dialectical thought. According to Perkus, to read The New Yorker was to find that you always already agreed, not with The New Yorker but, much more dismayingly, with yourself. I tried hard to understand. Apparently here was the paranoia Susan Eldred had warned me of: The New Yorker's font was controlling, perhaps assailing, Perkus Tooth's mind. To defend himself he frequently retyped their articles and printed them out in simple Courier, an attempt to dissolve the magazine's oppressive context. Once I'd enter[ed] his apartment to find him on his carpet with a pair of scissors, furiously slicing up and rearranging an issue of the magazine, trying to shatter its spell on his brain.'* ☾ Lethem 2009: 12–13, Wiedeman 2009 ⇛ If you open a font file, you will see various technical and copyright information fields, among which will be one called 'Description', typically used for documenting the typeface's history (for some Monotype fonts, described in the same succulently erudite language familiar from auction house catalogs). Digging one late night in my typeface collection, I was startled to discover the unusual presence of a narration in such a field, belonging to the Tfu Tfu [Tfu Tfu] font by Meir Sadan (1998), which discussed the appeal of typeface anatomy — and, presumably, legibility — for domestic animals! *'One day I was hanging around with my lovely kitty-cat, browsing different types of fonts. My kitty surprisingly started to stare at each typeface, examining its typographical correctness and structure, the serifs and the stroke angle. Suddenly, she meowed. It wasn't the regular kind of meow — it was her special* meow. *The meow she uses to greet people she likes... At that moment, it just hit my mind — my kitty happens to like Goudy's typeface. Goudy [sic] is that font on the cover of* The New York Times... *The one that says "* The New York Times *".'*

7 Douglas Hofstadter wrote an article pertaining to the im-

While this writer dreams, that swash-tailed gremlin over there is chewing letters, which raises some questions and suggests some answers about the mythology of illegibility.

Q: Genesis. *How do people explain illegibility?* — A: Gremlins is the short answer, as demonstrated by this illustration depicting the demon Titivillus, held responsible, during the Middle Ages, for introducing a wide gamut of textual errors into the work of monks, secretaries, printers, and non-professionals alike. The animist conceptualization of psycho-physical and instrumental phenomena persists during the Age of Machines, first mechanically, e.g. as the 'gremlins' invented by the acclaimed children's-book artist Roald Dahl (1916 – 1990), in reference to the imaginary beings he heard invoked by Royal Air Force personnel during World War Two to explain the unexplained breakdown of airplane machinery; and second digitally, as the ubiquitous cloak-of-invisibility-wearing mischievous monstrous supernatural armada of 'bugs' fought by computer programmers littering with slashed zerøs the screens set on wizardly dark mode. More generally, who pretends that the etymology of 'pixel' is 'picture element' should beware the ire of the Icelandic pixies, who will poke their screens full of 'burned', i.e. defective pixels. I leave to the readers' imagination the special torments inflicted by Titivillus' devilish cousins, the Arabic djinns, and other Japanese yokais. May writers and readers be preserved from the Evil Eye! [1]

Q: Treatment. *How to fight illegibility?* — A: Invoke Saint George to kill the dragon of illegibility and save the Virgin Lady of Immaculate

possibility of the perfect script. It is inspired by Donald Knuth's METAFONT parametric font programming language, touches on Kurt Gödel's (1906 – 1978) incompleteness theorem, and essentially argues against automating font design — on logical grounds, rather than aesthetic faith. © Hofstadter 1982

1 Wikipedia: 'Titivillus', '*The Gremlins*', 'Bug (engineering)', 'Defective pixel'

Deconstructing legibility

—

Titivillus at work in the former Dominicans' church, later Hugenots' church, Bern; 1495, attributed to the Master of the Cloves. All just fancy imagination? Consider then the all-too-real monstrous creatures you would see when looking at bookworms through a microscope! The most splendid exemplary may be Sigmund Freud himself, who in *The Interpretation of Dreams* (1899) confesses: 'I had become a bookworm'. © Gutscher-Schmid 2007, Freud 1971: 172

Reading. This is the true, ophthalmologic interpretation of paintings of eyeglassless Saint Mary having stopped reading, her finger between book pages marking a moment in the flow of time,[1] while waiting for archangel Gabriel to remove her cataract with a lancet, an exploit he will report at a round editorial table of the eponymous medical journal. Non-invasive exorcisms to improve eyesight are also practiced — didn't a talismanic shirt (possibly one of those inscribed with magic formulas) cure Joseph's father's blindness (Quran 12:93)? and wouldn't you drink milk from that magic-medical copper bowl engraved with Arabic letters to sooth your ophthalmia?[2] As for the mystic Ibn ʿArabī (1165–1240), 'in life people are blind, in death clairvoyant'.[3] Some legibility improvements can make instant readers from illiterates, as of the Prophet Muḥammad (ﷺ), who thrice claimed not know to read as the angel revealed to him the divine message, beginning with the injunction ﴿ Read! *Iqrāʾ!* ﴾, which in turn gave the name to the book known as the Alcoran ('The Recitation').[4]

Q: Ultima Ratio. *What is the apogee of legibility engineering?* — A: That is the font of 'Last Resort' (1998), a typeface drawn by Michael Everson and developed by Apple Computer for the Unicode Corporation, as the last font used by a computer operating system to display a character not available through any other installed font and to be represented by a generic symbol standing for the Unicode range to which it belongs; for example, 

for the Basic Latin range U+0000 – U+007F, and for the indeterminate, i.e. the word 'Undefined' on bendy sable & argent (that is on 'striped black and white background' in the language of heraldry, as the icons of this font resemble heraldic arms, a sort of 'Script's Arms, Tinctures, and Mottos' from the *Book of Unicode*). At a metaphorical level, Last Resort is a script whose function is to give form to the shapeless, the inexistent, the inexpressible, and to that which lacks the means to be expressed. It is a script for an imaginary message. As such, it also provides a definition of Ugraphia, the utopian graphonomical realm of the perfect legibility of the void.

… the void of visual information experienced during reading saccades, when the eyes dart between fixation points along text lines, a temporary blindness akin to a blink, a blink of the text itself during image refreshments of cathode-ray tubes or while switching from webbrowser default fonts to webfonts downloaded with perceptible latency for the display of webpages, a flash of unstyled text avoided by using Ken Lunde's 'Adobe Blank' (2013) special purpose font[5] *that renders as a non-spacing and non-marking glyph, as seen here between quotes for the word Ugraphia:*

, a perfect instantiation of said Ugraphia's essence of flawless reading & 'what you see is what you imagine' (WYSIWYI) character recognition performance …

1 Phaidon 2000

2 On graphical thaumaturgic opthalmology in the Middle East ⓒ Maddison 1997: 76, 82–84, Savage-Smith 2003, Dols 1992: 184, 226, Felek 2017: 650.

3 Pandolfo 2018: 14–18 ⇗ Hildegard von Bingen would object to this maxim, as she paradoxically managed to create an alphabet made up from 'unknown letters' *litterae ignotae* that are nevertheless disclosed graphically in her treatise on mystical language. ⓒ Wikipedia: 'Lingua ignota'

4 Wikipedia: 'Al-Alaq'

5 Lunde 2025 , Wikipedia: 'Flash of unstyled content' ⇗ Lunde muses that although technically a 'typeface designer' by virtue of creating Adobe Blank, he is practically more of a 'font designer', given that his font renders for Unicode valid code points as void (the fall back glyph being a rectangle, a.k.a. 'tofu'). An expert of CJKV font encodings and Unicode standard development, his last job title at Adobe was 'type architect' — one more term to add to the typographical nomenclature, alongside type director and kern master.

Jaywalking legibility

—

The choice of stripes to represent unidentified characters in the Last Resort font is an effective solution. Stripes (together with eyes) are functionally some of the most efficient static achromatic attention-grabbers (they are among the basic stimuli used in psychophysics). They are also asemic, conveying the potentiality of information without revealing the message itself (they say 'Look here!' and 'Watch out!', but not what there is to be seen). As such, stripes in our theoretical model of legibility define the pre-identification stage of script detection. Culturally, their exceptional visibility has often associated them with danger. For the medieval mind they are the devil's cloth, Mephistopheles compelling you to strike out words and render them illegible; 'kill your darlings', as Faulkner would advise (William, 1897–1962). In modern urban jungles jaywalking legibility is no less fraught with mortal dangers, as if writing's linear strokes were trees and building corners behind which circular shapes pry on you like the glowing eyes of primeval beast and the blinding lights of cars zipping by. © Pastoureau 2003 [cultural history of stripes]

Place Maubert, Paris, 2010.05.12

£3G4CY

A typeface designer is bound by the deep structure of characters, changing their *spatial configuration* by fiat too much would sacrifice their visual identity on the holy altar of legibility optimization, producing ungainly 'Stützstrumpfschriften' (German for compression stockings).[1] Please appreciate that, for the same rationale related to the comfort of my indulgent readers, I have refrained from substituting more than a few digits for letters in the section headingz.[2] Apart from cultural innocents[3] only script inventors, revolutionaries, and tyrants have the freedom to make decisions unfettered by the past.[4] In the words of one of their inspiration sources, Karl Marx (1818–1883), 'The tradition of all dead generations weighs like a nightmare on the brains of the living'.[5] Psychologists (if not psychoanalysts) are needed to clear the air of ghosts by determining the patterns with optimal legibility for each character set size and frequency, independently of any preexisting scripts. The trick is that each language has its own optimal set, which will change with the next orthographic reform and with the evolution of the language itself. Eventually, a dynamic equilibrium between legibility decay and revival emerges, sustained by script evolution being effectively more planned than language and thus more amenable to deliberate optimization.[6] The process is complicated by a set of non-graphical layers, the meta-usages of script. To learn more about these layers, flip, scroll, or click to the next page!

1 Script — for documents to read, but not for art to look at — appears to be a particularly poor graphical medium when contrasted with the exuberance of musical notations; dead letters, indeed, not flying words. C Sauer 2009 ⇗ Stützstrumpfschriften was coined by Andreas Uebele (conceiver of the new corporate design of the German parliament) and Jan Filek (author of a book on legibility for graphic designers) to characterize scientifically conceived products that lack aesthetic appeal. C Filek 2013: 9

2 Wikipedia: 'Leet' ⇗ The effects of distorting familiar characters, as though by magic mirrors in Luna Parks, can have surprising results, clashing together the shape and sound bits of interspreading digits and letters: Z3R0 might be *seen* as zero, but *heard* as zed–three–arh–zero, and *thought* of as a sort of *Star Wars* android. Transgraphemic ludography (e.g., K9 = 'canine', UR = 'you are', DV8 = 'deviate', 2B | ¬2B = 'to be or not to be', µtant = 'mutant'), like its bigger brother, the concrete poetry, the calligrams of which operate at layout level, is a phenomenon related to the 'font effect', named after the 'color [or Stroop] effect': blue [◄ word inked red] = {red | blue}? C Dean 2010, Shimamura 1987 [Stroop effect differences between kanji and kana]

3 Cross-cultural script production is conductive to unexpected results: '*The 8×8 monospaced format had enjoyed unnatural longevity because of the dominance of Japanese developers, whose writing system was monospaced by default, and developers gave little consideration to the proportional nature of the Latin alphabet.*' That pixel fonts of the early history of arcade games were created by both graphic artists & programmers (most of whom were Japanese) demonstrates that the role of outsiders in script production should not be underestimated. C Omagari 2019: 264–265

4 Changes in script are ideological weathercocks. As a double example of the power of writing, one might consider the 1971 political assassination of the creator of the Pahawh Hmong script of South-East Asia, an illiterate peasant acting under divine inspiration, as well as, on a grander scale, the extinction of Amerindian scripts following the Spanish conquest. Such events highlight the role of script creation for ethnolinguistic self-esteem manifested by some nations with the celebration of a 'National Alphabet Day'. The 1947 inconclusive competition for the reform of the Arabic script, organized by the Academy of the Arabic Language in Cairo, is insightful for script creation insofar as it documents the social and individual design process of a large set of on-demand scripts. A further case in point on power, identity, script politics, and its ramifications are the tribulations in search of a Somali national script. Latin was linguistically the most appropriate, but was also the script of colonialism and Christian proselytism; Osmanya had the patriotic advantage of being a native script, but was politically problematic, since issued from a specific clan; and Arabic, as the script of the Quran, was religiously prestigious, but technically unsuited to the Somali language. After decades of squabbling between the contenders' supporters, and lost chances to improve through writing social and political harmony, it took the advent of a military dictatorship to adopt Latin in 1972. C Daniels 1996: 619 [Hmong], Baines 2008: 231–310 [Americas], Wikipedia: 'Alphabet Day', Meynet 1971 [Cairo], Laitin 1977 [Somalia], Walter 1960 [dictatorships]

5 Marx 1907: 5

6 The distinction is mainly due to the technological nature of writing as opposed to the biological nature of speech, a contrastive criterion with various implications for legibility, as will be discussed shortly.

0V3RL04D

When Emmeline, the blind bride of King Arthur in Purcell's eponymous semi-opera (1691), gains eyesight through Merlin's magick, and the world is slowly revealed to her like a Polaroid picture, she first marvels at the increased level of detail ('The pretty thing You see within the Glass, is you. / What, Am I two? Is this another me?'). But when the Revelation is finally over, she asks the naive, yet profound question, 'Is this all? Do I see the whole world now?', as if she wants to go further, into the esoteric realities that lie beyond appearances.[1] So is it too with written representation: once pure legibility has been attained, is there perhaps more information to be gained from character shapes?[2] ⇛ Returning to the conservative attitude towards script shape suggested by the legacy argument is particularly interesting because it goes beyond visual considerations, as do so many other things related to writing.[3] It is not unusual to meet singularly strong-minded, if not outright dogmatic characters among theoreticians of typography (e.g., Morris, Morison, Tschichold[4]), while the spirit of technological innovation of the printing trade is coupled with a Confucian reverence for old masters,[5] as illustrated by the sheer number of important typefaces that are revivals (e.g., Monotype

Camelot in Ugraphia

Young Maximilian I (1459–1519), heir to the Holy Roman Empire, is demonstrating his penmanship skills in public. The future patron of the Fraktur script learned to write all by himself and reached a high level of calligraphic skill, explains his romanticized autobiography *The White King*. The stunning and cryptic beauty of Fraktur, at odds with modern concerns with legibility, made it the perfect candidate for use in imperial cultural propaganda, so effective as to last for the script's 500-year lifespan. Note the astonishment on the face of the onlookers, as he is writing from right to left — perhaps in Arabic, to impress an Oriental ambassador, or in mirror. The symbolic use of illegibility as a sign of exceptionalism and power is fit for an initiate in the occult arts of magic and cryptography, as he was. Baroquely arcane scripts are the locks and keys to messages watermarked into texts. C Maximilian 1775: 58–72, Kapr 1993: 24–32, Brann 1998: 106

1 Henry Purcell (1659–1695), *King Arthur* 3: 2; Dryden 1691: 25–29. ⇛ Emmeline's question is an ingenious off-libretto addition by René Jacobs' production at the Theater an der Wien, Vienna, 2019.01.26.

2 Yes, there is: not in the meager columns that follow, but rather in the four hundred and twenty-one pages of J¨urgen Spitzm¨uller's [*sic*] scholarly haiku on the social praxis of typography. Arigatōgozaimashita! C Spitzmüller 2013: 217

3 Fishman 1977: xv

4 Le Corbusier is another imperious visionary and designer of his own books. English writing masters, Ancient and Modern, have been described as '*temperamental as prima donnas, conceited and humourless as operatic tenors*'. C Morison 1973: 107–108, Moran 1973, 1974, Tschichold 1995: xviii–xix, Kinross 2010: 110, de Smet 2007, Sassoon 1999: 107

5 Tschichold 1987: 31–40 [beautiful apologia of tradition]

Bembo and Times, Adobe Trajan, Caslon, and Garamond, or Linotype Sabon Next, 'a revival of a revival' according to the font description) and the pleasure of dressing in antiquarian garbs (swashes, ligatures, & oldstyle figures seems to be what OpenType is all about ;-). ⇛ The following *sociographonomical* arguments aim to counter the fundamentalist concept that 'a printed work that cannot be read becomes a product without purpose'.[1] Rather, having evolved within sociocultural environments, a written message multiplexes overt, implicit, and involuntary signals, and legibility is one function among many, making a holistic approach necessary.[2] Script shape is the visible rhetoric of language — it can be brutally direct or exquisitely convoluted, gothically flamboyant or geometrically modernist, domesticated or savage. As such, style plays with legibility for its own ends. This is one insight obtained the history of *creating and reforming writing systems*, which are 'revolutionary rather than narrowly technical acts. They succeed or fail far less on the basis of the adequacy of their intra-code phonological systems or on the basis of their fidelity to model systems than on the basis of the success of the larger revolutions with which they are associated: revolutions in the production and consumption of economic goods [...] and revolutions in the distribution of power and influence.'[3] ⇛ A prime example: Fine design requires Polish and Czech acute accents to contrast in slant (ć vs. ć), and Romanian to use comma, not cedilla (Ț vs. Ţ).[4] Few are aware of such minimalistic *national distinctions*, so it might be argued that legibility is unaffected, but since readers may stop mid-sentence to reflect upon these improprieties, one cannot deny the legibility problem.[5] A ″ example: allographs (variant 'A' vs. 'a') are on one hand a waste of bandwidth, increasing stimuli complexity to the detriment of legibility. On the other hand, digraphy enriches communication, clarifying *logical*, *grammatical*, *lexicographical*, *semantical*, *emotional*, and even *theological & social categories*: Latin uppercase marks sentence start & proper nouns; Japanese uses sharp-edged *katakana* カタカナ for loanwords, while softer *hiragana* ひらがな was historically a women's script and its exclusive use has become associated with children's books;[6] the preference in some Quranic orthography for the use of the long *kāf* ک, more striking due to its size than ك, for the word كافر *kāfir* 'unbeliever', for which it became known as 'the kāf of impiety';[7] setting positively connotated words ('mercy') in Fraktur & negative ('anger') in Antiqua in Luther's Bible of 1545;[8] SHOUTING

1 Emil Ruder (1914–1970). C Ruder 1977: 6, Weingart 2000: 270, 410 [post-legibility layout of the quote by Ruder's student]

2 It is remarkable — nothing short of supernatural — how the alphabetic order lasted from the earliest Phoenician attestations to modern Latin computer encodings, while character shapes underwent considerable transformations. This remained the case even after characters were no longer used as numerals, which was a strong stability factor. Order changes did occur, but it is unexplainable why so few (notable examples are the reorganization of the futhark runes and the North African Arabic *alif-ba* [أ ب ت ث], visually more memorable than its Middle Eastern ancestor *abjad* [أ ب ج د]). C Coulmas 1999: 14 [alphabetic order], 420–421 [proto-Sinaitic], 459–461 [Semitic writing], 401–403 [Phoenician alphabet], 522–524 [Ugaritic alphabet], 161–162 [futhark]; Atanasiu 1999: 108–111 [Arabic]; Flanders 2020 [history]

3 Fishman 1977: xv

4 Twardoch 2002, Paul 2008, Małecka 2016

5 The dearth of proper digital fonts in Romania in the early 1990s lead to the use of cedilla, even on banknotes & traffic signs.

6 Further connotations: katakana/hiragana ~ official/private, peasants/lords, noise/speech in manga [Hayashi 2022]; hiragana & loanwords in hiragana instead of katakana ~ children, Japanese-ness, cool, unreal, emphasis [Kunert 2017]; katakana ~ national identity, place & person names [Hokokawa 2020]; connotations in manga [Robertson 2015]; association appropriateness between word meaning and script system [Iwahara 2003]; linguistic formality: 'you' *anata*: polite kanji 貴方 / informal kana あなた [Emmerich 2008: 55, n8]; philological history [Seeley 1991]

7 Atanasiu 2003a, 2003b

8 Kapr 1993: 42–44

DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! ~~DUCE~~! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!

DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! ~~DUCE~~! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! ~~DUCE~~! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
~~DUCE~~! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! ~~DUCE~~! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! ~~DUCE~~! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! ~~DUCE~~! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! ~~DUCE~~! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! ~~DUCE~~! ~~DUCE~~! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! ~~DUCE~~! DUCE! DUCE!
DUCE! DUCE! DUCE! DUCE! DUCE!

1954

DUCE! DUCE! DUCE! DUCE! DUCE!
DUCE! DUCE! DUCE! ~~DUCE~~! DUCE!
DUCE! DUCE! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
DUCE! ~~DUCE~~! DUCE! DUCE! DUCE!
~~DUCE~~! DUCE! ~~DUCE~~! DUCE! DUCE!
DUCE! ~~DUCE~~! DUCE! DUCE! ~~DUCE~~!
DUCE! DUCE! ~~DUCE~~! ~~DUCE~~! DUCE!
DUCE! ~~DUCE~~! DUCE! DUCE! DUCE!
DUCE! DUCE! ~~DUCE~~! DUCE! DUCE!
~~DUCE~~! ~~DUCE~~! DUCE! DUCE! DUCE!
DUCE! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
DUCE! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! DUCE! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! DUCE!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! DUCE! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! DUCE! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~!
~~DUCE~~! ~~DUCE~~! ~~DUCE~~! ~~DUCE~~! [1]

[1] Benito Mussolini's (1883–1945) official title, Duce ('Leader'), was supposed to be written in capitals as a sign of potency (idem for LOUIS LE GRAND [XIV]). by contrast, lowercase writing is a symbolic practice of democracy & anti-authoritarianism, in particular in nineteenth- and twentieth-century germany. ❖ As part of the cult of personality during the Pahlavi era in Persia (1925–1979), many books began with a dedication to the Shah and included his picture; after the Iranian Revolution, it became customary to symbolically decapitate the Shah in absentia with a pen stroke over his picture's neck or by striking out his printed name. This vast revolutionary bibliographical massacre was facilitated by rubber stamps inscribed with the words باطل شد *bāṭil shod* ('canceled'). An illustration of this method of *damnatio memoriae* is presented on this page spread, as is the progressive conversion of the masses' clamorous assent to overt dissent and ultimate annihilation of the tyrant. ❖ The age-old *strikethrough* graphical technique is remarkable among all remarkable aspects of Ugraphia insofar as it creates a hybrid state of legibility and illegibility: the text remains legible, if only barely. The semiologic mechanism it operates consists in severing — by lowering legibility — the link between signifier and signified, thus deactivating the power of words. The function of such partial canceling is *memorialization*. The triumphalism of having Mussolini's corpse hanging upside-down from a beam in Milan's Piazzalle Loreto in April 1945 is reenacted with each new strikethrough of his written name, for all readers in times to come to see. Illegibility marks the inactive realm of the dead where word-bodies have been discarded, while legibility keeps their memory alive. Strikethrough is the fine line separating these two worlds, the slash over the dead letters exposed for public contemplation along the text lines. ❖ In the world of graffiti, crossing out someone's mural is a disparaging gesture toward its artistic worth, and among urban gangs using graffiti to mark territories, it is a form of public disrespect inviting violent conflict. More prosaically, strikethrough also serves as a *documentary* device to maintain a versioning log of a text's transformation. It is certainly a faithful handmaid of good lite-rature and distinct from crossout, blackout, whiteout, and similar text obliteration and censoring techniques. Despite its identical visual manifestation, the strikethrough exegeted here also differs functionally from Derrida's & Heidegger's 'under erasure' (*q.v.*), which expresses the inexpressibility of human ~~experience~~ through language. C
BURKE 1992: 35, 200, KINROSS 2011: 139, PHILLIPS 1999: 170, 313

DEFINITION ☷. Memorializing — *Strikethrough effects a state of concomitant legibility and illegibility, intended for memorializing.*

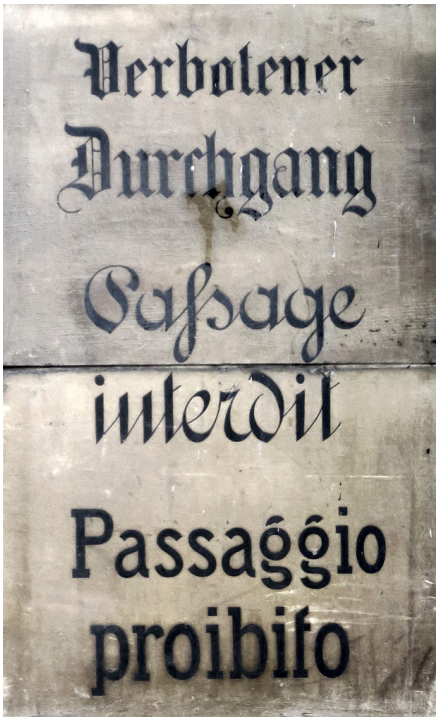
Yet, the abolition of the functional overload and rationalization through the use of a single character set have generated heated social debates and script reform failures.[1] ➾ Many other non-visual factors limit legibility optimization, *gender* and *economics* among them. An unresolved controversy on gender equality in French, which has embroiled, in addition to the general public, the Académie Française and the President of the Republic himself, advocates for the use of the middle dot to separate feminine word endings from the masculine word stem ('président·e'), which is considered by critics as offensive to proper legibility and laborious to type on current (gender-biased) keyboards.[2] Like the theological disputation on the angels' sex, the orthographic battle is fought even over the tiny dot's gender: isn't its simple & rational geometry a bold statement of masculinity? And superior legibility? Yet its perfect curves could as well be associated with femineity, & its androgyny with queerness, thereby proving the argument's arbitrariness and the true nature of legibility as a means to exercise power over gender identities.[3] Similarly, trimming character ascenders & descenders or using cryptic abbreviations does not improve legibility in any way but is simply a means to fit more text on a page of a newspaper or phonebook, an age-old response to economical imperatives of script production, as graphical real estate comes with the price tag of the paper (or marble) substrate.[4] Even *environmental* advantages are claimed from improving information density while preserving legibility:

[1] Kinross 2011: 131–142 ['kleinschrift' or the abolition of German capitals], Gottlieb 2016 [Japanese polygraphism], Unger 1996 [failure of the romanization reform during post-war Japan]

[2] Haralambous 2019, Haddad 2017

[3] Soulellis 2021, Sowersby 2021, RTPB 2023 ➾ Inclusive ligatures have been proposed by type designers, only to receive negative feedback about their poor legibility from readers with visual and cognitive disabilities. The prolific producer of non-binary fonts Franco-Belgian collective Bye Bye Binary originated the Queer Unicode Initiative for the encoding of polygendered glyphs. For example, in Adelphe (2022), by Eugénie Bidaut, the formulation 'he or she' becomes in French 'il ou elle' in extenso, and il·elle | ịḷẹlle | iɛl in inclusive typesetting; further glyphs include fɛ ɇ MP Ծ Ö SS XS. Homoneta (2022), by Quentin Lamouroux, expresses the feminine and masculine divinity as Godess and Dieuα; other ligatures are more complex: [illegible]. C Bye Bye Binary 2020

[4] War economy is a potent factor in typeface choice. In 1942, Beatrice Warde observed that '*the publisher who, with most of his stock wiped out, must function on 37.5 per cent of his normal pre-war allowance of paper*', and that '*they may relax in England, after the war, the present drastic rule as to the minimum of words to the page*', a situation that '*throw*[s] *a sharp light on the virtues of such faces as Times New Roman.*' C Warde 1942: 17–18 ➾ In the design of Times New Roman (1932), a compact face, legibility was subservient to commercial interests: '*Just as the text as written must be related to man's intellectual resources, so must the text as printed be related to his pecuniary resources.* [...] *It must be the object of typography, whether practiced under nineteenth-century capitalism or twentieth-century pseudo-communism, to multiply the greatest number of copies at the least cost, and The Times type complies with this requirement.*' C Morison 1973: 109 ➾ The British printers & early legibility researchers Lucien Alphonse Legros (1865–1933) & John Cameron Grant (*–†) proposed in 1916 to represent the two common English bigrams TH and NG by the 'logotypes' Ħ and Ꞑ, on the basis of £ 350,000 estimated annual savings in English-speaking realms. Another solution by Philip Rusher (*–†) in 1804: squeeze the descenders! An incommensurately vaster budget slashing was expected following the 1841 patent of the French printer & publisher Charles-Louis-Fleury Panckoucke (1780–1844): utilizing the anisotropic spatial distribution of entropy in script, 'hotter' in the upper parts than in the lower parts, only the more informative half of characters is printed (the effect fails for classical OCRs, unlike those combined with large language models). Rather than preserving paper, the typeface can you read me [can you read me] (1991) by Phil Baines seems to be designed to save precious ink. Another way to the same effect is to make tiny, quasi-invisible holes within character strokes, a procedure that, when using a software such as Ecofont, may increase by 49% to 86% the number of pages that can be printed with a single laser printer toner cartridge. More modest savings were achieved by '*The New York Times.*', when in 1967 it dropped the comma from its nameplate (causing uproar among readers): $41.28 per year. C Legros 1916: 152–155, Goudy 1977: 141–142, Laucou 2014, Ecofont 2022, Lambourne 2011, Keypoint Intelligence 2018, Imjai 2021, Wikipedia: 'Rusher's Patent Types', 'Ecofont', Dunlap 2017



Citadel Ugraphia

—

'*No Trespassing*', a public inscription at the Central Post Office in the border town of Basel, is written in different styles for each of the three national languages of Switzerland, perhaps before Romansh became the fourth in 1938. By that time (Anschluss, Kristallnacht), polygraphic legibility was used as a visual Swiss Army knife of sorts to defend the national cohesion of the Confoederatio Helvetica (written in Roman capitals) against the irredentist temptations of the Third Reich and Fascist Italy and the revolutionary sirens of the Soviet Union. Meanwhile, for many of those seeking a safe haven, this calligraphic idyll signified the threat of a bureaucratic rejection of a forbidden Utopia. They surely did appreciate the orthographic sophistication of the long-ſ in the double-s. C Church 2013: 193–226

'the *hz*-program [for justification] does environmental protection by typographic means'.[1] In a strange twist, bad legibility begets better legibility: cheaper books, particularly the pirated, lead to a *democratization of reading*, and because more people read more texts, they get better at it — the receiver becomes more sensitive by training, despite increased signal noise.[2] ⇛ One of the strongest grips on script is held by *ideology*, *politics*, & *conquest* in the glove of *emotions*. Software programmers around the world would write today in Punic, had Hannibal (247 B.C. – 183/181 B.C.) defeated the Romans! The strikingly different complexity of Antiqua & Fraktur or Traditional & Simplified Chinese, much more than representing purported levels of legibility, are Luhmannesque graphical means of sociopolitical differentiation between progressives and traditionalists, nationalists and cosmopolitans, mainland and overseas, 'us' and 'them'.[3] In such cases, legibility is instrumentalized for goals quite unrelated to itself.[4] ⇛ Supra I alluded to Tschi-

1 Karow 1992

2 Tightly set and physically inconspicuous pocket books, easy to transport and hide, are credited with helping to spread the ideas of Protestantism and the Enlightenment across Europe, while short ascenders and descenders have been advanced by numerous modern reformers of the Arabic script as factors of democratization. C Martin 1995: 312–313, Hamm 1975

3 Niklas Luhmann (1927–1998), a facetious totem of the sociology of systems. C Luhmann 2006, Jahraus 2012 ⇛ Antiqua and Fraktur are generic names for post-medieval Latin and German scripts: the former was used in Germany until the 1940s for, grosso modo, foreign language and scientific publications. A public debate representing diverse interest groups took place during the nineteenth and early twentieth centuries regarding which style was better and should accordingly be adopted countrywide. C Hartmann 1999, Rück 1993, Bain 1998, Kapr 1993, Wikipedia: 'Antiqua–Fraktur dispute' ⇛ Far from facilitating literacy, simplified Chinese characters have become a surplus of hundreds of characters to learn in addition to the traditional. C Zippel 2011: 67

4 On script politics C Petrucci 1993 [Latin], Kraus 1991 [Chinese], Atanasiu 2006 [Arabic].

Tschichold's [1] shifting stance on sanserif suitability, but which were his motivations? He is explicit: to left-leaning printers, a typographic revolution was the means for a social revolution, albeit of a kind that was unfortunately feeding from the same sources as National Socialism, namely intolerance & totalitarism.[2] In this, the parallel between the serif / sanserif and Antiqua / Fraktur disputes is striking. It seems self-evident to the modern reader that the arch-Germanic Fraktur, & to an even greater extent Gutenberg's textura, have serious legibility issues, given how letters are easily confounded.[3] Despite this, much ink & gall was poured into a century-and-a-half-long debate. At the time of the French Revolution, it was possible for Germans to denounce as feudal & clerical both Antiqua characters ('fatal aristocrats') and Fraktur ('monkish script').[4] Later on, Otto von Bismarck's (1815–1898) abhorrence of Antiqua was visceral, but to the shrewd statesman also a political blade. He backed up words with deeds, forbidding official publications of the German Empire to use anything but Fraktur.[5] To Bismarck, Antiqua was not merely an affront to the eye and patriotism, in fact, he refused outright to read any publications in such script, returning them to the sender. But aren't we rash with His Serene Highness by insisting that Fraktur is not exactly a epitome of legibility? He might very well turn the tables & question our own obsession with making script legible. Perfection is a modern Western pathology, not shared even by some hyper-technological cultures.[6] In Japan it coexists with the *wabi-sabi* philosophy of the unfinished & the wobbly.[7] The subtlest argument against perfect & universal legibility is, perhaps, that script & legibility are *social constructs*. Let us now look closer at this mechanism & its purpose.

1 In case the first part of a word hyphenated across pages is forgotten while turning the page, it is repeated. This bibliographical device,* the converse of a catchword, is called a 'rumination'.

2 Eugenics, too, made it into the raft of ideologies used to conceptualize typography; in 1946, and at a time when the genocides of the Second World War had become publicly known in the US, the Yale University Printer stated that '*Most books are as carelessly and casually procreated as children. Little of typographic eugenics guards the production of most books.*' C Rollins 1946: 333

3 '*The Fraktur alphabet consists of essentially similar characters that are made more individual.*' C Ovink 1938: 116, Forsmann 2002: 305, 309 [confusion examples], Houston 2016: 236–239 [use of Antiqua & Fraktur in Europe, 1500 to 1800]

4 Kapr 1993: 63–65

5 Reinecke 1910: 78–80

6 The typographer & typography's historian Harry Carter (1901–1982) writes about the difficulties created for punchcutters by the demands of the Renaissance Humanists for '*approximating the straightness of line and fairness of curve*', to match in typefaces presumed ideals of Greco-Roman antiquity. Half a millennium later, the company magazine *The Monotype Recorder* took stock of the advances in precision and its mindframe. '*The basic principle of cutting letters in relief in steel, and striking and finishing them into a series of aligning matrices, remains the same [as in the infancy of printing], though the tools and methods now used are such as to carry forward the original aim — that of making a series of objects indistinguishably alike — into realms in which the hunt for deviation has to be conducted through a microscope.* [...] *Precision, accuracy, "identical" likeness — these were ideals toward which the goldsmith-punch-cutters bent their efforts proudly, consciously, with no such deprecatory feelings as those of the mass producer of any articles that would be better, more cherishable, for being made singly by hand.*' As the deleterious ecological & social impact of this industrial outlook becomes increasingly clear (overexploitation of natural & human resources), voices clamor to qualify it as '*the violence of perfection*', and advocate imperfection (e.g., grunge typefaces). Psychologists have even documented an epidemic of perfectionism, manifested in unrealistic expectations and imputed to the rise of neoliberalism in the 1970s, although the phenomenon can be traced to the Industrial Revolution and, via moral and political philosophy, as far as Plato & Confucius. C Carter 2002: 54–55, Monotype 1956: 2, 5–7, Cheyne 2022: 39, Curran 2017

7 Koren 2008, Wikipedia: '*Wabi-sabi*'

* *Pecatus meus*

By definition, a legible text is more comprehensible, and its object more controllable, than an illegible one. Such a text is, moreover, the product of either an individual made compliant to

Definition 7. Power — *Legibility is the effectiveness of social control & command exerted through normative pattern production, & illegibility is a defense mechanism.*

graphical norms by the schooling system or a machine conforming to standardized procedures. Scientific research, pedagogical objectives, typographical marketing, administrative regulations, and even cinematic representations propagate the desirability of legibility, with the result that it acts as an extinctor of graphical diversity. The mechanical reproduction of writing has resulted in deindividualization; we see less of the handwritten personas of others, while our own writing is invisible to them, replaced by the relatively few 'type faces' that were until very recently the products of complex processes involving large teams of designers, engineers, workers, marketing operatives, investors, and many more, in a small number of private corporations and state enterprises.[1] The situation resembles Bentham's panopticon, in which interpersonal communication is thwarted.[2] Concomitantly, we observe the proliferation of scripts whose content is no longer accessible by humans without the aid of machines (bar-, QR-, and other codes), along with the ability of machines to read scripts intended for human consumption but that are no longer legible (ancient or unusual handwritings). These elements trace a sociological perspective into the nature of legibility as yet another artifice that conforms to the dictum that 'technology is a medium of power'.[3]

Definition 7. Power — *Legibility is the effectiveness of social control and command exerted through normative pattern production, while illegibility is a defense mechanism.* The historical links between legibility and power are so pervasive that the anthropologist Claude Lévi-Strauss (1908 – 2009) went so far as to argue that 'the primary function of writing, as a means of communication, is to facilitate the enslavement of other human beings'.[4] While his reflection was prompted by an incident he witnessed in the rainforests of Brazil (when a native chief discovered that by mimicking the white man's writing and reading, he suddenly appeared endowed with exceptional powers in the eyes of his fellows), Lévi-Strauss finds similar uses of writing for the purpose of exercising power throughout the great polities of human history. In Ancient Greece, we have the example of *democratic* Athens, which invested

1 Monotype 1954 [overview of industrial type production], Haley 2012 [historical evolution]

2 Foucault 1995: Fig. 1 – 8, 200 – 209

3 Cockburn 1985: 6, Sproat 202* [technographical factors]

4 Lévi-Strauss 1961: 292 [286 – 293] For a general assessment of the interplay of literacy and power, class and legibility, and the usage of violence in teaching reading and writing, see C Harris 1989: 332 – 337, Dubois 1975 [expanding on Bourdieu], Bloomer 2015, Woolf 2009 [emphasis on variety].

territories they claim from other graffiti encircling with a palimpsest of visual pheromones on the move the urban

in public and therefore legible inscriptions, as a means of transparent politics, and *militaristic* Sparta, where the graphic environment was substantially limited, that is to say where legibility was suppressed as if to guard against the disclosure of state secrets.[1] Since these inscriptions were costly — they had to be carved in stone —, legibility was the appanage of those endowed with money and authority, while those that are *deprived of power*, but still seek it, often express themselves in the form of a hasty, graphical ductus (latrine scrawls, subway graffiti, Red Guard slogans, 'US go home') or invent their own script to evade subjugation (a recurrent practice among highland minorities of South-East Asia).[2] Two fine examples of the symbiosis of power & legibility are *cryptography*, for which legibility serves only to deceive & camouflage, and *totalitarianism*, with its extensive use of written slogans to indoctrinate & propagate lies. *Literacy campaigns* and *script reforms* can also be traumatic experiences by enacting a break with the past (e.g., the disappearance of the Maya script and the Christianization of the Americas via Latin script). Power, and thus legibility, must also be *inalterable*, the reason behind the development of a tamper-proof car plate typeface in 1970s Germany, to prevent car thefts by the terrorist organization Red Army Faction (RAF). A successful design, it was adopted internationally, also to help automated car plate reading by computer vision, another technology of power by mass surveillance.[3] ⇛ Building upon the tradition of henna body painting, the Iranian artist Shirin Neshat signifies the oppressiveness of (Islamic) politics, (patriarchal) society, and language itself by imprisoning photographic portraits in the mesh of (traditional) calligraphy, the highest form of (codified) legibility.[4] Her symbolic protest materializes the point made by the French social philosopher Michel Foucault (1926 – 1984) that 'visibility is a trap'.[5] Foucault was describing the paradigm shift emerging during (aptly named) Enlightenment in respect to the social use of *visibility*. While, previously, recording & broadcasting (tweeting) one's daily activity conferred existence and power (see the public waking-up and going-to-bed of King Louis XIV of France [1638 – 1715]), visibility — of the child learning to write, of the soldier on parade, the prisoner & the madman caught in panoptical buildings — became a coercive technique. Tellingly, it was King Louis XIV who commissioned a paragon of rational (and implicitly legible) typeface, the Romain du Roi, designed on a regular grid.[6] ⇛ Conversely, power must remain *invisible* & *illegible* (like a mikado never addressing the peoples of Cipango until announcing on the radio, in archaic tongue, his capitulation by checkmate & nuclear obliteration,[7] or the ancient Sibyl oracles hidden in the Capitoline Jupiter temple by the successive republican & imperial Romes, so notoriously difficult to interpret that 'a script that takes a Sybil to decipher' means as good as illegible.[8]). Franz Kafka (1883 – 1924), like

1 Thomas 1992: 128 – 157

2 Kelly 2018

3 Schaller 2002, Wikipedia: 'FE-Schrift'; front cover

4 Mackert 2000

5 Foucault 1995: 200 [184 – 190, 200 – 209]

6 *'The Romain du Roi — very beautiful, although slightly cold due to being constructed in a dogmatic fashion — perfectly translates the classical spirit, an enemy of disorder and folly. To reinforce this architectural and classical aspect, horizontal serifs are added atop the lowercase b, d, h, i, j, k, and l.'* C Paput 2002: 88, Mosley 2002

7 Wikipedia: 'Jewel Voice Broadcast', 'Debate over the atomic bombings of Hiroshima and Nagasaki'

8 Note how these documents, used to such consequential ends as declaring war, are shrouded in multiple access-denying layers: physical locking away, 'sibylline' content, difficult legibility. In addition to exemplifying that information is power and how access to information is restricted, the case of the oracles hints at the creative power of chaos and the interesting cognitive process of willfully introducing noise and randomness to identify a

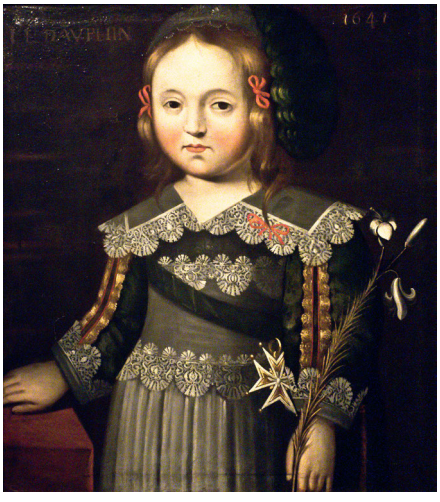
Shirin Neshat, faced a host of impediments: a similarly rigid society (the Austro-Hungarian monarchy), a troubled personal life (difficult father, suicide), and artistic doubts (an auto-da-fé of his manuscripts). Clearly in reference to the lace-like appearance of the Sütterlin script used in official documents,[1] his horrific short story *In the Penitentiary Colony* (far beyond what Edgar Allan Poe [1809–1849] imagined in *The Pit and the Pendulum*) explicitly identifies illegibility as a hallmark of absolutist, arbitrary, & inscrutable power.[2] In the pursuit of defending an eminent state monopoly, are banknotes not fueling the development of innumerable shrewed techniques to make script illegible by overlaying pompous swirl patterns (guilloches), ultra-petite text (micrography), partial characters (see-through register), hidden writing (watermarks), & invisible script (ultraviolet)?[3] Kafka describes a torture 'apparatus', a sort of Iron Maiden that tattoos a convict's sentence

signal and clarify what decision should be made. C WIKIPEDIA: 'Sibylline Books'; Plautus, *Pseudolus* 1.23–30; PLAUTUS 1980: 153

1 Kafka's apparatus has great evocative potential: the grooves imprinted on the body and the cries elicited prompt one to envision a Kafkaesque tattooing phonograph. The body as writing substrate is also an image of the literary creative act and a recurrent metaphor in art & spirituality, from the quasi-anthropomorphic giant calligraphic murals in Ottoman mosques, before which one can pray (as in front of Christian orthodox icons), to Dieter Roth's (1930–1998) *Literaturwurst*: sausages stuffed with minced books or magazines, such as Georg Hegel's (1770–1831) complete works and the German weekly *Der Spiegel*. For cultures using pictographic writing elements — Egyptian hieroglyphs are replete with cats, crocodiles, & a menagerie of human poses — the consubstantiality of script & body is explicit. C WIKIPEDIA: 'Old Mosque, Edirne', 'Grand Mosque of Bursa', MASSOUDY 1981: 27, 125, 132–152 [pictures], SCHICK 2001 [writing & body in Islamic calligraphy & mysticism], WIKIPEDIA: 'Literaturwurst'

2 STOICA 2009

3 RENESSE 2005: 129–168 ⇗ Tamper-proof car plates have parallels in the legal & financial sectors: to deter forgery, check values are customary handwritten in full letters on a background of parallel lines despite reducing legibility. Similarly, in East Asia, simple digits are replaced in fiduciary contexts, such as on banknotes, with complex characters (1: 一 → 壱, 2: 二 → 弐, 3: 三 → 参).



AUTHENTICATION

This portrait of the future King Louis XIV at age three shows him practically cross-dressed, wearing feminine robe and hairbands, an exemplar of his times' transition from the twilights of Baroque to the solar Enlightenment, in which he played a prominent role. The spirit of the Baroque is a conception of the world as fundamentally ambiguous and paradoxical, as manifested in the chiaroscuro painting, the taste for wigs, theater, and halls of mirrors at the Versailles court (all sorts of reflections of infinite realities), the opposition between French and English gardening, the Protestant–Catholic conflicts of the Thirty Years War, the rise of chromatic ideology (categorizing people into whites, blacks, and other colors), etc. etc. Such phenomena did occur in other ages and places, but their concentration during what came to be called the Baroque period provided its definition, with the dichotomy of rational Antiqua and chaotic Fraktur being an example of a typical Baroquism that substantially predated and outlasted the period. ⇗ Some of the Baroque practices of writing are particularly interesting for the study of legibility and its politics. Specifically, rather than writing himself, Louis XIV preferred dictating official correspondence, and his private *Mémoires* and love letters, to a few chosen 'secretaries of the hand', who were trained to impersonate the royal handwriting (thereby materializing the consubstantiality of sovereign and nation according to the absolutist precept, '*L'état, c'est moi!*'). This arrangement, common also to Kings Henri IV (1553–1610) and Louis XIII (1601–1643), as well as Cardinal Richelieu (1585–1642), is eminently ambiguous, as writing is used to record speech, although the two modalities are significantly different, in addition to which the writing's author is not the one it

over his body until death ensues, in these terms: 'it's not a script for schoolchildren's copy-books. One has to read it over a long period. You would certainly be able to make it out for yourself in the end. Of course, it shouldn't be a simple script; after all, it's not supposed to kill immediately, but only within a space of twelve hours on average; the turning-point has been calculated to come at the sixth hour. So the actual script has to be surrounded by many, many flourishes; the real script encircles the body only in a narrow girdle; the rest of the body is intended for decoration.'[1] Just before exitus, the convict unfailingly experiences an illumination and becomes able to read & understand the deep spiritual meaning of his predicament: 'Understanding dawns upon even the most stupid. It begins with the eyes. From there it spreads further. A sight that might tempt you to join him lying beneath the Harrow. Indeed, nothing further happens; the man simply begins to decipher the script; he purses his lips as if he were listening. You have seen it is not easy to decipher the script with one's eyes; but our man deciphers them with his wounds.' In short: legibility is a death sentence.[2] Kafka's story eerily mirrors the ordeal of the fourth-century St Cassian of Imola, patron saint of stenographers, martyred by his own students: angry at his wicked teaching methods, they struck him with their wooden wax tablets and stabbed & tore at his flesh with iron styli, jeering at him all the while to find faults in the insults they wrote in his bloodied body, while he himself encouraged them not to be timid & make him know the sweet ecstasy of martyrdom.[3] In this case, legibility is the morbid medium of struggle between paganism and Christianity.

These examples reveal that legibility per se is narrowly circumscribed, yet instrumentalized by a great variety of domains, which in turn are part of incommensurately broader historical developments. The rise of psychological research in legibility was soon followed by the marketing of legible typefaces in the printing industry, and occurred in parallel to both the world-wide development of handwriting styles for educational purposes and the German-specific Antiqua / Fraktur debate; the expanding sphere of legibility, therefore, is framed by phenomena such as capitalism, imperialism, and nationalism, variously fueled by the ideologies of progress (19th-century scientism), efficiency (20th-century Taylorism), and performance (21st-century omni-measurability). One insight from legibility overload & power uses is that while information aspects of writing such as production & reading depend on legibility, sociocultural para-uses may also depend on its contrary, illegibility, or even be independent.

When praising the benefits of legibility for traffic safety, unambiguous medical prescriptions, and low vision mitigation, it remains useful to keep a critical eye on the seductive ideology of perfect & universal legibility. The death of Stalin (1878–1953), prolific writer of literary works benevolently distributed throughout the libraries of the Soviet Gulag, was not two years past when Lévi-Strauss wrote his poignant epitaph to the quintessential function of writing as an instrument of enslavement.[4] One more charge against Ugraphia and building an infernal Paradise, the 'tristes tropiques'. As the historian of Communism Annette Wieviorka noted, 'Utopia is always deadly. But the intention leading to utopia is not necessarily bad. And that's what makes things complicated.'[5]

1 Kafka 2009: 83–84

2 Illegibility too: *'Once it becomes impossible to use, [an outworn Bible] is buried, just like a human corpse.'* C Sirat 2015

3 Cribiore 2005: 156–158, Jager 2000: 88–90

4 Kalder 2018 C is a tragicomic reading on the propensity of the twentieth-century's greatest dictators to produce books.

5 Péretié 2008: 15:00

S4US4G3

('My printers need to eat a healthy slice of fausage to squeeze the presses, else the Epistles for the forthcoming Frankfurt Book Fair will look as pale & illegible as apple purée & fish bones.' This is the essence of the Zürich printer Christoph Froschauer's (c. 1490–1564) defense of the sacrilegious fast-breaking of 1522, known as 'The Sausage Affair', in which the church reformer Huldrych Zwingli (1484–1531) also participated, and is considered the event that kick-started his Reformation.[1] The close association between printing and Protestantism is well documented[2] — one of Luther's crucial instruments was his Bible translation into German vernacular to increase its accessibility beyond those versed in Latin, and Helvetica is decidedly puritanical when compared with the mystery-shrouded Fraktur.[3] But food, as the third corner of the relationship, should not be forgotten — Froschauer's ['Frog-meadow'] graphical–religious appetite was chronic, since he depicted Luther & Erasmus milling God's words & kneading them into printed books.[4] Throughout this book, we will encounter other occurrences of the legibility–edibility link. The point, made together with Rabelais, Brillat-Savarin, and Spiekermann,[5] is that the Nirvana of gastronomy, and hence legibility, is anything but the same dish served over and over simply because it is prepared by the best cook in the world.) Sandwich closed.

1 Wikipedia: 'Affair of the Sausages', Locher 1979: 95–98

2 Stein 2010: 190–193 [historiographical state of the art]

3 In 1933, Swiss designer Max Bill (1908–1994) created a red & black book cover published in (Protestant) Zürich using similar connotations: '**SOZIALISMUS + katholizismus**'. ↻ ÉCAL 2017: 49

4 Ribi 2019, Göttler 1984 [mill allegory]

5 François Rabelais (1483?4–1553), literary father of Gargantua, who had an appetite commensurate with his name; Jean Anthelme Brillat-Savarin (1755–1826), theoretician of gastronomy, writing in a gourmet vein; Erik Spiekermann, enfant terrible of typography, who also said that *'you don't have to interpolate goulash and spaghetti'*. ↻ Wikipedia: 'François Rabelais', 'Jean Anthelme Brillat-Savarin'; Spiekermann 1982: 16, Terstiege 2022

purports to be. The situation reflects a Baroque perspective on legibility, as a matter beyond shape identification, one of ascertaining the true identity of the writer, id est authentication and authority.

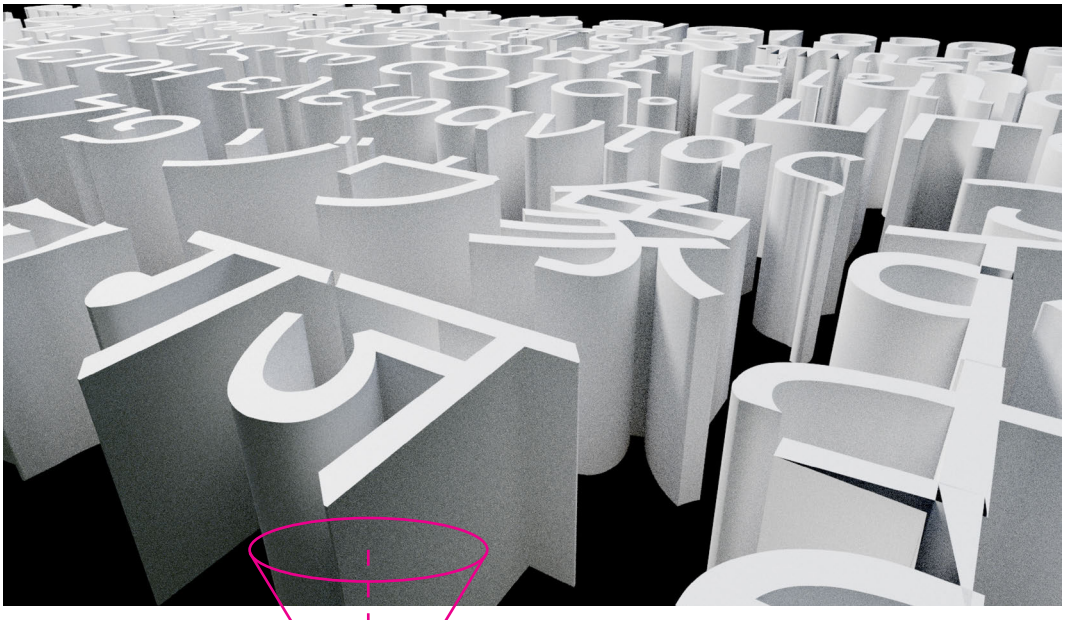
Definition ☰. Authentication — *A script is legible if it makes its author manifest.*

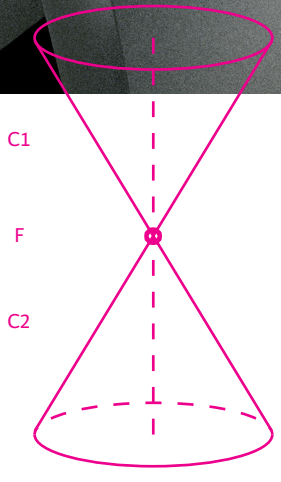
... just like corporate typefaces, or, for that matter, the Romain du Roi, the typographical hallmark of the French state well beyond the Ancien Régime. ⇗ Notice in the juvenile portrait the typical Baroque dark background, as heavy with mystery as the night in which faces light up for an instant before disappearing into nothingness, the brief afterimages leaving behind a choreographic notation for us to decipher. This allegorical reading has an objective grounding in the creation of the first modern choreographic notation for the king's ballets, himself an accomplished dancer.

↻ Wikipedia: Breeching (boys) [boys dressed as girls], Prest 2006 [cross-casting in performing arts]; secretaries of the hand: Saint-Simon 1865 (2): 150 [recollections], Avenel 1853: xvii–xviii [diplomatic evidence], Bély 2013: 221–231 [bureaucratic organization], Bjørnstad 2021: 52–53 [imitation limits], Burke 1992: 8–9 [love letters], Wikipedia: Body politic [metaphor of the polity made from human bodies], Mosley 2002: 72–73 [Romain du Roi] — Illustrations: previous folio: *Le Dauphin* (1641), unknown painter, similar to an engraving by Grégoire Huret (1606–1670), Museum of Art and History, Fribourg, Switzerland, inv. no. 8821, museum notice 2007-1; this page: *Louis XIV* (c. 1701), portrait by Hyacinthe Rigaud (1659–1743), Louvre, Wikimedia Commons: Louis XIV of France, Tsikounas 2008.

LEGIBILITY

Elephantine hypostases in various scripts, with code glitches





Scaffoldings of legibility

—

Script shapes are hypnotic snakes that make us forget the many abstract dimensions of legibility, such as power, discussed above, and statistics, to be introduced next. Invisible to the eye are the text's baselines; the red, green, & blue values defining headline colors; the handles of Bézier curves fixing character outlines, themselves only representations of mathematical formulas implemented in various abstraction layers of machine code driving the flux of electrons in microchips. These all are the invisible scaffoldings upon which legibility is built. They resemble coaxial cones whose touching tips are the fulcrum where script shapes emerge from their intersection.

Far from being a topologically unobstructed flatland, script shapes draw the plan of a maze of meanings in which each blind man reading the proverbial elephant senses its own reality, both inherited script and self-made ductus, as if Ariadne was playing with a cornucopia of multicolored threads, and the escape route, taken by Dedalus himself, was flying out through the open skies of ingenuity — the metaphor of legibility as a maze is a versatile instrument to think & act with.

—

Legibility as a maze

Sermon: As we commence at this hour a new page on our journey through the present book, let us take a moment and reflect upon some strange phenomena of legibility occurring at the limits of character set sizes. ⇛ Binary writing systems such as Morse don't have the smallest character set sizes, since transistors used as electronic switches signal with 'existence' (current on) and 'void' (current off). This example suggests that the vast majority of writing systems tacitly incorporate the void among their symbols. One possible exception is color-coded systems, in which symbols are represented by colors rather than shapes and can thus be juxtaposed without interstices.[1] For typo-semantical purposes, there are even a great variety of voids: em-, hair, flush, non-breaking spaces, &c,[2] and the space bar is the largest among the keys on current computer keyboards. The above cases have theoretical sharp distinctions between marked and unmarked states, allowing perfect categorization and absolute legibility, while their realization introduces fuzziness and uncertainty.[3] Definition ☲. Distinction — *Legibility is a location on the sharp – fuzzy – invisible spectrum of distinction.* More involved ontologically is the status of the signal set size in the case of the lock-in syndrome, when paraplegics may communicate only through eye blinking. In one widely publicized case, Morse code was impractical, so an assistant had to shuffle a set of cards inscribed with letters until the ensuing book had been dictated.[4] Here, communication no longer happen exclusively within a set of symbols, but co-opts the 'world' exterior to the set to remain operational (in this case, the assistant and the alphabetic cards). Of a completely different nature — indeed, supernatural — is the quasi-Borgesian communication with 'four madmen' via a *single* written character practiced after his return from heaven by Pa Chay Vue, the inventor of a writing system for the Hmong people of South-East Asia during the early twentieth century.[5] Through one omnipotent word ('meow') is also how cats communicate, according to the manga series *Sue & Tai-chan* by Konami Kanata.[6] While this reference is not entirely scientifically correct, it was noteworthy imagined within a 'high context' society, where meaning is strongly dependent on context, including for written communication and thus challenging legibility.[7] ⇛ The above cases illustrate how in the extreme case of a minimal symbol set, communication legibility is shifted in various ways from writing to its exterior, thereby emphasizing their osmosis & how arcane such communication may quickly become. To some extent, the phenomenon occurs even with large symbol sets, notably in respect to their connotations, which create a superset of linguistic and para-linguistic usages. In the end, only the zero symbol set size, the Biblical undifferentiated chaos, makes written communication truly illegible. Amen!

1 Faur 2024

2 Wikipedia: 'Whitespace character'

3 '⌐' denotes a sharp marker in the logical & philosophical notation of George Spencer-Brown (1923–2016) in *Laws of Form* (1969), and in Niklas Luhmann's social theory. Its blurred version, '⌐', may be used for fuzzy distinctions, or, adopting the cartographic convention of dashed lines for disputed borders, its bichromatic simplification '¯¦'. ☾ Jahraus 2012: 34–39

4 Bauby 1998: 19–22, Fuller 2023, Loncke 2022

5 Tapp 1989: 130

6 Kanata 2020

7 I allude to the numerous spellings and meanings of single kanjis. The real problem, however, is the overabundance of homophones, which argues against a purely phonetic writing system (the monument of classical Japanese literature, Lady Murasaki Shikibu's (c. 973–c. 1014/1025) *Tale of Genji*, was mostly written in hiragana, the counter-argument par excellence to this point). Modern Japanese writing does an admirable job of semantic disambiguation through the use of 'morphograms' and visual differentiation of content words (kanji), grammar (hiragana), and (Western) loanwords (katakana). As baroque the system may look, it evolved remarkable legibility value and creative potential. ☾ Taylor 2014: 303–321

It is assumed that legibility is enhanced by increasing distinctiveness (**O** is confounded more easily with **Q** than with **X**). In this sense, the problem of legibility optimization for a given human or artificial reading system becomes one of redundancy minimization within and between characters. However, minimizing redundancy also reduces material robustness and perceptual recognition. In the Morse-like symbol set {•, —}, for example, the dot is susceptible to being partially printed or difficult to see from a distance; by contrast, the set {**O**, **X**} is more redundant in terms of its shapes (at the intra-symbol level) and sizes (at the inter-symbol level), but also more robust and nearly as distinct in constituent shapes. Thus, troubles already begin to emerge at the fundamental level of the definition of 'legibility' & 'optimality'.[1]

1 The hypothesis equating legibility with distinctiveness, termed 'visibility', is intuitively appealing and relatively simple to test using character confusion matrices. It is also popular: *script designers* often explicitly refer to their attempts to maximize character distinctiveness, while the *general public* is perhaps aware that this is the principle behind the development of the OCR typefaces of credit cards; in *psychology*, there exists research on the enhancement of character distinctiveness; *computer scientists* favored the distinctiveness hypothesis from the early days of template matching and Fourier Transform for optical character recognition; moreover, in its own special domain, a NASA *flight* deck manual recommends avoiding typefaces with too-similar characters. A further example of a practical implementation of the principle of distinctiveness maximization is the Lincoln/MITRE typeface (ABCDEFGHIJKLMNOPQRSTU WXYZØ123456789), developed by the eponymous US military research organizations during the early Cold War for the various radar and other displays used by the SAGE aerial defense system; the extensive legibility research conducted for this project aimed at the specific needs of label reading (rather than continuous texts), short alphanumeric strings for identifying airplanes & missiles and displaying aeronautical data, which had to be visually easily differentiable and prevent confusion. ☛ Sanocki 1990, 2012: 1b, Grainger 2008, Lund 1999: 18, Fournier 1977, Degani 1992: 31, Bennewith 2016, Showman 1966: 2–3 ✎ Critics are perhaps too hasty in dismissing the utility of character topology for legibility on the basis of ill-conceived studies. While they emphasize the importance of word shape over character shapes, script is both discrete and continuous: depending on style and scriptor motivation, handwriting is partly cursive, partly segmented; print is usually made up of unconnected characters with a few ligatures, but paragraphs are perceived as distinct objects, i.e. high-contrast textures. ☛ Lund 1999: 96–102, 161–181, 220–223 ✎ The influence on legibility exerted by learning characters individually and thinking about script as a set of discrete characters, enforced by the modern electronic input and encoding technologies, also warrants investigation (Louis XV, King of France [1715–1774], and myself, your servant, both learned typesetting at the same time as learning to write). ☛ Martin 1995: 327 ✎ If character distinctiveness was truly irrelevant, certainly my eighty-year old mother would not have complained of confusing *zero* (0) and *eight* (8) on the electricity counter, and certainly no special Unicode code point for *zero* (0) would be necessary to distinguish it from *oh* (O), and no precious time would be spent by bankers, pilots, and computer programmers on avoiding confusion between *India*, *Lima*, and *One*: Il1 (Gill Sans typeface) vs. I l 1 (OCR-A). Indeed, the Remington typewriters from 1873 lacked keys for the figures '1' and '0' because their shapes could be produced by typing the letters 'l' and 'O'. Wim Crouwel's new alphabet [New Alphabet] (1967) is a darling of graphic designers, not least because it so outrageously maximizes confusion: k (k) ~ t (t) ~ t, x (x) ~ I, 8 (8) ~ H. Clear-cut utility for defining legibility as a measure of character distinctiveness is offered by special use cases. One belongs to optometry, another is that of typefaces for car license plates, with some designed to impede tampering by skillful painting and erasing to transform one character into another; dirt on car number plates is a further, mundane, source of character confusion for both human and machine recognition. ☛ Wendt 1969, Loxley 2004: 209–211, Kay 2013: 1176, de Smet 2007b, Tiven 2012, Wikipedia: 'FE-Schrift', 'New Alphabet' ✎ Visibility has a caveat. Most studies use characters from the same font family member, whereby the dissimilarity results from the structure, while superficial features (such as stroke width and contrast) are consistent across characters. Why not vary these shape features as well? Would it help legibility, as predicted by the theory of dissimilarity maximization? In a typographical stroke of genius, this path was chosen for a rendition of Mary Shelly's (1797–1851) *Frankenstein*, the project of a team lead by Ben Fry, creator of the Processing programming language for data visualization. In their edition, increasingly infrequent fonts, gathered from PDFs found on the Internet, are mixed together as the text progresses, so that it morphs from an unremarkable 'Frankenstein' into a Karloffian 'Frankenstein'. The effect is creepy, as intended, and harmonizes with the equally chilling content thrillingly enough that it compels one to eagerly keep reading. Notably, the technique of style mixing is also used by psychologists in legibility research. Contrary to the expectation that distinctiveness improves identification, it was found that mixing styles de-

Because scripts vary in set size, the character confusion potential is unevenly distributed across scripts, meaning that some scripts will always be disadvantaged in terms of legibility. A binary notation such as the Morse code has the highest legibility potential, but also has poor readability (at least in terms of symbols per saccade length) and productivity (producing dots impinges on the fluidity of handwriting, even more so when they are intermixed with dashes), so that natural scripts typically operate in bases other than two. Thus, the *encoding* of writing also affects legibility. When the Greeks, Dr. Seuss-like,[1] went 'beyond Z' and created the *new characters* Φ, X, Ψ, and Ω,[2] writing came to reflect their speech more accurately, but only as a trade-off with a relative decrease in legibility due to the expansion of the character set size. Surprisingly, character set size may be modified by the seemingly unrelated factor of *writing direction*. This is the case for 'boustrophedon' writing, the alternation of left-to-right and right-to-left ductus in successive lines, practiced in early Greek and South Arabic.[3] Characters are perceived oriented in the writing direction (ABC . . .) and flip from line to line (. . . ↄꟻA), hence doubling in quantity, at least to eyes not accustomed to bidirectional characters.[4] (Writing direction per se is a potential legibility factor, although psychophysical studies have found no conclusive evidence of difference in reading performance associated with writing direction.[5]) *Orthographic* change is also at work: Austrians are attached to the baroque shapes of the eszett (ß) in 'Weißsemmel' (white bread rolls), while the sensible Swiss would struggle with 'Weisssemmel' (the Helvetic custom is to use 'ss' for 'ß'), had they not instead opted to call them 'Brötli' (mini-breads). The deepest encoding level, which has the strongest influence on legibility among the encoding factors, is the *writing system*: phonetic writing systems (e.g., Latin, Hebrew) are advantaged over morphosyllabic systems (e.g., Chinese, Mayan), distinguished by large character sets. ⇗ When designing type, I focus initially on the visual coherency of character sets, disregarding for pragmatic reasons their frequency, despite being aware of its impact.[6] To some extent, I rely on evolutionary forces that theoretically model script to language frequencies, character simplicity generally increasing with occurrence.[7] However, the charac-

grades legibility performance, suggesting that stylistic coherence is necessary for optimal legibility. We will return to this issue in the discussion of the script style design experiment. C Wollstonecraft Shelley 2011, Sanocki 2012

1 In one of his children books, the celebrated American author (1904–1991) explores the shape of letters that lie beyond the end of the alphabet: '*In the places I go there are things I see / That I* never *could spell if I stopped with the Z.*' C Seuss 1955

2 Daniels 1996: 271–273

3 Coulmas 1996: 180, Robin 1991: 131–132

4 It is entirely possible that there is no legibility degradation for practitioners of boustrophedon writing. While it is difficult to make assertions about past civilizations, contemporary psychological research shows that in the early stages of learning to write, some children do not differentiate between non-reflected and reflected characters, and write them interchangeably. One might think about this phenomenon, sterosymbolia, in terms of face profiles, which are considered identical irrespective of the 'pointing' direction. C Dehaene 2009: 263–299 & 2010

5 Yu 2010 [Latin script], Obana 1997 [metastudy for Japanese horizontal and vertical writing direction]

6 Type designer Zuzanna Licko's quipped that *'you read best what you read most'*, a theory known in psychology as the 'letter frequency effect', which postulates that more frequent, i.e. familiar, letters are recognized faster and more accurately. C Garfield 2010: 60 [Licko], New 2011 & Appleman 1981 [effects of letter frequencies on legibility], Richaudeau 1969: 164–166 [defines the ideal script as adapted to letter frequencies], Atanasiu 1999 [sociocultural aspects of letter frequencies]

7 The Arabic (\), Chinese (一), and Roman (I) digit 'one' are all a single dash; likewise, *alif* (ا) and 'I', the most frequent letters in Arabic and Latin, respectively; Simplified Chinese reduces the complexity of traditional characters (廠 → 厂). Obviously, the rule is not absolute; in the Korean *hangeul* script, 'one' is comparatively fastidious (일) and Japanese children are required to draw 12 strokes in order to write the fairly common adjective

ter frequency to which they putatively should be optimized fluctuates within texts and from text to text, depending on content, author, and a myriad other factors; it differs with orthographies and evolves with the language throughout time, space, and society.[1] It is tempting to ask which combination of factors might produce the most illegible pattern! Leaving aside hypothetical adaptation to an ideal and indiscriminate statistical character frequency, it is impossible to perfect the legibility of a script for dynamic frequencies. Perfect typefaces and calligraphies can only be monolingual, frozen in time, and content-specific. Even character sequence may make reading difficult: *ɯɯɯɯɯɯɯɯ* ~ *šišmiš* 'bat' in Serbo-Croatian handwritten Cyrillic & *minimum* in Latin. Moreover, the inter-character space generates a great number of spurious gestalts (two A's create a triangle, '🜲'; two Z's, a rhombus, '⧆'),[2] and the juxtaposition of characters is source of numerous ambiguities ('13' = {1, 3}, {I, 3}, {B}). The implication is that a script style equally legible for all languages — a universal script — is also an utopia, given that *set size*, *frequencies*, and *combinatorial patterns* differ: each page, line, and word has its own degree of legibility.[3]

Should we optimize the legibility of individual characters or of entire words? Writing around 1030 A.D., Ibn al-Haytham suggested that it all depends on whether readers are familiar with a particular word, in which case its general shape is sufficient for it to be recognized, or if the word is new and therefore needs to be inspected letter by letter.[4] The precursor of modern optics has been proven to have a subtler theory of reading than that of the influential psychologist James Cattell (1860–1944), whose model of reading by 'word shape', en vogue for a long period, has been supplanted today by the reading model of parallel feature processing.[5] Word shape remains, however, a useful concept, applied successfully in the 'word spotting' technique for the automated localization of words based on their contour.[6] Word level optimization is furthermore necessary for maintaining word characters consistent with each other and grouped in a single perceptual unit. 'Grouping' is among the central 'laws of Gestalt theory' and purports that a stimulus perceived as a unit is construed as a single semantic entity.[7] A counterexample is provided by the out-of-context use of scripts designed to enhance character distinctiveness, such as numberplate typefaces, potentially resulting in unintended word splitting (**MARIJUANA** = Mari + Juana?). Some notable word character grouping techniques are *kerning*, *ligatures*, *swashes*, & *allographs*. Before we review them, let it be known that the extensive optimization of word gestalts for the purpose of facilitating recognition makes sense only in script systems that delimit words. Any

'cloudy' (曇). 🡅 This phenomenon is encapsulated in a parsimonious precept from the domain of data visualization, which advises maximizing the data-to-ink ratio. This principle could also serve as an additional definition of legibility. C Tufte 2001: 51, Lunde 2024 [sinogram oddities in Unicode]

1 I say 'putatively', because if the magnificent Latin capitals are an adaptation to the quantitative structure of the Latin language (the simple 'I' is the most frequent letter), then why do we still use them when this language ceased to be spoken long ago ('E' is the most frequent English letter, but graphically not the simplest)? I cannot think of a better explanation for these script fossils than the words *graphical relics*. 🡅 Even in synchrony, character frequency might need to be specified not at a language level globally, but rather by subsets. In Iran, for example, words of Arabic origin are more frequent in religious contexts, while a nationalist discourse would favor the Persian lexicon.

2 Hill 2023 [semantics & poetics of the typographic space]

3 Morse code exemplifies this conundrum: while it is an international communication tool, it was originally fitted to frequencies of the English alphabet. C Hailman 2008: 183–184, 187–190

4 Ibn al-Haytham (965–1039), was the Arabic mathematician, physician, and proto-visual psychologist also known as Alhazen. C Sabra 1989: 128, 130, 132, 217

5 Hillier 2006: 33–34, Grainger 2008, Larson 2017

6 Giotis 2017

7 Metzger 2006: 29–41

glance at many antique Roman inscriptions or contemporary Chinese writing will convince that this has not been, and is not, always the case. ⇗ Kerning is a typographical legibility technique consisting in the fine horizontal shift of adjacent characters to avoid splitting words into unpredictable others.[1] To give an example, a loose kerning of VAVIA (name) results in VA VIA (Italian for 'Get out'); a tight kerning of Arno (name; river flowing through Florence) produces Amo (Italian for 'I love'). Ligatures have linguistic, aesthetic, contextual, and multiple other functions.[2] 'Legibility ligatures' — such as **bl**, which keep **ablatio** distinct from **ab latio** — were immensely popular between the thirteenth and the fifteenth century as a solution to the graphical confusions occasioned by Gothic hands.[3] Gutenberg used several dozen ligatures in his B42 Bible,[4] but this medieval legibility technique died at the hands of the Italian printers due to the excesses it engendered. Ligatures survived only in the most brutish environments (to avoid character collisions: ***fi*** vs. ***fi***),[5] by chance (the use of @ in email addresses),[6] and as extravaganzas (typographers moonlighting as calligraphers & letterers),[7] before staging a comeback as commercial hits for the digital fonts industry (today, even no-nonsense Helvetica has to sport 'discretionary' ligatures, some of which look as if twisted into spaghetti by Herb Lubalin himself: HELVETICA [and here comes Optima: CA CIA]).[8] Extensive adaptation of gestalts, natural in

1 Kerning issues (and bad hyphenation) are more frequent and critical for languages that routinely compose independent nouns into single words, e.g., German as opposed to French: *Ur-instinkt* 'basic instinct' vs. *Urin-stinkt* 'piss stinks'. C Forssman 2015: 43, Kindersley 2001 [studies]. ⇗ The typeface **Helvetica** (designed by Zack Roif and Matthew Woodward of New York for Halloween 2019) features another use of kerning: as a parody of typographical good manners in matters of legibility through the use of intentionally poor spacing. C Roif 2019

2 Haralambous 1995 [functions], André 1995 [special journal issue on ligatures], Wikipedia: 'Typographic ligature' ⇗ I recall Christian Paput, engraver & keeper of types at the Imprimerie Nationale, Paris, explaining how a special '*gg*' ligature with crossed lower loops had to be cut for a Garamond intended for the Italian text of Dante's (c. 1265–1321) *Divine Comedy*, so as to avoid a gap or unseemly overlap between the two characters. Contrary to French, 'gg' [Gigi] is common in Italian, as in 'leggibile'. Hermann Zapf (1918–2015) was sensitive, as a calligrapher and scripto-tourist of Italy, to the bigram issue, and created no less than three ligatures for his typeface Zapfino: . So was the renowned German-Italian printer and scholar Giovanni Mardersteig (1892–1977), who designed his Dante typeface, initially intended for an edition of Boccaccio's (1313–1375) letters, with a '*gg*' ligature: *gg*. An unusual ligature, fit for Boccaccio's *Decameron*, is the copulating *gg* of the Garamondish iA Serif (2023) by Oliver Reichenstein of Zürich for iA of Tokyo. However, one need not fantasize that it was for maintaining the standards of proper microtypographical reporting of names of member of the Italian Mafia of its home city that the *New York Times Magazine* recently commissioned for its corporate typeface (from Henrik Kubel of the British A2-TYPE foundry) the exquisite *gg*, as well as the rare solutions to the *ff* and *rí* ligatures. Rather, the culprit is the French Connection: the glyphs were inspired by Deberny & Peignot's typeface Astrée of the 1920s, itself possibly following the zeitgeist or older traditions, since similar swashes appear in the logo of the renowned literary magazine *La Nouvelle Revue française*, founded in 1909 ( ). As this ligature story is not dizzying enough, I conclude it by reminding that doublets are known among German typographers as 'Schnapswörter' [schnapps words], for obvious ethylic reasons. Prosit! C Hoefler 2020, Wikipedia [de]: 'Schnapszahl', Rafaeli 2005: 124, Dowding 1995: 38, Devroye 2023b

3 Meyer 1897, Bischoff 1990: 'ligatures'

4 Kapr 1988: 144–145, 158–159, 225

5 It is debatable whether ligatures should be used indiscriminately. It would be blasphemous for typographers, poor devils, to feign mastery of the black art of transforming wolves into fishes, and vice versa, were they to set (unafraid of Virginia) *wolf fish* instead of *wolff ish*. They can wash their hands of such ambiguities with a Solomonic *wolf ffish*, and typefaces with no overhanging f-s, or they can pray for intelligent software design. C ELU: 'When should I not use a ligature in English typesetting?', Wikipedia: 'Zero-width non-joiner', Haralambous 1995: 89, Bringhurst 2004: 50–53, Knuth 1996: 31 ⇗ Readers who arrived here from the footnote on page 1909 may now return there; all others please continue.

6 Smith 2023

7 Blanchard 1992

8 Swashes and ligatures were hallmarks of the psychedelic typography of the 1960s and 1970s, inflecting everything from

handwriting, is unusual, tedious, expensive, and simply unmanageable for longer typographical sequences. In Latin typography, swashes and allographs are extravagances, but positional variants and *kashīdas* (inter-character stretches) are indispensables in Arabic. Contemplate for a moment the ninteen-letters-long curiosum Unicode U+FDFD, encoding the *basmalah*: بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ 'In the Name of God, the Most Gracious, the Most Merciful', the incipit of Quranic chapters.[1] The construct functions because a complex creative product, the Ottoman fruit of centuries of calligraphic tradition, was encapsulated into a single glyph, frozen in a time capsule. When comparing Hermann Zapf's *Zapfino* typeface, exquisite in its variants, with the vividness of his handwritten calligraphies,[2] or lithographic prints of Turkish *naskh* and Persian *nasta'līq* with digitally produced documents in the same styles,[3] themselves a feat and model of synergy between calligraphers and software engineers reminiscent of Aldus Manutius' collaboration with Francesco Griffo,[4] we can recognize how far we still are from a rich and informed use of allographs. ⇝ The *basmalah* is a good example because it can not only illustrate local 'gestalt-ing' but also provides evidence of long-range allograph interactions, from which extensive patterns emerge. In the particular case of the Quran, its chapters decrease in length over the course of its (typically) several hundred pages; as a result calligraphers realized that rhythmic effects could be produced by varying the allographs of the *basmalah*.[5] What appears superficially to be a question of fanciness, is in fact a visual manipulation of the readers' memories and expectations. Although at first glance they see a *basmalah*, its diversity makes them question what the meaning of the variation is, and if what they see is indeed only a plain *basmalah* (note that we are also dealing here with spiritual content, a context in which plain words need many decipherment keys; this is a process complicated by the fact that 'reading' the Quran is also cantillation, an interplay between visual & aural experience). Now, memory and expectation are essential for legibility, as has been recognized in theories ranging from the speculations of Ibn al-Haytham to neuroscience's predictive coding.[6] Therefore, when local and global shape optimization occurs, is it 'progress'? Certainly it is a refinement & diversification of means affecting communication.

Caslon and Bodoni to Helvetica and Avant Garde. This style characterizes the influential work of Herbert Lubalin (1918–1981) and Thomas Carnase, and resulted in many wild rides for Helvetica, one example being Phil Martin's Helvetica Flair (1970s) shown here, another the full set of 26 × 26 ligatured bigram letters for upper- and lowercase Helvetica by Gary Gillot for Letraset (1967, the year of 'Summer of Love'). C Wikipedia: 'Helvetica', 'Herb Lubalin'; Richaudeau 1969: 76

1 Wikipedia: 'Basmala'

2 Wikipedia: 'Hermann Zapf'

3 DecoType 1995, Milo 2002, SinaSoft 2018

4 Francesco Griffo (1450–1518) was a punchcutter for the Venetian printer Aldus Mantius (1449/1452–1515), credited with the first italic types. C Davis 1995

5 Atanasiu 2003a: 112–147, 167–176

6 'Predictive coding' is a neuroscience theory about the anticipation of future events based on past experience in order to speed up decision-making. Because systems endowed with memory and inference capabilities are able to adapt, the concept is fundamental in computer science, from Bayes' theorem to cybernetics and machine learning. C Clark 2013

U(rban)graphia

—

***Nothing is as it seems*, tells the *Book of Tao*. Here, a hypersynaptic intelligence has recognized the torso-like form of an air shaft grating, making this resemblance explicit with a stylized head. I went a metalevel beyond, identifying the Chinese character 皿 ('dish'), spelled 'sara' in Japanese, which provides the creature's name, Sarah, who tells you, '*Feed me!*' I term such naturally occurring readings 'natural rebuses'. The transformative principle they invite you to apply to your sensory world is to replace objects with their names and discover meaning in their juxtaposition. Or more concisely: wor(l)ds. Natural rebuses instruct you to 'read beyond the words'. C Le Guin 2019: 3; Picture: Hotelgasse, Bern**

S1Z3

Too small or too big and script becomes unreadable, as Alice in Wonderland discovered. Curiously, there is no middle ground either, readers pinching & stretching digital texts to various zoom levels.[1] Publishers, too, seem to have personal opinions on optimal print size; in fact, it is largely dependent on para-legibility script functions, usually (big) prestige & (small) expenses.[2] If progress there is, then it is in pushing the limits of microscript by artificial means (to write texts at nanoscale readable with atomic force microscopes), & of megalographia by social organization or individual dedication (monumental inscriptions & geoglyphs).[3] Size-wise, Ugraphia appears to be either private property or beyond human perception.

1 The measurement of the absolute script size, or its angular size determinant for optometrists' eye charts, relies on the distance between two parallels along the script line within which lies most of the script body, a factor related to character frequency. C Forssman 2004: 79–91 [x-height in Latin], Atanasiu 2003: 17–24 [*ṭāʾ* ط 'eye'-height in Arabic], Zippel 2011: 100–101, 110–111 [enclosing square in Chinese]

2 Cultural variation characterizes the script size of even mass-produced books. For example, one often sees contemporary novels printed in a larger typeface in Italy (e.g., an Einaudi Saggi at 12.5 pt, based on my own measurements) than in France (Gallimard's 11 pt Folio), and much smaller pocket-book typefaces in Germany (Reclam's 8 pt Universal-Bibliothek) than in the United Kingdom (Penguin Classics at 9.5 pt).

3 As script size increases, we observe a specialization of the text functions: larger text bodies for readers with low vision and for sumptuous books, display fonts for titles, posters, and monuments, and gigantic characters for geoglyphs. The same functional specialization takes place when decreasing script size: footnotes, legal 'small print', and Japanese furigana & ruby disambiguation annotations in non-pareille size, micrographed amulets worn in filigree boxes in Morocco and Yemen, and nanoscale books demonstrating novel technologies. C Forssman 2004: 83 [font size names], Van Praag 2007 [amulets], Brooke-Hitching 2020: 216–223 [nanoscript], Zippel 2011: 80, 258–259 [furigana]
⇛ The geoglyphs of the Peruvian Nazca Desert are famous, but they are not writing, unlike the bonfire in the shape of the character 大 (*dai*, 'big'), lit during the annual 16 August festivities on Kyoto's Mount Higashi or the slogans made up of white-painted boulders along the Tehran–Qom highway to commemorate military maneuvers. C Groemer 2019: 210–211, Atanasiu 2006: 13

The density of strokes per character area ('spatial frequency') ranks among the most significant legibility factors, closely linked to script size and page gray, which are discussed in the preceding and subsequent sections, respectively. High stroke densities are typical of writing systems with extensive character sets, pose challenges at small sizes, and hinder both script production and perception. While the issue is genuine, the question is how grave it is. Because the impact of high density on legibility is obvious, I wish to highlight the combined effects of several mitigating factors. ⇛ (*a*) Interestingly, psychophysical experiments involving Chinese writing indicate that moderately *complex* characters lead to faster and more accurate recognition.[1] Greater complexity likely renders shapes more resistant to confusion caused by sensitive transformations (e.g., character rotation and mirroring, stroke removal, addition, and alteration). From an ecological perspective of visual cognition, in scripts with figurative characters, richer details enhance memorization by associating characters with natural objects or faces.[2] (*b*) Excessively dense characters exhibit low occurrence *frequencies*.[3] Even zero occurrence outside dictionaries for the most stroke-prolific (84) character in Unicode:  (*taito*, 'appearance of a dragon in flight', composed of replicated dragons and clouds) — a compelling reason for the Japanese restaurant that has adopted this unique 'ghost character' as logo to become an Internet celebrity and a potential graphonomic pilgrimage site.[4] (*c*) Given their rarity, superdense characters stand out within the surrounding text, making them more easily recognizable. Indeed, it is not so much character complexity itself that affects legibility as it is its *distinctiveness*.[5] This observation illustrates the dual nature of character density as a within/absolute/constitutive and in-between/relative/contrastive shape characteristic. A further example of contrastive legibility factor is color, which we will examine shortly. (*d*) By vox populi, imperial fiat, or natural causes, the most detrimental effects of overly dense characters on legibility have been counteracted recurrently by script *simplification*. Again, empirical studies contend that not all simplifications have been beneficial to legibility.[6] ⇛ In conclusion, high character stroke density presents a manageable, albeit inconvenient, legibility factor. After all, the supposedly legibility-challenged Chinese script did not prevent the Chinese people from inventing printing before Latin alphabet-writing Gutenberg did.

Definition 8. Density — *Legibility varies with the internal density of character strokes and their external density contrast with surrounding characters.*

1 Taylor 2014: 54
2 Taylor 2014: 55
3 Taylor 2014: 52–53 [nine strokes is one average in Chinese]
4 Wikipedia: 'Taito (kanji)'
5 Taylor 2014: 55
6 Taylor 2014: 219–221

'Gray', or 'page color', is a technical term in typography denoting the perceptual homogeneity *of* a text block pattern, which will ideally be as even as possible [1] (due to the great range *of* the number *of* strokes per character, uneven texture density is inherent to printed Chinese and Japanese texts, so that a '*f*lies swarm' aesthetic has evolved among and *f*or those who enjoy this sort *of* stimulation; *if* desired, however, it can also be homogenized by being calligraphed [2]). The reason is rooted in the same grouping law observed at word level, now operating at the paragraph and page levels. Like clouds drifting across the sky, unevenness is *f*ormed out *of* conspicuous character con*f*igurations: peaks, ridges, islands, bridges, and other *f*eatures *of* textural topography, all spurious in*f*ormation that distracts *f*rom reading. The best-known *f*orms *of* scriptural pareidolia are the haphazard vertical alignments *of* white spaces stretching over several lines, those 'rivers *of* white' decried by the dramatist and alphabet inventor Bernard Shaw (1856–1950), which 'trickle up and down between the words like raindrops on a window pane'. [3] Inter-paragraph spaces may also resemble violent slashes across the body text & textural 'catastrophes' (in the sense of René Thom's [1923–2002] mathematical theory of catastrophes applied to texture analysis [4]). Gray defects are a non-issue for handwritten documents (significant character shape variability generally precludes rivers); however, considerable resources are allocated to gray management in analog and digital typography, involving sophisticated hyphenation & justification algorithms. [5] In addition to line length,[6] justification,[7] hyphenation,[8] script system,[9] style,[10] and

1 Rafaeli 2005: 9, Dowding 1995: 2–10, 17 ⇛ I removed paragraph indentations to increase texture evenness, while still permitting easy navigation via paragraph markers. To maintain coherence between typography and content, the traditional medieval pilcrow ¶ was replaced by the optometrists' ⇛ optotype (like 'End'), and the Landolt C in the case of references: C (as in 'see'). The didactic purpose of this design choice was to show at layout level how improving one legibility factor (gray) can degrade another (navigation), and how irregularity trumps regularity, by creating logical structure within the document. C Wikipedia: 'Pilcrow', 'E chart', 'Landolt C'; Wardrop 1963: Plate 5 [superb Renaissance pilcrow ■], Tzara 1918 [pilcrow ▮ in the Dada manifesto, or perhaps the homographical 'tombstone']

2 E.g., 九龍 vs. 九龍 ('Kowloon'). C The Type 2019 (1): 20

3 Shaw 1915: 4, Wikipedia: 'Shavian alphabet'

4 Thom 1975: 38–54 ⇛ Thom's wide-ranging interests led him to brief incursions in the fields of choreography and choreographic notation, relatable to handwriting kinematics and visual forms. C Thom 1990, 1991

5 Rafaeli 2005: 9–29, Németh 2006

6 Increased number of spaces in long lines facilitate homogeneous distribution, i.e. the 'elasticity' of lines — or what is called 'glue' in the TEX typesetting environment. C Knuth 1996: 69–83

7 Justification (as opposed to ragged alignment) degrades text evenness barring appropriate tools & know-how. Narrow columns may exhibit lakes if only inter-word spacing varies (as in the *Neue Zürcher Zeitung*), or a harmonium effect of alternating tight & loose line spacing when inter-character spacing also varies (as in *The New Yorker*, and on various pages of this book), incunabula remaining models of successful justification (complex result of inter-sentence, inter-word, & post-capital spacing, no space around punctuation & hyphens if necessary, abbreviations, & swashes). Justification allows increased text density and therefore reduces costs, and vertical symmetry conveys a sense of physical equilibrium and low informational entropy, well-known aesthetic notions. C Davis 1985: 27, 57 [Aldus' h&j]

8 Polyglots may struggle with segmenting words into syllables, since the perception of these phonetic units differs between languages; as a result, scholars in Italy hyphenate Latin differently from their North European colleagues. The San Franciscan Jane Grabhorn (1911–1973) solved the hyphenation conundrum — in her eyes, a ruse of the 'pompous' patriarchy of typography designed to keep women out of the trade — by promulgating that hyphenation should take place where letters happen to meet line ends, and without using the hyphen mark, as the first tenet of feminist revolutionary typography. C Beccari 2014 [Latin], Fanni 2020: 53–54 [Grabhorn], Davis 1985: 27, 57 [hyphenation without hyphen marks in Aldine typography]

9 Many incunabula are admired for their spectacular even page gray. Considering that a good proportion of them were written in Latin, a script system without diacritics and few majuscules, and thus naturally conductive to visual homogeneity, their craftsmanship may become less shamanic.

10 Monospaced typefaces (Courier) have fixed width. Thus,

glyph scaling,[1] page color is determined by non-graphical factors, notably by the text language[2] and content,[3] the know-how of the typesetter,[4] and the customizability of the typesetting software.[5] The variety of these factors is relevant to the discussion of readability, insofar as it showcases the fundamental diversity of conditions, criticalities, solutions, and ultimate qualities characterizing the optimization of written communication. ⇛ As is the case with other aspects of writing, rivers & similar faults in the page gray were used for para-graphical goals. Creating abstract and naturalistic shapes is a tried and tested typo-pictural device among followers of concrete poetry. A political usage was imagined in Katja Lange-Müller's novel *The Last Ones: Records from Udo Probich's Printing House* (2000), set in the 1970s former German Democratic Republic, in which the typesetter protagonist intentionally creates letter-shaped rivers that spell out obscenities, a covert means of rebellion using unwritten and unspoken between-the-words-and-lines communication against a totalitarian regime that dictates the talk of its citizens — metaphorical typesetters devoid of personal voice, who find in typographical rivers (Gassen, 'streets', in German) the only public places for free speech. His daring folly eventually drives him into self-imposed exile in the vast emptiness of Uzbekistan (a tree-less Siberian gulag ruled by the Montesquieuan despot Uzbek), in search of like-minded orthotypographical saboteurs.[6]

the only way to maintain an acceptable level of visual homogeneity was to create special character shapes — this is why the I has wide serifs, which brings its ink density closer to that of the M. The typewriter 'types' represent an interesting case of concern about how readability affects not only the spacing of characters, but also their very shape, and thus legibility (making typewritten texts similar to printed ones was also an economic imperative for the adoption of the new technology). C Trubek 2016: 83–97, André 2010

1 Many consider squeezing and stretching characters in digital typesetting to be an abomination, since it destroys the careful work of type designers. This is forgetting that we do this all the time in handwriting, and that stretching characters (in Hebrew) or inter-character ligatures (in Arabic) are canonical techniques developed by some script systems.

2 Welsh has notoriously long words — an issue of both typographical challenge and national pride.

3 You are triply challenged if you are a journalist, a Swede, and a communist: setting justified narrow columns is difficult, especially for a language that makes such hearty use of compound words (*Fackförbundet*: 'trade union') and an ideology with a bicephalous tutelary figure (M&L). From the horse's mouth: '*We typeset and printed 70% to 80% of all the leftist publications in Sweden during the 1970s. We had trouble with line breaks: journals like* Clarté *had narrow columns and you had to fit "Marxism-Leninism" and "the invincible thinking of Mao Zedong". You needed to break the words in the right places, and avoid too much empty space. You can imagine how pissed off we were at these wordy clichés, because they ruined the look of the text.*' C Fanni 2020: 140–141

4 One could conduct a statistical study of the spatial distribution of ligatures within text lines; it is quite revealing in terms of the know-how and psychology of scriptors regarding readability management. When I carried out such an investigation of Arabic manuscripts, it was as if I was peering into the minds of the writers: here was the foresighted, placing small ligatures well in advance of line endings, and obtaining an even gray; there was the carefree copyist waiting until the bell rang (to employ a typewriting analogy), when there was space for only one long, unsightly, 'ladder'-producing swash. (The 'ladder' is another bugbear of the typographic field, consisting in the consecutive occurrence of multiple hyphens — how many precisely are within the limits of good taste is debatable.) C Atanasiu 2003a: 148–156, Atanasiu 2003b: 331, Dowding 1995: 19 [ladder]

5 The printer Johann Balhorn (c. 1550 – a. 1604) has been immortalized in the German word *Verballhornung* 'ballhornization', meaning amending an author's text to suit the editor's concept of its topic (as well as including errors in a text while intending to correct it) — i.e., *bowdlerization* (after the English physician Thomas Bowdler [1754–1825], who had similar propensities). Deleting, adding, and modifying words is also a convenient way to improve the grayness of text blocks. However, not everybody can take such liberties, especially readers of printed matter. In this regard, digital documents, whose typographical appearance may be altered 'on the fly', represent a real progress in legibility (although efficiently handling the new possibilities is a source of unforeseen challenges in document ergonomy, and the object of 'Usability Experience', another field related to legibility). C Wikipedia: 'Verballhornung', 'Expurgation'

6 Lange-Müller 2000: 95–130 , Metz 2012: 60–64

You may choose the paper on which you write, but a typeface designer has no such liberty; it's the customer who decides on the printing surface. This matter matters because legibility depends not solely on script shape but also on the contrast between script & writing substrate,[1] as remarked aphoristically the aesthete & memorialist of the Japanese Imperial court, Sei Shōnagon (c. 966–1017/1025): 'Ugly handwriting on red paper' (she would have enjoyed Photoshop's 'drop shadows').[2] The issue of the perfectibility of contrast may seem settled insofar as the combination of black and white yields the best possible contrast. Why is it, then, that not all letters are black and papers white? First, a succinct historical retrospective is required to clarify some of the developments behind the prevalence of black-and-white writing, since, a priori, neither color is inherent. The nineteenth-century Western world was possessed by chromophobia, as illustrated, by the black suits & white shirts of men's fashion, the misplaced belief that Antique Greek sculptures were chiseled out of ivory-white marble rather than painted in garish colors, and the higher costs of white (but less nourishing) bread.[3] Furthermore, modern color science evolved out of a racist and misogynistic environment that made white and black into a fundamental sociocultural distinction,[4] while race, gender, & legibility were also linked by the chemical & papermaking industries' research for creating whiter papers.[5] The mobiles were mercantile (profits from technically exceptional products), as well as an ideology that employed the color white as a marker of ethnicity, gender, & class, and a means to reinforce power structures. The Western world was not alone in such attitudes: the Sinosphere had for centuries produced snow-white paper & jet-black ink (or 'China ink', as 'India ink' is called in French), and making skin whiteness the apotheosis of female beauty, an embodiment of wealth that allowed them to live in the shadows of their homes rather than in the sun-drenched rice paddies; in the Islam-

Definition 9. Contrast — *Legibility varies with the perceptual color contrast between text and background, and between parts of the text.*

1 *'Parafoveal word recognition is critically dependent on character contrast. The lower the contrast, the narrower the visual reading field and the lower, therefore, the readability* [sic].' Contrast is defined by the International Commission on Illumination as the difference between the object and background luminance divided by the background luminance. C Grandjean 1983: 23–24, 30, Carter Rob 2002 [manual on color in typographic design]

2 Shōnagon 1982: 71

3 Pastoureau 2008, Brinkmann 2017, Williams 2023

4 Taylor 2005: 292–293

5 Senchyne 2020: 125–156 *'Put simply, whiteness, in both paper and person, came to be understood as the common ground of representation, against which "blackness" became visible. Therefore, if learning to read words was figured as learning to "pick black from the white", as one children's book had it, then both racial legibility and alphabetic legibility are linked by a common technique.* [...] *These logics of reading and seeing have significant import in the period, as we will see, because they recruit material texts for the construction and maintenance of antiblack racism and white supremacy in the years leading up to the Civil War.'* C Senchyne 2020: 127

icate world, similar skin complexions were obtained by veiling, while such ingredients as egg white & starch were used to whiten paper for affluent readers through extensive manual labor.[1] In conclusion, one should not forget the social factors behind the innocent-looking progress in legibility due to the increase of the contrast between script and writing substrate. ⇛ One reason the written word is not an achromatic world is the necessity to enhance contrast not only between text & page but also between various semantical & logical text parts, for which color contrast is used as a grouping & navigation device in addition to shape. Examples are red for the schoolmaster's corrections and interlinear Quranic translations, yellow for highlighting words, and red, yellow, green, & blue for marking vowels in early Qurans.[2] ⇛ The light-reflective quality of gold is a potent means to increase contrast, applied in Byzantine mosaics, the hour numerals on tower clocks in Prague, Bern, & other medieval cites, the sumptuous ninth/tenth-century Tunisian? Blue Quran & twelfth-century Japanese Blue Sutra (both written in gold on blue), & the gold-on-green eight-meter-high medallion in Istanbul's Aya Sophia praising Allah.[3] Further contrast enhancement may be obtained from a light-absorbing background, perhaps the material so porous that it traps light within it, thereby appearing black, imagined by the Baroque-era, feminist, scientist, science-fiction writer, lady-in-waiting, &c. Margaret Cavendish (née Lucas), Duchess of Newcastle (1623–1673).[4]

These examples suggest that maximizing legibility is a matter of prestige, afforded to comparatively few inscriptions. ⇛ The case seems different for computer & other electronic displays, whose early models covered the entire color spectrum — from black-and-white cathode ray tubes to the 'friendly orange glow' of plasma screens, the oscilloscope green, & the blue of the Commodore 64 home computer.[5] These color choices, however, have less to do with legibility (e.g., better visual sensitivity in the yellow–green range) & more with ad hoc factors such as costs, phosphor characteristics, or simply the 'Wow'-effect experienced by users.[6] ⇛ Even the issue of polarity is not settled: the predominant use of a white-on-black terminal window color scheme reflects both a community ethos among command-line programmers, and real legibility benefits (glare reduction).[7] ⇛ The strongest contrast is achieved by light-emitting writing, be it the minute digits of phosphorescent watches or the alluring nocturnal city lights. Yet even in such cases, full legibility remains unattainable: according to Jewish mysticism, the Torah received by Moses was fashioned from black and fires, one the legible realization of the divine text, the other a potentiality (white letters on white substrate).[8]

Definition 9. Contrast — *Legibility varies with the perceptual color contrast between text and background, and between parts of the text.* ⇛ NB: Our discussion of chromatic contrast is an intimation to study other light-related perceptual effects of legibility, considered at once constraints (e.g., glare degrades legibility) & solutions (e.g., polarized lenses reduce glare).[9] ⇛

1 Déroche 2006: 52–53

2 Déroche 2006: 222–224 ⇛ Text-to-text differentiation is a matter of readability, but insofar as it affects text-to-background contrast, it also concerns legibility. ⊂ Grandjean 1983: 101–120

3 Wikipedia: 'Basilica of San Vitale', 'Prague astronomical clock', 'Zytglogge', Fu 1986: 36, 68–69, 110, Blair 2006: 504

4 Vantablack (2014) is one such example of super-black pigments, based on carbon nanotubes. It became infamous for its controversial exclusive licensing to the artist Anish Kapoor. So much for improving legibility for everybody. ⊂ Cavendish 2004: 143, Wikipedia: 'Vantablack', McGurk 2017, Mead 2022

5 Dear 2017 [plasma screens], Wikipedia: 'Commodore 64'

6 Grandjean 1987: 13–15, 42, Dear 2017

7 Atanasiu 2021: 137, 151, Grandjean 1987: 14, 1983: 2, 128–142

8 Gilbert 2012: 186, 200–203

9 Atanasiu 2023

When considering script legibility the matter of shape most readily comes to mind, and it is easily forgotten that it assumes good lighting conditions to create sufficient contrast between script and background for optimal writing and reading. This issue was discussed above for writing produced by inking, omitting the less common but not less interesting case of 'dry script' obtained by incision and harnessing the interplay of light and shadows, applied in epigraphic inscriptions of all scales, from coins to obelisks. When Quintilian (c. 35 – c. 100) suggested swapping your wax tablet for parchment if you have weak sight, it is not so much the plain differences in script contrast that is remarkable but the radically different attitude to legibility between the two writing media resulting from how they use light.[1] The Roman wax tablet, and even more so the Mesopotamian clay tablet, are constantly reoriented in respect to the incident light to cast meaningful shadows in the three-dimensional script groves. In this process, the question of legibility is omnipresent and the readers grapple with it not only mentally, constantly making reading hypotheses, but also physically, literally manipulating it with their hands. One wonders if the intellectual alertness demanded by these technographical circumstances of yore translated to activities beyond legibility. Were stylus-wielding Sumerian scribes and Roman writers more cunning in navigating their respective worlds than the papyrus-clad Odysseus? Perhaps it is not incidental that the convergence of rebus-like phonetic and pictorial principles was so often at the origins of writings originally produced by incision. ⇻ A further legibility-related dimension of epigraphy is its aesthetic and spiritual dimension, deriving from the metamorphosis of script shapes and the text's legibility and possible meanings under changing lighting conditions.[2] As the morphology of public monumental inscriptions varies with the sun's position during the day and along seasons, as it becomes pixelized by mist, raindrops, and snowflakes, writing is no longer bound to the stone's gravely embrace and seems to come alive, if only as a memento mori addressed to the passerby, its ghostly effect increased when the moon's rays reduce inscriptions to achromatic bare bones at night. Light is also the catalyst in the interplay between the mineral and the living, with script and legibility their medium, nowhere metaphysically so appropriate as in funerary texts. A source of energy, light has a vivifying effect, even the power to resurrect decrepit inscriptions. For evidence, look at the shady side of epigraphs, where moist green moss embedded in the porous gray stone reveals writing that creeping yellow, livid, and rusty lichens seek to obliviate.

Schlosshalde cemetery, Bern, 2022.10.30

[1] Quintilian, *Institutes* 10.3.31; Quintilian 2006

[2] On light in architecture © Valero Ramos 2015. Carved windows with lace-like geometric and calligraphic motifs, sometimes inlaid with polychromatic glasses, a hallmark of Islamic architecture, let one experience first-hand the effects of projected dynamic light patterns that resemble golden tattoos, dancing across walls, floors, and people in a fascinating lumigraphic display.

***Not marble, nor the gilded monuments / Of princes shall outlive this powerful rhyme; / But you shall shine more bright in these contents / Than unswept stone, besmeare'd with sluttish time. When wasteful war shall statues overturn, / And broils root out the work of masonry, / Nor Mars his sword nor war's quick fire shall burn / The living record of your memory.* — Thus the Bard proclaims the superiority of the living word over the lapidary letter, still audible after the other became illegible. ⊂ Shakespeare, *Sonnets*, 55. Pictured is a plasticine tablet inscribed with the word */wgrapia/* 'Ugraphia' in Ugaritic cuneiforms, viewed from different illumination angles. Note the materialization of the words 'shake' and 'spear' in the bottom image (< long wedge < *cuneus* [Lat.]). Wikipedia: 'Ugaritic alphabet'; https://www.archaeform.de**

V01C3

Times and Helvetica let you hear the impersonal language of bureaucracy when arriving by post in your mailbox. A handwritten letter, however, may evoke the sender's own voice as if present across time and space. This cinematic voice-off illusion is reinforced when the inscribed object speaks directly to you: the stabbed tree telling Juliet that Romeo loves her, or the proclamation commencing with the collective utterance of 'We the People', or the sarcophagus accosting you on one of Rome's *viae* for a chat with the dead: 'You wanderer of these roads, put down for a while your labors here. Why such haste?'.[1] (For the Ancients, inscriptions were like vinyl records and readers like gramophones, reflexively compelled by the mere presence of writing to move their visual rays in the letter groves and lend their voices to the silent text.) Standardization of handwriting and print alike kills the script's individuality and the writer's voice as mouthed by the reader, casualties in the pursuit of perfect legibility.[2] Must silence or white noise or, God forbid!, the bubble of one's own voice, be the sound of Ugraphia? We would surely go mad!

1 On 'talking objects' in Ancient Rome ⊂ the enlightening study of Valette-Cagnac 1997: 73–109, 79 [quote].

2 The muteness of writing has bothered thinkers since its inception, as the auditory dimension is part of its nature, most systems requiring some level of grapheme-to-phoneme conversion. Ancient Greeks, and Muslims too, were proficient detractors of writing by way of the aural argument, in contrast to the utilitarian attitude of Romans , who were more inclined to see writing as a dispassionate instrument of communication and recording. As for the Japanese, the epigraphs may content themselves with silent reading, as erroneous kanji spellings are common, especially for personal names, due to multiple readings of the same sinogram. ⊂ Desbordes 1990: 77–100, Taylor 2014: 313–314, 320 ⇗ Reconstructing the sound of a defunct language or ancient pronunciation from its written form is notoriously hazardous. However, if the writers' voices remain veiled, what has often been preserved on soft writing media are their fingerprints.

P3RC3PT10N

Take a pen, might it please you, and carefully mark by sight the center of this page. ——— Now measure with a ruler the deviation of the optical center from the geometrical: in all likelihood, it is offset upwards and leftwards. ⇗ The phenomenon is known in psychology as the 'line bisection bias', and generalizes to the perception of depth and time (spacetime is perceptually inhomogeneous), to the tactile modality, is also documented in non-human species, and varies with a host of factors, including writing direction, handedness, age, sex, and certain pathologies; its causes are sought in particularities of the functional brain anatomy (e.g., lateralization) and ecological adaptations.[1] The bisection illusion is well ingrained in the practice and theory of typeface design: horizontal midlines are slightly above the geometrical center (H vs. H).[2] More needs to be done to accommodate a special class of readers: those with dyslexia. Individuals with left-neglect dyslexia tend to misread the first half of words; disgrazie ('woes' in Italian) becomes grazie ('thanks'), for example.[3] If letter spacing is progressively increased (D I S G R A Z I E), a significant error reduction is achieved for both horizontal & vertical word presentation.[4] While calligraphers, typographers, & software designers invest considerable effort in making text blocks as regular as possible, not all reader demographics might benefit from this isotropy. The solutions are heavily technology-based, such as scrolling texts that contract as they advance laterally, and more complicated for entire pages, where eye tracking might help.[5] ⇗ It is reported that the prevalence of dyslexia is up to 12% in the English speaking world, in stark contrast to the less than 1% among the Japanese, and close to the 3% among Italian speakers.[6] The granularity and transparency hypothesis suggests this is due to the non-intuitive English orthographic mapping of images to sounds at the level of individual graphemes and phonemes.[7] This is an elegant demonstration of how nonvisual factors (orthography) affect legibility, of which many further examples are offered throughout this volume. In fact, it is a trick of the senses — the flow of pixels speeding in 13 ms from the retina to the cortex through which we interface with reality in a highly visual manner[8] — to believe that legibility is merely visual perception. ⇗ What do lateralization and the many, many other perceptual phenomena reveal about script legibility progress?[9] They expose yet another aspect of the Procustean impossibility of a script suitable for all. Whether this knowledge will translate to actual script changes, only time will tell. The failures of theoretically superior technologies to gain market acceptance — surely you could switch to other keyboards than QWERTY on your smartphone, should you wish to do so — are reminders of the vagaries of progress in matters of script.[10] So much so that beyond percep-

1 Jewell 2000, McCourt 1997, Koenderink 2013, Chokron
2 Hochuli 2015: 18–19 [2009
3 Ellis 1994
4 Savazzi 2004
5 Geminiani 2004

6 Makita 1968 [Japanese], Wydell: 2012: 1 [English], Brunswick 2010: 141 [Italian & other languages], Taylor 2014: 150–152 [writing systems affect dyslexia type: morphosyllabic systems, such as Chinese, depend on visual more than on phonological processing, contrary to phonetic systems, such as English], Paulesu 2001 [cultural diversity and biological unity in dyslexia]

7 Wydell 1999: 280–282, Daniels 2017 [critique]

8 Potter 2013 [speed], Koch 2006 [bandwidth: 8.75 MB/s]

9 Beier 2017 [a trove of visual perceptual effects related to type design], Jamra 1993 [perceptual type design], Cheng 2020 [letter-by-letter studies], De Waard 2019 [thickness illusion]

10 QWERTY has been shown to be near-optimal to avoid typewriter jamming; despite the fact that QWERTY is optimized to English letter frequencies, and that virtual keyboards can be individualized in up to ~10^{54} combinations, QWERTY variants remain the global dominant layout, irrespective of slower typing and greater fatigue. (Serial expatriates have learned to switch between QWERTY and AZERTY, adding extra spice to life.) The following remarks on keyboards may have been made about leg-

tion looms the motor system, and memory beyond it. ⇛ Before moving to the next section, I would like to bring up a fascinating and underexplored aspect of legibility that straddles perception and PH3N0M3N0L0GY. I will do it from a personal empirical point of view. To properly learn a new script, it is not sufficient to copy models: my introspection tells me that I seek some abstract attributes of the shape — such as angularity, irregularity, dynamics, and force — that help me build the 'character of the character', a persona. Thus, the hiragana か *ka* is as assertive as a monkey, ひ *hi* is as fat as a Daruma good fortune doll, ん *n* has the agility of a hare, ね *ne* looks like a cat, and む *mu* is impossible to draw. Once I have figured out how I experience a shape, I have a reference, which allows great flexibility during production. A caricaturist does the same when probing a face and its owner for their defining characteristics, and the practitioner of spiritual archery does it when seeking the state of mind necessary for the perfect target hit. 'Building characters out of characters' is not a vacuous literary gesture, it is an existing pedagogy for learning the thousands of Chinese characters by facilitating their imprint in memory through storylets about each.[1] In a more abstract way, you may consider shapes as the memory of the processes that generated them: a U-shape is a bent I, a T is the assemblage of ¯ & I, and X may be two overlapping sticks \ & /, two colliding arrows ^ & ˇ, four converging short sticks ⤫, or a cross sliced into the paper.[2] The perceptual–phenomenological attractor states exist in the learning-to-write process, as well as in reading. Is ϑ an unidentified character (a fancy V, perhaps) or the digit 2 maliciously rotated counterclockwise by 45°?[3] These are just some of the multiple stable perceptual states afforded by the shape above.[4] Its legibility depends on finding the correct mental template of the stimulus. — And you, do you see the same things in the above shape? What do you feel when transitioning between different points of view? ⇛

ibility: '*It becomes apparent that there is a wealth of literature concerned with reforming the QWERTY keyboard, which has resulted from an immense amount of thought and work. It is unfortunate that the majority of these keyboards never passed the stage of being patented. Rearranging the letters of the QWERTY layout has been shown to be a fruitless pastime, but it has demonstrated two important points: first, the amount of hostile feeling that the standard keyboard has generated and second, the supremacy of this keyboard in retaining its universal position. The question then arises as to why previous research has not made any impact on the design of the standard keyboard.*' C David 1985 [sparks the Dvorak controversies], Noyes 1983: 274 [quote source; compendium of keyboards phylogenesis], Liebowitz 1990, 2013, Margolis 2013 [contra the QWERTY myths], Kay 2013 [advanced arguments against the QWERTY myths], Arthur 2013 [retrospective article on the debate; what matters is not the veracity of the example (QWERTY sub-optimality), but the bigger picture for which it stands for (the idea that the market is right)], Liebowitz 2001 [further examples of myths]

1 The method was popular in premodern Japan and adopted by modern Western educators addressing second-language learners. C Inagaki 2006: 239–240 [Japanese example utilizing moji-e], Rose 2013 [evaluation of the modern methodology]

2 Leyton 1992 [book blurb: 'In this investigation of the psychological relationship between shape and time, Leyton argues compellingly that shape is used by the mind to recover the past and as such it forms a basis for memory.']

3 So-called 'multistable stimuli' are a rich source of visual illusions. Well-known examples are Anonymous/Wittgenstein's duck/rabbit (1892/1953), Gilbert's woman/skull (1892), Rubin's profiles/goblet (1915), Hill's young/old lady (1915), and Dali's naked women/skull (1951). One of their characteristics is that only a single state can be perceived at a time, hinting to why sometimes the identity of letters is elusive, and when the solution is found, it may elicit a '*Wow!*'. Within this context, it may be pointed out that, despite its claim to ideal transparency, even the notorious Crystal Goblet of typography is ambiguous, given that it may be read as two profiles. C Kruse 1995, Pisarchik 2022

4 It is easy to forget that script characters are defined not solely by shape but also by orientation, size, and other graphical features. Some people are apt at visual mental manipulations of shapes, which may enhance their legibility performance. Other people are exceptionally flexible, such as those young children who write mirror-reversed letters of the alphabet with great innocence. C Pinker 1997: 275–284, Dehaene 2009: 263–299 and 2010, Maikita 1968: 605

te て hair knot
i い eye
ka か face profile

Hallucinogenic writing

—

On this page, the hiragana characters of the Japanese first name Teika ていか have been fused into single shapes resembling a human head. This graphical curiosity is called 'picture in writing' *moji-e* 文字絵 and has been practiced since the Heian times (794 – 1185), with various entertaining variations, such as hiding characters in paintings, pareidolia-like, and morphing objects into the shape of letters, Arcimboldo-like (a modern Japanese gastrographic variant by the graphic artist Koichi Kosugi represents sushi plates with the hiragana characters of their names instead of their customary pictures on restaurant menus). While all twelve anthropomorphic words represent the same anatomical entity, each hypostasis has its own personality and attitude. In Arabic calligraphy such exercises of the pen, *mashq*, have become a venerated style in itself, demonstrating the creative richness that lies beyond ordinary legibility, Rorschach-like. © Brisset 2009, 2018, Inagaki 2006, Sumeshiya 2023

There are other aspects to the link between facial appearance and writing in addition to playfulness and mysticism. At the terminological level, English uses the words 'typefaces' and 'characters'. The link also has direct bearing on legibility in respect to character identification and memorization, which will be discussed here. The issue concerns the distinguishability of small morphological differences, which especially affects writing systems using large character sets. One solution involves leveraging the receiver in the legibility system, that is, the human visual system. As it turns out, vision is anisotropic, meaning that detail levels are not uniform, not only in terms of the visual fields – with the fovea area providing the highest resolution – but also in terms of the object viewed. [1] In this respect, humans are, generally, able to distinguish and memorize a large number of individual faces and interpret a similarly large variety of subtle visual expressions. [2] While prosopagnosia may impede mental face processing, some individuals – superrecognizers – are especially gifted in memorizing faces. [3] Within faces, it is the eyes that are looked at most frequently, and hiding them — in print by black bars or pixelization and in reality with masks — is an anonymization technique. [4] This peculiar object-specific hypersensitivity is important socially, emotionally, and health-wise – and potentially improves legibility when the morphology of written characters imitates that of faces. Such is the case with the Mayan script, in which cephalomorphic glyphs abound. For example, the numerals of the Mayan base-twenty system may be written using abstract combinations of dots and lines or archetypal representations of their tutelary divinities' heads. [5] Iff face-characters are indeed more distinguishable than abstract characters, then the Mayan script is advantaged. The same applies to the more recently invented emoticons (aptly named 'prosopograms' *kaoji* in Japanese), [6] and the Chernoff faces that are used for multidimensional information visualization and encode data categories and magnitudes via the size and shape of the head, eyes, eyebrows, mouth, nose, etc. [7] The longevity of the former — circa fourth century B.C.E. to circa seventeenth century C.E., perpetuated to this day from Mexico to the Andes in the form of pictorial catholic catechism aide-memoires — and the popularity of the latter are tokens of their success. [8] They testify to a further function of 'face-types', that of overcoming the arbitrary and abstract natures of writing and script as impediments to the acquisition of literacy. It has been rightly noticed that the first writings of humanity had a strong pictographic component underlining the universal tendency for figurative written communication. [9] The history of this perceptual legibility mechanism represents a case of legibility optimization ad originem, followed by a 'Fall' from this 'El Dorado', so to speak, and a recent partial resurrection.

1 Anisotropy is a general characteristic of the senses, the somatosensory homunculus diagram being a basic teaching aid in psychology, and representing the human body distorted by the variation in sensitivity, the fingers and the lips being disproportionately large. C Saadon-Grosman 2020, Boff 1988: 118–119

2 Rhodes 2011

3 Sacks 1998: 8–22, Russell 2009

4 Birmingham 2007

5 A bust purportedly of the God of Zero perfects the naturalness of the figurative Mayan numbers, making them even more memorable than bas-relief carvings. C Macri 1985 [study], Macri 2003: 22 [list], Blume 2011: 55 [statuette]

6 However, texts written entirely with emoticons remain exceptional. Bing Xu's 120 page opus *Book from the Ground* is one well-known example, another being the emoji-edition of Jane Austen's *Pride and Prejudice*, surprisingly well suited to its reimagining in the era of instant messaging. C Xu 2014, Austen 2016, Wikipedia: 'Emoticon'

7 Chernoff 1973

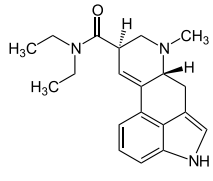
8 Gaillemin 2018

9 Hoppan 2018: 67

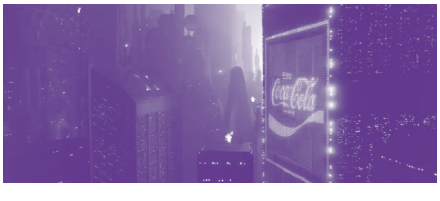
Above: Maya numerals head variants. C After Macri 2003: 22

PSYCH3D3L14

Peter runs frantically through the Manhattan night. He has survived Second World War concentration camps, escaped communist Hungary, and arrived as a stowaway in New York harbor. It is 1953, and the Iron Curtain has fallen across Europe. Peter runs among the evening crowds, underneath dizzying neon lights advertising bars, restaurants, hotels, and a cornucopia of merchandise. The police is on his heels. He must find Tom, an ex-soldier and jazz player he saved during the war, to obtain his testimony and avoid being deported. The urban frenzy mirrors his turmoil and his longing for felicity. He doesn't grasp all the words rushing by between glimpses. The street signs swirl around kaleidoscopically, superimposed on close-ups of Peter's face, street cars, people, and bands of musicians, rhythmed by jazz beats. We are in the noir movie *The Glass Wall* (1953) and experience through the camera eye and post-production ingenuity the masterful modification of legibility parameters — speed-ups, orientation changes, distortions, layering, and fading — to create sensorial overload and bring about a sensation of awing visual intoxication by flashing words. Like no other medium before — excepting chocolate letters, perhaps — cinema has transformed legibility into a psychedelic. As such, it is a lure, true to the essence for Ugraphia. *Blade Runner* (1982), the science-fiction movie iconic for vesperal and exotic lettered advertisements, says as much about the role of script in a dystopian world.



Skeletal formula of Lysergic acid diethylamide (LSD), $C_{20}H_{25}N_3O$ © Wikipedia: 'LSD'



Script shape is not ruled by an exclusive evolutionary drive for better legibility (if it were, the number of scripts and styles would dwindle [1]), but also results from the constraints of human kinematics and a desire for easier, faster writing. This motor factor (writing) restrains scripts from being adapted to the sole benefit of visual perception (reading). The observation is particularly cogent for *stenography* [2] but applies as well to the evolution of longhand (frequent characters undergo simplification).[3] Most writing cultures have also developed a range of styles along a continuum from formal scripts, geared towards visual processing and legibility, to cursive scripts, optimized for production. Notwithstanding that typing speed is a prized quality of typesetters [4] and secretaries, and lead to many text input technologies and SMS abbreviations, hand and finger movements are arbitrarily associated with the resulting shapes. Thus, mechanical printing and data entry enforced the dominance of the visual and the remote, the *tele*-vision, over the unmitigated corporal interaction, the happening, and further transformed handwriting producers into consumers of ready-made fonts selected from software application menus.[5] New technologies (the digital stylus, virtual ink, e-paper) have the capability to facilitate a return to ductile interfaces & fluid scripts of older technologies (fax, still popular in Japan and among medical doctors for writing convenience [6]). With an eye on this spectrum, the educationist and handwriting researcher Rosemary Sassoon writes about graphical needs in the computer age as follows: 'The concept that only neat handwriting is acceptable and praiseworthy dies hard, yet it is fast handwriting that pupils need'.[7] In nineteenth-century America, it was hoped that both speed & beauty could be achieved by following the chirythmographical method, which consisted in using a metronome as a teaching implement to develop rhythmical writing movements.[8] The Montessori method advocated the development by children of a motor memory of hand-written characters before imprinting with their visual shapes, using the striking practice of tracing sandpaper letters with the fingers while blindfolded, which was 'kept up long after the children are able to write, and in fact they write more by muscular sense than by sight'.[9] ⇈ A *social* dimension to the kinematics of writing is suggested by the Chinese characters, endowed with a canonical stroke order. Just as a Latin script writer might be embarrassed by an orthographic error, so might a writer of Chinese characters lose face by making a ductus error. We could extend the modality gamut beyond kinematics and consider that the *emotions* imparted by the script content also affect legibility, an aspect well beyond the reach of the script producer.[10] Synesthetes would furthermore contend that the phenomenal experience of script as *sound*, *color*, *taste*, or *heat* impacts its legibility.[11] The question I am asking is not so much that

1 Like languages, scripts go extinct, often not for technical reasons (e.g., legibility): the rise and fall of cuneiform, Egyptian hieroglyphs, or Mayan script were all tied to the fate of the empires they served. The same fate will befall Latin, the universal script of computer programming. C Baines 2008

2 Greene 2022 & Tursi 2015: 75–81 [speed of court stenographers]

3 Daniels 1996: 814

4 Rumble 2003 [typesetting speed competitions]

5 '*Handwriting was increasingly being seen as a visual activity, and being confused with the letter-recognition aspect of reading. Apparently little thought was being given to the consequences.*' C Sassoon 1999: 70 ⇈ Indeed, legibility psychology and design is by and large unconcerned with writer performance.

6 Coopersmith 2016

7 Sassoon 1999: 141

8 Spencer 1866: 143–145

9 Smith 1912: 28–31, Gilet 2011 [action–perception model]

10 Kuperman 2014 ⇈ Satire printed in Times New Roman is funnier than that set in Arial. C Juni 2008

11 Dzulkifli 2013 [color may improve text memorization]

This is not blindfolded Justitia objectively evaluating the legibility of a typeface, but a child tracing sand-paper letters, demonstrating the Montessori multi-sensory method of learning to write. The picture was commissioned by Carl R. Byoir (1886–1957), pioneer of public relations and early American promoter of Montessori schooling. © Canfield Fisher 1912: 86

of whether these factors have an adverse impact on legibility, but is rather more concerned with whether aspects such as *pleasure could compensate for mediocre legibility by facilitating recognition*. In a slightly different context, the writer and fighter pilot Antoine de Saint Exupéry (1900–1944) wrote on behalf of a little prince, 'It is only with the heart that one can see rightly.'[1] ⇛ When I perform calligraphy and arrive at a stage in which I feel the motion of my fingers like a small-scale choreography (a 'chirography'), and an auditive rhythm taking shape in my ears, I know that the result stands a chance of being high-quality. The eurhythmic mind flow and bodily pleasure derived from graphical design is both a potent and addictive incentive to script creators and a source of inspiration for contemporary dance.[2] A Wagnerian Gesamtkunstwerk may not be required for the public to enjoy what is known to psychology as illusory motion and auditive experience; simply contemplating ancient or modern calligraphy in a museum or a gallery urges the limbs to move and the tongue to hum, as though one has caught the faintest glimpse of a distant dancing party.[3] ⇛ The parallel drawn here between the activation of the motor cortex by auditory stimuli and motor–visual activation has been observed for script, with fMRI scans showing a stronger activation of the cortex and other areas during reading of handwriting than when reading printed text.[4] Perceptual studies suggest that knowledge of shape production improves their recognition.[5] Aside from insights into the kinematic aspects of script perception, there are also a number of interesting questions that arise from *neuroimaging* studies: for example, is the localized neural activation by typefaces indicating a faster character recognition, or is the broader and more complex activation by handwriting a sign of better recognition?; also, could it be that typeface designers, who spend long periods mentally creating and manipulating shapes, experience motor effects similar to those resulting from the perception of handwriting? is there a difference in neural activation between designers who work with pencil and paper and those who draw with digital interfaces & displays?[6] ⇛ Calligraphers (in premodern times secretaries & copyists rather than what we term 'artists' today[7]) and typeface designers (artisans related to the world of engravers, and later industrial typography[8])

1 Saint Exupéry 1995: 139

2 *'Each of my designs is a new exploration of the rhythm that visualizes motion'*, says Kris Holmes, type designer (of Isadora and Apple Chancery inter alia) and trained modern dancer. 'Cursive' is a production of the Taiwanese dance group 'Cloud Gate' inspired by Chinese calligraphy. **C** Stock-Allen 2016: 41–42, Chen 2009, Wikipedia: 'Cloud Gate Dance Theater'

3 An 'induced' kinesthetic artwork of renown is Roy Lichtenstein's *Whaam!* (1963), which exudes the kinetic power and explosive decibels of an aerial dogfight between rocket-armed fighter jets. The impressive fact is that it is all an illusion: the work is a painting in which nothing moves or resonates — as much Pop Art as Op Art. **C** Wikipedia: 'Whaam!'

4 Longcamp 2011, Caliguri 2012 [handwriting neuroscience]

5 Freyd 1983

6 More generally, the mental representation of script with eyes closed, in dreams, or experienced by synesthets as subtitles to speech are fascinating in respect to script styles and their legibility. **C** Hauw 2023

7 For the artistic status of calligraphy producers in medieval Middle East **C** Atanasiu 2003a.

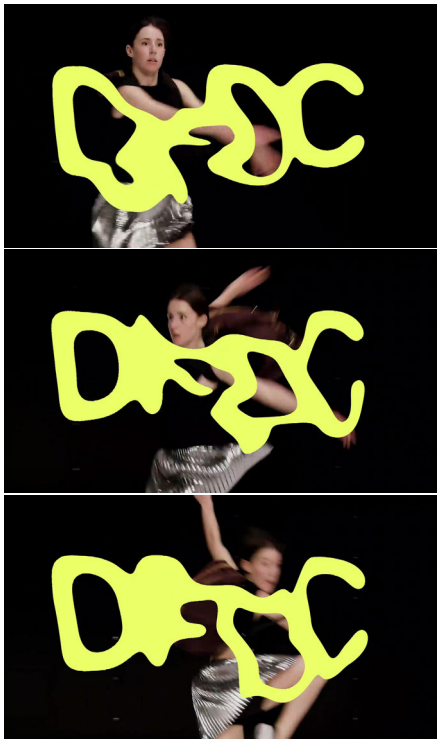
8 Gutenberg, of course, was a goldsmith, as was Dürer (in addition to being an engraver, painter, and Antiqua and Fraktur letter designer); in contrast, many Italian Renaissance and Baroque calligraphers, who were also involved with the printers of the time, worked as secretaries for the Papal and princely administrations, or (like Michelangelo [1475–1564]) were architects, to this day a profession with a predilection for lettering. Machine printing and industrialization nourished the utilitarian character of typography and lettering, as in the familiar shapes of the London Underground typeface, the Charles de Gaulle airport public signage, or those of the Bauhaus movement, unapologetically devoted to scripts selling plumbing and toothpaste, to the dismay of William Morris (1834–1896), Eric Gill, and their Pre-Raphaelite kin. **C** Kapr 1988, Mediavilla 1996, Wardrop 1963, Morison 1990, Hollis 2006, Kinross 2010, Wikipedia: 'Johnston (typeface)', 'Frutiger (typeface)', 'Futura (typeface)'

are a specialized sector of society who are largely responsible for what are considered canonical script styles: those, used in books and official documents, displayed on public buildings, & taught in schools, from the Antiqua to Fraktur & Sütterlin [Sütterlin] & DIN stencil lettering, from the Arabic *thuluth* to the Persian *nasta'līq*, from the Chinese seal script *dazhuan* to the sutra script *kaishu*.[1] One can therefore wonder about the extent to which what we conceive of as legibility is not in fact an induced *multimodal* property of script. Type historian Harry Carter wrote about eurythmic kinematics as unexpected sources of legibility: 'I think [the Schwabacher script] is comfortable and pleasant to read because it looks as though it had been delightful to write.'[2] If this hypothesis holds up to scrutiny, then we can speak of optimal legibility only in the way that dance and music are pleasant and appropriate to a given ear, time, and place (nowadays we tap-dance on computer keyboards, while our grandparents waltzed their penmanship): there are no fewer than seventy-two possible optima, as many as tongues after Babel; indeed, an infinity.[3] — Which brings us to the next psychological factors on our list: memory & its prelude, learning.

1 Sütterlin was a handwriting style taught in German schools during the early twentieth century. DIN scripts, named after the German norming organization Deutsches Institut für Normung, were part of the German public signage landscape and defining implements of technical drawing classes, in the shape of stencils or Letraset dry transfer sheets. C Wikipedia: 'Sütterlin', 'DIN 1451'

2 Carter 2002: 57

3 Seventy-two equals sixty plus twelve, which in kabbalistic terms stands for 'beyond the countable'; that is, 'infinity'. The rationale is rooted in the Sumerian base 60 arithmetic, possibly devised for time-related measurements in astronomy: 60 represents the great whole, 12 the minor whole, and together they form an unspeakable great magnitude. Somewhat similar is the plural that starts after two in Indo–European languages, seven (as in the Seven Wonders of the Ancient World), thirty-six (as an expression of numerosity in French; 'trente-six' is roughly equivalent to 'umpteen'), and one thousand and one (as in *1001 Nights*; albeit here in base 10). C Powell 1972



Imagine words that became animated — morphing this way & that, perhaps smiling, blushing, and turning their eyes away, shouting at you, or whispering while you read them. Animated typefaces, named 'livefonts', have been developed experimentally for improving legibility on small display devices, especially for users with low vision. This idea also extends the basic scope of legibility as the correct retrieval of words from written shapes, by letting characters encode other meaning-conveying dimensions, *speech prosody*, for example, as in the Prosodic Font, which maps loudness to character size, and rising pitch to diminished character width and weight (avatar of Massin's 'sonic calligraphy'); or *body movement*, as for the above dynamic logo of the Dresden Frankfurt Dance Company (DFDC). Such visual communication imposes new criteria of legibility that designers need to discover and readers to learn. In *kinetic typography*, temporal medium, meaning is essentially fleeting & multiple, similar to reflections on water. C Bragg 2017 [livefonts], Rosenberger 1998 [Prododic Font], Ionesco 1966 [Massin]; choreographic logo: DFDC 2023 [dance company], Any Studio 2023 [logo designers], Parent 2023 [dancer]; kinetic typography: Geisler 2023 & Motion Together 2023 [fonts in action], Bellantoni 2001 [panorama], Brownie 2014 [study], Cho 1999 [technologies], Dietzmann 2003 [methodology], Scheffer 2014 [script *as* and *in* cinema], Khajavi 2019 [Arabic script]

Korean newspapers found it advantageous to use Chinese characters (hanja) in headlines because they take less space than equivalent Korean concepts written in the Korean phonetic script (hangul) and are read faster.[1] However, this practice has declined since the 1960s, when hanja began to be periodically untaught in schools.[2] As these circumstances illustrate, legibility not only depends on mastering a script system but also varies with reading proficiency, with experts having lower recognition thresholds.[3] Therefore, legibility is not entirely a reflexive response to stimuli; it is also a skill acquired and perfected through learning and practice. Thus is fast reading explained, the eye's stenographic sprint in chase of meaning from one predicted location of an essential word to the next with ever longer strides increasing with oracular expertise, until the gaze leaps off-page, freed from the ensnaring reality of the text.

Definition 10. Skills — *Legibility is not entirely a reflexive response to stimuli; it is also a skill acquired and perfected through learning and practice.*

1 Taylor 2014: 223–227
2 Taylor 2014: 176–179
3 Taylor 2014: 231–233, Wiley 2019

Learning to read consists in creating a binding between a visual stimulus and a certain response to it, or (to use the linguistic terminology) between signifier and signified. Legibili-

Definition ii. Retrieval — *Legibility is a measure of the performance of storing in, maintaining in, and retrieving from memory the identity of written characters.*

ty is thus also a matter of memory, the ability to *re*-cognize, a notion leading to a new definition of legibility.

Definition ii. Retrieval — *Legibility is a measure of the performance of storing in, maintaining in, and retrieving from memory the identity of written characters.*[1] ⯮ The questions we will now turn towards concern the means by which this binding is realized and what the matter might tell us about the perfection of scripts. We proceed by keeping in mind that whatever is in the memory of the reader does not affect script in its materiality; rather, it represents our perception of it. ⯮ The first observation is that transferring the shapes of writing to memory is difficult, and that this difficulty stems from their abstract nature: that is, the absence of apparent meaning. Investing characterless characters with meaning — *semantization* — is an operation that is carried out along various dimensions. For instance, relating a visual shape to the *motor program* necessary to produce it, as previously discussed, can help with its recognition: we experience different movements from perceiving different static shapes, as we think shape in terms of action.[2] We can also better infer the identity of characters in phonetic writing systems when similarly *sounding* characters also share visual commonalities ('f' sounds and looks like 'ſ' [archaic long s]). Bauhaus engineers of the 1920s did indulge in the haphazard activity of constructing 'phonetic alphabets', although their technocentric idealism may have made them oblivious to the fact that the mimetic adequacy between form and content is one of the oldest explanations of the origin of writing.[3] The usefulness of this principle becomes more evident when considering that even silent reading leads to the low-level activation of phonatory muscles or of the motor cortex (at times, you feel the tongue moving as you read).[4] A refined variant, surprisingly enjoyable to read in large amounts of text, is Philipp Stamm's Phonogramme typeface (1995), in which otherwise individually written characters of diphtongs & triphtongs are fused: äuchckdteieuiephpfngquschsttz .[5] It also comes as

[1] This definition is more precisely a corollary of definition 1, qualifying character identification as a retrieval process that takes place in the brain. As was mentioned at that point, the nature of that which is retrieved is variegated and depends on the writing system: for example, the reading of alphabetic writing, such as Latin, retrieves *sounds*; reading logograms, such as '©', retrieves *concepts*; for their part, emoticons may induce *emotions* :-) .

[2] Knoblich 2002, Noë 2004

[3] Stamm 1997: 10 – 15 [samples], Kinross 2011: 238 – 239 [discussion], Eco 1995: 82 – 84 [ancestors]

[4] Pollatsek 2015

[5] Stamm 1997, Meier 1999 [novel composed entirely in Phonogramme] ⯮ Phonogramme was specifically designed for the

no surprise that during the early stages of the introduction of writing in Greece, when reading happened aloud, script was seen as meaningful only insofar as it stimulated the production of sounds, which were the true source of intelligence.[1] At any rate, letter cantillation — forward and backwards and in pairs — has been since antiquity (Greek, Roman, Jewish, or otherwise) a favored method of learning the alphabet by rote in elementary school.[2] ⇛ Another method is to *name* the shapes. The letters of the Latin alphabet are designated by near-bestial vocalizations (*Ah*, *Bee*, ...), thus in contexts where their discernibility is critical (such as civil and military radio communications), they have been given meaningful names, like 'Papa', 'Tango', 'Juliet' in the NATO phonetic alphabet, 'Tell' and 'Sempach' in the Swiss military, 'Zeppelin' in the German Reich, and 'Omnibuso' in Esperanto. Greek letters have real names ('alpha', 'beta', and so forth), although their Semitic etymology was opaque to Hellenes (A = 'ox', B = 'house', etc.). This provides the comic material for the now-anthological fifth century B.C.E. play of the Athenian Callias, *Alphabet Revue*, in which the chorus sing-songs all two-letter combinations and mimes their shapes through dance, as if they were somehow deeply meaningful, thus parodying the work of tragical poets.[3] The Japanese solution to this problem was not to name each character individually, but rather to compose a pangramic poem out of the *kana* syllabary bits, the elegiac *Iroha*, so that these could be properly remembered and duly ordered in a dictionary: 「Even the blossoming flowers いろはにほへと /Will eventually scatter ちりぬるを /Who in our world わかよたれそ / Is unchanging? つねならむ」[4] In addition to sharing many of the general problems of universal communication systems, such as sociocultural relativity, these eminently practical naming schemes in the phonetic domain share with script legibility their function as discriminance maximizers; they also use semantization as mnemonic. Morphographic writing systems have no need for artificial naming: the Chinese character 中 is referred to in words as 'middle', which has natural meaning (in contrast with 'U+4E2D', the Unicode used in communication within computer systems). ⇛ A more elaborate binding involves the *stories* and *myths* that explain how script characters got their shapes. The fourth-century Chinese calligrapher Wang Xizhi is said to have written

current German orthography, and would also be practical in other languages where di- and triphthongs appear, such as Italian ('gli' = [ʎ(:)]); Dutch would also benefit, to make clear when two visually distinct juxtaposed shapes 'ij' are to be read [i] + [je:] or [ɛɪ], as in 'Nijmegen'. The Phonogramme design took into consideration the continuity with existing character shapes, distinctiveness from other characters, and harmony of the overall script pattern. Psychophysical evaluations and feedback from the population of the good city of Basel were overly positive. The example of English orthography — often with little phonetic one-to-one mapping, as the Victorian joke of 'potato' spelled 'ghoughphtheightteeau' illustrates, and therefore somewhat less amenable to solutions such as those implemented in Phonogramme — shows how decoding script is a tributary of language, orthography, and all the factors impinging on them: historical (the mix of words of Germanic, French, and Latin origin), cultural (ideologies reflected in theories of writing), social (politics of writing), scientific (knowledge about language), technological (flexibility of handwriting vs. constraints of printing), economical (character set size and typesetting duration and complexity), subjective (design of characters), and more. C Zimmer 2010, Wiktionary: 'ghoughphtheightteeau' [fr]

1 Svenbro 1993: 160–186

2 Bonner 1977: 166, Perlow 1931: 57–59

3 Athenaeus (170–223), *Deipnosophists* 10.453–454, Athenaeus 1959–1971 (4): 555–563 [source], Ruijgh 2001 [play content and context], Johnson 2015: 137–143 [various rationales], Rosen 1999 [debates issues], Smith 2003 [on play title], Slater 2002 [other oral descriptions of letter shapes in Attic drama], Dante, *Divine Comedy*, Paradise, canto 18 [the alphabetic choreography is an evergreen literary topos: in Dante's *Divine Comedy*, paradisaical spirits draw hymns as they dance across the Heavens]

4 Gordon 1973, Arciuli 2010, Wikipedia: 'Acrophony', 'NATO phonetic alphabet', 'Buchstabiertafel' [de], 'Cockney Alphabet', 'Iroha' [*Iro ha nihoheto Chirinuru o Wa ka yo tare so Tsune naramu* [...]]

the Chinese characters in the shape of the geese on the back of which Daoist monks came from the Heavens to visit him.[1] Perhaps as part of the cultural dowry legated to Persia by the Eurasian Mongol Empire, the ne plus ultra of Persian calligraphers, the fourteenth-century Mīr ʿAlī Ṭabrīzī (d. 1446), also created the *taʿlīq* style from the shapes and proportions of the body parts of geese, after being instructed in a dream to do so by ʿAlī (c. 660 – 661), Prophet Muḥammad's son-in-law and a central figure of Shiism.[2] At around the same time, the European Renaissance graphic artist Geoffroy Tory explained that all Latin letters, originating from Attica [*sic*], are issued from 'I', which has been 'fantasized out of the flower of a lily of purple color';[3] the lily, of course, has Marian significations, and the fleur-de-lis is a symbol of the French monarchy. The shapes and rhythms of the natural environment are inexhaustible sources of calligraphic inspiration to the sensible soul: ' The opal, quartz and ammonite, / Gleaming beneath the wavelet's flow, / Each gave its lesson — how to write'. The purpose of this transcendental rhapsody of the alphabet's genesis — written by Platt Rogers Spencer (1800 – 1864), the creator of the eponymous American method and style of penmanship — was no less than the moral and spiritual elevation of mankind.[4] The practical side of the calligraphic lore is that these metaphors are indeed used to teach and think of the proper shape of characters.[5] In the teacher's arsenal for the inculcation of letters, one can also find *mathematics*. The numerical values attached to letters in Semitic writing systems enabled Jewish schoolmasters in antiquity to play algebraic games with the children and thereby prepare them for the esoteric readings taught by the Kabbalah (from the root <qbl> 'to switch position', 'turn upside-down' or 'inside-out'; also 'combinatorics').[6] ⇛ The early modern printing trade seems to have developed a fondness for adorning book frontispieces with naked and winged infants, *putti*, happily engaged in reading, writing, and loitering, as if the codex were a schoolroom, as amply demonstrated by Luther's first complete Bible in the German language (1543).[7] Seeking any means they could muster to instruct their angelic monster pupils, pedagogues also did not overlook the senses of *touch*, *smell*, and *taste*. The integration of sensory modalities was so successful to teach writing, recalls Maria Montessori (1870 – 1952), that it looked as a 'miracle', and once reading was also mastered, 'the books went like hot cakes'.[8] NB, more often than not, 'sensory' was understood as the quintessential imprinting method, physical punishments, for which testimonial references to Saint Augustine (354 – 430) or Montaigne (1533 – 1592) — still shuddering at the past miseries of childhood even on their deathbeds — are most likely superfluous to any well-educated reader (according to the fourth-century B.C.E. Greek comedy author Menander, 'He who is not thrashed cannot be educated').[9] But teachers also took advantage

1 Kraus 1991: 27, Taylor 2014: 37 [dragon & chicken models]

2 Atanasiu 1999: 82

3 RMN 2011: 72, 74

4 Spencer 1889: 20, Spencer 1866: 175 – 176, Higham 2001: 149 – 151, Thornton 1996: 49 – 50, Trubek 2016: 71 – 78

5 Atanasiu 1999: 54 – 89

6 Perlow 1931: 56 – 57, Wikipedia: 'Kabbalah'

7 Wikipedia: 'Putto', 'Luther Bible'

8 Montessori 1936: 168 – 172; 1912: 231 – 232, 246 – 270 ⇛ Nominated three times for the Nobel Peace Prize, Montessori considered child-rearing as the key to world peace. ⓒ Kramer 1988: 360

9 Michel Montaigne, *Essais* 1.26; Montaigne 2004: 166; Augustin, *Confessions* 1.9 (14, 15), 1.14 (23, 26); Augustin 2014: 24 – 29, 40 – 4; Cribiore 2005: 69 [Menander]; Bonner 1977: 117, 143 – 145 [disciplinary instruments and methods in Roman schools, including a flagellation scene from Pompeii's frescos]; Bloomer 2015 [rationales of pedagogical violence]; Marrou 1965: 397 – 398 ⇛ It has been reported that not only the teachers, but also the students, could be violent in antiquity, with the latter fling-

of children's appetite for play. In his treatise on upbringing, in which he qualified Gothic writing as 'clumsy', and 'uneducated and barbarous', in comparison to the 'elegant, clear, and readable' Latin,[1] the great Humanist Erasmus of Rotterdam (1466 – 1536) mentions a curious game of chess with the opposing figures shaped as Greek and Latin letters, suitable for teaching the alphabets, as learning by playing was a progressive method already advocated by Plato (428/427 or 424/423 – 348/347 B.C.E.).[2] Erasmus also cites with enthusiasm the poet of antiquity, Horace (65 – 8 B.C.E.), regarding the use by (well-to-do) Romans of letter-shaped cookies (*crustula*) as entreaties for facilitating the acquisition of reading and writing skills by their children.[3] During Enlightenment, the German educator Johann Bernhard Basedow (1724 – 1790) set out to put into practice the methods of Erasmus and Horace.[4] He calculated that, for just one Groschen (id est one penny), an edible alphabet regime could be produced that would make a child literate in two fortnights, and promptly charged the bakery of his Philanthropinum school in Dessau (later the location of another revolutionary school, the Bauhaus) to produce the required educational material.[5] Thus, buttressed by references to the matter in scholarly books on antique pedagogy,[6] similar methods have since spoiled generations of children, be they confectioned as **Russian bread** — letter-shaped chocolate cookies popular in Germany, Austria, and the Netherlands — or the well-known alphabet soup (both of which are also available as digital fonts).[7] In Proust's (1871 – 1922) madeleine, the trend attains its literary Olympus, with the author famously conjuring one of the monuments of twentieth-century literature, the seven-volume *In Search of Lost Time*, by using the mnemonic power of the olfactive, gustative, and visual qualities of a simple cake as an alphabet to read the past.[8] Years later, neuroscience would

ing their stationery at lecturers and even enrolling parents in their malevolence. ⓒ Cribiore 2005: 156 – 158

1 *'Write a speech of Cicero's in Gothic letters, and even Cicero will seem uneducated and barbarous.'* ⓒ Erasmus 1985: 390 – 391, Carter 2002: 78 – 79

2 Erasmus 1985: 400, Grasberger 1867: 259 – 261

3 Erasmus 1985: 339, 399 – 400

4 Basedow may have got the alphabet-cookies idea from Erasmus, having published both Erasmus' and Horace's works. ⓒ Basedow 1775a, 1775b

5 Basedow 1786: 30 – 32, Wikipedia: 'Johann Bernhard Basedow'

6 The Roman use of letter-shaped cookies appears without references in, inter alia, ⓒ Clarke 1896: 73, Marrou 1965: 231, 398, 600 n. 15, Bonner 1977: 166, Newman 2007: 111, Maurice 2013: 53. ⇛ It also provides an effectual ingredient for a modern historian aiming to engage popular scientific communication on classical education by depicting a fictionalized Roman childhood during the fourth century B.C.E. in the manner of a gripping novel. ⓒ Bonner 1950: 7

7 Wikipedia: 'Russisch Brot' [de], 'Alphabet pasta', Haslam 2011: 182 – 183, Ovink 1958

8 Genetic editing is seminal to Proust's literary method and experience of reality. He describes their mechanism as that of the game of alphabet, in which players apply the operations of permutation, subtraction, addition, and virtual morphing to letter-shaped wooden blocks to form new words.[1] In *The Search*, he comments on the poor legibility of 'Gothic'-looking handwriting, in which 'Gilberte' appears to be 'Albertine', excuses the trouble this confusion engendered by pointing out how words are skipped, guessed, and invented during reading (he had a keen interest in the sciences, and his father and brother were medical doctors of considerable renown),[2] and uses the psychophysical observation to make a general statement on the role of error in the genesis of most things.[3] The material production of his work was one of cutting and pasting, of writing down content as short as a few lines, to be assembled at a later editorial stage or expanded with supplements written on scraps of paper and glued into the *Cahiers* (his notebooks). Ironically, one such line never made it into the rigid shape of print, despite being a great poetic metaphor of language's visual and aural undulation of its linear signal: '*quand au soir tombant il regardait la ligne infinie de l'écume violette qui semblait laver de l'encre sur le sable*' ('when by dusk he watched the infinite line of the purple surf as if washing up ink on the sand').[4] Other than this creative power of illegibility, there is, for somebody who spent his life producing script (half-crouched in his bed, using 'Sergent-Major' nib pens[5]), conspicuously little in his work that explicitly

addresses the graphic aspects of writing. What Proust does is to shift the matter of legibility past readability and comprehension — at both levels, his prose is equally plain — into the domain of text connotation, which is a very dense graph of allusions, or the telescopic structure illustrated in the painting by Félix Vallotton (1865–1925), *Interior with woman in red from behind* (1903), showing a suite of rooms, one opening into another, until the final bedroom, a gateway to dreams — an apt image of both the dwellings and oeuvre of Proust himself (who didn't think much of his fellow artist).[6] When Proust compares the blossoming of remembrances in his mind to the Japanese folded papers that, once put in water, expand into flowers, houses, and people,[7] and we place next to it the madeleine dipped in a cup of tea,[8] we do, however, obtain the implements and products of writing: paper, ink, stylus, and written words. In this opening scene of the *Search* — in which the Narrator drinks in bed ('*lit*' in French) a cup of tea ('*thé*') and describes the shape of the cake as similar to that of a scallop shell ('*coquille*', meaning also 'typographical error', i.e., '*rature*') — we are encouraged by the omnipresent use of puns by Proust ('the master of dissimulation', said of him Oscar Wilde), to see encoded the word '*littérature*' itself, one that will become an exquisite pearl during the subsequent volumes. 🡅 Proust's times were also those of Dr. Freud, and there is a sprawling sexual dimension to the madeleine episode.[9] The 'short' and 'plump' 'sensual' cake, 'molded in a grooved valve' and procuring 'delicious pleasure' of 'illusory brevity' when taken to the mouth, in the same manner as 'love operates' — the one dispensed by Venus surfing the waves on a seashell, by the cake's namesake, Mary Magdalene the sinner, or (with the Japonisme cultural movement flourishing during the Belle Époque) by Hokusai's (c. 1760–1849) woman depicted having intercourse with a giant ink-squirting octopus [10] — the true nature of the common madeleine is therefore made explicit by Proust himself when he draws in a notebook a woman in the shape of an erect phallus.[11] Given that 'dipping the biscuit' ['*tremper son biscuit*'] and 'drinking tea', even more so if in bed ['*thé au lit*', which rhymes with '*pain au lait*', 'milk bread', male member], was (homosexual) slang for sex (and '*théière*', tea-pot, and '*tasse*', saucer, meant a vespasian, or gay meeting-point),[12] we cannot help but begin to toy with the 'so fattishly sensual under their stern and devout pleating' '*coquilles de Saint Jacques*' ('St James' scallop shells),[13] in which we may find by perspicacious editing '*coq*' (cock), '*couilles*' (balls), '*seins*' (breasts), '*é[ ]jac[ulation]*', and possibly further indulgences. One of Proust's famous quotes takes on quite a different meaning in light of such Rabelesian metonymies: '*the true life . . . the only life really lived, is literature* [= '*lit*' + '*thé*']'.[14] 🡅 While it would be preposterous to engage further in Proustian exegesis in this footnote, it is at least worth highlighting, in the context of edible letters, the considerable pedigree of script eroticism (Eros always finds his way into everything). Among the ancient highlights to consider are the libidinous baboon Thoth, god of writing and patron saint of scribes in pharaonic Egypt; [15] the pederastic model of understanding writing (= adult penetrator/educator) and reading (= young penetrated/uneducated) in Ancient Greece,[16] and the description of forming words from letters as if by graphical copulation in the tragedy *Alphabet Revue*; [17] the well-known Roman euphemism (apud Plautus, *variae operae*) between sex and primary education (school = brothel, mistress = prostitute, alphabet = intercourse positions).[18] Inspired by a seventeenth-century novel, Yu Li's *Carnal Prayer Mat*, Hong Kong cinema also makes a cameo appearance, with brushes, tufts, and ink being used to great comical effect in the B-movie *Sex and Zen* — who says that Chinese characters are not the universal writing ?! [19] C [The madeleine episode:] Proust 1987: 45–47, 51 [fr], Proust 2013: 50 [en, Moncrieff, rev. Carter], Proust 2002: 45–48 [en, Davis]. — 1. Gaubert 1980. — 2. Proust 1987b: 84–87, 90–94, Ollivier 2018. — 3. Proust 1987: I.493, III.234–235. — 4. Proust 2010: 89 [Cahier 26, fol. 43 r°]. — 5. Albaret 2003: 267–280. — 6. Raillard 2013: 17, Wikimedia: 'File:Félix Vallotton, 1903 - Intérieur avec femme en rouge de dos.jpg'. — 7. Inoue 1972, Carter 2013: 367–368, Louis 2019. — 8. Carter 2013: 466–467 ['toast' in manuscript became 'madeleine' in print], Eells 2002: 140 ['oysters and Sauternes wine' in manuscript replaced by 'madeleine' in print]. — 9. Paganini 1994 [*Search* is a web of metareadings], Doubrovsky 1974 [psychoanalysis of madeleine episode], Lejeune 1971 [madeleine as genitalia], Gury 2002 [obscenity in Proust and his time]. — 10. Wikipedia: 'The Dream of the Fisherman's Wife', Hokenson 1999 [Proust and Japonisme]. — 11. Carter 2006: 96 [Cahier 29, fol. 68 r°]. — 12. Hayes 1995 [gay reading of the madeleine episode], Karlin 2005: 14 [Hayes commits an ahistoricalism; however, see Gury 2002: 26, 220, 233, 246–247], Sandry 1960: 35, 167, 229, 232 [slang dictionary by an actor and a police inspector of the French Sûreté Nationale]. — 13. Carter 2013: 30 [on scallop shells in the church of Cambray]. — 14. Proust 1989: 474. — 15. Wikipedia: 'Thoth'. — 16. Svenbro 1993: 187–216. — 17. Slater 2002. — 18. Bonner 1977: 35 n. 9, 339. — 19. Li 1996, Mak 1991.

confirm the role of odors in memorization.[1] In fact, it was all a misunderstanding, Erasmus having overinterpreted his Horace, who only stated that children were given pastries as reward for learning the alphabet, but never that these were shaped into letters.[2] Quintilian, the most cited source on Roman education,

1 Herz 2008, Christianson 1992

2 Horace, *Satira* 1.1.25–26; Horace 1870: 10; Erasmus 1985: 597–598 (note 145) 🡅 An English book illustration from 1593 depicts a schoolmaster apparently rewarding a pupil with some sort of pastry (fruits are also stowed nearby). C Erasmus 1978: 688

mentions only ivory block letters used to acquaint children haptically with the elementa of writing,[1] while the fourth/fifth-century biography of past Roman emperors *Scriptores Historiae Augustae*, a critique of political decadence, relates with contempt how consular charges were bought simply by offering sweet-balls and doughnuts (*dulcia et circuli*) to child-emperors who could not even hold the pen to sign official documents by themselves without the help of their preceptors.[2] Erasmus might have been carried away by the nascent gingerbread industry that he experienced first-hand in Basel, where he resided and printed many of his books, but the viral meme he created (his still-lasting intellectual influence had the required potential), or at least anticipated, emerged from a fertile cultural ground.[3] A fifteenth-century Irish legend recounts how the fabled Saint Columba (521–597) became instantly literate when, as an infant, he ate a cake inscribed with the alphabet;[4] in the same vein of literally reaping the fruits of knowledge, the magnificent fourteenth-century prayerbook of Worms illustrates Jewish children observing the ritual eating of letter-inscribed pastries & eggs, and licking letters written on a table covered in honey before the first ever study of the Torah at age five or six.[5] More generally, the ingestion of writing is a widespread theological, mystical, & magical procedure.[6] The Ashkenazi tradition extends as far as the Old Testament, specifically to Ezekiel 3:1–3, in which Prophet Ezekiel eats a scroll given to him by God that tastes of honey. The concept of the word made flesh can also be taken literally for the beginnings of writing in China, facilitated by a gargantuan supply of tortoises, the shells of which were used for divination, while their meat was doubtlessly consumed by the minister.[7] Today, graphophagy is a daily occurrence, perpetuated by the 'font menu' metaphor of graphical user interfaces. In the future, 'edible knowledge' may become, with appropriate development in gastro-transubstantiation technology, how schoolchildren learn. Doraemon, a robotic cat beamed back in time to tutor the lazy ancestor of his Japanese owner, shows in the namesake manga how this works: stamp the 'memorization toast' on a textbook page, check that the contents have been copied on the bread, eat it, and voilà, you remember what's in the book![8] To cut a long story short, ingestion is in many cultures & times a way to make script legible and readable.[9] It can be painstaking: as a typeset-

1 Quintilian, *Institutes* 1.1.26; Quintilian 2006

2 *Scriptores Historiae Augustae* 'Vita Tacitus', 6.4–8; Anonymous 1932: 304–307; both Latin words are translated as 'cakes' (*gâteaux*) in Gaffiot 2016: 516b, 311a. ⇛ The same critique was leveled at some underage Mamluk sultans. ☾ Atanasiu 2003: 208

3 Erasmus would be pleased to witness the consequences of a minor philological slip of the pen and to recognize in it a confirmation of the special place given, in his Bosch-like panorama *Praise to Folly* (1511), to the delusions of scholars (they forfeit good life for a handful of grumpy readers) and schoolmasters (tyrannical funnel hats). ☾ Erasmus 1986: 122–124

4 Gaidoz 1887

5 The medieval Ashkenazi tradition was revived in Israel and America. ⇛ Marcus 1996, 2001: 118–119, Kogman-Appel 2012

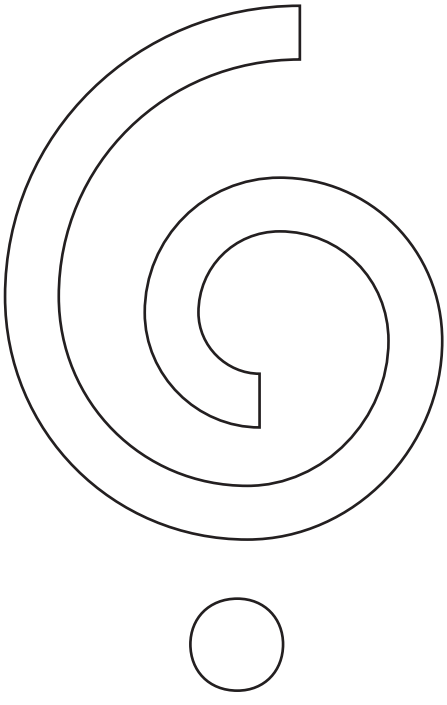
6 Dornseiff 1916: 17–18, Schmidt-Hannisa 2003, Kühne-Wespi 2013, Koering 2021: 156–166

7 Keightley 1978: 12

8 Fujio 2015 ⇛ Doraemon's toast could be cryptically related to Erasmus' cookies via the Portuguese, who introduced bread (*pan* in Japanese, from the Portuguese *pão*) and Christianity to Japan, hence the sometimes inscribed sacramental bread. This, at least, is the totemic reasoning in the episode 'The Transforming Biscuit', where it was revealed that some confectioneries have the propensity to metamorphose you into the creature of which they have the shape. Oh, sweet legibility!

9 Even before fostering literacy, the benefits of ingestion can extend to spoken language acquisition. In a collaboration on teaching foreign languages, started in Japan in 2002, between the fast-food chain McDonald's and an educational publisher, toddlers were trained to order from menus using English words. '*Children see English, listen to English, touch English — and eat English?! They experience English. Sooner or later, they will start using those words which were "input" during this term. And their interest in English will grow greater and greater.*' ☾ Seargeant 2009: 16–20

ter, you buy as much daily bread as pennies you get for the amount of characters you set, which is why typefaces for the text body are called, in the mother tongue of Marie Antoinette (1755 – 1793), *Brotschriften* ('bread types').[1] To paraphrase the queen, what legibility tries to achieve is to 'have the cake and eat it' — and this, despite Basedow's cautious intimation to the children that 'cakes may taste better than bread, but only for a while'.[2] 𝌆 Returning to semantization, nowhere is it so consequentially pursued as in the *visual* domain. The world over, children learn to read & write using abecedaria in which the abstract characters of writing are drawn in naturalistic shapes.[3] The readers might recall their own past delights at discovering the marvel of such books: for instance, Rudyard Kipling (1865 – 1936) in the *Just So Stories* describes the invention of writing by a witty neolithic girl, who drew the **S**-sound in the shape of a snake 'when it is thinking and doesn't want to be disturbed'.[4] Learning is certainly much more entertaining this way, and hopefully also more efficient. Figurative letters are not for puerile consumption alone: during the Middle Ages, serious books — Gutenberg's Bible, royal books of hours, the Haggadah — were swarming with fantastical and often burlesque anthropo- and zoomorphic initials, and Master E.S.'s (c. 1420 – c. 1468) marvelous human alphabet looks just as if it has been commissioned as a theatrical prop by composer Carl Orff (1895 – 1982) for his tempestuous rendition of truculent medieval poetry in *Carmina*



Similar to emojis, typojis are abstract typographical symbols with semantic or emotive value; one familiar example is the interrobang, ‽, marker of disbelief and rhetorical questions. I contribute here three more typojis: *Gratitude* is manifested as a spiral, representing a gracious outward movement; *Legible* and *Illegible* depict the gaze of the eye, converging on a single meaning, and scanning multiple possibilities respectively (also referencing the mathematical / logical operators conjunction / AND, and disjunction / OR). © Kulish 2021, Bohatsch 2017

1 Schöning 2009: 123, Dowding 1995: xvi 𝌆 *'I was scrambling along, earning the family's bread on magazine work at seven cents a word* [...]. *I never write "metropolis" for seven cents, because I can get the same money for "city".'* © Twain 1910: 206 – 209

2 Basedow 1786: 78

3 Renonciat 2009 [French/Japanese historical comparison]

4 Kipling 1912: 150 [letter s], 122 – 167, pictogram in Infini (2015) by Sandrine Nugue for Centre national des arts plastiques

Burana.[1] This fashion enjoyed a revival during Romanticism, as an attempt, through the use of elaborate drop caps, to reenchant a world lost in the smog of industrialization, and again during the twentieth century, most notably in Anthon Beeke's (1940 – 2018) naked ladies alphabet (1969),[2] an erotico–artistic experimentation with the written language, of which kind there is no end in sight, not after the inclusion of emojis [3] in Unicode.[4] For most of its existence, writing evolved in a world where communication was essentially oral, and that at times valued the spoken word more than the written.[5] The history of legibility is thus situated at the nexus of orality and literacy, for both of which the need for a good memory and appropriate mnemotechnics is relevant. Let us consider the example of *the art of memory*, as it was practiced in the Western world from antiquity until the rise of modern science.[6] The art of memory was one of the five branches of classical rhetoric in Greece and Rome and consisted in attaching images (*imagines*) to elements of a discourse one wished to remember and placing them in a specific order in fictional places (*loci*), usually urban landscapes, for later retrieval. For example, a story about returning safely home from a maritime voyage might be remembered by placing an imaginary anchor next to an imaginary pool of an imaginary (or real) villa. What should interest us is the remarkable mnemonic usage of architecture, in the knowledge that 'monument' denotes etymologically 'anything that preserves a memory of something' and was formerly used to refer to written documents, in addition to the modern meaning of commemorative edifices of various sorts.[7] Now, the Roman fora and the Athenian agora, where public life of any consequence took place, were awash in inscriptions, be they celebrations of Emperor Trajan's (53 – 117) great conquests or the newest laws enacted by the Athenian democracy.[8] In this sense, script was the abstract transfiguration of mental images that the art of memory enjoined to place on landmarks. The longer these memories could be preserved, the better the mnemotechnic performed, so that monumental inscriptions — as long-term hardware memories — are characterized by distinct and legible characters. Cursive script dominated in documents with less stringent archival perenniality requirements or prestige, such as commercial transactions or literary works. For short-term memory recording, the Romans invented the even more ephemeral and abstruse shorthand, the famous 'Tironian notation' employed by Cicero's (106 – 43 B.C.) eponymous slave (c. 80 – 4 B.C.).[9] It is said that no less than seven stenographers, and as many copyists, in addition to female calligraphers, were recording the works of Church Father Origen (c. 185 – c. 253) in third-century Caesarea or Alexandria.[10] What a sight! For the Ancients, the system of correspondences between writing, memory, architecture, and the body was evident.

1 Wikipedia: 'Master E. S.', 'Carmina Burana'

2 Beeke 1971 [pictures], Bouwhuis 2003 [making of], Bennewith 2016b [typeface eroticism], Devroye 2023 [erotic fonts list]

3 Rabane 2021 [in brief], Sproat 2023 [in extenso]

4 For further forays in figurative writing ⇨ Bedos-Rezak 2016 [cross-cultural], and Schick 2001 & Schimmel 1990: 110 – 157 [Arabic script], & samples in Massin 1970 [compendium], Vogel 2001 [tip-top anthropomorphic initials], Abbink 2010: 81 – 99 [3D].

5 In Ancient Greece, as a case in point, written documents had for a long time less legal value than witness testimonials, while Plato's distrust of writing was notorious. ⇨ Thomas 1992: 141, 147, 148 – 149 [legal value], 3 – 4, 126 [Plato]

6 Yates 1966

7 *OED*: 'monument'

8 Harris 1989: Fig. 7 [fresco depicting people reading public inscriptions in the forum of Pompeii], Augustine 2014: 45 [schooling fees advertised in the forum], Carcopino 1964: 141 [evocation of the forum of Rome], Thomas 1992: 137, 139 – 140 [public inscriptions in Athens]

9 Di Renzo 2000

10 Haines-Eitzen 2000: 41 – 52

Trigger Warning: Protest pictures follow on next page !

Memory was analogically the 'wax tablet of the mind', while architecture was an extra-corporal memory space. This link is explicitly illustrated in the letter-shapes of balustrades and other architectonic elements of Gothic cathedrals,[1] the ritualistic shaping of title pages as monumental frontispieces known since Roman times,[2] and the anthropomorphic ornaments of medieval manuscripts already alluded to. The Latin source on the art of memory insists that, to be memorable, the mnemotechnic images and places must be remarkable. It is precisely an increase in structuredness — and, hence, ease of navigation and memorization — that is observable in the long-term history of documents, in which *imagines* correspond to script and *loci* to layout. To the patent good legibility of Greek and Roman inscriptions, the use of increasingly ornamental initials (up to Morris, before being damned by Tschichold) added the 'memorable' touch that makes the identification of sections so much easier (the *New Yorker* upholds this tradition). Aside from the educational virtues of naturalistic letters, they also contribute to text readability. The texture of monumental inscriptions, be they Greek, Roman, or otherwise, are typically homogeneous; this aspect — beautiful but quite difficult to segment semantically in under hectic circumstances — also characterized lesser documents until the introduction of headings, title pages, footnote call numbers, and other functional elements of the document machinery that made reading more accessible through visual structuring. 𝍐 Kūkai (774 – 835), the Japanese monk, calligrapher, and founder of an esoteric Buddhist school, contended that learning by oneself is ineffective. This is precisely why the yeshivas foster knowledge development through dialogue between students (or between students and master in the Épinal version of the Socratic method).[3] These examples point toward a further mnemotechnic, *interaction*. In a comparative perspective, legibility may also be considered in terms of the *learning rate* of various scripts according to different study methods. 𝍐 The best mnemonics do not protect, alas, from insidious *amnesia*. Although decoding characters (e.g., mapping graphemes to phonemes or concepts) is, per the definition used in this étude, independent of the characters' legibility, knowing the signified entities can contribute towards recognition. Losing the ability to identify characters due to memory impairments does, however, degrade legibility.[4] The issue of maintaining script memory fitness is particularly acute for users of writing systems with large character sets, such as Chinese, or, in the past, Egyptian or Mayan. 𝍐 The emerging image of the history of *script mnemonics* is variegated. On one hand, it fluctuates socioculturally; on the other hand, the link between legibility and memorization is consistent, especially in the crucial phase of reading skills acquisition. If there is no interface between signifier and signified (thinning the interface is precisely the role of semantization), comprehension is instant; which is to say that the script is perfectly legible. This is a fallacy, but it works well on the human psyche to trick us into learning meaningless patterns. Ugraphia is an effective self-deception that may save lives. It saved those of Hansel & Gretel in Brother Grimm's (Jacob, 1785 – 1863, and Wilhelm, 1786 – 1859) fairy tale, who learned to read the trail of breadcrumbs, and shed their illiterate chrysalis while gingerly nibbling on the witch's letter-shaped gingerbread house. A beautiful metaphor to reflect on the perils & promises of legibility.

1 Carpo 2001, Smith 2000

2 Delbeke 2016

3 Takahiro 2006: 78, 102

4 Forms of 'agraphia': C Hillis 2015: 3 – 56.

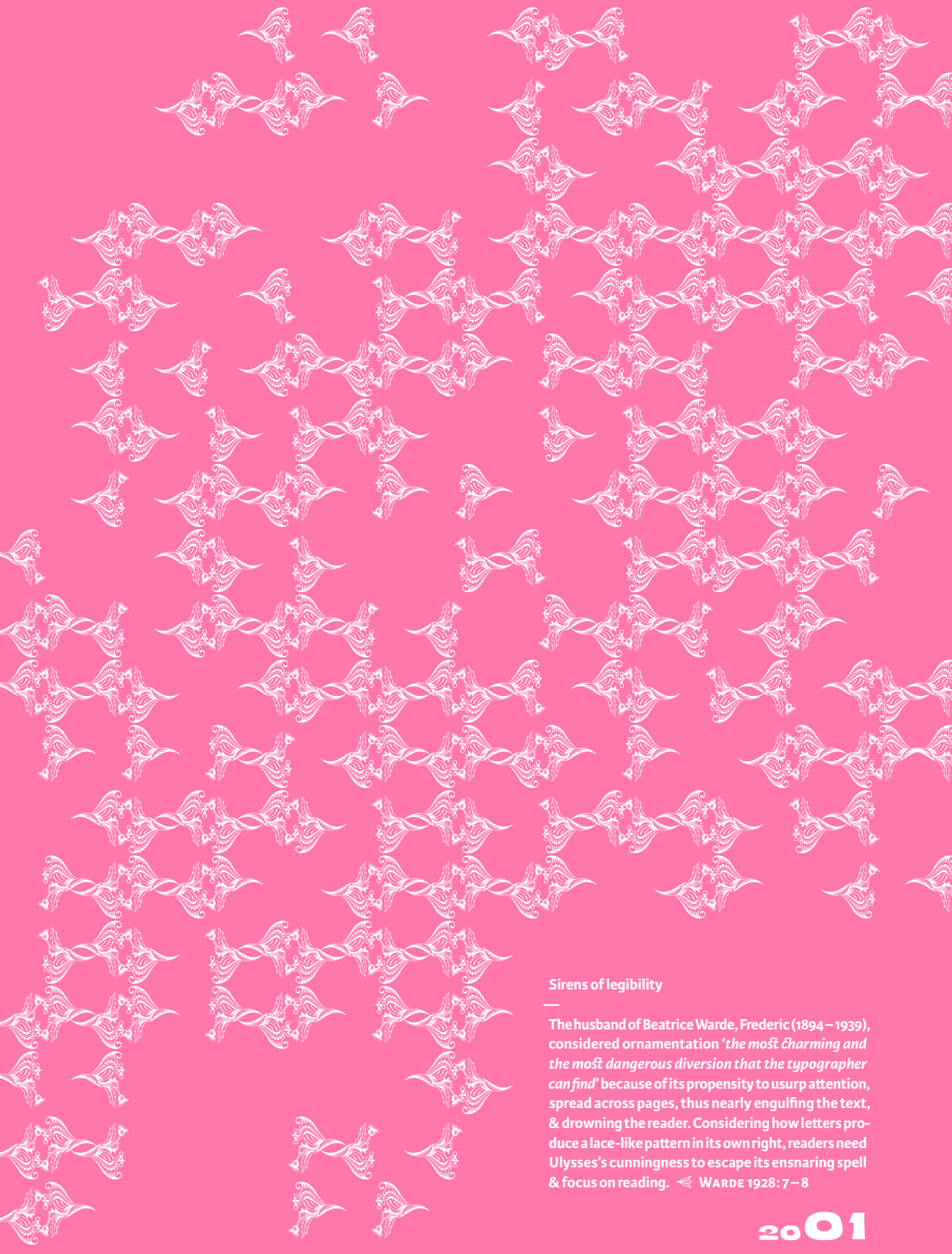
The author protesting and counter-protesting legibility.

1998

— Berna, Helvetia, 2023.10.04, pictured by a passerby, dressed by Henjl, Levis, Scarpa, Sloggi

1999

This section aims to consolidate some of the more preeminent legibility issues addressed throughout this book into a single model, the 'Pragmatic Mechanism'. It should help understand why and how the road to Ugraphia was built, and where it leads. In the following, the parameters *I* & *F* have practical relevance for script design, parameter *P* for interacting with the script, and parameters *D* & *E* are of social and historical importance. To allow for variability in the conceptualization of this model by the readers, and to deepen engagement with it, a graphical diagram was omitted. ⇗ Let us mentally visualize the diagram of the legibility SYSTEM *S*, whose OUTPUT *U* is Ugraphia and inputs are the MOBILES *M* and FACTORS *F*. It is traversed by the ATTITUDES loop *A*. The mobiles represent the intent to pursue legibility optimization, and consist of the INITIAL GOAL *I* of noiseless communication, and many PARA-USAGES *P* beyond legibility, in particular as tools of power. The {psychological, material, environmental, social, cultural, identity, historical, technological, scientific, economic, political, religious, aesthetic, subjective, etc.} factors constraining legibility are numerous and interact in complex, dynamic ways. They form HYPERSPACE *H*, shared between factors and mobiles. The attitudes are a meta-set of mobiles, providing individuals and social organisms the DRIVE *D* to pursue legibility optimization, and the EFFECTS *E* of said activity on the same and other entities. Specifically, but not exhaustively, a double column list would contrast attitudes such as pragmatism | visionary, intellectual | sensual, perfectionism | laissez-faire, desiccated | exuberant, conformism | pioneering, intolerance | acceptance, denotative | connotative. ⇗ To concretize the interplay between the above components, consider their presence in script debates and reforms, from the emergence of humanist writing to the demise of Fraktur to the popularity of sanserif. These examples from the Western culture show how legibility endeavors are fostered by intellectual environments open to interpretation, which provide the means for such exploration, while in 'closed societies' adverse to inquiry, legibility and illegibility are tools to enforce a social order, or contrastingly, to challenge it. The same mechanism may also describe, in the linguistic domain, the sociolinguistic causes and effects of the dichotomy between standardized languages and mundane dialects.



Sirens of legibility

—

The husband of Beatrice Warde, Frederic (1894–1939), considered ornamentation '*the most charming and the most dangerous diversion that the typographer can find*' because of its propensity to usurp attention, spread across pages, thus nearly engulfing the text, & drowning the reader. Considering how letters produce a lace-like pattern in its own right, readers need Ulysses's cunningness to escape its ensnaring spell & focus on reading. ◁ **Warde 1928: 7–8**

The ½ Antiqua, ½ Fraktur centralschrift (1853), **Royal Family** (1997), and **Fraktendon** (2009) attempt to bridge (by love not war) the ideological divide between Antiqua and Fraktur. Beyond such ephemeral thrills, hybridization of stylistic dimensions has resulted in many popular typefaces, among them, Otl Aicher's Rotis (1988), a family that ranges from Serif to Semi Serif to Semi Sans to Sans Serif, and Donald Knuth's ComputerModern (1986), exponent of the upright-roman–curvy-italic mixed class. Even trendier are the chimerical compositions of human, animal, & vegetal elements into decorative letters (dragon + z = ). Script creolization is a common byproduct of cultural encounters, be they due to the Crusades (the fascination with Arabic script in medieval European painting [1]), imperialism ('Egyptian', the sanserif and later slab serif typeface category, took its name from the early nineteenth-century Egyptomania [2]), or globalization (pseudo-arabic, fake GREEK, superficially devanagari, essentially JAPANESE, obviously BOLSHEVIK). In fact, the entire history of writing, its neat genealogical trees, could be viewed as a millennia-long sexual intercourse between graphical features, and the study of writing, a struggle to untwist their genetics.

Question — If biological entities adapt to their environment, and given that writing is a technology with an strong human component, then could it be that writing systems, scripts, and readers are subject to evolutionary optimization? We are not alone in asking this; long time ago an Egyptian pharaoh was already seeking the fairest among languages.[3]

Systems — The pioneer of the study of writing systems, Ignace J. Gelb (1907 – 1985), defended such an evolutionist view of writing, with pictograms as basal stage and alphabets at the apex.[4] As has however been explained, this hypothesis not only fails to stand up to evidence and ignores the variegated sociocultural functions of writing, but is also a manifestation of 'the belief in the superior nature of the Roman alphabet which is part of Western supprematism', as stated by the latter-day scholar of writing Florian Coulmas.[5] Perhaps even more ingrained is the awe in which the modern era holds the Arabic numerical notation; none other than the popular historian of numerical notations, George Ifrah (1947 – 2019), whose topical book has been translated into fourteen languages, proclaims that 'This really is the end. Our positional number-system is perfect and complete.' [6] The overtones are, again, unmistakable ('our', not 'their'), and this argument too fails, by not linking efficiency to purpose (not all numerical systems are for computation), according to the new systematic reevaluation undertaken by Stephen Chrisomalis.[7] While we do not focus here on writing systems, it is useful to mention them to address the reasons why their progress was claimed and refuted.

Stimuli — Western cultures have a long tradition of savant explanations of the form of script, extending all the way back to Plato's conversations with Cratylus and expressed according to the state of the art during the respective periods.[8] The latest avatar, written

1 Atanasiu 1999: 66 – 76

2 Mosley 1999, 2007, Heller 2016

3 Wikipedia: 'Language deprivation experiments'

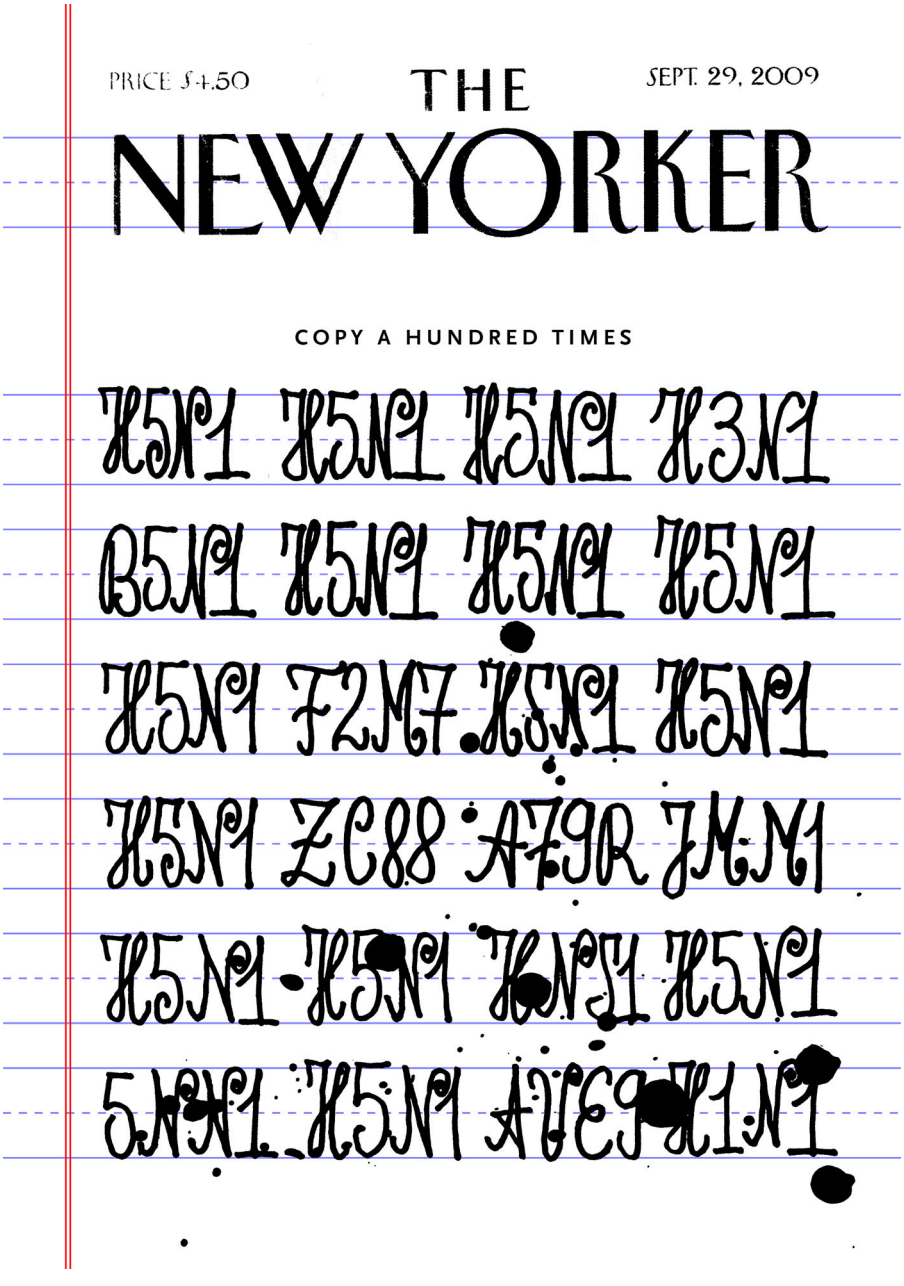
4 Gelb 1963: 190 – 205

5 Coulmas 2009: 9a, Daniels 1996: 7 – 9, Wolf 2007: 60 – 69, Trigger 2004, Lurie 2011: 361 – 364 ⇏ Gelb is, however, right in one important respect: there is progress from no writing to writing. The process took millennia, from the first paleolithic tallies, and the apparent current evolutionary plateau could deceive: digital technology might radically alter writing. C Schmandt-Besserat 1996 [writing origins] invalided by Zimansky 1993, Sproat 2023 [simulation of writing evolution in neural networks]

6 Ifrah 2000: 592, Dauben 2002 [critique]

7 Chrisomalis 2010: 29 – 33, 2017

8 Fichtenau 1946: 1 – 71, Watt 1994: 89 – 114, 215 – 246, Brekle 1994



The Eternal Combat of Ugraphia and Dysgraphia, materialized in a penmanship assignment for schoolchildren. (My cover proposal for the *New Yorker* at the start of the academic year 2009, during the H1N1 virus pandemic.)

2003

con brio, belongs to genetics and neuroscience: 'Before the writing virus became pandemic, it had to mutate. As with biological evolution, this mutation — the alphabetic principle — probably emerged in small groups of people on the fringes of mainstream society [...] in the Sinai peninsula. [...] Cultural evolution, through trial and error and a progressive selection across many generations, arrived at a small inventory of minimal and universal letter shapes.' [1] A bibliographical crux of natural script optimization can be found in two articles by Mark Changizi & fellow cognitive scientists, who have conducted an extensive analysis of mankind's scripts and proposed an ecological hypothesis according to which script characters have evolved to match patterns in the natural human visual environment.[2] ⇛ Unfortunately, there are serious issues with the data, its processing, and the interpretation of the results. Notably, these studies ignore the variability of character *shapes* (restricted to one typeface and no handwriting), the variability of character *frequencies* (a crucial element of a comparison between scene and script statistics), the language–script *isomorphism* (while assuming the script–visual ecosystem isomorphism), the *kinematic* constraints (educators & calligraphers are well aware of how writing is learned & practiced as a motor activity, not solely visual), the *material* conditions (which affects the production & perception of shapes), the *history* of scripts (involving many factors unrelated to legibility), and the bias of scene *datasets* (their incongruous mixing of polar bears, Amazonian tribes, and skyscrapers amalgamate stimuli that are unlikely to have shaped the visual cortexes of the early developers of writing). While a growing number of publications propagate the natural ecological explanation of the evolution of scripts, it has been largely ignored that its very empirical & methodological basis needs to be revised.[3] ⇛ An *epigenetic* perspective on the fit of scripts to their visual ecosystem has better evidential basis. In addition to natural factors, visual scenes are shaped by cultural artifacts with which scripts dialogue in mutual refashioning. Familiarity with one aids legibility of the other.[4]

1 Dehaene 2009: 190, 192 ⇛ Among type designers, Frutiger as well is espousing the evolutionary theory of script perfection. However, it assumes that conditions have remained stable for an optimum to be attained, which is obviously not the case, new script styles being created continually just as languages don't regress to an ideal state, and new forms emerge. *'As precision parts of a highly sensitive set of instruments, the letters of our alphabet have been assimilated to one another and balanced against one another through centuries of use.'* C Frutiger 1980: 64.

2 Changizi 2005, 2006

3 In 2018 there were 118 citations of Changizi 2005 & 2006 on Scopus, 'the largest abstract and citation database of peer-reviewed literature' (https://www.scopus.com). Dehaene and collaborators took Changizi et al.'s findings to be accurate and largely contributed to their publicity, through the theory of a cortical area specialized in reading, numerous empirical studies involving neuroimaging, as well as popular science publications and conferences. Their work has been expanded upon by other researchers, sometimes using the same approach to data processing as Changizi et al. Critiques were voiced by cognitive scientists, anthropologists, and medievalists. The gist of the ongoing debate is that if the cortex & the environment cannot be excluded from script models, so must also be the case for numerous other factors. C Dehaene 2011 [recycling hypothesis], Szwed 2011 [localization of the visual word cortical area], Chang 2015 [fMRI experiments testing the ecological hypothesis], Dehaene 2016 [research summary], Dehaene 2009 [popular science book], Dehaene 2014 [response to critique], Testolin 2017 [deep learning modeling of the ecological theory], Morin 2018 [preferential stroke orientation in scripts], Coltheart 2014 [neurocognitive objections], Downey 2014 [anthropological objections], Goldie 2012 [humanities objections; link to historical precedents] , ImageNet & CIFAR [image datasets widely used in computer vision]

4 A few further cases in graphical acculturation: Arabic written with a brush is a hapax in the Middle East, while unexceptional for Chinese Muslims; and the shape of some South-East Asian & African scripts show commonalities with indigenous embroidery & symbols. 'Horizontal' influences between artifacts are supplemented with 'vertical' effects, where script shapes reflect abstract non-visual generator principles, such as the vital energy *qi* 氣 in the Sinosphere, omnipresent visually from calligraphy

Receptors — A further evolutionary explanation of legibility progress rests on the hyperexposure of humans to script proliferation. This is known in psychology as the 'mere exposure effect', and I call its application to writing the *graphical Babel conjecture*.[1]

Definition 12. Adaptation — *Given adequate motivation the sensitivity of a sensory system is improved by exposure to increasing amounts and diversity of stimuli.*

Definition 12. Adaptation — *Given adequate motivation the sensitivity of a sensory system is improved by exposure to increasing amounts and diversity of stimuli.* ⇛ Throughout the history of writing, the *amount*, *diversity*, and *generation rate* of scripts have increased [2] by *accumulation* (we have access to more and more scripts, although with respect to handwriting, we tend to see less and less of other's scripts), *demographics* (more people, and more literate people), *globalization* (were he alive today, Livingstone would likely be greeted at the source of the Nile by Coca-Cola signs & Chinese noodle restaurants), *behavior* (silent reading increases reading speed),[3] and *automation* (what Gutenberg ignited, Tim Berners-Lee blew out of proportion). Our age is one of visual hyperexposure to a great variety of typefaces, active selection of fonts with the ease of a mouse click, & the democratization of type design and distribution thanks to personal computers and the Internet. In this high-entropy environment, legibility can improve without any need to modify the scripts themselves, and solely by their mere proliferation, an ecological pressure factor that sharpens the reader's faculty of visual discrimination. This is how optical character recognition has improved over the years: through better algorithms and more data rather than by coercing people to write in a more machine-legible man-

to painting and from landscaping to martial arts. ⊂ Massoudy 1981: 71, Tapp 1989: 130, Mafundikwa 2004: 11–49, Steele 2025 [general discussion & more examples]

1 Zajonc 1968, Sahin 1998, Changizi 2008 ⇛ The Babel conjecture relates to the conditioning theory of the 'Theories' section. My terminological choice for the conjecture makes reference to the multiplicity of languages after the fall of the Tower of Babel, and can in fact be just as well applied to the natural emergence of polyglotism in multilingual environments, tele-connected societies, or mobile individuals. Babylon is also used as archetype for the dazzling script-scape of great metropolises by night, from the Big Apple's Times Square, to Tokyo's Ginza, Hong Kong, Delhi, all the way round to  [cat + eye + Ra > Cairo], and the ambiance in the Mos Eisley cantina scene of the first *Star Wars* movie, *A New Hope* (1977), in which creatures of all shapes, colors, and tongues, from all over the universe, assemble in a jazz-filled pirate haunt. ⊂ Wikipedia: 'Mos Eisley Cantina'

2 The number of typefaces has increased exponentially, from around four thousand to more than hundred thousand during the sole period 1975–2000, according to one estimate. The same source suggests fashion theory to explain their proliferation. ⊂ Cahalan 2007: 60–64, 190 [statistics], 171–188 [explanation]

3 A comprehensive meta-study found the average oral reading rate for English to be 183 words per minute (wpm), and for silent reading 238 wpm for non-fiction and 260 wpm for fiction. The reading rate for reading aloud ranges across languages, from 133 wpm (Korean) to 191 wpm (Spanish), while for silent reading, these rates span from 181 wpm (Arabic) to 285 wpm (Italian). Age, second-language proficiency, and individual variation are among other factors affecting reading rates. ⊂ Brysbaert 2019

ner. Further parallels can be found in how learning one language opens the doors to others, & in the ability of animals to recognize their congeners, despite the fact that they all look alike to human eyes, just as Hamburg and Hamburg (Helvetica and Univers) contain nuances that evade less fanatic followers of type-*faces*.[1] Moving from the scale of human evolution to that of individuals, the same phenomenon of sensitization takes place during the acquisition of literacy, with the novice reader becoming more discriminant through practice. ⯮ While script proliferation is undeniable, it should not be forgotten that there is also script *death*, *loss* of records, and graphical *uniformization*, all of which can affect proliferation and undo any progress in legibility that might have been achieved. As an example : the Quran was the great freezer in the evolution of scripts in the Arabic peninsula, similarly to the role played by typography for the Latin script.[2] A further ingredient that must be present for sensitization by exposure to take place is *motivation* within a sociopolitical context : New York, patently, has the highest density of languages and scripts on this planet, but it did not evolve into a catalyst of polyglossy and polygraphy in a manner seen in sub-Saharan Africa or the Indian subcontinent. [3] ⯮ The meaning of the Babel conjecture is that, if proven, humans live in a natural state of legibility progress : not so much in matters concerning the perfecting of scripts (engineering the paradisical pre-Ba[b]bel monoscript), and more with respect to reader clairvoyance (developing post-Ba[b]bel polygraphic abilities).

Pressure — The fundamental mechanism of natural, cultural, & technological optimization is *evolutionary pressure*, central to any discussion of legibility from an evolutionary point of view. Literacy has progressed in both absolute & relative numbers over the five millennia since writing came to exist,[4] this being arguably a strong indicator of legibility bettering, given the need to train increasing numbers of readers and an increase in the amount of script manipulated by these readers. We also observe *antagonistic forces* at work. Literacy, for one, is not distributed uniformly : [5] *application*-wise, writing emerged as an economic & commercial technology (counting taxed or exchanged animals & goods, e.g., in Sumer & Mycenaean Greece [6]) and an oracular technology (e.g., inscriptions on bones & shells in China [7]), leading to its practice being circumscribed to a very limited number of administrators & priests ; over *time*, the European Middle Ages represented a low in comparison to Greco-Roman antiquity ; [8] across

1 It is an open secret that in {Zürich | Basel} typographers worship exclusively {Helvetica | Univers}. C ÉCAL 2017 : 84

2 When Islam appeared in the seventh century, there were many scripts used concurrently for recording Arabic dialects, but only the one script, tied to the nascent religion, perdured; notably, it was not the most legible by any means. In addition to using a dedicated word boundary marker (|), the geometrical and non-ligatured characters of epigraphic South Arabic (𐩠𐩡𐩢𐩣𐩤𐩥𐩦𐩧𐩨𐩩𐩪𐩫𐩬𐩭𐩮𐩯𐩰𐩱𐩲𐩳𐩴𐩵𐩶𐩷𐩸𐩹𐩺𐩻𐩼) look more distinct than the ligatured Arabic script issued from its Syriac ancestor (أبجد هوز حطي كلمن صعفص قرشت), much like to the difference between the monumental and cursive styles of the Romans. This twist has been referred to as an 'accident' in the history of legibility. C Robin 1991 : 127

3 Ross 2024 : 5, 377n29 [over seven hundred languages], García 2001, Kelly 2018b : 189 [indigenous African scripts] ⯮ This same lack of interpenetration has been commented upon with regard to the propensity of New York coffee houses to polarize by political tendencies. C Gopnik 2018 : 84b

4 Wikipedia : 'Literacy'

5 OECD 2016 [global, 2015], Mitch 2004 : 343 – 345 [Britain, eighteenth – nineteenth century], Furet 1977 [France, Ancien Régime to Third Republic]

6 Schmandt-Besserat 1996, Ruijgh 1998 : 659 – 660

7 Keightley 1978

8 To illustrate the contrast in reading proficiency across ages, or at least the availability of reading material, it will suffice to juxtapose (*a*) the Acropolis of antiquity, through which Athenians strolled to inspect the latest public inscriptions, carved in stone, on city benefactors, war heroes, various offenders, traitors, and tributes collected (akin to reputation billboards); (*b*) a Gothic cathedral, where pictures rather than words instructed the masses

the *gender* divide, male literacy has dominated throughout history ('In woman ignorance is a virtue' was the concept),[1] although the current better reading performance of girls is a modern remarkable phenomenon;[2] *spatially*, one might note spikes of literacy, such as in Iceland, or, on the *religious* dimension, among Protestants and Jews;[3] *ideological* lows are well-documented, e.g., laws against teaching reading & writing to slaves in pre-Civil War America;[4] moreover, *social* divides are illustrated by the fear of mass literacy gripping the well-to-dos of eighteenth- and nineteenth-century Britain, who dreamed of ways to remove the ability of the populace to read & write, judging by the coinage of such verbs as 'to illiterate someone', i.e. to reverse its state of being literate,[5] at the antipodes of King Sejong's (1398–1450) benevolent creation of the Korean script in the 1440s expressly for instructing his subjects.[6] Particularly interesting is *polygraphy*, which adds even more variability into literacy but usually disadvantages scriptors belonging to hegemonic scripts, since they have less incentive to learn more than one script. Finally, one should not be blinded by the ability of *technology* to single-handedly increase literacy levels: analphabetism was endemic in China until modern times,[7] notwithstanding printing being practiced there since early antiquity,[8] while barely over half of the French population appears to have been literate at the onset of the French Revolution, 350 years after Gutenberg.[9] It took social transformations — such as compulsory schooling instated in Europe during the nineteenth century,[10] and the rise of nationalism during the same period[11] — for universal literacy to be achieved. Even so, for morphosyllabic writing systems such as Chinese, one can only speak of levels of literacy, depending on the number of characters one knows (about 5100 characters cover the needs of modern communication, while historical dictionaries contain over 50,000 characters; 2136 *kanji* is the official current Japanese standard[12]). Moreover, as long as writing is used as an instrument of *power* and *identity*, either legibility is irrelevant, or there is a deliberate search for visual arcanes. The convoluted legibility of graffiti is one example from the creative fringes of society, from Pompeii's lupanars to New York subways,[13] with the extensive drills necessary to learn proper penmanship that were a classical prerequisite to a comfortable position in Sumerian (or Victorian, Ming, or Aztec) administrations representing another. At length, any script optimization that might have been achieved is undone by the *epidemiology* of scripts (e.g., Latin supplanting Pre-Columbian Mesoamerican scripts as a result of military conquest, itself due to a complex set of factors in Europe) and their *mutation* (stylis-

about the Bible; (*c*) Tokyo by night, a firework of scripts; and (*d*) the Mugamma', the colossal all-purpose administrative building in central Cairo, processing everything from taxes to visas, a pharaonic temple of Byzantine bureaucracy and a Kafkaesque anthill drowning in Babylonian paperwork. **C** Thomas 1992: 139–140, Wikipedia: 'Terrorism and Kebab'

1 Mitch 2004: 344, Taylor 2014: 106–107, 130–132 [China]

2 Jerrim 2016: 99–100, Halpern 2020: 319, 334

3 Lyons 2011: 97–98, Beit-Arié 1992: 80

4 Goodell 1853: 319–325

5 Brantlinger 1998: 1

6 Feudalism, colonialism, and communism long conspired to diminish the benefits of hangul's improved legibility: illiteracy was still as high as 78% in 1945 and despite having been eradicated soon after in both North and South Korea, their respective populations now enjoy vastly different living standards. **C** Taylor 2014: 180–182, 250–253

7 Henze 1983, Rawski 1979, Taylor 2014: 108–111

8 Tsuen-Hsuin 1985

9 Blum 1985: 946–948

10 Prost 1979 [the case of France]

11 Gellner 1983: 35–38

12 Henze 1983: 295–296, Coulmas 1996: 82, 242–243, Taylor 1996: 48–50, 1136, Wikipedia: 'Jōyō kanji'

13 Weeber 1996, Austin 2001

tic transformations within script systems, e.g., typeface proliferation under economic pressure in the printing industry and a lust for aesthetic novelty). The *lifespan* of scripts is as bewilderingly diverse and unpredictable as the multiplication of fashions and languages, and the course of history, with time scales ranging from centuries (the hieroglyphs) to a person's lifetime (individual style), some appearing by fiat (Korean) and disappearing equally abruptly (Fraktur), while other are resurrections of imaginary pasts (Humanist minuscule) or destined to quasi programmed obsolescence (bitmap pixel fonts for low resolution displays and printers) or living fossils having outlived their original medium (vector pixel fonts made for creating a 'retro-techno' ambiance). All these evolutionary forces act concomitantly upon scripts, thereby diminishing their adaptation to the sole purpose of legibility. Take as example the progressive shift in medieval Hebrew books from square to cursive styles, the result of balancing legibility, production speed, paper economy, visual text structuring, aesthetics, and social status.[1] This process varied with respect to the importance of each factor within the cultural areas of the Jewish diaspora, with square writing dominating in France & Germany and cursive prevalent in the Maghreb, the Iberian peninsula, and Italy (possibly a case of acculturation to the North European textura on the one hand and the ductus of the Arabic script & the Humanist vogue of cursive Latin scripts on the other).[2] Contemplating a unified theory of the evolution of medieval books, the codicologist Ezio Ornato envisioned this great variety of factors as a dynamic system of physical forces, whose resultant vector oscillates over time in magnitude and direction.[3]

Niches — The limited character recognition capabilities of early OCR systems led to the development of specialized, 'cyborg' typefaces intended to be equally legible by humans & machines, such as OCR-A and Viafont-X.[4] They represent an *evolutionary niche* of legibility far from unique or with limited public visibility. Typefaces for bitmap fonts, car number plates, and highway signage are among similar areas of conspicuous effort in legibility research. They are characterized by technical constraints and peculiar looks that contribute to them outliving their original ecological niches, a curious evolutionary twist. More generally, *application-specific legibility* appears to be as important as general-purpose legibility.

Conclusions — The picture emerging from the above considerations is one of *perpetual fluctuation* in evolutionary pressure for and against legibility; unsurprising given the tremendous diversity of conditions over such a long time span as the history of writing, so much so that one could even question the notion that script evolves towards increased legibility at any larger scale than over limited time spans and sociocultural settings. If it were otherwise, why has humanity still not engineered a solution that enables it to write in the perfeckt skript and speak a single language? *Refrain:* Is this quest, perchance, utopian?

1 Beit-Arié 2003: 67–81

2 Beit-Arié 1992: 25–78, also 1–23

3 Ornato 1997: 117–159, 617 ⇝ Ornato, his collaborators, and Beit-Arié, have investigated the question of 'progress' in the Latin and Hebrew medieval manuscript traditions on quantitative and qualitative basis, obtaining similar results to my own with respect to legibility. They find that progress fluctuates with the specific book aspects being considered and that printed books are more clearly subject to optimization than handwritten ones.

4 Viafont-X was commissioned from Harry N. Peble by the Viatron Corp., which patented it for its OCR systems (1971). It has seen at least three revivals (Buzzer Three [1995] by Paul Crome and Tony Lyons for ITC, Synco [2020] by Raphaël Verona for Altiplano, and Viafont [2020] by Robert Janes for Dinamo [shown above]), demonstrating the appeal of technical typefaces to artists such as Andy Warhol (1928–1987), who used it to set the title of his book *America* (1985). ⇝ Wikipedia: 'OCR-A', 'Viatron'

Photo: Angelic script, Agrippa 1651: 440 ⮔ Among the many ex libiris adorning copies of Agrippa's (1486–1535) *De occulta philosophia* is that of the son of a Hungarian rabbi, the escapologist and magician Harry Houdini [Erik Weisz] (1874–1926). © Agrippa 1855

Constructed evolution

—

Fantasy scripts, such as the runes in J.R.R. Tolkien's (1892–1973) *The Hobbit* hailing from a parallel world,[1] represent a relatively obscure if remarkably productive evolutionary niche in writing history. These so called 'constructed scripts' or conscripts, created by a thriving online fandom dedicated to the grapholinguistic and ethnographic study of imagined worlds, are the visual counterparts to the equally prolific constructed languages.[2] It is a phenomenon mirroring the historical, linguistic, cryptographic,[3] and magical interests during early Islam in foreign & ancient scripts, both real & mythical. The resulting catalogs, notably the 'seventy-two' specimens from *Cryptic Alphabets Unveiled* attributed to the Iraqi savant & occultist Ibn Waḥshiyya (d. c. 930) [4] and the few from Ex-Pseudo-Majrīṭī's (d. 1007) *Picatrix*,[5] achieved international bestseller status as founts of esoteric symbols.[6] Two copies of the *Picatrix* were owned by the Holy Roman Emperor Maximilian I [7] and many more circulated among the astrologers of Queen Elizabeth I (1533–1603) [8] and the Italian humanists,[9] while a manuscript of Ibn Waḥshiyya's work, obtained as booty from a failed Ottoman invasion of Malta, aided Athanasius Kircher in his attempts to decipher Egyptian hieroglyphs.[10] Later, a printed version edited by the Austro-Hungarian diplomat to the Sublime Porte, Joseph von Hammer-Purgstall (1774–1856),[11] made its mark on the incipient Egyptomania and flourished anew with the advent of digital facsimiles. However, these alphabets themselves are tributary to older Hebrew [12] and Greco–Roman [13] astrological & magical graphic repertoires, ultimately derived from the script of Angel Raziel's book provided to Adam, three days after his banishment from Paradise.[14] Today, exoticism and sheer fun drive the creation of modern fantasy scripts. Their primary impact on real writing likely lies in their contributions to dynamic writing cultures, though perhaps the characteristic ring letters [15] of the grimoires also inspired the appearance of the Glagolitic script, created in the ninth century for recording Old Church Slavonic.[16] Constructed scripts are not only abundant but also technically interesting for their individuality, reflected in intra-set stylistic consistency and inter-set distinctiveness. Their availability as digital fonts [17] and the standardization efforts for including them in the Unicode system [18] suggest a potential future increase in their contribution to script evolution.

1. Wikipedia: 'Tolkien's scripts' • 2. Neography 2025 [gallery & forum], Segments 2025 [journal issue], CBB 2015 [design] • 3. Kahn 1967: 93–99, Kadi 2010, Schwartz 2009 • 4. Toral-Niehoff 2018, Burak 2021 • 5. Attrell 2019 • 6. Gettings 1981 • 7. Attrell 2019: 6 • 8. Yates 1999, Saif 2015: 155 • 9. Garin 2007: 33–60 [circulation] & 2012: 41–51 [importance], Saif 2015: 125 [Pico] • 10. Saif 2024: 389–391 • 11. Hammer 1806 • 12. Harari 2017: Fig. 4 • 13. Gordon 2014 • 14. Wikipedia: 'Sefer Raziel HaMalakh' • 15. Ullmann 1972: 362 • 16. Mathiesen 2020 • 17. Lynch 2025 • 18. Wikipedia: 'ConScript Unicode Registry'

Ex Libris Kabikadj

—

When a computer bug burrows through machine code, flipping ones to zeros and vice versa, a new mysterious script emerges from the material decay of old legibility. In this Manichean struggle between script and anti-script, one might choose to combat the corruption by infusing paper and ink with essence of kabikadj, Persian for a poisonous parsley-like plant (*Ranunculus asiaticus*) or by invoking the eponymous Indian king of cockroaches. Both are trusted methods, according to the annals of Middle Eastern codicology. Kabikadj (كبيكج in Arabic) grants additional protective power through the similarity of its numerological value, 55 (٥٥), with a pair of eyes — or four large insect eyes if we write using the initial form of the letter *ha'* (هـ) — that seem to be on perpetual lookout against any maleficence. Oh thou Kabikadj, Guardian of Ugraphia! C Gacek 1987, Gacek 2009: 137–138, Haneef 2024 — Photo: Corrupted JPEG image file of the cover of a book on 100 curious stories from the Grisons. Röthlisberger 2021, https://m.media-amazon.com/images/I/91vFmDu+m1L._SL1500_.jpg, 2024.10.03

4CCULTUR4T10N

Typography should mirror the zeitgeist & the spirit of nations, proclaimed the Futurists.[1] Thanks to the Font Cornucopia unleashed by the generation Pintrest of the Unicode era, the present state of type design is one of *multilevel eclectic syncretism*: ⊙ *morphology* (**Serifless Romans**, **Latin–Cyrillic crossovers**, outrageous **PLASTICITY** ['The structures of its glyphs are mostly derived from hand-written dynamics, that feed from both calligraphic & graffiti references.'],[2] &c., all sharing one design philosophy: 'What if we try to combine seemingly incompatible graphics — fonts of different classification categories, with different personalities and styles — in one space?'),[3] ⊙ *historical references* ('There is little point in discussing SangBleu in terms of categories like oldstyle, transitional, modern etc. While the design inevitably was informed by history, stylistic purity or authenticity were of no concern. SangBleu appropriates the best from the past and transforms it into an effective tool set for the aesthetic and technical environment of our day and age.'),[4] ⊙ *designer origins* (global), ⊙ *natural environments* (to raise awareness of the endangered giant clam, and inspired by its peculiar undulating shape, the Filipino David Maza created **TAKLOBO**: 'hard on the outside but soft on the inside, Taklobo is both rigid & fluid in nature, in shape for eclectic visual identities'),[5] ⊙ *designer training* (graphic arts schools incorporating academic research are international melting-pots, and contribute to the typographical education of the larger public, while their publications are valuable collectibles), ⊙ *technologies* (the role of typeface engineering in experimentation, as opposed to pure drawing, e.g., for COLOR typefaces, dynamic fonts such as Beowolf, and the proliferation of superfamilies enabled by variable fonts), ⊙ *interdisciplinarity* (typefaces that 'illustrate mathematical & algorithmic structures, theorems, & open problems'),[6] ⊙ *social aims* (by definition, militant & revolutionary typefaces, e.g. LGBTQI+ & ACT UP, are anti-establishment and, thus, anti-established-legibility),[7] ⊙ *genre* (the popularity of revivals, those 'Ancient Moderns',[8] sometimes mating as many as thirteen type-creators across four different periods [9]), and ⊙ *theories* (type design as a dialogue with the past & the future, and 'fonts as time machines').[10] Today's syncretism only amplifies a feature that is, anyhow, a universal of writing (you could mistake Hebrew for Arabic in the Levant, and Arabic for Chinese in Turkestan).[11] Its impact creates conditions for a more versatile legibility, exposing readers to a wide range of homomorphic shapes & educating them in the art of communicating via script connotations. Acculturation is also the perpetual generator of new script forms & challenges to legibility, by the combinatorial virtue of cultural interactions.

1 Friedl 1986 (1): 14 [Marinetti], 11, 15 [beyond Futurism]

2 Moglia 2019

3 CSTM 2019, Lord 2023 [typeface designer directory]

4 Swiss Typefaces 2017, Bringhurst 2004: 12–15 [cultural periods and their typeface pendants, including axis variation] ⇗ Scripts referencing other scripts is a mimetic phenomenon with parallels in movie and literature cross-referencing.

5 Maza 2022 ⇗ The rough edges and random character orientation of another typeface, Valnera (2010–2019), by Riccardo De Francesch for CAST Foundry, reference the rugosity of the Piedmontese Alps. In fact, one could produce a cartography of places that have inspired typeface designs. ⊂ Gonzato 2019

6 Demaine 2015

7 Pyper 2023, GenderFail 2022 [protest sign fonts]

8 Adobe's wording in an advertisement for the Lithos, Trajan, and Charlemagne typefaces, inspired by epigraphic Greek, monumental Roman, and Carolingian scripts. ⊂ Stock-Allen 2016: 84

9 *'The aim of the project is to capture the spirit of Renaissance and Baroque types by analysing the works of Nicolas Jenson, Francesco Griffo, Claude Garamont, Pierre Haultin, Robert Granjon, Hendrik van den Keere, Christoffel van Dijck, Nicholas Kis, Simon de Colines, Guillaume Le Bé, Pierre-Simon Fournier le Jeune and Giambattista Bodoni. Hierax Antiqua aims to crystallise this era with an added contemporary feel through rigorous digital design.'* ⊂ D'Elisiis 2021

10 Underware 2018, Pyper 2023

11 Sirat 1976: 13, Massoudy 1981: 71


TROP

Pop Art vs. legibility research: Even for traffic signage, it is not necessarily the most legible script that has the most impact. — '*Too fast ?*', road sign of the Swiss Council of Road Safety, near Vallorbe, Switzerland, 2018

The exalted Kūkai said: 'Kūkai does not choose his brush'.[1] The pearly apothegm implies that contingencies, such as bushy brushes, are irrelevant to true masters. Since he also said the contrary, in true zen fashion, in general the same script can have radically different legibilities depending on its materiality, technology, & environment. The research profusion prompted by low-resolution displays & printers — on hinting, anti-aliasing, or light trapping — is a modern case in point. Signage for cars zipping day & night down autobahns is another.[2] In just a single generation a tremendous material transition was accomplished from the hand press to mechanical printing to photocomposition to digital typefaces to AI-generated fonts.[3] Tomorrow ambigrams [4] will morph into space scripts, readable from all directions (holograms?),[5] and hyperdimensional characters for the transhumans of the day after the Singularity.

1 Andō 2006: 78

2 The stroke width of letters in British road signages developed in the 1950s were thinner when painted in white on dark backgrounds, with the goal of reducing character blurring resulting from headlights illuminating the script at night. Designing types for photocomposers was a similar struggle, with Adrian Frutiger complaining that, '*I nearly had to introduce serifs in order to prevent rounded-off corners — instead of a sans serif the drafts* [*of Univers*] *were a bunch of misshapen sausages*'. This effect may be due to light scattering, or be perceptual, termed 'irradiation'. The opposite result (of too-slender strokes) characterized many early digital typefaces. C Hawkins 1999: 9, Brewer 2014: 226, Osterer & Stamm 2014: 80, 82, 104, Shapiro 2017: 27

3 Southall 2005

4 Words that remain meaningful after some spatial transformation, such as 'SOS' that reads the same for two readers facing each other (for 'tandem reading'?). C Wikipedia: 'Ambigram'

5 An example is a shadow art device by poet scientist Douglas Hofstadter from the cover of his *Gödel, Escher, Bach* book, depicting a cube whose shadows along its three axes spell the initials of the three personalities. Space may also be used to place character parts at various depths, such that they can be read only from a specific point of view — an Op Art effect of the anamorphic typography genre. C Hofstaedter 1999; Claan 2023 [signage], Egan 2023 [architectural], Wilson 2023 [objects], Eerdekens 2023 [shadow art], Lai 2023 [instructions]

'Unsightly' (*migurushi*), 'monstruous' (*oni no gotoshi*) — that's how Fujiwara no Teika (1162–1241), one of Japan's most revered poets, described his own handwriting.[6] Characterized by exaggerated stroke width variation & an unsteady hand, this graphic epitome of wabi-sabi could be mistaken for the work of a drunken Bodoni.[7] In a culture that valued deference as a form of politeness, especially in the presence of Emperors, whom Teika served as a literary counselor, his self-belittlement could also have been a refined way to dispel any hint of arrogance that an overly virtuosic hand might have suggested.[8] Yet, it was a legible script, free of confusing simplifications and interminable ligatures, as befitting a punctilious philologist running a commercial scriptorium. The combination of stylistic idiosyncrasy and legibility, coupled with the author's fame, led to Teika's informal personal script being adopted as a worthy model by his adulators. In fact, he actively nurtured his copyists to imitate his hand. Over the ensuing centuries his writing evolved into an autonomous calligraphic style that commands high prices in the art market and whose latest avatar is a 'quasi-grunge' digital typeface commissioned by a leading foundry.[9] Teika's case directly questions the relation between legibility and aesthetics. The opinion among artists that 'taste plays so important a part [in legibility], as we believe it should' emerged from scientific legibility experiments, such as those

6 Nagoya 2006, Atkins 2017: 5–7, 196–198, 201, 206, 208 See p. 1981 for his portrait in moji-e style. For another apocryphal rendering C Nagoya 2006: 24.

7 **Giambattista Bodoni** (1740–1813), the Prada of Italian typographers, did in fact influence the Japanese (日本) script landscape, as following the import of Western typography technology during the nineteenth century, types with strong stroke width contrast became a fundamental stylistic category of modern Japanese graphic design. C Komiyama 2006, Wikipedia: 'Giambattista Bodoni'

8 Kalgren 1927: 105, Taylor 2014: 42 [dishonorable legibility]

9 Kazuraki (2013) by Ryoko Nishizuka for Adobe.

for unifying British motorway signs from 1957 to 1963.[1] However, writing does not need the beauty of Trajan's Roman inscriptions to become a paleographical totem. Legibility and aesthetics are not necessarily correlated. The most *eugraphic* text may be read cold-blooded, just as it may move even illiterates to tears.[2] Nevertheless, while Teika should be absolved of his graphic sins (he suffered from bad vision and paralysis), it remains mystifying why some people like <shiver>Comic Sans</shiver>, however legible it may be. Aphrodite is truly blind.[3] (Ophthalmology links her to Bodoni, who, elaborating on Renaissance aesthetic theories, defined the three levels of typographical beauty [*bellezza*] in aesthetic-medical terms as the 'splendor' [*splendore*] visible to presbyters [i.e. layout], the 'prettiness' [*leggiadro*] so closely examined by myopics [letter shapes], and the 'handsome' [*bello*] discernible by normal-sighted people.[4])

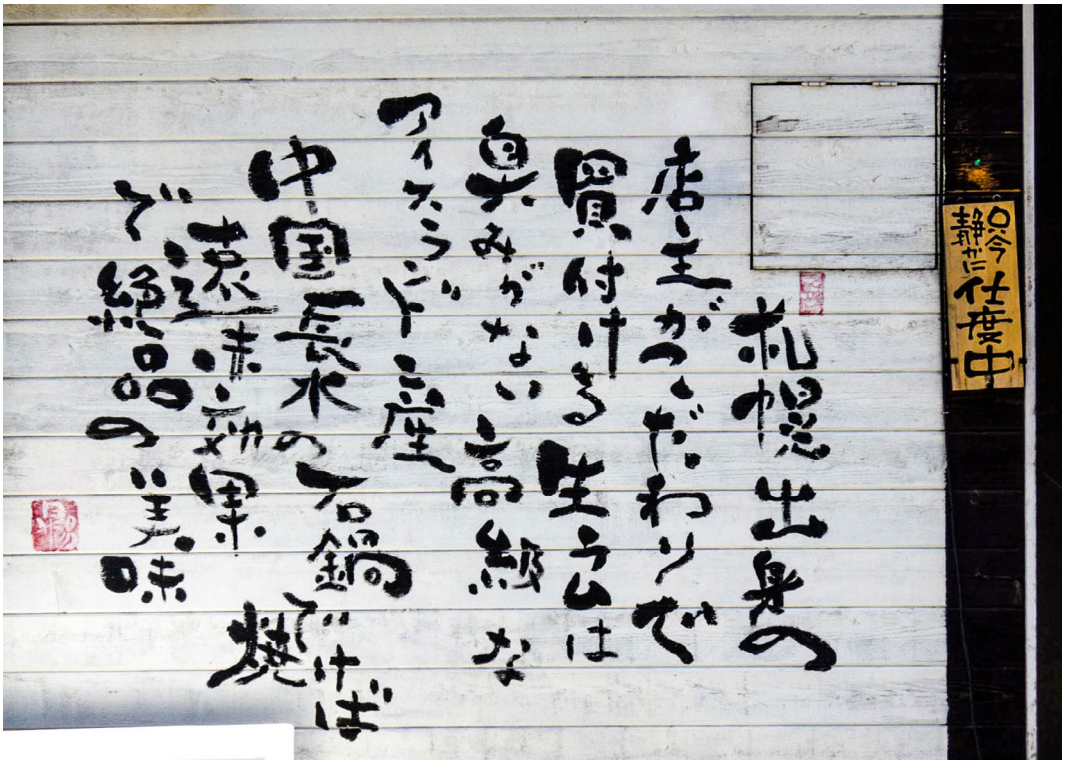
East: Sample of Teika's handwriting at age seventy-one. Entry of June 1, 1233, from his journal, auto-derisively called 'my foolish diary' *guki*, formally *Chronicle of the bright moon* (*Meigetsuki*). ⩔ Northwest is the word 'unsightly' and southwest is 'monstruous', both set in Kazuraki, a typeface based on Teika's style. ⊂ Atkins 2017: 5; Picture credits: "Meigetsuki" (Diary of Fujiwara no Teika), B-1394, Tokyo National Museum, ColBase: Integrated Collections Database of the National Institutes for Cultural Heritage, Japan, https://colbase.nich.go.jp

1 Lund 1999: 138, 126–147, Wright 2021

2 Minorski 1952: 52

3 The problem with Microsoft's **Comic Sans** (2006; by Vincent Connare) is not its legibility per se but rather the use of this informal script – ostensibly created with comics in mind – in formal contexts, such as official letters in F***, a country with a great typographical tradition otherwise. Depending on one's mood, such missives may evoke feelings of revulsion or exhilaration, the point being that script aesthetics is a motivational factor in legibility. ⊂ Wikipedia: 'Comic Sans' ⩔ And by the way, there is an entire geek folklore around Comic Sans, Arial, Papyrus, Hobo, and Co. if you wish to surf your day away. ⊂ Google: 'comic sans humor'

4 Bodoni 1818 (1): v–vii



'The store owner's pride and joy is the premium, odorless lamb he sources directly from Iceland. When cooked in a traditional Chinese stone pot, it's incredibly efficient and tastes absolutely divine.'

A modern incarnation of the Teika calligraphic style on a restaurant front wall · Nakamuraya's Genghis Khan BBQ & Hokkaido ramen shop, Yokohama, 2011

‘Do you read me ?’ · Bacchus and Dionysus, Valais
Blacknose sheep, Aletsch glacier, Switzerland, 2013

2017

P3RS0N4L1Z4T10N

In an era of personalized everything, one could anticipate scripts designed for specific readers & that adapt as their perceptual & cognitive faculties evolve throughout life (MyScript®).[1] Applications to generate fonts from one's handwriting do exist; handwritten emails also exist, as does software to adapt font width & weight to readers physiognomy,[2] while script styles specific to particular communities emerged alongside writing itself.[3] Interpersonal legibility is promoted through standardization, ergo the utopianism of a universal script, but in a world of technological interfaces, writing can become a strictly personal matter. In such a future, we will have written transaction only with machines, which will be aware of our graphical peculiarities & communicate in their own codes with other machines, themselves translators of the singular scripts of their respective masters; we will read through augmented reality glasses any script, legible or not. Or so some writing policy planners like to think: 'It might, however, mean that we are edging towards the flexible, efficient, personal handwriting needed to deal with the rapidly changing situation that is likely to face us in the next century.' [4] Psychologists concur: Font Tailor was created by low vision researcher Aries Arditi for facile font parametrization & do-it-yourself 'adjustable typography' suited to individual needs & tastes.[5]

1 The graphics software & typeface firm Adobe found that people read faster when allowed to chose typefaces. It would be interesting to test the placebo effect as well. C Wallace 2022

2 Tselentis 2011: 50

3 See the protocol in medieval Arab administrations of using correspondent & content-specific scripts & paper formats. E.g., the caliph writes to kings in *djalil* ['majestic'] large-size style on *tumar*-format paper and in *thulthain* ['one-third'] bold when addressing governors or emirs; medium *sidjilat* ['deed'] is for real estate transactions, and *dibaj* ['ornate'] for diplomas; *mudawwar* ['round'] is a universal script. The same design space will emerge in Western typography: size, weight, & cursivity. C Atanasiu 2004

4 Sassoon 1999: x

5 Arditi 2004

My Own Private Ugraphia

Twins, like lovers, may develop their private language, technically 'cryptophasia'. Similarly, one can invent a writing for oneself, perhaps as in the above picture, more *sumi-e* painting than *shōjō* calligraphy. C Thorpe 2006 [cyptophasia], Srihari 2008 [on the challenging discriminability of the handwriting of twins]. Picture: artist unidentified, Yokohama, 2011

Given the brain's plasticity, its exquisite capability at recognizing the slightest smirk on a face, is it raelly neceassry to invset in lblgitiiey? [1] Even when we have already predicted the next word we will read, and the one after? [2] Even when we stop teaching handwriting,[3] and any day now, ever-more-clever machines will do the reading for us? (The latter has a long tradition: Romans felt that anything more than cursory reading and writing was better left to the slaves, who were also used as 'living libraries' and required to retrieve content from their memory on command, while in modern times the first 'computers' were (notoriously) ladies who performed mathematical calculations under male supervision.[4]) Why, soon enough, we shall also grow eagle eyes, read barcodes, and communicate through the ether with distant aliens by telepathy alone! [5] Until then, however, we must wrestle with age, dyslexia, deteriorating corneas & mental flexibility, glaucoma, and various other personal visual impairments by striving to increase legibility — a Sisyphean task, with countless ramifications.[6] Paleographers are not shy about identifying what should be credited for major developments in script evolution: 'So we may say that presbyopia started the reform of [Humanistic] handwriting'.[7] You may want to put it more starkly, indeed, as increased legibility does not come for free: manuscript colophons are replete with the aching complaints of copyists working in dark and cold monastic scriptoria, typesetters had to drink milk to avoid poisoning by lead types, when they did not poison themselves with alcohol, abuse the children working in the print shops until not long ago, or qualify fellow woman workers as the 'natural enemies of books'.

1 Words can remain legible despite randomization of all but the first and last characters. C Wikipedia: 'Typoglycemia'

2 Viz. 'predictive coding'. C Clark 2013

3 Ceasing to teach handwriting for the sake of children's creativity and freedom had already begun in the 1970s. In the 2010s, typing skills are the emphasis. Later on, '*handwriting [will] cease to be taught at all — for us to have the interview with the "last handwriter" as we do today with the last living speakers of some languages*'. C Sassoon 1999: 123, Russell 2015, Trubek 2016

4 Svenbro 1993: 193, Harris 1989: 255–259 [literacy of Roman slaves], Jacob 2000: 109, Wikipedia: 'Hidden Figures' [movie]

5 Mental images have been recorded from brain activity, as have transcriptions of internal speaking from facial muscle activity. Writing by telepathy appears in Stephen King's *The Dark Half* (1989). C Wen 2018, Kapur 2018, Wikipedia: '*The Dark Half*' » Aliens raise the issue of how to communicate with recipients of unknown constitution. Mathematics has been used for the Pioneer and Voyager spacecraft messages and the Search for extraterrestrial intelligence (SETI) program. In science fiction movies, this is with few exceptions (e.g., *Arrival* [2016]) a non-problem: English (presumably French for Georges Méliès (1861–1938) in *A Trip to the Moon* [1902]) does the trick even for the nastiest Klingon.

6 'Sisyphean' because script changes in time and space. Optometric acuity charts developed in Germany in the nineteenth century lost their calibration when introduced in the US, as the Fraktur script was replaced with Antiqua. C Rubin 2013: 44

7 Referenced here are letters by Petrarch and other Humanists justifying their demands for manuscript copies in larger and more legible script styles due to their diminishing eyesight in their old age. Similar reasons, linked to politically influential and aging individuals (Pope Boniface, c. 675–754), have been advanced as possible factors in the rise of the Carolingian minuscules, later recuperated by the Italian Humanists. The increased precision of type design itself might be due to the use of eyeglasses by Renaissance punchcutters. C Ullman 1960: 12–15, Carter 2002: 54

[1] ← Metanote to myself: fix the execrable runts !

The expression 'bad writing' is symptomatic of the focus on script shape when assessing legibility, notwithstanding other criteria. In various technical domains (e.g., electronics and machine learning) a small amount of noise may improve performance, an idea that can be applied to typeface design, to emulate the liveliness imparted by the natural irregularity of handwriting.[2] Here, I wish to entertain the counter-intuitive view that imperfect script may in fact help optimize legibility, point out the importance of the long temporal dimension for the study of legibility, & include the 'reading between the lines' as part of an extended definition of legibility, named script acts. I group these distinct aspects into a single section due to the natural way in which they interlock. ⇻ 'Lead desert' (*Bleiwüste*) is a German typographical epithet for the sensation of emotional aridity induced by an overly uniform and large block of text [3] — it could also be applied to the results of reviving in digital media typefaces made for metal type.[4] Pages set in the

1 Porck 2017 [colophons], Ross 2021 & Fanni 2020: 171 [sexism] ⇻ Whether typesetters benefit or not from imbibing milk is murky; but in Transylvania, home of Dracula, I saw them do drink milk. ⇻ ——— Severing the head or queue of a paragraph from its body is considered a typographical infelicity, hindrance to a smooth manual (page turning), ocular (saccades), & cognitive (flow) reading experience, similar to having to wait for too long between meals. 'Widows' (*|w) designate pages or columns starting with the last line of a paragraph found on the precedent page or column ('*they have a past but not a future*'), 'orphans' (o|*) are pages or columns ending with the first line of a paragraph, 'runts' (*·r) are last paragraph lines containing a single word, and, I may add, 'benjamins' (*–b) are a too short part of a hyphenated word anywhere within the paragraph. In the academic carrier nomenclature these colorful figures may appear as emeriti, tenure-track, post-docs, and interns, respectively. ☾ Bringhurst 2004: 43–44, Lacroux 2007: 96–101, Wikipedia: 'Widows and orphans'

2 Divenire ('becoming' in Italian) is a typeface explicitly driven by shape irregularity: '*Divenire demonstrates how a lack of uniformity can produce consistent results.* [...] *I have observed* [...] *that if a degree of irregularity is applied* [...] *the text is enriched with depth and nuances, it is less 'gray' and less flat.*' More than a graphical device, the virtues of irregularity are also a political statement about the nature of democracy, the typeface being commissioned by the Italian Democratic Party in 2012. ☾ Gonzato 2022 [Divenire], Wikipedia: 'Dither' [noise]

3 Mortal sample pp. 2128–2129; Schöning 2009: 119

4 On the practice of typeface revival ☾ Hurka 2019: 142–143 & Olocco 2022 [Latin script] and Bringhurst 2004b [Greek]. ⇻ Given the difficulties involved in preserving the spirit of typefaces when transferring them between media, critics are keen to highlight enterprises of this kind that are especially successful. Typographer Max Caflisch (1916–2004) commended Erhard Kaiser's revival (1994) of Johann Fleischmann's (1707–1768) Antiqua (1738) for the Dutch Type Library as '*imparting a pleasant liveliness and finesse, without appearing soulless and mechanical*'. The concept of 'liveliness' is a key descriptive term, found throughout the type literature, as in Frutiger's description of the inspiration he found as a type designer in architecture ('*Modern concrete*

2020

Photo: Not quite the calligraphy of the Taj Mahal, this graffiti of Tangier (2010) is a love declaration all the same.

WHERE WE LEARN THAT IMPRECISION IS A LIFE PHILOSOPHY, LEGIBILITY IS JUDGED BY EFFECTIVENESS, AND WRITING IS A PERFORMANCE

former are regular: each character instance is identical to all others (provided proper hinting), their outlines are faultlessly continuous curves (provided proper hinting), and their printed surfaces are blemishless (provided the right toner & paper). By contrast, a fair amount of variability, imprecision, and outright errors permeate the ancient models, which, in comparison, confer to the page a lively and agreeable character (and why should bad hinting not be an aesthetic in its own right? just as pixelated fonts came to be!). The secret of Caslon's success, for example, is 'a perfection of the whole, derived from harmonious but not necessarily perfect individual letterforms'.[1] It seems that the less technology intercedes between the human and the script — or, at least the more rudimentary its effects appear — the more highly regarded the result (calligraphy is better than hand presses, which are better than digital fonts, while bitmap-, ASCII-, and animated GIF-art are more endearing and kawaii than hyper-realistic pictures produced with 'Artificial Intelligence'; the issue is the well-known dichotomy between the artisan & the machine).[2] ⇗ Smooth-edged & regular typefaces may be faster to recognize (good for headlines, traffic signs, and wayfinding lettering), but for lengthy reading, it is the entertainment of the imperfect script and the choreography of a beautiful handwriting that can be expected to sustain the reader's attention (or attract the gaze towards a short shop sign, product label, or advertisement).[3] Diversity, and even imperfection, as positive factors of legibility, are perspectives that may be easily understood through translation to the musical domain, where the monotonous metronome beat can become maddeningly exasperating,[4] while jazz improvisations can be exhilarating.[5] For the cellist Yo-Yo Ma, it is human expression that counts in music, rather than perfection, a luminous thought that may as well define what Ugraphia could mean.[6] ⇗ The Japanese have

buildings aren't necessarily geometrical; their forms have tension and liveliness.'), or in this font description by Monotype: '*The character of ATF Garamond is lively, reflecting the spirit of the French Renaissance as interpreted in the 1920s.*' Such an emotional effect of patterns may be achieved through the subtle shaping of characters: one of Monotype's italic Garamonds (based on Robert Granjon's [c. 1513–1590] type circa 1557) features multiple optical slants (*O Q S I i*); this is also the case for Hoefler Text (*I i*). **C** Caflisch 2000: 7, Osterer & Stamm 2014: 88, MyFonts: 'ATF Garamond'

1 Updike 1922 (2): 105–106

2 Tullett 2014 [typewriter art], Schlömer 2018 [typeknitting], Omagari 2019 [video game typefaces]

3 Lund 1999: 20

4 Gavin Bryars' piece *Jesus' Blood Never Failed Me Yet* (1975), in which these words sung by a London homeless loop mantra-like for 25 minutes, the similar *It's Gonna Rain* (1965) by Steve Reich, Maurice Ravel's (1875–1937) *Boléro* (1928), & Erik Satie's (1866–1925) day-long *Vexations* (ca. 1893–1894), among others, demonstrate that repetition may also be trance-inducing, and the 'speech-to-song' and 'phantom words' auditory illusions (in which repeating a word makes it sound as being a different word: rose|roseroseroseroseros|eros) show a fundamental difference between the experience of shapes and patterns. There are a few equivalents to these effects in the writing domain: while schoolchildren usually resent being required to copy some sentence a hundred times, the copying of Buddhist sutras as a meritorious act may procure a 'flow' state. The temporal dimension of legibility is made explicit in an anecdote about the Ottoman Sultan Murad IV (1612–1640) commissioning a Quran before leaving for his Baghdad campaign, and being surprised on his return to see the writing progressively improve; in response, the calligrapher explained that the bettering reflected his state of mind changing with the prospect of seeing the Sultan coming back victorious (and remunerating him). **C** Bryars 1975 & Reich 1965 [music], Wikipedia: '*Jesus' Blood Never Failed Me Yet*', '*It's Gonna Rain*', '*Vexations*' [context], Baumgärtel 2015 [a history of loops in twentieth-century Western music], Warren 1970 & Deutsch 2019: 61–70, 103–115, 151–169 [illusion], Hellmuth Margulis 2014 [repetition in music], Ulrichs 2018 [rose], Schimmel 1990: 47–48 [calligraphy and Sufism], Derman 2009 [anecdote]

5 In general, musical pieces that strike a balance between predictability and unexpectedness are considered more appealing. Such is the case for pieces with a fractal structure, which have information at all scales; this is also characteristic of display typefaces, endowed with small details. **C** Voss 1978, Temperley 2007

6 *'At one point I had the audacity to think that I could play a perfect concert. I was in the middle of the concert, & I realized everything was going perfectly well — & I was bored out of my mind. That was the moment that I made a fateful decision that I was actually to devote*

developed imperfection into a design principle & existential attitude (complemented by perfectionism).[1] The Dutch type designers Just van Rossum and Erik van Blokland realized that 'the sameness of type seems an arbitrary thing that we can do away with in certain cases', and produced the subversive Beowolf (1990), a software-driven typeface that injects a parameterizable amount of jaggedness into the outlines of characters.[2] The 1980s were a time of great experimentation with il·legibility — who suspected that Glasnost (= political transparency) had anything to do with (typographical) legibility ? —, with the products of the punk & grunge movements looking like typographical palimpsests fitting a hotchpotch of corroded characters to random grids.[3] (Sociologist, surfer and) grunge pioneer David Carson, who during those times published an interview with the musician Bryan Ferry set entirely in ✺❁❐❆ ✤❉■❋❂❁▼▲ (Zapf Dingbats), pointed out the expressive power to be found in il·legibility: 'Don't confuse legibility with communication. Just because something's legible doesn't mean it communicates and, more importantly, doesn't mean it communicates the right thing.'[4] Succumbing to the nefarious influence of graphic designers[5] — lately adepts of the second hand / vintage fashion / ideology,[6] typographers have engaged in anti-typographic guerrilla and sinfully commingled with the lowest of trash typefaces: a freakish recent edition of *Frankenstein* uses thousands of fonts and changes them practically every other character — so much for legibility (but what a joy (which may improve legibility (doesn't it ?) !) !) ![7] ◈ However, the dominant expectations in the modern typeface industry are to produce types with smooth curves & relegate 'grunge' fonts to the fringes of the typographical underworld. These mentalities are not unique to typography, or unavoidable consequences of technologies: until the twentieth century, Western aesthetics of writing have valued regularity,[8] and the same is true for Arabic calligraphy (with the exception of some Persian styles, such as *shekaste* and *siah mashq*, which may ultimately reflect Chinese aesthetic influences of the Mongol period[9]). It was in China that a culture covering the spectrum between hyper-regularity and randomness was first elaborated; subsequently, it spread throughout the Sinosphere, manifested in calligraphy, painting, poetry, stone carving, and rock gardens. The Noble Savage became a fashionable mirror of unmitigated nature. ◈ From this point of view, legibility may be pursued in two equally desirable directions, of diminishing & increased visual complexity. It is a change from the crispations of a geometrical Helvetica that can never attain the perfection of its self-imposed Euclidean abstractions. The difficulty of deciphering intricate scripts spurs

my life to human expression versus human perfection.' C Ma 2023

1 On the concept and sociology of imperfection in Japanese script see, e.g., C Sampson 1980: 203–232, Petts 2021: 119–132, Fu 1986 [samples]. ◈ There is a certain equivalence between the irregularity of fluid handwritten Japanese script and the Japanese literary genre known as *zuihitsu*, which consists in a plotless juxtaposition of observations about the natural and human world, a literary cabinet of curiosities. C Groemer 2019: 36

2 MoMA 2011, Middendorp 2018: 210–211

3 See the works of the exponents of British new wave, Neville Brody, American grunge, David Carson, Swiss punk, Wolfgang Weingart, & the Californian type foundry Emigre. C Wozencroft 1988, Blackwell 2000, Weingart 2000, VanderLans 2005

4 Blackwell 2000: [unpaginated], 149 [ok, I counted the pages — now it's up to you to do the same to find the reference; includes memorable quote layout, demonstrating diagonal reading path], Hustwit 2007 [movie], 2015 [book, paginated]

5 Drost 2013

6 Typeset in Arial Regular 16pt with no page margins !

7 More precisely: according to their frequencies sampled from Internet PDF files. C Wollstonecraft Shelley 2011

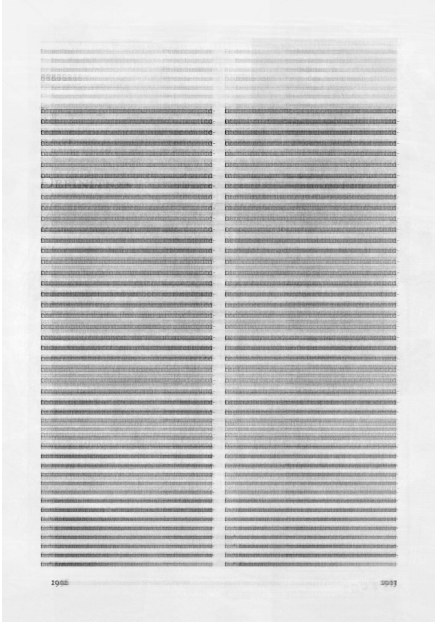
8 Compare the academism of past copperplate penmanship with the Pollock-like contemporary calligraphic experiments. C Thornton 1996, Gürtler 1997

9 Atanasiu 2003

a reader to become more involved with a text, and consider legibility as an emotional & intellectual involvement in the communication process. Thereby it transcends the readability stage and acts upon the message interpretation & subsequent decision stage.[1] Conversely, low-complexity scripts will elicit a narrower response. Thus, legibility is not only uncorrupted transmission of messages (a simple conduit or a window), but much more: their efficient processing. A metaphor of this script property is the *dusk*, the time at which we must work on our imaginations to make sense of shadows, as opposed to uncritical daytime vision. In yet other words, there exists a legibility of the between the lines. In his *In Praise of Shadows*, the Japanese novelist Jun·ichirō Tanizaki (1886 – 1965) went so far as to describe how a painting displayed in a dark alcove procured his imagination with a sense of absolute harmony, precisely because being barely discernible. The same principle is at work in haikus, whose essential incompleteness is a mechanism of creativity, sometimes reinforced by a handwriting difficult to decipher and a ductus evocative of movements and sounds alluded to by the poem.[2]

1 This kind of legibility has been linked to participative art forms, in which the public is an active participant. **C** Dauppe 1991

2 *'We have all had the experience, on a visit to one of the great temples of Kyoto or Nara, of being shown a scroll, one of the temple's treasures, hanging in a large, deeply recessed alcove. So dark are these alcoves, even in bright daylight, that we can hardly discern the outlines of the work; all we can do is listen to the explanation of the guide, follow as best we can the all-but-invisible brush strokes, and tell ourselves how magnificent a painting it must be. Yet the combination of that blurred old painting and the dark alcove is one of absolute harmony. The lack of clarity, far from disturbing us, seems rather to suit the painting perfectly. For the painting here is nothing more than another delicate surface upon which the faint, frail light can play.'* Also: *'A phosphorescent jewel gives off its glow and color in the dark and loses its beauty in the light of day. Were it not for shadows, there would be no beauty.'* Likewise: *'I wonder if my readers know the color of that "darkness seen by candlelight." It was different in quality from darkness on the road at night. It was a reple-*



Benefits of bad kerning

—

By printing all the pages of this book on a single sheet, we obtain the above 'auto-palimpsest', resembling a visual rendition of coffeehouse chatter, rich in interpretation possibilities. The question arises how to instill ordinary script with such a desirable effect of variety and mystery while maintaining some clarity in comprehension and legibility. One option is given by handwriting, including that computationally generated. Alternatively, the creative may rely on low-quality paper, low-resolution display, or random kerning and further distortion of the typographical text. Such experiments indicate that the value attached to various levels of legibility is goal-dependent.

Definition 13. Effectiveness — *Legibility may be evaluated in terms of the degree to which a script engages a reader in communication, and the outcomes of the actions that the reader undertakes*

Definition 13. Effectiveness — *Legibility may be evaluated in terms of the degree to which a script engages a reader in communication, and the outcomes of actions that the reader undertakes as a consequence of reading.*

as a consequence of reading. ⇛ To take the example of the subliminal statement 'Tips don't lie' found in a bar, it would be one thing if a patron was able to read and understand the message, and entirely another if the patron did indeed heed the message due to the way it was presented (using a purposefully authentic handwriting that seems to address the reader in an individualized manner). If we consider that legibility is about steering actions through effective visual communication, then the above definition applies, which expands the usual definition (limited to the recognition of written characters) towards the domain of *graphical rhetoric* and what may be called performative *script acts*, by reference to the linguistic theory of speech acts.[1] ⇛ Graphomancy, magic with writing, exemplifies script-mediated acts and the importance of twilight legibility. Consider the multiple occulting layers of a Middle Eastern amulet containing enigmatic charms inscribed by block printing, a technique of almost miraculous reproduction, in barley legible script, perhaps in an invented script, on tightly rolled or folded paper, concealed in a tiny metal box, and sold by a bohémien to an illiterate believer.[2] ⇛ Viewing legibility from the perspective of the broader research fields of *communication* & *epistemology*,[3] the message is not (dead) letters, but rather their meaning; the correct decoding of signifiers is not spelling, but the actions undertaken. I propose a holistic definition of the legibility convolute — legibility, readability, connotation, encoding, etc. — as effective visual communication: not just transmission of symbols, but that of meanings, of information, of information as verb and not as noun. In this frame, communication is not a pipeline process (a sequence of data transmission > symbol decoding > message interpretation), because the visual symbols also have meanings other than their position in the alphabetic order, which are necessary to message interpretation: they are *polycodes*. (^_^)/

tion, a pregnancy of tiny particles like fine ashes, each particle luminous as a rainbow.' Even: '*Our cooking depends upon shadows and is inseparable from darkness.*' C Tanizaki 1977: 19–20, 30, 34, 17

1 Wikipedia: 'Speech act'

2 AKM 2024

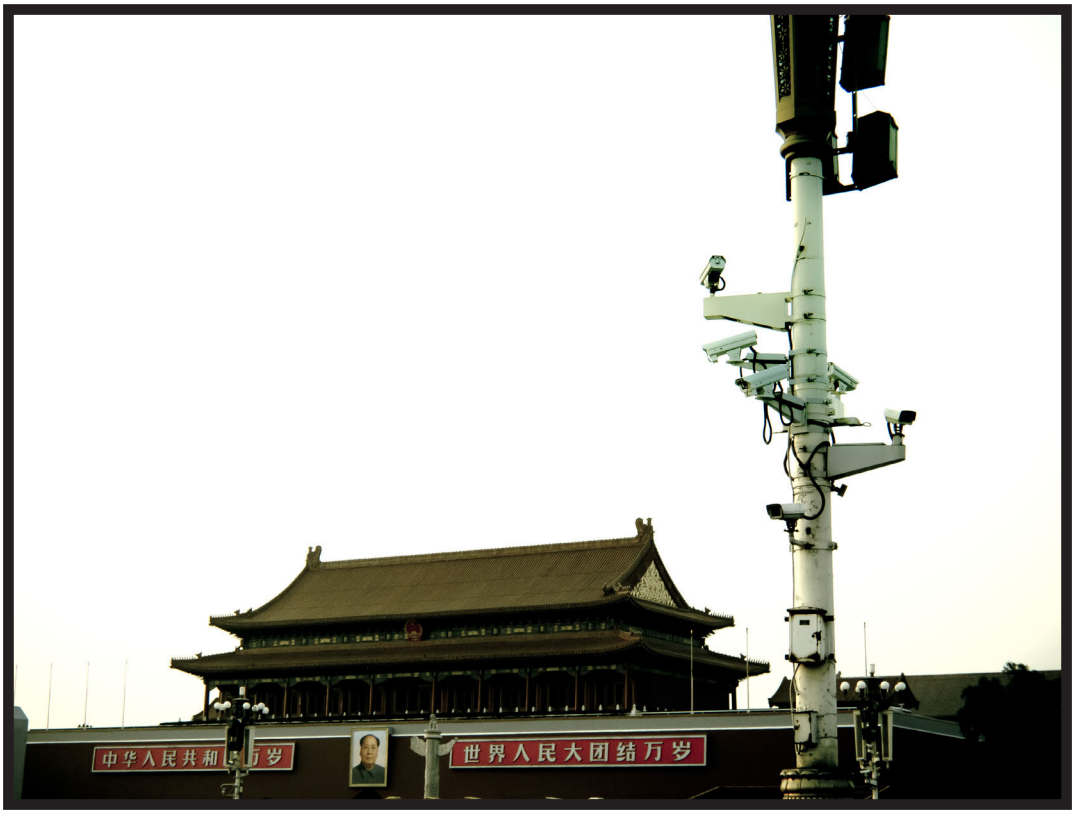
3 Barnard 2005, Kress 2006

Meaning is action · PROGR Café-Bar, Bern, 2025

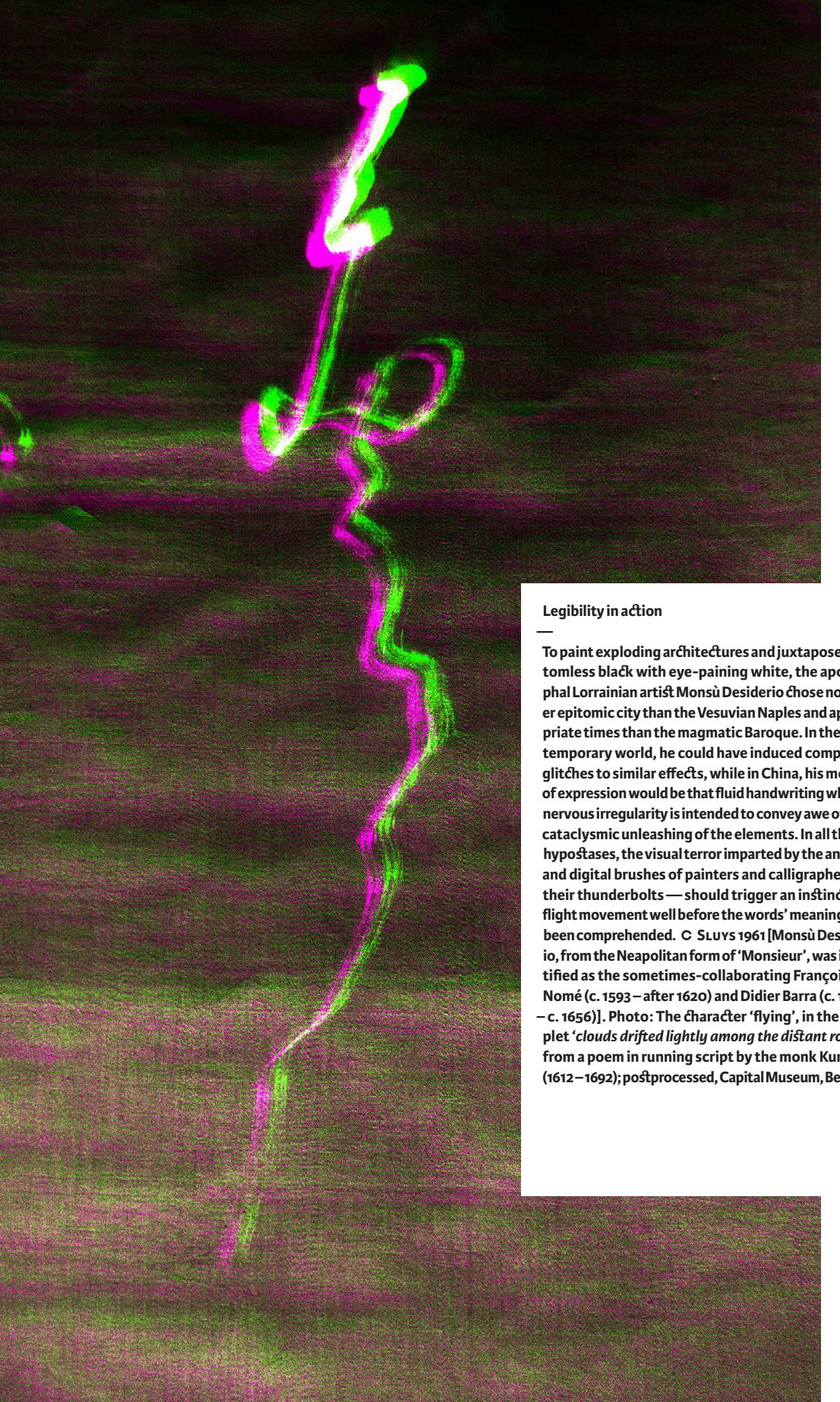
Ugraphia bugged

—

Before sleep, I finish Sun Tzu's *The Art of War*. It concludes with the commentary '*An army without secret agents is a man without eyes and ears.*' I think: what if the mask of writing is not only a one-way communication device between writer and reader, a silent loudspeaker so to speak, but also a recording machine, a microphone hidden in its every nook, a videocamera blinking behind closed loops, a termal lie-detector, with antennas sprouting from ascending strokes? 今 I dream of standing at the world's center, where heaven meets earth, in the Tiananmen Square, under a tree-like metal pole covered in surveillance cameras. From the Chinese character 'tree' (木) derives that of 'book' (本): the Place of Heavenly Peace is a library that browses its readers' minds. I'm taking a picture of a colossal inscription flanking Chairman Mao's (1893–1976) scrutinizing portrait: '*Long live the People's Republic of China! Long live the great unity of the people of the world!*' The legible script looks squarish and imparts a feeling of ideographical rigidity — it is an instrument to project power and exact submission. In the past, rebels bombarded it with ink and rotten eggs, and brandished anti-slogans hastily written on cardboards, only to be chased by police and arrested. My photographic document will be an excellent synthesis of the Wars of Legibility. 今 Once I wake up, I reconsider the 'typographical' style, regimenting ideas and people like tin soldiers. Was its choice accidental, a product of 1950s art politics or material constraints? Mao himself practiced an imaginative cursive writing to escape the straitjacket of power, and various calligraphic styles adorn other buildings of the Forbidden City. My ignorance of the script's evolving perceptions across time deepens the uncertainties of this histo-graphical exegesis. Even equating Cartesian geometry with increased legibility requires pious thinking. What remains of my dream, then? C



Sun 2015: 296 [Kia Lin on Sun Tzu], Wikipedia: 'Tiananmen', Kraus 1991: 58–74, 89, 99–105, 121 [Mao]



Legibility in action

—

To paint exploding architectures and juxtapose bottomless black with eye-paining white, the apocryphal Lorrainian artist Monsù Desiderio chose no other epitomic city than the Vesuvian Naples and appropriate times than the magmatic Baroque. In the contemporary world, he could have induced computer glitches to similar effects, while in China, his means of expression would be that fluid handwriting whose nervous irregularity is intended to convey awe of the cataclysmic unleashing of the elements. In all these hypostases, the visual terror imparted by the analog and digital brushes of painters and calligraphers — their thunderbolts — should trigger an instinctive flight movement well before the words' meaning has been comprehended. © Sluys 1961 [Monsù Desiderio, from the Neapolitan form of 'Monsieur', was identified as the sometimes-collaborating François de Nomé (c. 1593 – after 1620) and Didier Barra (c. 1590 – c. 1656)]. Photo: The character 'flying', in the couplet '*clouds drifted lightly among the distant rocks*', from a poem in running script by the monk Kuncan (1612–1692); postprocessed, Capital Museum, Beijing

Through intonation, speech instills conversation with ambiguity and polysemy. In contrast, script is literal: its ideal – epitomized by the Crystal Goblet metaphor – is pure transmission, and legibility is a matter of pristine writing precepts – demonstrate how ambiguity and polysemy may be induced by the legibility of script shapes. Calligrams and concrete poetry use layout for the same effect.[2] The rebus — another case of sharing principles with

Definition 14. Poiesis — *Legibility has the creative power to instill script with polysemy and let worlds emerge out of words, rather than aiming exclusively at the literal transmission of unequivocal messages.*

or corrupted bits of information. However, the examples sedimented page after page in this book suggest that a different conceptualization of legibility is possible, one in which it is a creative instrument for calling into being worlds autonomous from ostensible messages – much like a haiku, half writer's art and half reader's imagination. Highly cursive and ligatured script styles – be they the tracks of quick East Asian hare brushes, the Persian Qajar's graphic melopoeia, or ensnaring Byzantine monocondyls,[1] all 'graphic delirium' to contemporary the il·legibility phenomenon — is an instrument of mental training for interpreting the world, grounded in deliberate mystification and the pleasure of coding & decoding. It is also a tool of social distinction and power through the creation of codes and aptitudes. For letter mystics, Jewish kabbalists and Muslim hurufists, visible shapes are mere portals to esoteric legibility, in the same way that notes are only keys to the worlds of music. As for Egyptian writing, it developed a variety of metalinguistic uses, surprising enough to compel the modern Western scholar to explain that 'the purpose of script in this context was therefore to accumulate mean-

1 Monocondyl = writing style produced without lifting the writing instrument from the inscribed surface, typically resulting in a labyrinthine pattern; a Byzantine scribal specialty. Lace-like calligraphic virtuosities were fashionable throughout the Baroque & Romantic periods as 'display scripts' and remain so to this day for tradition-conscious diplomas and banknotes. Of universal fame and inscrutable substance are Laurence Sterne's (1713–1768) monocondylic infographic lines in *Tristram Shandy*, representing the twists & turns of the novel's plot  and the flourishes of a life in liberty  . Already a highly streamlined script, Arabic became almost stenographic within the bureaucracy of the Qadjar dynasty (1789–1925). Mirzā Mohammad-Reżā Kalhor (1829–1892) was a remarkable exponent of that period's penmanship, in the more legible *nasta'līq* style, appropriate for the publications intended for the general public of the shah's Bureau of Publications, for which Kalhor worked occasionally. ⓒ Sterne 1760, Wikipedia: 'Mirza Mohammad Reza Kalhor', EIr: 'Kalhor, Mirzā Mohammad-Reżā'

2 The sometimes transparent pictographic ancestry of kanji, combined with the kinematic liberty conferred by the brush to Japanese writing, have contributed to the development of calligrams as a literary genre based on graphical polysemy and the invention of novel kanji. Their zenith is the Dictionaries of Fake Etymology. ⓒ Inagaki 2006: 244–250

ing, rather than refine it'.[1] ⇝ This is *the coffee grounds theory of legibility,* that of the blue hour and baroque chiaroscuro, and (se non è vero, è ben trovato) of the German etymology of letters – 'Buchstaben', derived from beech trees – fortuitously referencing the visual ambiguity characterizing navigation in a forest (Dante's *selva oscura?*) or in a book, also etymologically related to the woods, in English this time (and the romanticist realm of Morris's Kelmscott Press).[2]

1 Pries 2023 ⇝ Some scripts, in particular those with transparent pictographic mechanisms (Chinese, Egyptian, Mayan, etc.), are by virtue of their writing system more prone to develop a graphic culture than others, although cultural factors can play a compensatory role (Arabic and Latin are both phonetic scripts, but differ in grapho-cultural sophistication).

2 *OED*: 'book, n.'

Somewhere near Violet-leDuc's historicist Castle of Pierrefonds – Forest of Compiègne, France, 2008

UND3S1R4B1L1TY

Pace Crystal Goblet: It is not difficult to list circumstances where less rather than more legibility is desirable.[1] Toward the end of a long career, the Dutch legibility psychologist, typography art historian, and type designer Gerrit Ovink (MCMXII – MCMLXXXIV) found solace in interpreting the people's overall indifference towards typography as a form of self-preservation from information overload.[2] Information designers themselves once discovered a startling fact about legibility: near a river, there were two signposts warning about sudden overflows, one scrawled by a local on a shoddy wooden board, the other an official sheet printed in a traffic typeface. Apparently, passers-by found the handwriting more trustworthy than the depersonalized but more legible typeface, since the only well-trodden path was sneaking past the latter.[ ] In a similar vein, participants in a psychological experiment were more successful at solving mathematical problems when these were presented in uncommon and poorly printed typefaces (presumably because the additional reading effort improved comprehension).[3] Were you to seek entry to the Heavens

Spirits of Ugraphia

—

According to Muslim traditions, two angels record the good and the bad deeds of each human being. Their heavenly writing is surely the closest legibility may come to perfection, second only to Him '*who only for canceling does write*', in the words of Dante. Alas, angels script is illegible by humans, confess the theologians, and in consequence the Arabic expression '*angels script*' is a tactful way to qualify derelict writing, explain the linguists. The paradox of Ugraphia being one and the same with Dysgraphia exemplifies how legibility is a matter of perspective, on par with the comprehension of foreign languages. In this respect, Persians were called in Arabic *'ajam*, or 'mute', given their inability to speak Arabic. Following this logic, illiterates would be 'blind', which is precisely the official term used in China. As per the authority of the Quran, they are relieved from their state of ignorance, *jāḥiliyya*, by angels, responsible for conveying God's writing to humanity via a prophet. Homer himself may have called them '*winged letters*'. Ipso facto,

---

Definition ☲. Spirit — ***A legible script is one inhabited by the 'winged spirit of the letter'.***

…which is a 'spiritual' definition of legibility. Its antithesis, 'dead letters', are as good as illegible. ⁂ When Gerrit Ovink, interbellum, was using experimental psychology to make 'typeface psychograms' quantifying the '*atmosphere value of type faces*', his quest was nothing less than understanding '*the form of a stir of the soul*'. An example is '*Frank and rough Farmers' Life. This kind of literature, by Dutch and Scandinavian authors, is very popular in Holland. Positive correlations with strength, reliability and warmth. 1. Beton, 2. Grasset, 3. Thannhauser-Bodoni-Romaansch, 4. Bembo. Saeculum is probably a little too spiritual. Bembo is spiritual too, but has the necessary "swing". The position of Bodoni is due to its strength.*' ☪ Dante, *Divine Comedy*, Paradise, canto 18: 130; Grabar 1992: 90 [angel script]; Taylor 2014: 109 [blind]; Ovink 1938: 127, 129, 154 – 155; picture: Qazwīnī, *The Wonders of Creation*, Iraq, 1279; München, Bayerische Staatsbibliothek, Cod. arab. 464, fol. 36 r°, CC BY-NC-SA 4.0

1 Related are perfectly legible texts that are effectively unreadable or only after considerable effort: foundation deposits from Mesopotamia to the present, Roman laws malignantly set too high for anyone to read and epitaphs written *inside* sarcophagi, Chinese tombstone inscriptions written in mirror for the benefit of ancestors observing us from afterlife, the apotropaic practice of reverse writing & deliberate errors in church bells' inscriptions, names of Jewish cemeteries destroyed during the Nazi era written underneath cobblestones, secret archives, Amelia Earhart's (1897 – 1937) HELP message on a Pacific island beach. In a certain sense, they are an invitation to read the world differently, as enjoined in reverse script on a mural in the Vodou museum of Strasbourg. ☪ Frese 2014 [foundations], Corbier 2006: 42 – 44 [epigraphy], Tsuen-Hsuin 1985: 141 – 143 [stelae], Netzle 2017: 39 [bells], Mickel 1986: 256a [Stolpersteine], Bodel 2021 [etc]

2 Dreyfus 1977: 571 – 579

3 The 'low toner effect' stipulates that to increase critical awareness, the comprehensibility of the stimulus ('cognitive fluency') must be decreased. More generally, illegibility makes a written message imperishable, by turning it into a curiosity-arous-

despite your ~~many~~ sins, so advises one Kashmiri poet, simply sin more: the record of your deeds will become an illegible palimpsest that censors the censors (Aristophanes [c. 446 – c. 386 B.C.E.] proposed to remotely burn the incriminating writing using a light-focusing lens). [1] In 'blackout poetry', another example, meaning emerges from erasing words, while 'asemic' writings are scribbled works of art exempt of meaning, and thus perfectly illegible. [2] Perfectly legible but deprived of meaning are the calligraphic textures of Adolf Wöflin (1864 – 1930) & fellow art brut artists & occasional psychiatry patients. [3] Meaningful and legible but not meant to read were 'alegible' inscriptions on ceremonial swords used by ancient Japanese emperors as 'a marker of power and political authority, not as a conveyor of specific factual information', in a display of 'sacred illiteracy'. [4] As for bibliophiles, style can procure pleasures beyond legibility. [5] Suppose choosing a typeface for a poetry book, set in a large size to emphasize details, printed on a manual letterpress on seaweed paper to give the text a tactile sensuousness. Summon from memory the Book of Kells & its Persian carpet of Irish intricacies. These 'slow fonts' manipulate the 'cognitive speed' of readers to increase awareness of the text's polyphony & polysemy, and create physical support for hedonism & contemplation: carpe scripto! [6] *Letter shapes, far from obscuring the meaning of words, are the rosaries that keep us busy while we think them over.* 🡅 Penmanship was in former times a status symbol — surviving as expensive Mont Blanc fountain pens & Apple iPhones — that demanded extensive training & leisure time to master. Instead of evolving into legible styles, some bureaucratic & calligraphic styles were deliberately abstruse, peacockish marks. [7] Illegibility can also contribute to preventing document *forgery*, through illegible signatures, microprinting, see-through registers, and other document security devices. [8] Poor page gray is also a bib-

ing mystery. C Alter: 2007, Oppenheimer 2008, Reber 1999

1 The poet alludes to a word play on *naskh*, both a writing style & 'abrogated' in Arabic, & *siah mashq*, both style & exercises, in which one overwrites a page until it becomes almost black & illegible. The symbolic blackening script & self was illustrated in *Family Tree* (2000), a series of photographs by the Chinese artist Zhang Huan, showing names & words progressively covering his face & shaved head over the duration of a day. C Schimmel 1990: 80 [sins], 104 [dotless Arabic], Edgü 1983 [beautiful collection of *mashq*], Chéroux 2007 [Zhang Huan], Plachta 2007: 148 [subverting censorship], Germano 2017: 14 – 15 [Aristophanes]

2 Wikipedia: 'Asemic writing', 'Erasure poetry'

3 Peiry 2004

4 Hansen 2016: 11, 22, 101 – 102, Lurie 2011: 67 – 115

5 *'If "the tone of voice" of a typeface does not count, then nothing counts that distinguishes man from the other animals.* [...] *The best part of typographic wisdom lies in this study of connotation, the suitability of form to content.'* C Warde 1956: 148 🡅 For the Japanese court lady Sei Shōnagon, legibility extends to the perfection of writing implements: '*Some people seem to think that the actual appearance of their writing utensils is unimportant. They have a box of plain black lacquer with a cracked lid; into this they put a tiled inkstone, which is broken on one side and whose every crack is so embedded with dust that one feels that a lifetime would not be long enough to clean it properly. They rub a little ink on the stone, barely blackening the surface, and pour water over it all out of a celadon jug, whose tortoise-shaped spout is broken so that there is only a gaping neck. Yet they are quite content to let people see this unsightly collection of objects.'* C Shonagon 1982: 206 🡅 For illiterate persons, writing has no use, regardless of legibility; yet, remarks the Persian court secretary & calligraphers' hagiographer Qāẓī Aḥmad (d. c. 1606), if well written, it can procure them a gratifying sense of aesthetic wellbeing. C Minorski 1952: 52

6 Dowding 1995: 9 & Ovink 1938: 120 [slow poetry], Lund 1999: 63 [legibility ~ reading speed ~ content type]

7 Rudolf II (1552 – 1612), Holy Roman Emperor, sponsored exquisite Fraktur calligraphies & miniatures on flora & fauna, in the direct lineage of the art of 'visual ideology' of his ancestor Maximilian I, author of chivalric literature illustrated & lettered by artists of note in the history of script, such as Dürer. To find modern equivalents in quality and spirit, one could think of John J. Audubon's (1785 – 1851) *The Birds of America* (1827 – 1838), a magnus opus of American printing. C Wikipedia: q. v.

8 Renesse 2005 🡅 A smart banknote for transferring via QR-codes the value of physical bills to digital wallets is Orell Füssli Securities's fictitious 'Dual' denomination for the Central Bank of Utopia (2022). C OFSP 2021

liographical feature used to identify pirated books,[1] while writing in captcha-like leet and anti-LXI {OCR} typefaces protects one's anonymity from electronic mass surveillance.[2]

collection *The Songs of Bilitis* (1898) serves as an illustration. A literary invention of the Belgian writer Pierre Louÿs (1870 – 1925), these poems were presented as the genuine homoerot-

Definition 15. Concealment — *Reduced legibility has its own usefulness, to repel and attract.*

Intentional illegibility aims to impede access to information, transform it into 'eyes only', and even obliterate it. Ugraphia acts as the protective shell of a paradisaical garden. A secondary goal is to attract the gaze & arouse curiosity. This can also be a trap to divert attention to spurious data, suggest the veracity of false information, or drain resources. A positive effect is the potential progress in legibility, as the reading system is trained on challenging data. Thus, illegible script serves to both repel and incite text penetration, like curtains, frosted glass, pixelation, and other visibility reduction methods. They are assessed by how effectively these aims are achieved, using the recognition rate of characters, words, or semantic units, expressed in formulas of varying complexity and insight.[3] For purposeful illegibility, the true & false states should be supplemented with mixed, multiple, partial, ambiguous, and failed states.

Definition 15. Concealment — *Reduced legibility has its own usefulness, to repel and attract.* This definition hints at the paradox as the essence of intentional illegibility. The poetry collection *The Songs of Bilitis* (1898) serves as an illustration. A literary invention of the Belgian writer Pierre Louÿs (1870 – 1925), these poems were presented as the genuine homoerotic autobiography of Bilitis, a companion of the sixth-century B.C.E. poet Sappho, purportedly discovered during German archaeological excavations in her scrypt on Cyprus. It took some time for literary critics to recognize the hoax, and Bilitis's full name, Legibilitis, remained unknown until it was recovered by this author. One striking aspect of this story, common to funerary epigraphy, is that writing — meant to be disclosed — creates an Ariadne's thread between the past and the present while simultaneously remaining inaccessible, entombed in the darkness of a grave. Moreover, while the inscription lends an audible voice to the dead, the script, engraved in 'primitive capitals',[4] resembles desiccated bones, including the distinctive distal protuberances known as condylar serifs. The writing pictographically warns of the mortal dangers of excessive legibility, akin to the effect of a blinding light. The poetess explicitly states in one of her poems: 'An old blind man lives up on the mountain. / For having peeped at the nymphs, his eyes / have long been dead.'[5] The conclusion of our discussion is that purposeful illegibility reveals a counterpart to the Crystal Goblet, the Frosted Glass theory of legibility.

1 Nehrlich 2012: 34 – 35

2 'Шσгd'§ ẘгįţţєи ţђįƀ ẘαу αгє įllєϿįƀlє ţσ αυţσṃαţį⊂ §єαг⊂ђ ρгσ©§§є§ αиd' d'αţα ṃιиιиϿ σρєгαţįσи§.' C Mun 2012, Aranda 2013

3 Wikipedia: 'Precision and recall'

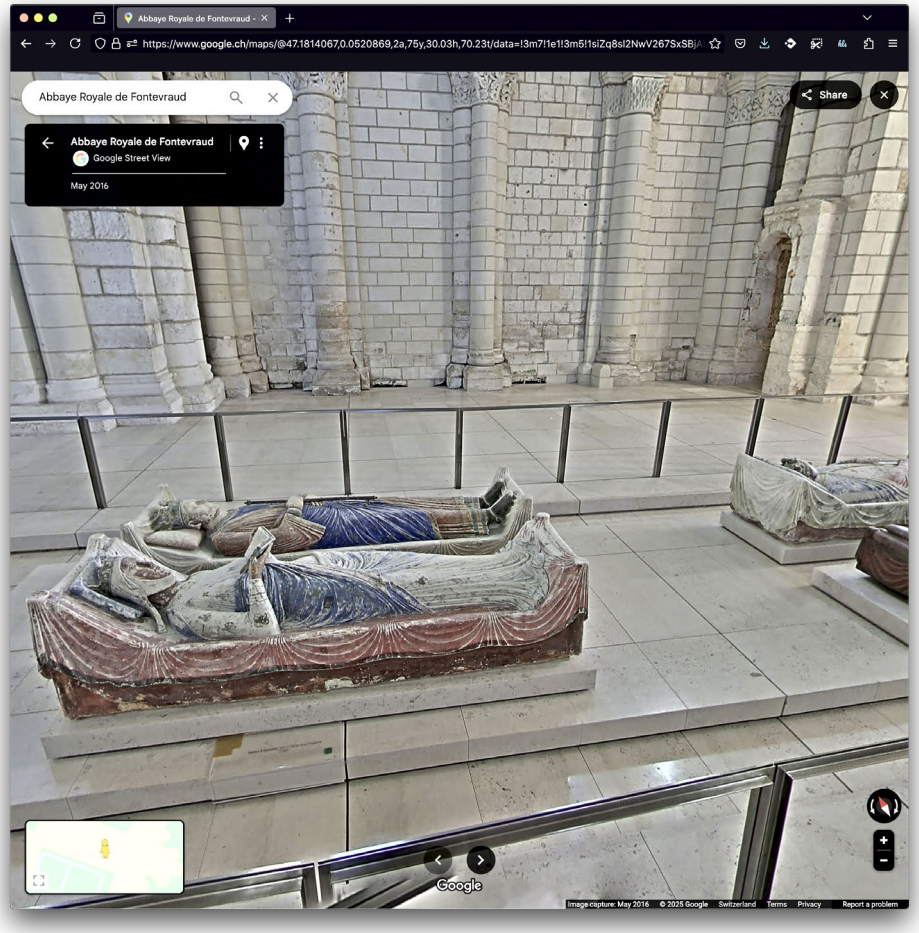
4 Loüys 1898: 23

5 Loüys 1898: 35 [bucolic no. 5]

The insomniac sufi's Ugraphia

—

The reader imagines the content of the empty book she is holding before her eyes for eternity. Nobody else sees what she sees. It's the perfect cryptographic legibility. C Tomb effigy of Eleanor of Aquitaine (c. 1124–1204), Queen of France and England, next to her husband, King Henry II Plantagenet (1133–1189), and her son, Richard I, the Lionheart (1157–1199). Google Maps 2016, Shah 2016 [the zen of empty books], Gopnik 2025: 24



SP3CTRUM

Is it really incongruous to ask what the function of legibility may be? The case studies seen in the preceding pages, and those to come, depict a *spectrum* of legibility, running from highly desirable to undesirable through irrelevant and various subtypes, such as contextual or partial. Consider how different legibility optimization is for casual reading, fast reading, software code, transportation signage, low vision conditions and pathologies, Braille, machine reading, and so forth. The implication is that…

Definition 16. Spectrum — *There are degrees and kinds of legibility, for different contexts and functions.* ⯁ We may therefore speak of *functional legibility* instead an undetermined legibility.[1] To put it in more generic & abstract terms, legibility is a set of script qualities that meets the requirements of a specific function. Since legibility fulfills many functions, the corollary is that legibility is multiple, not unique and universal.

Definition 16. Spectrum — *There are degrees and kinds of legibility, for different contexts and functions.*

3V1D3NC3

What is the historical evidence in favor of progress in legibility? A panorama will show two categories emerging from the mists of the past, bioscript and mechascript.

Bioscript — Did the fate's hand play a role in legibility's story, when Steve Jobs (1955–2011) continued to attend calligraphy classes at University of California, Berkeley, after dropping out of all other subjects, to which he credited the typographical excellence of the Macintosh?[2] Was it the discovery of <space> that spelled the end of voiced reading, improved legibility, ushered a Renaissance, and brought Enlightenment to Europe?[3] The Chinese do not between words see the void, but did invent printing before Gutenberg! The creation of the zero made mathematics easier, but are any one of the Indian figures' incarnations more legible than any other (for 'four': Devanagari ४, Persian ۴, Arabic ٤, or Western 4)? Doth the use by

[1] 'Functional legibility' mirrors the term 'functional literacy', which is the ability to manipulate writing for limited functions: signing one's name, for example, or recognizing only the few toponyms that matter during a trip abroad, such as 東京 (Tokyo) or ᛗᛁᛞᛞᛚᛖ ᛉᚱᚦ (Middle Earth). C Thomas 2009 [functional literacy in general and in Ancient Greece]

[2] As the co-founder of the Apple computer company recalls in his biography: '*If I had never dropped in on that single course* [*of calligraphy*] *in college, the Mac would have never had multiple typefaces or proportionally spaced fonts.*' C Isaacson 2011: 40–41.

[3] The separation of words by blanks facilitated the transition from voiced to silent reading during the Middle Ages. This improvement in legibility had purportedly various social ramifications, including increasing literacy rates and contributing to the emerging culture of privacy, individuality, and social distinctiveness. It remains baffling why word division was abandoned during much of antiquity, despite its benefits. C Saenger 1997 [essential reading], Lund 1999: 25 note 22, Martin 1995: 67–68, Eisenstein 1979: 83–85, 230–231, Svenbro 1993 [Greek antiquity], Coulmas 1996: 454–455, 550–551 [interpretation of evolution], M. 2019 [variability of phenomenon]

Messrs. Ibn Muqla, Dürer, Grandjean, Renner, and Knuth of compass, ruler, and Bézier curve make the so-conjured Euclidean geometry of letters more legible?[1] We abandoned teaching Copperplate, Sergent-Major, and Sütterlin, but the legibility of children's handwriting did not improve with the adoption of print script, a scholastic trend backed by UNESCO & disapproved by the Association Typographique Internationale, nor with the inescapable injunction to use fat pencils, based on non-existent "'research"'.[2] The demise of the esoteric Fraktur was as much an attempt at National Socialist imperialism (to help carry out international propaganda campaigns in a more familiar script), as it was an expression of Hitler's (1889–1945) repressed inferiority complex (to have a grander printed media than the United States), and an ideological misunderstanding (on the script's presumptive Jewish lineage).[3] Examples of decadent scripts abound, suggesting Bacchus's hand in Clio's tortuous walk: Did the Persians really invent a 'broken script', the illegible *shekaste*, at the precise time when their Ottoman neighbors wrote the clear *naskh* with mechanical precision?![4] None but the bamboo-ruffling Aeolus and Zhao Mengfu himself could be expected to read the fluid Chinese 'grass script' *caoshu*![5] Are the towering accent clouds of Vietnamese an attempt at pointillist user-friendliness, or rice grains left over for Buddha?[6] Jesus Loves You is the thorniest typeface in the grunge class, hardly outstripping even Flesh Wound.[7] While it is true that quadri-color voweling did not last long in Arabic script, it did at least survive, reduced to vermilion, in illuminated Qurans.[8] Justification in medieval Hebrew codices seems to have had more to do with showing off the scribe's virtuosity than with legibility.[9] *Nay, I'm not done!* Surely we can trust the ever-practical Romans to devise the perfectly legible script — after all, script zealots pilgrim to the feet of Trajan's Column in Rome, prostrating themselves before the perfection of its Eternal Roman capitals (Father Catich).[10] Surely their successor Charlemagne did nothing more than promote the Carolingian minuscule — which 'was a total suc-

1 The Abbasids' vizir Ibn Muqla (885-86–940) is credited with devising a generator principle for Arabic letters based on square dots and the circle, which remains valid to this day as calligraphic metrology. The Enlightenment typeface Romain du Roi, commissioned by King Louis XIV in the last decade of the seventeenth century, designed by a committee and with initial punches cut by Philippe Grandjean (1666–1714), was constructed on a fine orthogonal grid; the Bauhaus typographer Paul Renner (1878–1956) created the successful geometrical Futura sanserif; Donald Knuth's METAFONT language defines fonts mathematically. C Eir: 'Calligraphy', Mosley 2002, Eisele 2016, Knuth 1986

2 Sassoon 1999: 70, 81, 94–95

3 Hartmann 1999: 258–268, Rück 1993, Bain 1998, Walter 1960: 356–357, Wikipedia: 'Antiqua–Fraktur dispute'

4 The overly cursive *shekaste* — literally, 'broken' (Fraktur!) — had its heyday during the Persian Qadjar dynasty (1785–1925). Like like [*sic!*] Chinese and Japanese cursive, it is difficult to read for a non-initiate. Poets seem to revel in the sinuosity of these styles, and when entire bureaucracies indulge in curly scripts, social decadence soon follows. C Kvernen 2024: 'Shikaste' [samples], Kafka 2012 [bureaucracy and the French Revolution]

5 'Grass script' is a Chinese cursive script, and Zhao Mengfu (1254–1322) is hailed as one of the great masters of *caoshu*. C Fu 1986: 30, 86–87

6 While you should definitely eat what is on your plate, remember to leave a little something for others too, if only for your cat. You never know who's reincarnation it is. C Personal communication, Chieko Shindo, Japan/France. 🔗 A similar tradition exists in China regarding the *tangyuan*, a sweet dumpling eaten during the Chinese New Year festivities; to attract good fortune, married couples should ensure that there are two dumplings left over, while single persons should leave one. C Yu 2019

7 Their three-dimensional counterpart, the Rhyzome typeface, has philosophical connotations. C Miller 1996: 50–52

8 In the early days of Arabic script, red, yellow, green, and blue dots marked diacritical vowels in deluxe Qurans. Later, vowels were distinguished by shape instead of color (ـَ for *a*, ـِ for *i*, ـُ for *u*). The colored script tradition persisted in Maghrebine manuscripts. C Kvernen 2024: 'Maghribi' [illustrations], Déroche 2006: 222–224 [color diacritics], Atanasiu 200* [visualization]

9 Beit-Arié 2003: 45

10 Shaw 2015, Wikipedia: 'Edward Catich' [1906–1979; American priest, calligrapher, & paleographer, historian of the serif]

cess in legibility', according to modern paleography, without further empirical ado.[1] Surely Renaissance's Italian Humanists consciously designed a 'careful and clear' handwriting (Petrarch to Boccaccio dixit) and typefaces, both roman & italic (Griffo for Aldus facit), by concocting their salmagundi of Roman capitals, Carolingian minuscules, and black Gothic flavor, packaged in the mystique of Classical antiquity, a dowry for posterity that defines the Latin script to this day.[2] The Darwinian question is all but settled: Latin script's fitness for diffusion is such that it outgrew its Mediterranean cradle, sailed through the Pillars of Hercules, set foot on the Moon, on Mars, and left our solar system behind on its way to the stars.[3] We can only marvel at the genius of this writing, and at such textbook progress in legibility. *Vale!* ⇗ The unquestionably divagatory nature of the preceding litany only reflects the paleographer's embarrassment at being hard-pressed to bring forward a consequential body of substantiated evidence on the possible progress of legibility in the evolution of handwriting. Not to leave the gentle reader empty-handed, I will produce one case of what I believe to be such a progress. ⇗ The Persian *nastaʿlīq* fits better — to the unanimous acknowledgment of both Iranians & Arabs — the letter frequencies of Farsi than do Arabic styles, thus resulting in more harmonious & legible texts.[4] Conversely, a *nastaʿlīq* Quran is an atrocious disfiguration. There are two primary reasons behind this aesthetic disposition. First, due primarily to the use of the definite article *al-* (ال), vertical strokes abound in Arabic script transcribing Arabic language, a quasi-aural beat emphasized by common Arabic hands such as the majestic *thuluth*; that is, something that simply cannot be reproduced when using Arabic script for the Persian language, which in fact lacks articles altogether. Second, certain letters that are not connected to their neighbors despite the cursive nature of the Arabic script — *rāʾ*, *dāl*, and *wāw*, such as in the Persian word رود *rūd* 'river' (نهر *nahr* in Arabic) — produce by their frequency in Persian a quantity of finely segmented words, allowing Persian writers to stack characters to a degree physically impossible for their Arab brothers without overlapping. Compare a *nastaʿlīq basmala* بسم الله الرحمن الرحيم with a *thuluth* one بسم الله الرحمن الرحيم.

Mechascript — So much for the paleography of legibility. In the meantime, a wealth of evidence in favor of legibility improvement is furnished by the history of typography. In fact, legibility has been a steady concern of printers ever since Gutenberg ensured that his printed Bible mimicked manuscripts in classy **textura** hands to prevent charges of illegibility from being leveled against his brand-new technology. It turned out that his artifice was of such perfection as to allow prints to be sold dearly by unscrupulous printers as handwritings and, in Paris, to be accused of sorcery by panicked and jealous copyists, it being common knowledge that the 'black art' [= ink intensive] was invented by Faust [= Johann Fust (1400–1466), Gutenberg's investor], and produced by 'printer's devils' [= apprentice boys].[5] The Italian Humanist printers, for their part, took similar care of legibility by adopting what were deemed the styles of antiquity, a gold standard of ancient typeface beauty and legibility revived in Romantic garb by the 'apostle' of British Arts and Crafts typography, William Morris.[6] The

1 Martin 1995: 129, Daniels 1996: 319–320

2 Martin 1995: 193–194, 303–305, Bischoff 1990: 146–149, Daniels 1996: 323–324, Wardrop 1963, Ullman 1960, Carter 2002: 45–67 [typography] ⇗ Francesco Petrarca (1304–1374), Giovanni Boccaccio (1313–1375)

3 Wikipedia: 'Voyager Golden Record'

4 Atanasiu: 1999: 91–92, 2006 [extended version]: 38 note 28

5 Marshall 2017: 47–48, Greswell 1818: 7–10, Eisenstein 2011: 107

6 *'I began printing books with the hope of producing some which*

rise of sanserif at the onset of the Industrial Revolution,[1] culminating in the omnipresence of Helvetica, Futura, and lesser Universes,[2] is a textbook illustration of the success of a script being due as much to increased legibility (in terms of visibility for public advertisements & saliency of newspaper headlines) as to other factors, as diverse as novelty, ideology (pre-Shelleyian philhellenism), fashion (post-Napoleonian Egyptomania), class (serifs for the man of means, discernment, and taste, and sanserifs for the tabloid consumer), production and costs (easy to cut and draw), and competition (between the producers of whatever the types were advertising, as well as between the type foundries themselves). Crafted in 1968, the OCR-A and OCR-B typefaces, familiar to us from credit cards, bills, and passports, are notable in the annals of legibility research, having been expressly developed for optimal dual use by both human and machine readers.[3] To this day, legibility remains a common selling point for fresh typefaces, an argument empowered with the aura of objectivity and ring of potential rise in market revenue (or so the student of any earthbound visual communication school will be taught).[4] ⇛ Gutenberg's legibility angst was justified: poor aesthetics and legibility have been impediments to the adoption of mechanical means for mass-reproducing Arabic script. The use of block printing for amulets, at least since the ninth century, Mekkan pilgrimage certificates, and paper money, in Mongol Persia, remained marginal and ephemeral, while Arabic typography was more common in Christian Europe than in Islamic realms.[5] Of particular concern was the typesetting of the *nasta'līq*, with its complex spatial arrangement and fluid shapes. Thus, when lithography appeared in the nineteenth century, it rapidly became popular in the area between Persia and India, where *nasta'līq* was endemic.[6] The facsimile reproduction of hand-

would have a definite claim to beauty, while at the same time they should be easy to read and should not dazzle the eye, or trouble the intellect of the reader by eccentricity of form in the letters.' C Loxley 2004: ii, Goudy 1977: 148–149

1 The links between the Grand Tour of Europe and the Levant, the spirit of Romanticism, epigraphical scientific endeavors, and the advent of sanserifs are beautifully cast in a book by the St Bride's Printing Library librarian James Mosley, and recounted with no lesser verve by Stanley Morison himself. C Mosley 1999, 2007, Morison 1972: 315–339

2 The sleek, industrial typographic style developed in the interbellum years in Switzerland became the defining style of international typography in the post-war era. Its flagship typeface, Helvetica, carries in its digital font information by Linotype the following description: '*no ornament, no emotion, just clear presentation of information*'. To Shannon's ears, this would sound like the perfect communication channel, devoid of interferences, were he to take Linotype's advertisement at face value. C Hollis 2006 ⇛ The story of Helvetica's creation reads like the product of cut-throat competition between typographic hardware firms and industrial customers, involving many interwoven layers of designers, draughtsman, punch cutters, managers, and customers, rather than the mooning musings of an inspired solitary artist. C Müller 2009

3 Frutiger 1967

4 In font file informations you can read that 'Palatino *was designed for legibility*', that Century Schoolbook has '*inherent legibility*', and on Comic Sans: '*This casual but legible face has proved very popular with a wide variety of people.*' In the more extensive space provided by publicity brochures, you learn that the acclaimed **Futura** typeface (1931), by Paul Renner, was marketed on 'scientifically proved' grounds of excellent legibility, although, in fact, there was little research to speak of. C Lund 1999: 107–111, Burke 1998: 112–113

5 Schaefer 2006 & 2014, Aksoy 2000, EIr: 'Čāv', EI2 (6): 'Maṭba'a', 794–807 ⇛ It is unclear why block printing succeeded in East Asia but not in West Asia.

6 EI2 (6): 794–795, 803–807, Nemeth 2017: 150–151, 153, 286–288, 448 ⇛ Lithography (*1796) necessitates that script be written in reverse to appear the right way when printed; offset lithography (*1853) removed this constraint, through the use of an ink-transferring roller between the lithographic stone and paper. As this technology demanded some mental gymnastics and exercising on the part of the aspiring lithographic scribe, similar to the know-how of seal makers, or, for that matter, of the typesetters, it was useful that 'mirror writing' happened to be a genre of the Arabic calligraphic repertoire. C Massoudy 1982: 132–135

writing by the lithographic process provided readers with a familiar and legible yet mass-produced script, in addition to being economically advantageous and allowing easy integration of text and image. Lithography is a good example of optimization in mechascript and its adaptability to graphical and sociocultural specificities. Noteworthy, it is based on the symbiosis of bio- and mechascript, and it demonstrates the pivotal importance of legibility in the success of information technologies and the impact on transformation and progress in society, culture, education, health, and politics. ⇗ Underlying mechascript is standardization & *encoding* of written communication for information interchange, whose optimality depends on avoiding confusion & mutatis mutandis on legibility. Because writing is inherently standardization & encoding, it also characterizes bioscript, as reflected in alphabetic order and the use of radicals to construct Chinese characters & organize dictionaries. In mechascript, this sophistication reaches its zenith with the unification of scripts, both present & past, within a single encoding standard: Unicode. More so than bioscript, mechascript accelerates legibility research through rigid technical constraints and its capacity for mass production, high speed, and precision. A story from China exemplifies how mechascript, in conjunction with culture, fosters a self-sustaining cycle of script optimization for specific needs. In times when literacy was limited, people venerated the power of the written word, so scraps of inscribed papers were collected & burned in 'character burning pagodas' (*xizita* 惜字塔).[1] The tradition endured, as ritualized writing cremation also served the important function of communicating with gods, ghosts, & ancestors: script ascended in smoke to the heavens, the ashes dispersed on earth and water to chthonic spirits, or were dissolved in liquids and ingested as medicine. These character burning pagodas now operate as telephone booths of sorts, and writing burning as facsimile exchanges with the netherworld.[2] Important messages are costly calligraphed by professionals on special paper that burns to fine dust, and as the interworld exchanges intensified, the supporting technology of mechanical word reproduction, its architectural infrastructure, and fire safety regulations have to improve. ⇗ Legibility improvements are rarely as spectacular as the apparition of a new branch in typeface taxonomy,[3] such as nineteenth-century sanserifs, or the stupendous resolution of the Retina computer displays at the dawn of the twenty-first century,[4] but are more often than not minute, painstaking, and arcane innovations and adjustments: open the 'eye' of an *o*, thicken its strokes, reduce its width contrast, sharpen corners, and it can be better distinguished from farther away;[5] use 'ink traps', and one can avoid blotches on rapidly printed newspapers;[6] lighten the strokes of capitals to make

[1] He 2004: 13, Myrvold 2010 [writing disposal across cultures]

[2] Stacks of very legible and genuine-looking imitation money too are transferred. ⇗ Scott 2007: 20–21, 58

[3] For a infographic synthesis of 26 typeface classification systems ⊂ Childers 2013; for a book-length survey ⊂ Petri 2019.

[4] Wikipedia: 'Retina Display', 'Dots per inch'

[5] Shape simplification, sharpening, and opening improve legibility at small print sizes, such as for footnotes; conversely, titles are given more shape detail, such as delicate serifs. This procedure is known as 'optical scaling', and the design of the families of such fonts has been semi-automated, by interpolation of reference shapes, hence the name 'multiple master fonts'. ⊂ Ahrens 2007, Adobe 1995, Lund 1999: 29, note 31, Wikipedia: 'Multiple master fonts' ⇗ Examples: Typographes [Typographes] vs. Typographes [Typographes] (Minuscule [2007] by Thomas Huot-Marchand designed for 2 pt and 6 pt, scaled to 8 pt between brackets); Typographes vs. Typographes (Hoefler Text vs. Hoefler Titling [1991, 2001] by Jonathan Hoefler and Tobias Frere-Jones) ⊂ Huot-Marchand 2018, Hoefler 2018

[6] Take the letter 'V', and note how its branches meet at an acute angle; within it, make a notch, like this: V; when the character is printed, the notch will fill with excess ink, accumu-

them less conspicuous, and they will sell better in German-speaking lands, where majuscules abound.[1] Considering the amount of time spent by our contemporaries in front of computer monitors, special acknowledgment must be made of the heroic souls that have contributed to progress in screen legibility, through manual work or software development focused on hinting, anti-aliasing, subpixel alignment, and specialized screen fonts.[2] Paragraph optimization is a further aspect of legibility, which comes naturally to handwriting, but is an arduous task when it touches the finer points of microtypography.[3] Printers never tire of repeating that even the best typeface can be ruined by sloppy composition.[4] Here, the parameter is no longer the shape of individual characters, but rather the shapes that emerge from setting an entire text block: the topology of texture. As discussed above, the goal is a uniform page 'gray', or a texture void of unevennesses that might unduly detract from reading, with the principal means of achieving this being suitable kerning, hyphenation, justification, and avoiding rivers.[5] Moreover, there are even greater scales of legibility. When writing by hand, one struggles to modify what has been written; in digital media, however, modification is trivial. A statistician will respond with incredulity when informed that novel chapters tend to end about halfway through the last page (I speak here from experience), yet a company important in the history of desktop publishing, URW of Hamburg, has developed software for chapter composition, to address automatically the problem of too-short or too-long chapter coda.[6] ⇛ Aside from the printing industry and graphic designers,[7] oth-

lated by capillarity, and the V will look sharp: **V**; with no notch, the ink will blunt the angle: **V**. This is called an 'ink trap' and was invented to preserve the shape of characters under the constraints of printing, especially of fast-moving rotary presses. For the same purpose, but to protect outer edges, there are tiny spikes, called 'horns', in phototypesetting. One typeface with ink traps is Bell Centennial, illustrated here, designed by Matthew Carter in the 1970s for AT&T's telephone directory. A recent ink trap extravaganza is **Retina** by Tobias Frere-Jones (2016). Dubbed a 'light trap', the technique should improve legibility on low- & medium-resolution digital displays, a design principle for the B612 typeface commissioned by Airbus for cockpit instrumentation (KMQZ). ⊂ Wikipedia: 'Bell Centennial', Sherman 2005, Frere-Jones 2018, intactile 2017, 2021, Stock-Allen 2016: 63–63 ⇛ Both ink trapping and optical scaling use outline sharpening. As the sensitivity of the human visual system decreases with stimulus size, finely printed characters lose information at high frequencies and appear blurred. By sharpening the typeface, the designer augments the power of high frequencies and maintains the desired perceptual character shape. The effect was observed by William A. Dwiggins (1880–1956) while creating marionettes, and he subsequently applied it to typeface design. ⊂ Unger 1981 ⇛ Ink spread in general is a script distortion factor over which typeface designers have little control. It is sufficient to change the printing polarity (inking the area around characters and leaving them uninked) to produce thinner strokes, or even break up the strokes. Usually, in such cases, the use of a slightly bolder face solves the problem. However, if a white-on-black page is read during a sunny day, and half of it is in shadow (i.e., if there is high luminance contrast between parts of a texture), then the sunnier characters will appear bolder than the shadowed. The disparity is due to the impossibility of simultaneously properly focusing the eye on highly contrasted areas; photographers known this problem as 'under-' and 'overexposure', and also know one solution: high-dynamic-range imaging (HDR).

1 Monotype 1956: 14

2 'Heroic' is not at all a hyperbolic qualifier to describe those with an experiential understanding of what manual font hinting means: it consists in finding, by trial and error, & with great *Fingerspitzengefühl* [fingertipperspicacity], the best placement for pixels to preserve character shape at low resolution. The other techniques mentioned are somewhat similar in that they are meant to combat shape distortion induced by quantization. ⊂ Haralambous 2007: 505–548, Wikipedia: 'Font hinting', Stamm 2011

3 de Vinne 1904: 89–90

4 Lund 1999: 19

5 Karow 1992, 1998, 2013 [URW's comprehensive composition technologies], Kindersley 2001 [a lettercutter on kerning]

6 Karow 2013: 39–42

7 E.g., this is the **TINKER** typeface by Sofie Beier (2009), and this is **Legilux** by Antonia Cornelius (2017), both developed on the basis of psychophysical experimentation. ⊂ Beier 2012, Cornelius 2017, Bigelow 2019 [further such typefaces]

er professionals have made expert contributions to legibility research, with optometrists having designed letter-based visual acuity charts used the world over,[1] psychologists becoming involved in typeface development for normal-sighted people,[2] or those affected by low vision, dyslexia, and other impairments,[3] and educators researching scripts suitable for children.[4] If we extend the scope of legibility to cover notations, such as for mathematics, music, or dance, heraldry, kinship, and road signs, and information visualization in general, we will discover further contributor categories and a strong level of experimentation and advancement, at least in terms of the sophistication and accumulation of available solutions.[5] ⇛ To counter a rosy image of typographic legibility improvement, traffic lettering is a sobering case in point. On this topic, substantial investment has been made throughout a century of scientific research; despite this, the custom-designed typefaces or those culled from catalogs exhibit great variety.[6] That no agreement has been reached by scientists on an application of such import to modern life highlights the limits of legibility optimization.[7]

Synthesis — At this point, the reader has likely sensed the presence of two evidential categories for progress in legibility — bioscript and mechascript — and acquired a vague notion of their nature. I will now examine the elements that they share in respect to legibility progress, i.e., the issue of *consistency*, before turning in the next section to a formal model. ⇛ The basis of a legible handwriting is consistency in production of instances of the same character.[8] This is the fearsome drill inculcated in elementary schools,[9] as well as the bread and butter of the daily effort of the scribes of yore.[10] While the

1 E.g., the **SLOAN** typeface for optometry, by Louise Sloan (1959) and Denis G. Pelli (1990). ⓒ Rubin 2013: 44–46, Pelli 1988, Bailey 2016, Wikipedia: 'Snellen chart', 'Sloan letters', Germano 2017 [a nonpareille cultural history of the eye chart, by an editor, and author, himself, of *On Revision: The Only Writing That Counts*, of which recalcitrant matter there is never enough]

2 E.g., Graphophonic (1990) is a typeface design concept developed by the psychologist Thomas Sanocki consisting in translating phonological differences into visual distinctions, such as the two shapes of 'c' in '**cat**' & '**city**'. ⓒ Sanocki 1990

3 E.g., **OpenDyslexic** for dyslexics, by Abelardo Gonzalez (2012). ⓒ Wikipedia: 'OpenDyslexic', Hillier 2006 [creator of the Sylexiad typeface], Xiong 2018 [evaluation of other dyslexia typefaces]

4 E.g., this is the *Sassoon Primary* typeface for children, by Rosemary Sassoon and Adrian Williams (1998) and this is the *Écriture* typeface, commissioned for public schools by the French Ministry of Education from the graphic arts school École Estienne, Paris (2013). ⓒ Sassoon 2018, MEN 2013

5 Daniels 1996: 785–879 [encyclopedic reference], Caraës 2011: 50–51 [fascinating Inuit kinship diagram by Jean Malaurie], Sauer 2009 [music notations, lavish], Pastoureau 2018 [heraldry, gorgeous], Tufte 1990 [information visualization, buy it now !]

6 Wikipedia: 'List of public signage typefaces'

7 Florian Coulmas made a similar remark on writing systems not converging to a single optimal solution. ⓒ Coulmas 2009: 5

8 This does not necessarily mean that characters need to be identical: local adaptation is desirable.

9 Harry Potter, in the *Order of the Phoenix*, was punished by a malefic schoolmistress by having to copy the sentence *'I must not tell lies'* with the magic Blood Quill, which engraves the words on the skin as they are written and uses the blood flowing from the wound as ink. Quills with various other highly useful scholastic properties appear in the *Harry Potter* world (e.g., the anti-cheating, auto-answering, and spell-checking quills), but none improve legibility. ⓒ Wikipedia: 'Magical objects in Harry Potter'

10 I was tempted to add that the highest degree of consistency can be found on lapidary inscriptions of public monuments. However, manually carved lettering can display a subtle and harmonious variability equal to calligraphy, its sensuousness tempting the finger to caress its sun-bathed outlines and probe its mossy depths. This sort of physical interaction feels liberating from the despotism of writing that demands to be read and its wretched attempts to remain legible, ad æternam. My temptation can be replicated by any visitor to the good cities of Cambridge in England or St. Gallen of Switzerland, cities replete with many street and building names lettered by the artists and writing theoreticians David Kindersley and Jost Hochuli. It is the replacement by typography of such visual and spiritual liveliness with industrial soulless uniformity that was deplored by the Victorian art critic John Ruskin (1819–1900): '*that abominable art of printing* [*that*] *makes people used to have everything the same shape*'. ⓒ Cardozo Kindersley 2010, Shaw 2011, Carpo 2011: 81

overt justification is visual noise reduction, the unspoken aim is social compliance. Less random handwriting also facilitates communication via standardization, is itself limited by the need for the ductus to be adapted to the graphical context, as well as by the functional diversification of scripts. The levels at which consistency operates are both individual & social: for character generation consistency, and for the regulation of writing styles. The nature of the interface between thoughts and visible script determines the nature of the level of individual consistency. For the human system, this means the consistency of the biological performance in writing production, by customary means (such as fluid hand movements) or neural interfaces attached to computers and robotic writing instruments. As the work of children filling page after page of writing exercise books suggests, the nature of *bioscript* performance is fluctuation: initial training is followed by a continuous struggle to maintain quality and ends in progressive decay, similar to a sports activity and drawing zen circles.[1] When writing is produced artificially (e.g., by mechanical print or electronic display), consistency of character instances is less of an issue, with the problem becoming one of visual consistency across media and conditions. Contrary to bioscript and sports, progress in *mechascript* performance can last longer and attain (in some regards) higher quality, paralleling progress in engineering. Consistency is a matter of both individual performance and social organization. The primary regulatory instances of writing consistency are state administrations, which generate writing models and manage their use; the industry and the arts, acting as generators; and the educational system, acting as conditioner of writing consistency. All these organizations, in addition to the general public, are also the source of increased writing entropy, the antithetical force to consistency. ⇗ What progress in consistency — and, implicitly, in legibility — is detectable through this reading frame? Bioscript and the social regulation of styles appear in a state of perpetual transition between progress and regress, which is at best an inconclusive finding regarding the possibility of perfect script. In this way, the divide between bioscript and mechascript mirrors that between oral and literate cultures, betwixt the floating worlds of kaleidoscopic polysemanticism of aural waves and the fixed point-of-view of vision.[2] ⇗ Now that this divide has been established, we might next ask about its impact on the evolutionary paths taken by the two script categories. An essential feature of machines is that they enable the indefinite reproduction of optimal script shapes. Walter Benjamin might have said that handwriting is for recording & adorning, while typography is for the multiplication of words and monies.[3] This did not escape the attention of medieval monks, as typography spelled the

[1] The *ensō*, a circle drawn in a single stroke, encapsulates a host of ideas about the nature and purpose of legibility, many of which are at odds with the pursuit of perfection characterizing its understanding in the Western world. Concretely, a perfect circle cannot be produced, given the limitations of human kinematics, and the materiality of the brush & paper. Thus, the *ensō* stands for the quest for an ideal, & reveals the mistake of considering the ideal as being (Euclidean) perfection, rather than coping with the (fractal) 'imperfection' of life and nature. 'Legibility' may even be beside the point: the writer of the *ensō* tries to achieve a certain mental state (of pleasure, concentration, spiritual enlightenment, etc.), which the reader attempts to recover from the visual trace. Both may acquire karma from such deeds as those of the Instanbulite calligrapher Hasan Celebi copying for two years the same sentence. C Seo 2007, Atanasiu 1990: 137

[2] A teaser for this well studied topic: '*Prose remained oral rather than visual for centuries after printing. Instead of homogeneity there was heterogeneity of tone and attitude, so that the author felt able to shift these in mid-sentence at any time, just as in poetry.*' C McLuhan 1962: 136 [quote], Goody 2000

[3] Walter Benjamin (1892–1940), the sociocultural critic and author of 'The Work of Art in the Age of Mechanical Reproduction' (1935).

end of a certain concept of calligraphy; progress had certainly been made towards attaining the bliss of Perfect Shapes, but like Paradise itself, that stage was ultimate. Thus, penmanship became an activity of never-ending sensorimotor self-improvement, meditation, emotion expression, social vanity, and aesthetic hedonism. Mechascript, however, is strongly characterized by steady progress, and if all things remained as they are, it would not be long before engineers had solved the vexing problem of perfect legibility and cracked open the gates of Utopia. If we believe in artificial intelligence, the end might indeed be near.

Formalization — First a definition, then a model. ⇛ The terms {bio | mecha} script are short for 'biotech script' and 'machine-mediated script', respectively. They draw attention towards (*a*) the fact that between a source of script & its realization exists at least one mediating interface, (*b*) the kind of interfaces, and (*c*) which is the predominant kind.[1] The first interface is endogenous to the source; the second is exogenous. Typically, one is biological (a human), while the other is artificial (a mechanism), but not necessarily: dictation uses a biological scriptor as interface, and visual communication can take place between robots. Furthermore, various amounts of each kind usually coexist, and even low-tech interfaces can have a relatively complex fabrication process.[2] Thus, {bio | mecha} scripts are to be taken cum granum salis, as practical shortcuts. ⇛ The present discussion revolves around progress in writing, in which we distinguish, as mentioned in the introductory remarks to this book, the abstract encoding system of messages (writing system) and their visual representation (script); it is the latter that is our particular focus. We have identified two segments of interest in the writing process, a biological and a mechanical segment. The former is itself dissectible for our purposes into perception, cognition, emotion, motor programs, physiology, and biological noise. Mechanical technology acts as an *interface* between mental and material representations of script; the *thickness* of the interface corresponds to the complexity of the technology of script production, while the *transparency* of the interface qualifies the quantitative and qualitative script transformation introduced by the technology. Both factors determine the location of a script on the spectrum between bioscript and mechascript: the interface thickness in factual terms of the machinery involved, and the interface transparency in terms of perceived results. For exam-

1 'Biography' had to be eschewed for obvious reasons of synonymy, as did 'technography', used to denote specialized scripts, such as the International Phonetic Alphabet used by linguists. 'Mecha' is a Japanese manga and anime term designating mechanical contrivances, from powerful or magic tools to the wearable suit robots of *Gundam* (1979) and *Neon Genesis Evangelion* (1995). There is also the French typographical term 'mécanes', used to designate a class of typefaces with a 'mechanical' look, that is, the slab serifs. C Daniels 1996: 628, 631; Wikipedia: 'Mecha', 'Vox-ATypI classification' ⇛ The invention of {bio | mecha} script stems from a lack of terminology to express the ideas disclosed herein. 'Handwriting' (a.k.a. 'chirography') and its pendant 'typography' are restrictive terms, given the broad possible range of script production (by hand, feet, mouth, or even by thought given adequate instruments), the biological aspects involved (e.g., cognition, perception, sensorimotor system, physiology), the technologies (e.g., stylus, printing, electronic, and future means), and even the script producers (while the realm is fictional, we still need to be able to speak about writing generated by non-humans in literature or cinema). ⇛ Since its inception, long before printing, writing was seen as a 'technology of the intellect'. C Ong 2002: 2, 18; Goody 1968: 1

2 For example, the simplicity of László Bíró's (1899 – 1985) ballpoint pen obfuscates the lengthy experimentations that were necessary to develop such an unobtrusive artifact. Or consider the logistics of organizing an expedition into the delta of the Tigris and the Euphrates to find the best reeds for Arabic calligraphy, or a hunt party for the mythical snow dahu of Mongolia, used to make the perfect Chinese brush ! Suddenly, these mundane implements will appear quite valuable and worth treasuring in pen cases inlaid with diamonds.

ple, drawing (writing?) a heart emoji on sand with a finger is the level zero of bioscript (no exogenous mediation involved), while doing the same with an electronic stylus on an electronic signing pad is mechascript, mediated by a variety of computer chips, software, and materials science; since both glyphs are similar, we might say that e-writing is a *transparent* script interface technology, as opposed to an *opaque* technology, such as when an inscrutable algorithm converts the emoji into the character sequence LOVE.[1] ⇛ These formalisms being provided, let us now consider how they affect legibility. As we have seen, production constancy is an important aspect of legibility.[2] On the biological side, constancy depends on individual training and social organization, resulting in a constant need for maintenance in the context of a 'messy' and ever-changing set of human factors; while on the mechanical side, constancy is the result of a more rational and organized approach, subject to as much sociocultural evolutionary pressure as logical and physical limitations. The mechanical interface is, crucially, also located outside the human body and typically non-organic, meaning that it is more stable and easier to understand & repair. In short, mechanically induced constancy is easier to perfect than biological constancy. ⇛ The theoretical model presented herein accords with the reviewed historical exhibits. — PRIMO, insofar as we can speak about legibility progress, the phenomenon is *not continuous, linear, and equally dense in sociocultural spacetime*, and thus paralleling sociocultural evolution. — SECUNDO, the above presents ample evidence in favor of the legibility *progress of mechascript*, as opposed to the murkiness surrounding bioscript evolution, better qualified as transformation than progress, more a constant struggle than a straight road to the nirvana of legibility. However, the history of science & technology (backed up by the daily miseries that characterize the age of willfully smart devices) has shown that even mechascript does not necessarily improve steadily, but is rather also subject to a series of missed opportunities and inefficient decisions, even including the collapse of know-how.[3] — TERZO, legibility improvement seems to occur primarily at the *micromorphological level* of script as an adaptation to specific rendering technologies, with slim evidence existing to support a general evolution of the deep structure of scripts towards greater legibility. — QUATRO, it is conjectured that there exists progress in the written communication system at reader level, whose recognition performance improves by increased exposure to *proliferating and diversifying scripts*. — QUINTO, some of the conclusions on script legibility progress match those regarding progress in the evolution of *writing systems*, such as the model of 'repeated bursts' of innovation interspersed with stagnation, or the abandonment of the teleological stance on the inherent superiority of specific writing systems.[4] *Universal scripts* are also an idea with universal appeal; in practice, however, they have been proven to be just that — a distant ideal.[5]

1 On writing 'transparency' C SPITZMÜLLER 2013: 53–56

2 Constancy and the possibility of precise descriptions and reproducible processes are supplemental arguments for the power of the artificial reproduction of writing to help usher in forms of societies that are industrial and capitalist, dependent on scientific advancement and technological know-how, the discovery made time and again by book historians. C EISENSTEIN 1979: 53, 83–85, ONG 2002: 124–125

3 MACKENZIE 1999, DIAMOND 2005

4 HUSTON 2004: 5–6

5 KINROSS 2011: 233–245

Human metabolism

—

That the famous quote on legibility by the typographer Wolfgang Weingart, reproduced opposite, appears in various forms in the literature is not by error but by design and circumstance. The phenomenon reflects its author's philosophy of typography as an infinite variation around the theme of communicating with 26 letters, akin to the graphically ever varying signature representing the same legal individual. The quote originates in a typoscript of Weingart's lecture notes, in which, he mentions, '*the text and especially the visual material will undergo slight changes with respect to the most recent work results*'. Between 1972 and 1976, there were six recorded German editions and four English versions, possibly translated both ways by the author and other editors. The lack of definite original and perpetual metamorphosis of the quote (so vexing for the bibliographer) is a fitting metaphor for the high rate metabolism of bioscript and its incidence on legibility.

C Friedl 1986: 41 [top quote], Hunt 2020: 40 [middle quote], Weingart 1999: 235 [bottom quote], Weingart 2000: 376 [typoscript metadata]

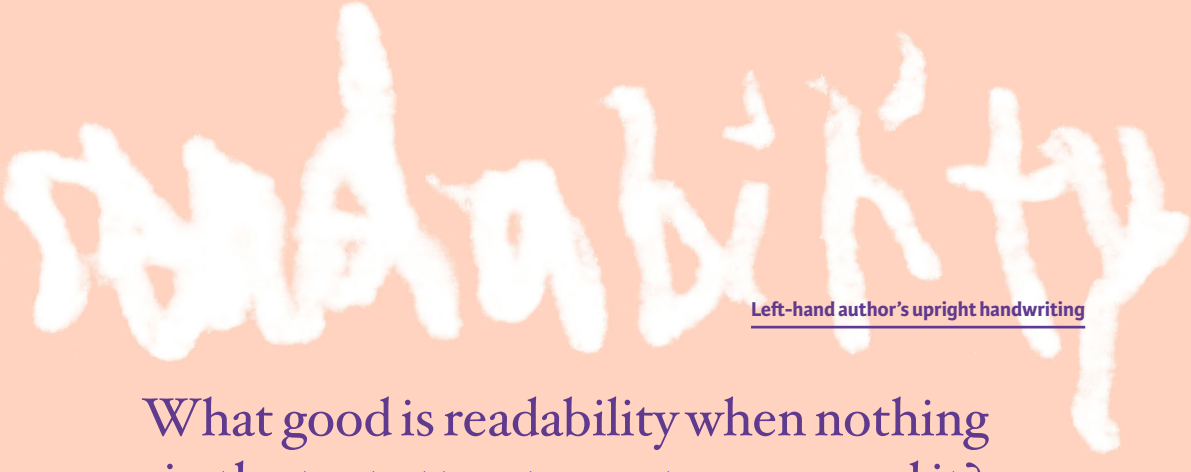
Behind the scenes, inside the author's brain · CT scan, 2017

Right-hand author's upright handwriting

Of what use is readability if there is nothing
to excite us to take notice of a text?

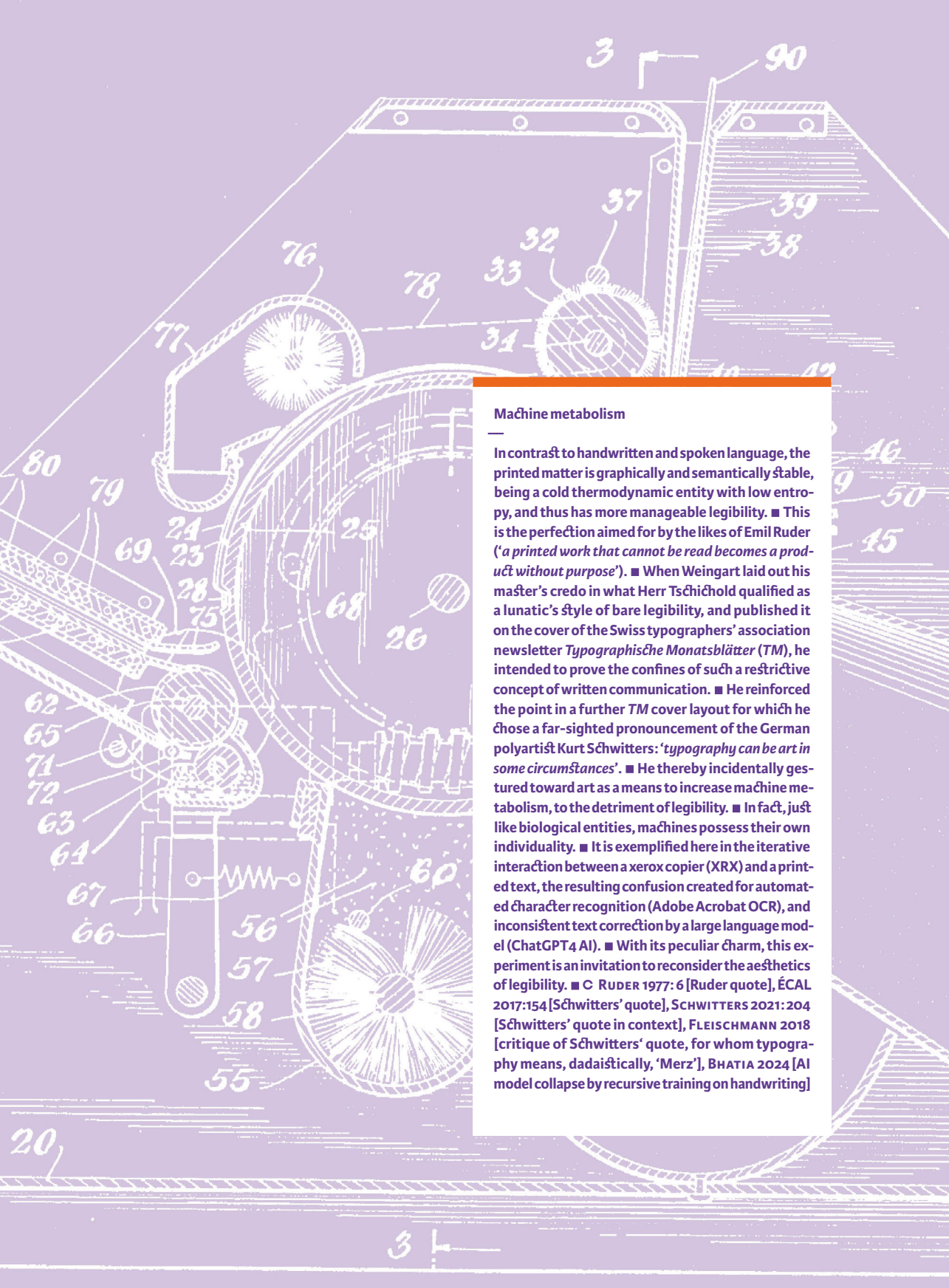
Right-hand author's slanted handwriting

What's the use of being legible,
when nothing inspires you to take notice of it?



Left-hand author's upright handwriting

What good is readability when nothing
in the text attracts one to even read it?



Machine metabolism

—

In contrast to handwritten and spoken language, the printed matter is graphically and semantically stable, being a cold thermodynamic entity with low entropy, and thus has more manageable legibility. ■ This is the perfection aimed for by the likes of Emil Ruder (‘*a printed work that cannot be read becomes a product without purpose*’). ■ When Weingart laid out his master’s credo in what Herr Tschichold qualified as a lunatic’s style of bare legibility, and published it on the cover of the Swiss typographers’ association newsletter *Typographische Monatsblätter* (*TM*), he intended to prove the confines of such a restrictive concept of written communication. ■ He reinforced the point in a further *TM* cover layout for which he chose a far-sighted pronouncement of the German polyartist Kurt Schwitters: ‘*typography can be art in some circumstances*’. ■ He thereby incidentally gestured toward art as a means to increase machine metabolism, to the detriment of legibility. ■ In fact, just like biological entities, machines possess their own individuality. ■ It is exemplified here in the iterative interaction between a xerox copier (XRX) and a printed text, the resulting confusion created for automated character recognition (Adobe Acrobat OCR), and inconsistent text correction by a large language model (ChatGPT4 AI). ■ With its peculiar charm, this experiment is an invitation to reconsider the aesthetics of legibility. ■ C Ruder 1977: 6 [Ruder quote], ÉCAL 2017:154 [Schwitters’ quote], Schwitters 2021: 204 [Schwitters’ quote in context], Fleischmann 2018 [critique of Schwitters‘ quote, for whom typography means, dadaistically, ‘Merz’], Bhatia 2024 [AI model collapse by recursive training on handwriting]

Patent for one of the first xeroxing machines · Chester F. Carlson, 1940, US2357809A

Robustness to self-induced noise

—

Copy No. 1

Typography can be art in some circumstances

XRX ▼

Typography can be art in some circumsrances

OCR ▼

Typography can be art in some circumstances

AI

Copy No. 15

Typography can be art in some circumstances

ypograp yca.n.· e art 1nsome c1rcumstances

Typography can be art in some circumstances

Copy No. 20

Typography can be art in some circumstances

T,·vpographyc1nbeart insornec;rcumSt:L7,:es

Typographic art in some circumstances

Copy No. 21

Typography can be art in some circumstances

Typograph_-·c1nbe art 1nsofncc;rcumsta;7,:es

Typographic art in specific circumstances

Copy No. 34

[recognition failed]

[no output]

'Polygraphy' designates the co-occurrence of different scripts within the same documentary unit. The legibility discussed up to this point has pertained to a single script; this, is the typical case in legibility research, since our goal is to discover the single most legible script. However, scripts are seldom found alone. Like gregarious polyglot languages, modern documents contain a variety of typefaces and writing systems; it is therefore necessary to investigate the relationship between polygraphy & legibility, a vast & fascinating subject. ⇛ The first step is to ask whether polygraphy is a matter of legibility. To answer, one must distinguish between *outline polygraphy* (e.g., stylistic variants in text-processing software, such as regular, italic, bold, and small caps) and *structure polygraphy* (e.g., Hebrew juxtaposed with Arabic on street signs in Jerusalem). In both cases, pattern distinctiveness functions as a linguistic marker at supra-character level, e.g., for EMPHASIS (capitals) or language identification (עברית vs. عربي). From this point of view, polygraphy is a readability-related rather than a legibility-related phenomenon. Nevertheless, the increase in character set amplifies the difficulty associated with perceiving, learning, memorizing, and producing characters. The co-occurrence of multiple scripts impacts in many related ways the identification of characters, thereby making polygraphy a matter of legibility, after all.

Definition 17. Extent — *Legibility can characterize a single character, a set of characters, or an ecosystem of character sets.* ⇛ As such, legibility contributes to make literacy — of which it is a component — a matter of *degrees*. In this regard, an oft-cited example in the literature on ancient literacy is that of a freedman in *Satyricon*, attributed to Nero's (37 – 68) courtier Petronius (c. 27 – c. 66), an 'arbiter of elegance', who claims to be knowledgeable of only 'lapidary writing' (*lapidariae litterae*); that is, his ability to read extends only to neat monumental inscriptions, not hasty cursive writing.[1] This very same partial literacy can be reenacted by the readers themselves if they attempt to read Latin graffiti during a visit to Pompeii. More generally, 'people did not relate to literacy as a single object, but as a collection of objects in different languages and type-faces; in manuscripts or print; as letters, pictures, or sound'.[2] In short, as individuals, we can consider legible only a fraction of the myriad of script systems and styles that have ever existed, while each of them is legible to one or another member of the collective readership. ⇛ Let us now examine some empirical evidence of the evolution of the legibility of polygraphy. During antiquity private & administrative documents (e.g., Greek papyri), and even sumptuous pub-

Definition 17. Extent — *Legibility can characterize a single character, a set of characters, or an ecosystem of character sets.*

1 Thomas 1992: 8 – 10; Petronius 1925: 106 – 107 [58.7]

2 Houston 2016: 237

lic inscriptions (Trajan's Column), were usually written in a single style, be this Latin, Greek, Hebrew, or other scripts. Part of the explanation for this is that handwriting evolves in an idiosyncratic manner, similar to the uniqueness of an individual's speech, such that it is rare to develop more than one style.[1] There is also little utility in developing distinct handwriting styles, given that underlining or coloring (think medieval minium red and contemporary fluorescent yellow highlighters) offer straightforward methods of circumventing the learning of new styles for the purpose of text marking. One must to seek out ceremonial documents (the highly ornate initials of liturgic books) and multilingual administrations (the Rosetta Stone) to find polygraphy in some abundance. During the long rise of the Renaissance, however, polygraphy proliferated, with several graphical innovations being developed in response to practical considerations (orthographic symbols and mathematical notation) and intercultural encounters. The adoption of Arabic numerals was occurring in physical reality, while the search for a mythical past by Italian Humanists consisted in an imaginary elixir obtained by mating Roman capitals with Carolingian minuscules and the newly minted Italics. Bold, sanserif, small caps, lining figures, and other experiments in the visual design space followed in the subsequent centuries. The Victorian age marked the pinnacle of polygraphic exuberance (book title pages changed typefaces every line, as if these disgorging script cornucopias were triumphal parades of the empire's riches through a Universal Exhibition).[2] Maximalist discoveries of stylistic and pecuniary possibilities, such as the interpolation made possible by digital typography (the rational system explicit in the Univers typeface) and harmonization across arbitrary sets of scripts spurned by globalization, the Internet, and Unicode, characterized the twentieth-century proliferation of scripts (it takes only the click of a mouse to change fonts). A similar acceleration of polygraphic sophistication can be readily observed in scripts other than Latin: Japanese scripts with their own strands of history have come together, and today's Japanese handwriting (not just typography) is an admixture of (Chinese) *kanji*, (round) *hiragana*, (angular) *katakana*, (Latin) *rōmaji*, (Indian) *siddhaṃ*, and (Arabic) numerals, while the interplay of native calligraphic and Western typographic conventions define print.[3] In conclusion, polygraphy endows script with a similar richness of expressiveness that intonation and gesturing provide to oral & visual communication. However, just as Byzantine manners make life so much more rewarding, so does polygraphy also come at the expense of legibility. ⇛ Throughout the history of scripts, there are theoretical and practical enterprises of stylistic rationalization that counter the centrifugal forces of unbridled artistic creativity and polygraphic promiscuity detrimental to legibility. Adrian Frutiger's typeface Univers, released in 1957 by the Parisian typefoundry Deberny & Peignot, is the emblematic example of the integration of disparate typefaces into a single system of continuous variation along the weight, width, and slant axes, equivalent to the 'periodic table of fonts': aaaa**aaaaa**, aaaa, *aa*.[4] Recent publications on polygraphy illustrate the basic tendencies at work in pairing scripts & designing families of scripts: *harmonization*

[1] Which does not preclude 'myriapods', writers practicing more than one script style, for private or professional reasons (secretaries, copyists calligraphers, forgers). **C** Atanasiu 2016: 3, 5

[2] Daly 2015, Rosenberg 2003, Henkin 1998, Wikimedia: 'Parrywatercolour' [the polygraphical invasion of Victorian British streets is memorably illustrated in a painting by John O. Parry (1810–1879), *Fantasy of a Billsticker*, 1835]

[3] Seeley 1991 [systems], Takagi 2015 [harmonization]

[4] Osterer & Stamm 2014: 88–117, Wikipedia: 'Univers'

(D3CLUTT3R)

of some aspects and *differentiation* of others.[1] Aided by technical developments such as the PANOSE system for font description,[2] other visual dimensions have been incorporated into unified font design concepts (e.g., degrees of serifness in the Rotis typeface) and implemented in a panoply of software tools (Donald Knuth's METAFONT, URW's Ikarus, Adobe's Multiple Master, and Macromedia's Fontographer, to name only a few milestones before the advent of variable fonts).[3] Parametric font design is today routine, resulting in unprecedented number of typeface choices. The successes of technologies based on the Latin script may however obscure the fact that other script ecosystems have developed similar solutions to optimize polygraphic legibility. As already discussed, an integrated system of continuous multidimensional script variation mirroring the principles of Univers was used by tenth-century Muslim bureaucracies,[4] whereas medieval Hebrew manuscripts evolved towards a differentiation system between elements of the logical structure (titles, text, glosses, etc.) based on the degree of script cursivity (square to semi-cursive to cursive).[5] ⇝ Turning to the future, the obvious matter to address is that of legibility and polygraphy in robot-written communication. From the evidence collected on mechascripts that document the optimization of their legibility, it can be surmised that algorithms will also perfect polygraphic legibility. What remains to be seen is whether and how the machines' design spaces will differ from those of humans, as well as how the human and machine scripts will mesh together: will children be required to learn barcodes in schools, lest they be zapped by Daleks, or will C-3PO broaden his intercultural mediation abilities by bravely learning copperplate calligraphy? ⇝ *Parenthetically speaking*: The solutions to polygraphic bulimia are, you may concede, fastidious — why not just use one script? Less is more! Back to the basics! This is the philosophy of graphical frugality advocated — to the point of indigent abstinence and in need of its own kind of keyboard shortcut gymnastics — by the minimalist design movement in reaction to wanton 'font porn'. It is manifest in the growing popularity of text editors (Sublime, Notepad++, Emacs/vi, etc.), as opposed to word processors (Word), for 'putting thoughts in writing', beyond the natural constituency of software programmers constrained by the inherent minimal typographical structure of computer languages. Yet, script 'monography', even reduced to the ASCII character set, does not preclude a sophisticated appearance for supporting linguistic organization, as proven for well over a century by the art of typoscript, thanks to typewriters. These devices promise a distraction-free writing & reading experience through VISUAL DECLUTTERING, which enhances legibility by removing such confounders as multiple script styles and replacing them with graphical markers like underlining and color, which act as optical communication dimensions different from text or are 'orthogonal' to shape.

1 SMITSHUIJZEN ABIFARÈS 2012, WITTNER 2018 ⇝ Until well into the twentieth-century typefaces from different writing systems had distinct looks (even italics and romans had their own 'personalities', just as in their handwritten sources). Nowadays, they are generally integrated into homogenized superfamilies (in which the target stylistic characteristics are, typically, set by the Latin script). This global standardization has made more difficult to differentiate languages in multilingual dictionaries, and on multilingual product labels, to refer to the impact on just two document types. ⇜ SADEK 1997 [polyglot typography], WEBER 2021 [history of italics, from analog to digital]

2 HARALAMBOUS 2007: 424–439, WIKIPEDIA: 'PANOSE'

3 The 'variable fonts' technology allows users real-time modification of typefaces along various stylistic dimensions. ⇜ MIETKIEWICZ 2017, WIKIPEDIA: 'Variable font'

4 ATANASIU 2004

5 STAMM 2003: 67–81

OVERLEAF: What did Magritte say on legibility?

7.19

Layout specifications

—

Two columns, justified text, footnotes, 10.5/12 pt C
Green life forms sprouting between mineral letters, Old City of Bern

Now that we have reviewed the evolution of script shape, what can we say about layout ergonomy?[1] ⇛ There are developments to report with respect to bioscript in all grapho-cultural areas, be it the Sinosphere, the Islamicate world, Europe, the Americas, and others, past and present.[2] The most impressive is the apparition in documents of sumptuous frontispieces that both mirror and compete with public inscriptions.[3] Mini-versions of these documentary dispositives are used as chapter headings (leafy banderoles of the Quran and of the Italian Renaissance princely editions of classical literature). Multi-column (for the Bible) and interlinear (for the Quran) layouts are used to present multilingual translations on the same page for exegetic purposes (e.g., Hebrew next to Greek & Latin, and Arabic next to Persian). In terms of visual appearance & cognitive functionality, the most complex bioscript layout techniques, however, are the concentric glosses that consist of layers of annotations that annotate annotations annotating a source text, organized onion-like on a single page around the root paragraph (of which the Talmudic commentaries, and their antecedent Greek and Latin Biblical exegeses are remarkable exponents).[4] ⇛ This being said, what type of evolution becomes apparent? It is one in which the writing attempts to disenfranchise itself from the temporal linearity of spoken language, by making more extensive use of the potentialities offered by the two-dimensional space of the writing surface. ⇛ As mechanical text reproduction was developed and expanded (first in China, then in Europe), novelties in layout design also underwent an unprecedented expansion, as a consequence of the ease afforded by the new medium of experimenting with various visual solutions, and the needs of readers to access more efficiently an ever increasing amount of information. While exploring the manifestations of mechascript layout evolution, one will recognize as particularly consequential the structural shift from regular to irregular page appearance, from a single text block per page to title headings, paragraphs, and footnotes, authors, addresses, copyrights & similar metadata, page numbers, references, and other navigation devices, as encountered, for example, on the first page of scientific articles, in addition to the consecration of further paratextual elements necessitating their own layout design, such as covers, content tables, indices, and hyperlinks.[5] Moreover, the spatial arrangement of such a variety of elements on the page, and within and across documents, promote the *empty space* to an important instrument in communication design, including in negative form, as a tool of censorship.[6] ⇛ The *visual*

[1] *Layout ergonomy* includes the recognition of the document's logical structure, the navigation within documents, & their browsing, and is realized through character styling (italics, bold, sanserif, etc.), marking (lines, colors, etc.), & text block placement. ⊂ Richaudeau 1969, Waller 1979, Brath 2021: 211–220

[2] Zali 1999 [a global study of the evolution of layout], Lommen 2012 [one hundred great names from five hundred years of Western printing], Pigeon 2013 [specimens of layout evolution]

[3] The gamut runs from ornate initials to super-sized incipits of official documents (as in the English Magna Carta and the American Constitution) to the elaborate full-page letters in the Book of Kells, the architectonic chapter headings *sarlawḥs* of Persian books, and the totemic *ṭughras* of Ottoman decrees. The long-term stability of the layout of charters, diplomas, and similar documents is intentional, as it is designed to embody the stability of the laws they promulgate; however, it is also not absolute, as demonstrated by the birth and marriage certificates used by the city of Saumur, France, in 1992, which have a highly irregular yet beautifully musical layout. ⊂ Christianson 2015 [anthology of remarkable documents], Fu 1986 [*sarlawḥs*], Nadir 1986 [*ṭughras*], Schwesinger 2007: 218–219 [design certificates]

[4] Beit-Arié 1992: 95, Tufte 2020: 128–129 [Arabic example]

[5] On the history of documentary devices ⊂ Duncan 2019 [parts of the Western book], Smith 2000 [title page], Mathieu 2017 [tables of contents], Ridehalgh 1985 [indices]

[6] Christin 2009 [space as absence and space as presence: comparisons across cultures], Kliesch 2017 [on contemporary image censorship, using a book design that simulates censoring]

fragmentation of modern layout — one might be tempted to say, anachronistically, 'Fraktur layout', but the canonical term is 'asymmetrical layout' [1] — serves to reveal the *functional* organization of documents and facilitate their navigation and comprehension. Increased distinctiveness between parts reduces redundancy and increases discriminance & potential information load. The maximization of distinctiveness is achieved in a multidimensional scale space of visual features.[2] Such irregular layout — theoretically more legible [3] — is attested historically and the outbreak of the First World War in 1914 can be taken symbolically as the watershed between two layout eras,[4] one in which order predominated, followed by one characterized by irregular layout configurations. In stylistic orgies of tabula rasa after stylistic orgies of tabula rasa, perfect alignments of text blocks mirroring Neoclassical architecture were abolished by Mallarmé's throw of a dice, by the exploding Honeggerian Zang Tumb Tumb of Ubuesque Dadaism, Italic Futurism, Soviet Constructivism, and the subsequent psychedelic typography of the 1960s and deconstructionism of the 1980s.[5] These revolutionies and Euclidean geometry, to the irregular: quantum mechanics, fractal dimensions, catastrophe and chaos theory. In this vast sociocultural transformation, document design is both an actor and an acted-upon entity, like the diamonds of deva Indra's net, each a reflection of the other. It should come as no surprise, therefore, that layout readability has come to be considered in terms of maximization of shape, location, and texture distinctiveness of paragraphs. C Woolf 1924: 5

1 Nobel laureate Georg von Békésy (1899–1972), biophysicist and art collector, introduced the concept of the 'mosaic' methodology of complex problem solving, which involves approaching problems piece by piece without reference to the larger context. Media theoretician Marshall McLuhan (1911–1980) explicitly used this approach as the basis for his *Gutenberg Galaxy* (1962), given the kaleidoscopic nature of the typo-sociological domain he set out to explore. He might also have delighted in the term 'fractal', to be invented by Benoît Mandelbrot (1924–2010) a few years later. C McLuhan 1962: 0, 42, 127

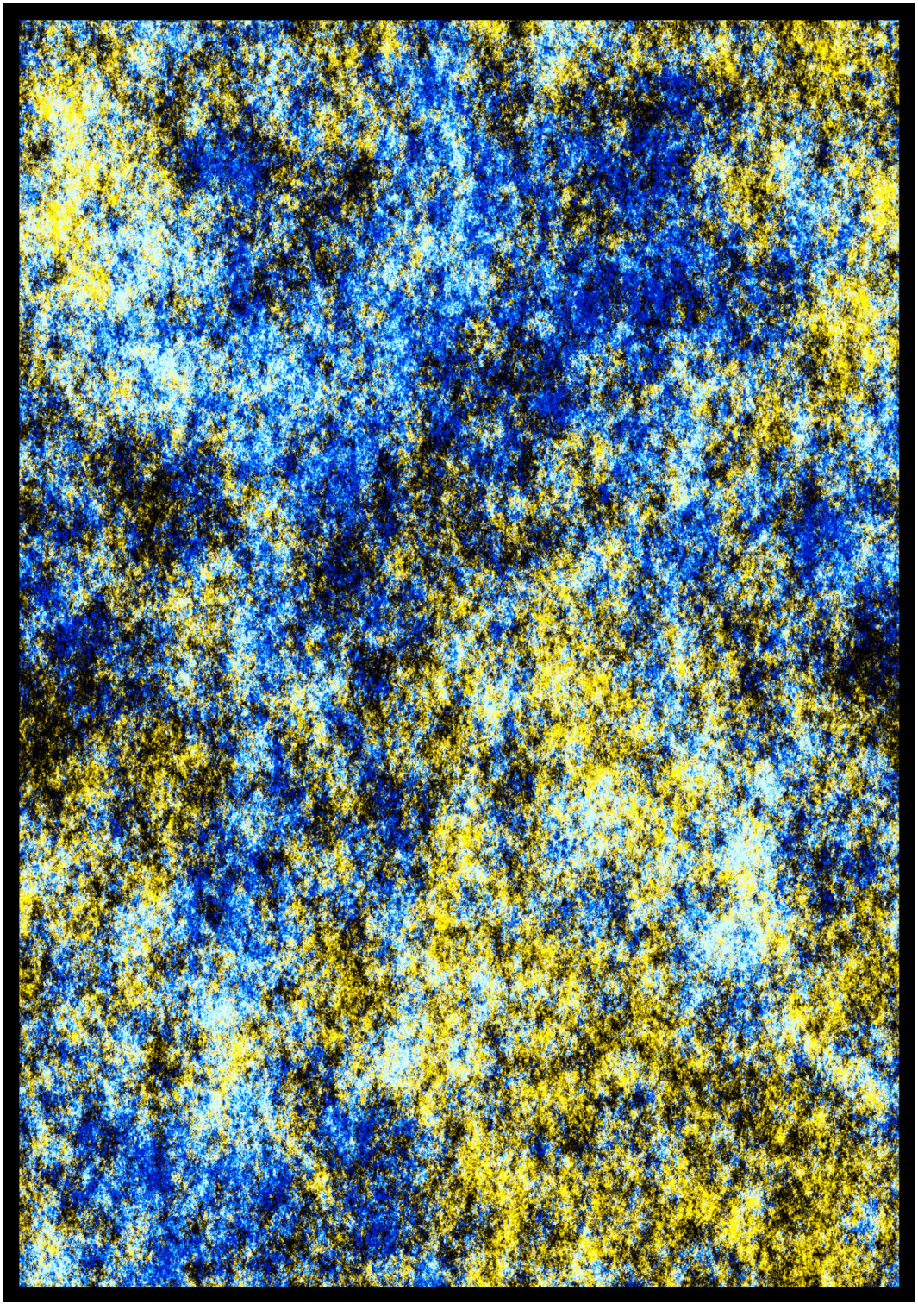
2 **Opposite is a synthetic fractal of dimension 2.55, corresponding to this page's layout & information potential. Large color clusters emerge from the asymmetry of text, footnotes, & margins, contrasting with the fine details of the line regularity's typographic gray. C Atanasiu 2022c, Watt 1993**

Fig.

3 Richaudeau 1969: 184–223, 2005: 76–86

4 The year 1914 was the uncompromisingly sharp divider erected between 'old' and 'new typography' by Tschichold in his book *The New Typography*. He is explicit about its sources and intentions: '*The liveliness of asymmetry is also an expression of our own movement and that of modern life.*' Layout irregularity existed before, and Tschichold knew it full well, since he had studied manuscript layouts based on the golden ratio, the most dissimilar proportion of parts and whole. C Tschichold 1995: 15, 68, 1993 [de]: 41–44, 45–75 [en: 1991]; Richaudeau 2005: 83–86, Meer 2015 ⇛ The First World War is just the original cataclysmic fault line of a long and multidimensional dislocation, over the last two centuries, of political entities, mores, beliefs, arts, and concepts of time and space. Virginia Woolf's (1882–1941) quip is famous: '*On or about December 1910 human character changed*'. Modern science itself expanded its interest from regular phenomena and models, such as the ancestral Platonic regular bod-

5 '*Countless rules can be set down for typography. The most important is: Never do anything the way someone has already done it. Or you could also say: Always do it differently from how others have done it.*' So declares the Merzian Kurt Schwitters (1887–1948) in his 'Theses on Typography' (1925). C Schwitters 2021: 204 ⇛ Stéphane Mallarmé's (1842–1898) poem *A Throw of the Dice will Never Abolish Chance* (1897) is interesting for our discussion in terms of its substance, form, and editorial history. It deals with the paradoxa of randomness, and its layout appears random but is in fact a carefully constructed clustered pattern; it also took many editions, spanning from 1897 to 2002, to arrive at a rendition that the author might have wished for. One could say that despite being able to spell the words of the poem for a hundred years, we are possibly still unable to fully comprehend it, owning to the lack of a perfect layout and typeface. Its defective journal publication was in 1897, and the first book format was published in 1914. C Wikipedia: '*Un coup de dés jamais n'abolira le hasard* (Mallarmé)', Pierson 2002 ⇛ As we can see, there were many midwives of modern typography beside Tschichold. Marinetti (1876–1944) was the herald of Futurism (its *Manifesto* was published in 1909), and made great use of typography to visually convey the substance of his ideas. In his own words: '*The typographic revolution that I've proposed will enable me to imprint words (words already free, dynamic, torpedoing forward), every velocity of the stars, clouds, airplanes, trains, waves, explosives, drops of seafoam, molecules, and atoms.*' C Wikisource: 'I Manifesti del futurismo/Distruzione della sintassi, immaginazione senza fili, parole in libertà', Rainey 2009: 150, Wikipedia: '*Zang Tumb Tumb*', Bartram 2005: 24 ⇛ Arthur Honegger (1892–1955) ?



Fleeting visions of Galaxy Ugraphia: night-sky reflections on bioluminescent ocean surface

ary excesses were tamed by Bauhaus and Modernist layout, ostentatiously gearing the asymmetrical paradigm towards industrial efficiency of communication. For the kabbalistic artist Joseph Semah, however, the asymmetrical layout of the Talmud has a metaphysical dimension, representing the 'fundamental openness of Jewish thought' via ever-new commentaries that grow on the written page like graphical tendrils around century-old teachings.[1] Thus, the thick cultural references of these layout concepts are proof that layout, just like script, is also endowed with a *connotational function* intrinsic to the intended message: the 1922 edition of James Joyce's (1882–1941) *Ulysses* is 366 pages long, as many days as the leap year 1904, one full day of which is narrated in the novel as a compressed exemplar of larger time frames.[2] ⇈ The intricate demands of complex layout design have led to the emergence of a new *scriptural actor*, the layout designer, and his lofty superior, the art director, in whose service the type designer toils by drawing typefaces in a myriad of sizes and shapes adapted to their function. This specialization of means of mechascript production reflects the functional diversification of layouts: application forms are adapted to bureaucratic needs; tables neatly arrange money and state resources; clever text and image integration facilitate reading Diderot and d'Alambert's scientific *Encyclopédie*; the Bauhaus served industrial communication and advertising; and 'didactic typography' revolves around the design of educational material, from dictionaries to textbooks to alphabet books (which make different demands than, say, poetry books, business reports and newspapers).[3] ⇈ Layout *design methods* have also evolved, from simple geometric procedures employed to place a rectangular text block on a page (appealing to the theories of harmony of the Ancients, be it the music of the spheres or the golden ratio) [4] to the flexibility of orthogonal grids [5] (yet another consequence of industrialization, providing necessary visual information frameworks to support the broad circulation of newspaper and magazines.) [6] One may wish to extend the notion of layout from page spread to the three-dimensional *information architecture* of a codex, with its own steady complexification of the visual–functional rhythm of chapters and supporting book parts, such as tables of contents, indices, and so forth. Stretching our inquiry even farther into the realm of *codicology*, we note that the proper assemblage of these readability and comprehension devices depends on the *material* production of documents, for which it was necessary to develop specific techniques (e.g., catchwords, signature marks, and collation marks), proving the close coupling between form, function, materiality, legibility, readability, connotation,

The steam locomotive Pacific 231 roaring through six minutes of music in 1923. Zang Tumb Tumb ? Shrapnel shards shredding war paragraphs into lines of Balkanic soldiers, thought Marinetti at Adrianopole, 1912–1913. Dada ? Tza, Tza, Ra ! ⇈ Iconic designs of the 1960s generation are Quentin Fiore's for Marshall McLuhan's *The Medium is the Massage* (1967), Robert Massin's (1925–2020) for Eugène Ionesco's (1909–1994) *The Bald Soprano* (1972), the Beatles' *Yellow Submarine* (1969) movie, and various vinyl LP covers of the era. ⊂ Friedl 1998 ⇈ The deconstructionist layout is characterized by clustering and superposing elements of different sizes, i.e. by a 'fractal' look. ⊂ Lupton 1999 : 2–23 [theory], Cahalan 2007 : 21–26 [overview], Carter 2018 : 195–220 [samples]

1 Gilbert 2012 : 193

2 McKenzie 1999 : 57–61 [which is also, as its title spells out, an introduction to bibliography — in the sense of information science before there was one — and the sociology of texts]

3 Schwesinger 2007 [formularies], Grinevald 1994 [*Encyclopédie* (1751–1772), edited by Denis Diderot (1713–1784) and Jean-Baptiste le Rond d'Alembert (1717–1783)], Bosshard 2012 [Bauhaus], Borinski 2019, Nadolski 1984 [didactical], Rädecker 2011 [reports], Franchi 2013 [newspapers]

4 Bringhurst 2004 : 143–179, Tschichold 1987 : 45–75

5 Samara 2002, Elam 2004

6 Morison 1932 [a folio-sized antiquarian trove]

and comprehension.[1] ⇛ One dimension of layout design that appeared early, and has remained relatively constant until recently, is that of *sensory modalities*. Text and image have intermingled since the early days of writing, when winged Mesopotamian divinities carved in alabaster were brought to (imaginary) speech through cartouches, and the angel and Mary conversed via phylacteries.[2] A modern novelty is the merging of veridical video, sound, & sometimes haptic and olfactory experience, which deploy layout beyond the dimension of static images. For example, even the best legibility is useless if a text is not seen — hence the use of flickering neon lights to attract the gaze toward shop names in nocturnal downtown Tokyo or aural cueing toward digital airport timetables via the simulated sound of analog split-flap displays. Proto-modalities of multimodal texts are worth mentioning here; for example, the *1001 Nights* stories were once read out loud from books in coffee houses in Egypt and Syria (my grandmother did the same for me, in our garden).[3] The odors exuding from ink, paper, binding, and document conservation environments create olfactory experiences with the potential to foster strong attachment or repulsion (Helvetica reminds me of quinces since I purchased a special edition of fragrant Swiss post stamps from 2017). The criteria of 'legibility' for these modalities are, accordingly, also very different from those applicable to script. This is not the case for some other aspects made possible by electronic documents. For example, layout is no longer fixed by a designer-dictated line length, number of columns, character size, font, and color — these, and other similar possibilities to adapt documents to specific display sizes, technologies, physical environments, and user demands, represent undeniable progress in text and layout ergonomics. ⇛ Another development that goes even further beyond the possibilities offered by analog communication is the ability to *interact* with data. Manipulating data through technological interfaces as a means of message exploration is a form of legibility improvement, as attested since long by the differences between codex, scroll, and other text support formats. There exists a rich tradition in computer science of developing three-dimensional document representations: to name just two, inspired by the layers of Talmudic interpretation

Definition 18. Processing — *Layout ergonomy is commensurable with the degree of information selectivity and manipulation that it affords.*

1 Roberts 1982: 48, 235, 24, De Vinne 1904: 269–275, 388–389

2 Bazin 2019 [on speech balloons in comics]

3 Garcin 2013: 22–23, 628–630, Herzog 2003, 2007: 11–19, 419–420, Depaule 2003 ⇛ Related ancient multimodal storytelling techniques are puppeteering & picture recitation, the later with a fascinating history, originating two millennia ago in India and subsequently diffused throughout the world, which uses large paintings on canvas as an edifying backdrop illustrating the narrative. ⊂ Mair 1988

and their concentric material layout, David Small's 'Information Landscapes' displays text as a suite of orthogonally arranged translucent curtains displayed in an ethereal-looking virtual space; while this author's 'Document Towers', a Babelian reference to the limits of communication, represent paragraph bounding boxes stacked by page order, thereby facilitating the comprehension of the layout structure and motivating its interpretation.[1] At this point, our investigation of legibility joins research into visualization, interaction design, an information architecture, an interesting outcome, full of potentialities, for the evolution of writing. ⇛ If digital documents are as fabulous as described above, then why is the layout of the twenty-first-century e-reader not the Creation's culmination initiated in the Sumerian silicon of cuneiform tablets, 3000 B.C.E.,[2] why are there still endnotes when it is just as easy to produce (the more ergonomic) footnotes?, why does Geoffrey Dowding (in 1966, reprinted in 1995), the author of the classic *Finer Points in the Spacing & Arrangement of Type*, lament that 'we seem, in some instances, to be reverting to the worst malpractices of the Victorian era [typesetting standards]'?[3] Probably because expediency and ignorance are the enemies of legibility, and this is why Ugraphia does not exist. ⇛ When there was only one book in the house, legibility was beside the point: one learned the content by heart, and there is no layout progress to report from this standpoint. However, the numerous devices we have surveyed transformed the book & the reader into an integrated reading machine, and are thus tangible evidence of layout readability optimization in the *longue durée* history of document design. Moreover, the evidence presages that future, as-yet-unsuspected improvements remain possible. Also, our inquiry suggests an additional definition related to legibility, based on the irregular layout's facilitation of locating various types of information, and on the benefits of interacting with the document.

Definition 18. Processing — *Layout ergonomy is commensurable with the degree of information selectivity and manipulation that it affords.* ⇛ This definition is also a reminder about how information is both a noun and a verb, an entity that can be given, acquired, and stored in space, and a process of shaping taking place in time.

1 Small 1999, Atanasiu 2021, 2022a, 2022b

2 Fun fact: In one EPUB-formatted book on the history of writing, the notes are presented at the end of chapters — but as all of them are marked with asterisks (since there is only one note per page), it is impossible to determine which reference refers to which note.

3 Dowding 1995: xv

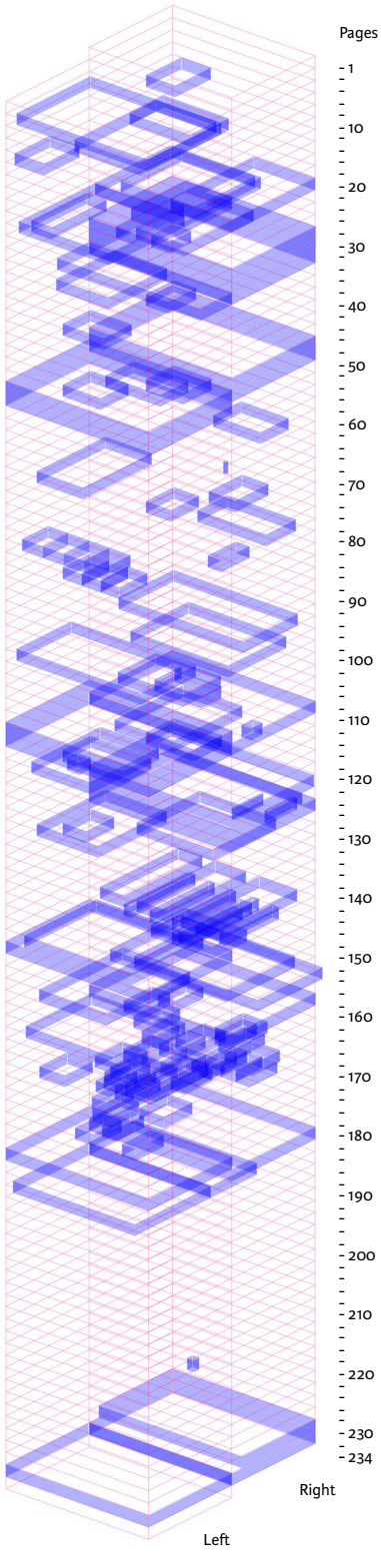
Document architecture

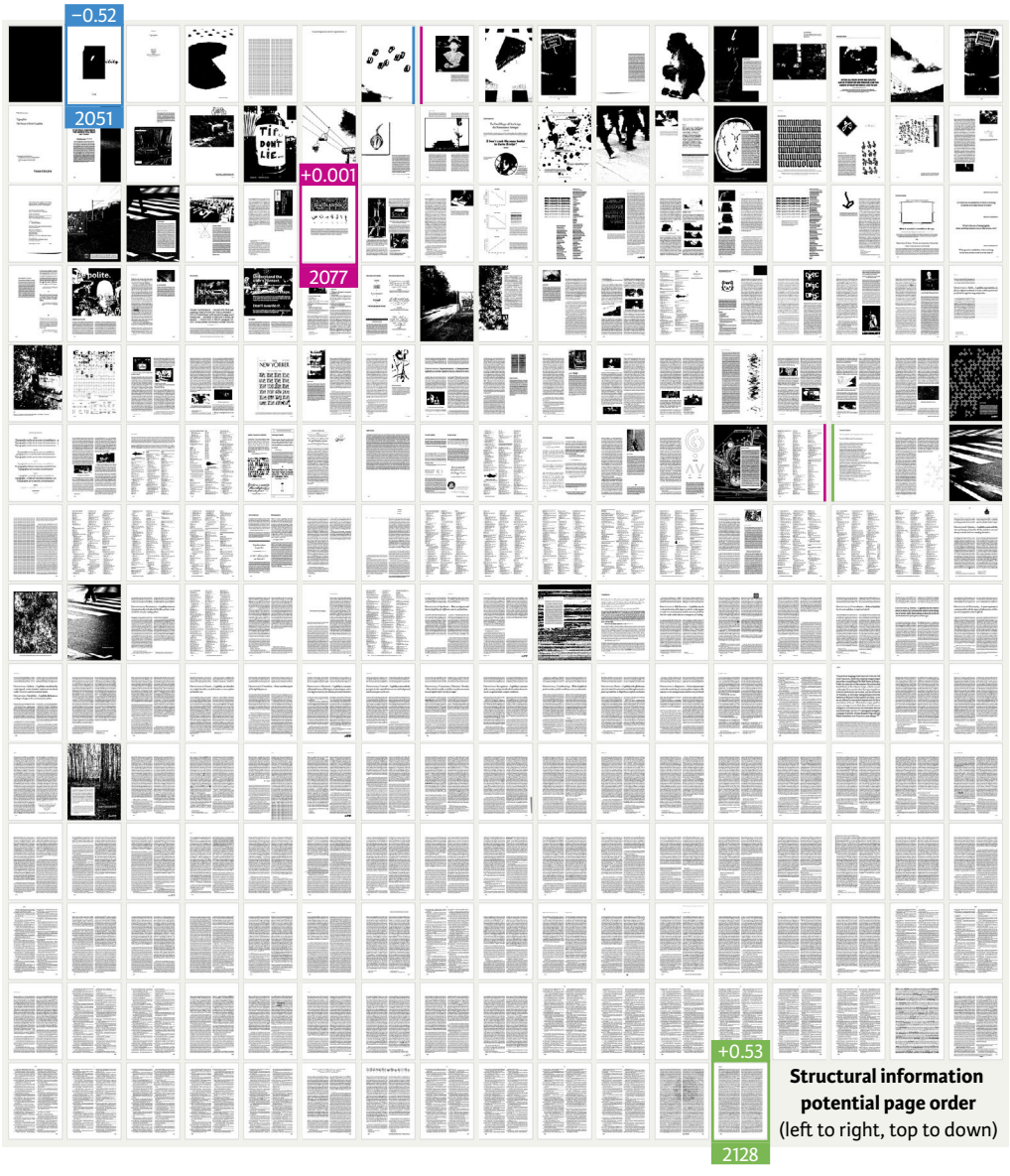
—

Beyond character legibility and layout readability is the ergonomy of document architecture, with its own history of optimization. As the scale and complexity of information increases, new devices emerge for navigation, processing, communication, storage, and other purposes, ranging from the humble table of contents to virtual and augmented reality. The author conceived two such techniques, the Document Towers and the structural information potential, presented here as part of the functionalities of this book.

The Document Towers aim to offer an overview of the structure of a paginated document by presenting the location and extent in the three-dimensional space of its graphical and semantic constituents, using an architectural metaphor. The adjacent Document Tower shows the physical extent of the stack of double pages in this book as ● red slabs, and the occurrence of bitmap images as extracted from its PDF file in ● blue. The pattern of other elements, such as text paragraphs, specific fonts, and keywords, are equally representable, as is the contiguous display of multiple documents (or versions thereof) in a 'document city', for comparison. In brief, Document Towers allows a look into documents without opening them, and delivers information similar to that obtained by browsing, thus responding to a need in the area of digital documents, where this functionality is currently limited.

The structural information potential (SIP) is, in essence, a mathematical formula that provides a numeric characterization of layout patterns/colors along the empty/blank – clustered/rainbow – random/blackout – homogeneous/gray spectrum, and a proxy of their potential informativeness. SIP considers the empirical observation that clustered layouts are typically rich in information, generated as they are by a variety of elements, such as title, abstract, text, footnotes, and editorial metadata on the first page of scientific articles, whereas homogeneous layouts correspond to text paragraphs and are indicative of semantically focused information. Largely empty pages such as may occur at chapter endings, carry relatively less information. Random patterns are indicative of annotations, stains, and experimental typography. The next page demonstrates the application of SIP to document overview and triage. The pages of this book are arranged according to dSIP, the divergence from maximal SIP, from nearly empty to clustered to homogeneous. SIP makes it possible to evaluate at a glance (like the Document Towers, without browsing) which and where are the pages most likely to contain the most multifarious information. The barcode encodes the pages' dSIP in their logical book sequence, as compact representation that may be printed on book spines for the convenience of appraising their structure at a distance, without physical manipulation. © Atanasiu 2021, 2022a, 2022b, 2022c





Structural information potential page order
(left to right, top to down)

Visualization

Page pattern correlates

Structural information potential	Visual pattern	Typographical color	Typical content	Optimal applications	Sound correlates
divergence from maximal SIP			art stains	aesthetics forensics	
+1	homogeneous	gray	text	reading	speech
+0.3	random	blackout	notes	study	noise
0	clustered	rainbow	first page	browsing	music
−0.3					
−1	empty	blank	last page		silence

The writing of yore, spice trade Linear A and marmalade pot Kurrent, lest you remember them not, who can read it anymore?[1] Legibility, like all things on this earthly orb, is subject to the ravages of Time, her steely worms gnawing through wooden books at the perfect O-s of tender Garamonds and fleshy Didones, as if they were the smiling empty eye sockets of a skull in Hamlet's hands, while all around, infernal machines break the angels' feathery serifs, one lachrymal teardrop after the other.[2] This, my valiant readers, is the ultimate argument against universal legibility, I promise. Where, I beg you, is the designer's anti·dot to carnal decay and the troubadours' lost fo(u)nt of youth? Where the butcher's manila kraft paper to replace the wrinkling skin of expired typefaces? ⇈ This complaint having been articulated, the question remains: how do legibility and time relate to each other? In the preceding sections, we have dwelled on how the duration of exposure to the written stimulus generates new forms of script and layout with improved legibility, for applications such as fast-moving traffic, and the crowded context of urban advertisement. The legibility imparted by the text-to-background contrast also has a temporal parameter, cream paper being traditionally preferred for long texts over ivory white.[3] We also discussed different attention spans, from casual reading (the news) and thrilled page-turning (novels), to slow reading for comprehension (scientific texts) and contemplation (poetry), to critical reading (deciphering ancient papyri). Here, the focus will be the permanence of legibility in terms of the reading system components, i.e., the materiality of script & the inscribed, the physical environment, the decoding capability, & the functional intent of the writing. One such temporal and non-graphical factor involves linguistic and social elements: loanwords, whose proportion increases during some periods as a result of interaction with foreign people, ideas, and goods, are not rarely more difficult to read when occurring infrequently or having an unfamiliar structure (think of lengthy names of chemical compounds and medical or other scientific terminology sourced by the Western world from Greco-Latin etymons, or the scientific, administrative, and religious lexical commerce between Arabic & Persian in early Islam, or the greater difficulties for non-native learners to memorize the Japanese katakana script compared to hiragana:[4] in pursuit of comprehension, the reader vacillates between visual and phonetic interpretations of the written words by swapping graphemes and phonemes like playing a slot machine). Some scripts have intentionally transient legibility (ephemeral calligraphy written with water, 'read and burn' secret messages, post-it notes), while other have an unintentionally limited lifespan (ink that degrades the acidic paper surface, a common occurrence during the nineteenth century; obsolete digital font formats). Through research, the durability of messages can be increased, by modifying

1 Scherzbrecher: Linear A is a yet-undeciphered script used in Crete between the third and second century B.C.E. presumably for accounting, while Kurrent is the cursive form of Fraktur, of the kind used by Goethe's 'Bonne Maman' to label marmalade pots, before he discovered **nutella** in Italy. C Wikipedia: 'Linear A', 'Kurrent' ⇈ The paleographer has been born as an interpreter of ancient scripts, and the editions of ancient texts he outputs are migrations along the perpetually moving timeline to keep documents within the present legibility window.

2 Character parts overhanging its metal body (the delicate descender of an Italic '*f*' or the kerned '*New*') were prone to breaking during the rigors of the printing process. C Jacobs 2004: 88

3 *'It is then only a step until suggesting buyers of e-book readers that maximizing contrast is desirable. This is a bankruptcy statement of any consideration toward the human perception faculty.* [...] *Considering it "normal", or even selling the use of cold blue-white* [*paper*] *as an answer to a necessity, is cynical. A publisher who does something like this has no respect for the reader.'* C Reuss 2014: 62–63

4 Taylor 2014: 260–266, 292–293, 312, 343–345, 349 [katakana vs. hiragana]

the material (acid-free permanent paper), the storage format (archivable PDF/A), or the environment (archives with controlled hygrometry and access), or through 'revival' (deciphering remains is the spoken verb: 'Not marble, nor the gilded monuments / Of princes shall outlive this pow'rful rhyme'.[3] ⇛ This inquiry into the *temporal regimes* of script and reading allows

Definition 19. Permanence — *Legibility is inversely proportionally to the speed of the 'flow of time', or the metabolic rate of a reading system.*

hieroglyphs; writing emulators for the Commodore 64 operating system). A fascinating issue is that of very-long-term legibility, of the order of thousand to ten thousand millennia, to preserve humankind's memory (by inscribing information into DNA, in special silicon–metal alloys, and onto ceramic slates stored in a mine 'ark' under the Austrian Alps),[1] or to warn future beings (of the dangers of nuclear waste storage sites).[2] Long-term legibility is affected by material decay and loss of decoding know-how due to the continuous transformation of the physical and sociocultural environment. Obviously, such conditions prevent perpetual legibility, but do leave room for progress, supported by the Sisyphean struggle to maintain the legibility of texts. A fact worth meditating upon is the apparent increased friability of writing supports with each new iteration of writing technologies (and subsequent countermeasures): stone is more durable than argyle than parchment than papyrus than paper than floppy disks, CD-ROMs, & the Cloud. And when every written glyph falls to dust, all that a further definition of legibility:

Definition 19. Permanence — *Legibility decays proportionally with the speed of the 'flow of time', or the metabolic rate of a reading system.* ⇛ This definition can be operationalized using a corollary: to preserve legibility, the metabolism of the reading system must be slowed. 'Freezing legibility' is challenging; for example, it is desirable for messages to be as error-free as possible while still permitting corrections (the Korean War Memorial in Washington, D.C., contains misspelled names), which contradicts a requirement for untamperable messages (infringed by the practice of damnatio memoriae).[4] These are questions of legibility, but depend on ethical & other attitudinal tenets, highlighting the core issue of 'permanent legibility': foreseeing the future as a component of script design.

1 Doricchi 2022, Vries 2013, Kunze 2018

2 Options ranged from IKEA-like instructions to terror-inspiring architecture to myths of doom. ⊂ Trauth 1991

3 Shakespeare, *Sonnets*, 55 ⊂ Shakespeare 2022: 491

4 Philipps 2023, Wikipedia: 'Damnatio memoriae'

— *We operate on the political history.*

Orlando: My Political Biography (2023) is a docufiction film using Virginia Woolf's namesake's novel as a frame to present the emotional and social tribulations of sex reassignment in contemporary France. One memorable scene is the surgical operation performed metonymically on *Orlando*'s ink-perfused original edition, in which the typographic and gender identities of characters are fused in the discourse on book–body politics. (Tangentially, the movie also dwells on the use of low legibility to protest the established order of high legibility, one handwritten, the other printed employing substantial technological, financial, and human capital, such as for passports.) — Oops! It appears this text is out of sequence, coming before I have introduced the section on cinematic representations of legibility. An error recalling times past, when analog film reels were shown out of order. Unless it was simply a meta-level "error", a play on writing meaning and para-usages, often affected by cinema and elevating revealing details to the status of memes, such as Dr. Evil's claw-like "air quotes" from the *Austin Powers* (1997) franchise.

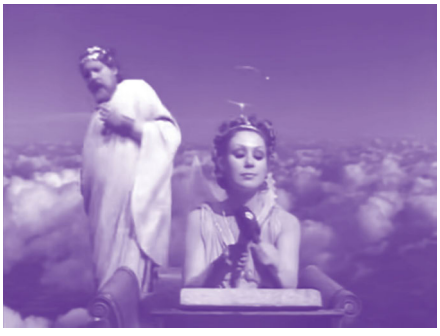
Plautus, the Roman playwright of the second century B.C.E., disparaged one Greek's handwriting by comparing it to chicken scratch (*zampe di gallina* in modern Italian), while the French would have said that he 'writes like a pig' (*écrire comme un cochon*), and the Chinese seen in the unintelligible script the 'writing of ghosts' or a hermetic 'heavenly script'.[1] Having found little else in the dictionary about the representation of legibility, I turned to cinema.[2] If the Seventh Art is a mirror of the state and aspirations of societies, we may then ask: what has it to tell us about the perfect script?[3] One facet of script in cinema, sampled below, reveals how reading is framed as a feat & writing as a mystery. Those who succeed are little Champollions. Legibility is not a routine matter of confounded *p*-s and *q*-s and stern admonitions by the schoolmistress, but is rather something that cinema examines at the stage of text decipherment, during which the cognitive rush translates to dramatic action on the screen. The written code seems as sure as a Swiss bank safe, and humanity's future depends on breaking it. Even Superman can fail to read an eye chart, as

1 The tenth-century Japanese Sei Shōnagon used the same metaphor ('*writing as feeble as the tracks of a bird's feet*') in her *Pillow Book*. The illegibility of chicken scratches is used metonymically in divination by chicken bones, as practiced, e.g., by the Karen of Burma, who lost their revealed writing when inadvertently eaten by chicken, who thus acquired gnostic powers. Their footprints did serve, unsurprisingly, as models in the invention of script, according to Chinese lore. C Shōnagon 1982: 172; Plautus, *Pseudolus* 1.23–30; Plautus 1980: 153; Wikipedia: 'Roman cursive', 'Greek to me'; Wiktionary: 'zampa di gallina', 'chicken scratch', '天書'; Fine 1997; Taylor 2014: 37

2 On the representation of legibility, I could have also turned to literature; the reader is encouraged to do so. Exempli gratia, in Greg Egan's science fiction novel *Diaspora*, writing patterns cover an ocean planet, are embodied in a single molecule, and are encoded via the Fourier transform in a multi-dimensional frequency domain. In such a world, you need to have the right mathematical spectacles to make script legible! C Egan 2001: 224–240

3 For further representations of writing in cinema, especially of forensic expertise, C Atanasiu 2014.

he did at his medical examination for enlistment in the army during the Second World War: his X-ray vision caused him to spell the letters of another chart, one displayed behind the wall, in the adjoining room ![1] In the end, nothing is perfect, and we are served a great tribute to the human ability to learn the most random of patterns if properly motivated. ⇛ Let us now watch a few cinematic vignettes featuring bio- and mechascript, starting with Plautus himself in *Up Pompeii!: The Ides of March* [S1E2] (1970), dictating lapidary aphorisms in his Olympian dwelling to an angelic secretary, who is handling a hammer and a chisel with the same dexterity as an inked reed pen: tak! tak! tak! ta——k!



— *Hear now the wise words of Plautus.*

The mix-up between script genre (epigraphic vs. paleographic) and writing functions (official inscriptions vs. literature) should amuse the scholars among the public as much as the improbability of engraving at the speed of speech (to say nothing about the accompanying infernal din obliterating any thought [but how about typewriting?]).[2] Beyond the screen of entertaining effects, said scholars may also find the scene to be a thoughtworthy portrayal of the dichotomy between orality and writing, in particular that writing is a technology, and as such creates its own sociocultural structures (notice not only the obvious distinctions of class and gender between the older corpulent boss and the alluring maid, but also how those in power, then as now, delegate the material production of writing, while retaining control over its contents). As for what the screenshot tells us about the representation of legibility, it is that it is the result of a process apparently so intimidatingly complex that it must be disarmed by means of humor. ⇛ 'For a big doctor, his handwriting is super legible.' As this quote from *Pretty Little Liars: Along Comes Mary* [S07E05] (2016) illustrates, problems with legibility (and afferent clichées) can be explicitly employed to comical effect, even becoming an essential part of the movie's plot. In *Take the Money and Run* (1969), directed by and starring Woody Allen, a bank employee is unable to read a badly written hold-

Definition 20. Representation — *Cinema presents legibility as a techno-cognitive feat & a mystery to solve.*

[1] Siegel 1942, Mullaney 2016: 12, Germano 2017: 109

[2] This parody of ancient writing habits is also found in the comic book *Asterix the Legionary* (1967), in which Roman clerks engrave marble tablets instead of handwriting (while their Egyptian counterparts were using papyri, as in *Asterix and Cleopatra* [1963]).

up note, resulting in increasingly farcical complications. Forty-two years later, this improbable situation occurred in an American bank.[1]

— That looks like 'gub,' not 'gun'.
— No, it's 'gun'.
— It's 'gub.' That's a 'b'.
— No. See, that's an 'n'. 'Gun.'
— George, would you step over here a moment, please? What's this saying?
— 'Please put $50,000 into this bag and abt natural.' What's 'abt'?
— It's 'act'.
— Does this look like 'gub' or 'gun'?
— 'Gun,' see? But what's 'abt' mean?
— It's 'act.' You see? 'Act natural.' 'Please put $50,000 into this bag. Act natural.' It's not...
— Oh, I see, this is a hold-up.

Maintaining legibility is a perpetual uphill battle for the nuns of *Doubt* (2008), who run a recalcitrant school during the 1960s in the Bronx. In addition to the vexing question of the visiting pastor and the choirboy, their greatest enemy is the ballpoint pen, a technological incarnation of modernity, which can only spell decadence.[2] Illegibility is a grave matter, since, as Cassiodorus (c. 485 – c. 585) asserts, 'every word of the Lord written by the scribe is a wound inflicted on Satan'.[3]

— What's this?
— A pen.
— A ballpoint pen. The students are not using them for assignments, I hope.
— No, of course not.
— I am sorry I allowed even cartridge pens into this school. Always an easy way out, these days. Every easy choice today will have its consequence tomorrow. Mark my words.
— Yes, Sister.
— Ballpoints make them press down. When they press down, they write like monkeys.
— I don't allow them ballpoint pens.
— And yet here one is. Penmanship is dying all across this country.

The Moderns' discord in legibility studies (on whether serif or sanserif is more legible) was a non-issue to the ancient Romans, at least according to *The Twelve Tasks of Asterix* (1976): of course, traffic signs all over the Roman Empire had to be manufactured in standard-issue TRAJAN Engraved! — or was it Cesar Display? or Nero flamboyant? Similar stereotypes of national writing styles and writing as identity marker — which reinforce the notion of legibility as a matter of conditioning — see to it that Goths write and speak in **Textura Bold** (unintelligible to Asterix), Greeks in Apple's yogurtish SKIA; Sarmatians via mirrored Яs 'ethnic fonts', while Parisians sell perfumes labeled with *swoosh* handwriting, and Egyptian scribes claim to know to write once they master figurative drawing. You may say that you are how you write!

1 Johnson 2011
2 Sassoon 1999: 109 – 110
3 Brown 2011: 277

— [Asterix to Obelix:] *Have we really become the masters of Rome?*

Catering to people from all over the world, the San Franciscan German-American optometrist George Mayerle (1870–1929) produced in 1907 a multiscript visual acuity test chart (including Latin [Antiqua and Fraktur], Japanese [*katakana*], Chinese, Cyrillic, and Hebrew characters, as well as symbols and color patches).[1] The dazzling result looked as much like a typographer's typeface catalog as the typeface catalog resembled an eye test chart. This is a striking example of the localization of a script-related technology that emerged from practical scientific necessity, conjoined with welcomed global mercantile opportunities. An extreme case of such contextualization appears in the episode *From Venus with Love* (1967) of the British spy thriller series *The Avengers*, in which an optometrist uses, rather than letters, a collection of hats representative of various social, professional, and ethnic types as an eye test chart. While ostensibly poking fun at the human infatuation with headwear, it also unwittingly exposes class aspects of the scientific practice, in that the use of script in eye charts beginning in the nineteenth century is predicated upon literacy, which did not attain universality even today. Furthermore, naming hat types is possibly just as challenging as spelling As, Bs, and Cs, which underscores that legibility is more than a matter of distinguishing between shapes and colo(u)rs: its performance depends on reading proficiency, from the barely literate to the fast reader, with all the social and financial means for developing the required knowledge.

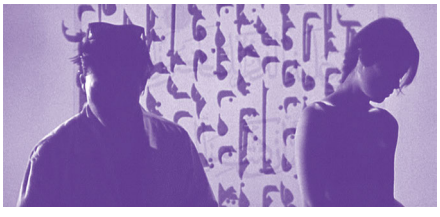
— *From the top, if you please.*
— *Trilby, homburg, bowler, cap, jockey, pork-pie, topper, boater, busby, fez.*
— *Eyes perfect, Mr. Steed.*

Peter Greenaway's *The Pillow Book* (1996) creates an original definition of legibility as proportional to the beauty of the script. Visually and conceptually, it is a phantasmagorical movie, set in the last colonial days of the cultural melting pot of Hong Kong and revolving around miscellaneous protagonists for whom the quality of orgasms is ostensibly commensurate with the quality of script, which serves as an object of sublimation to their transports. There is God himself, creating Man and the World by writing them in Chinese characters; there is the bodypainting calligrapher's daughter, and the publisher who makes a book from his dead lover's heavily tattooed skin.[2] It does

[1] Sappol 2012: 136–137

[2] A number of libraries own books bound in human skin, many on medical topics. **C** Rosenbloom 2020, Brooke-Hitching 2006: 48–57, Wikipedia: 'Anthropodermic bibliopegy'

not take an arcane-minded spectator to see this film as an East Asian graphophile version of the *1001 Nights*, in which a Japanese Scheherazade is interpreting literally the Biblical verse 'And the Word became Flesh' (John 1:14). This is legibility extended to Weltanschauung.



— *In remembrance of my father and in memory of Sei Shōnagon, I was determined to take lovers who would remind me of the pleasures of calligraphy. I could not be sure which was more important: an indifferent calligrapher who was a good lover or an excellent lover who was a poor calligrapher.*

The same movie also contains the following memorable reflection on iconoclasm in Islam, articulated by a calligrapher writing in the ephemeral medium of clear water (a Chinese specialty [1]), which in the context of legibility could equally refer to the culmination of the 'invisible typography' considered ideal in the trade: 'You know, some cultures permit no images. Perhaps some cultures ought to permit no visible text.' 🡅 Sporting a calligrapher's veneer I confesses that I was turned off during this otherwise excellent erotic movie at the sight of an Arabic script sample incongruously presented vertically, as if it were Chinese or Manchu (see above). This faux pas was likely committed by a props hand keen to give the proper orientation to the exotic script, and is thus indicative of the impact of the visual environment on what is considered 'good' or 'bad' legibility (unless, of course, there is a deeper meaning to the verticality, related to the content of this circa ninth-century Quran page describing the Prophet Muḥammad's Dantean nocturnal journey through the Heavens [2]). The exoterical hypothesis is supported by my small collection of misoriented script samples, where the orientation of alien scripts seems to be determined with reference to the statistical pattern properties of scripts familiar to the orienter.[3] 🡅 A more informed set designer worked at *Smiley's People* (1982), adapted from John Le Carré's spy novel, in which bad legibility contributes to conjuring up the creepy atmosphere of a dank & misty December evening at a Cold War Berlin border crossing where British intelligence anxiously awaits the defection of the brilliant Soviet general Karla: the kerning of 'Bagdat' is dreadful, and the abracadabrant choice of a Far West typeface for a shoddy Turkish restaurant makes it look like the cut-throat haunt of the Thief of Baghdad & his forty acolytes.

[1] Chastanet 2013

[2] Ziolkowski 2015 [Dante and Islam]

[3] The iconic code streams of *The Matrix* (1999) are also mirrored (on the vertical axis), although most likely for prosaic ends (to make the script look less conspicuously Japanese). This feature may have caught the attention of the AI generative image program Midjourney when it was prompted to picture a version of the movie produced in the 1950s and created a whimsical image showing vertical lines of text coming out of a typewriter. C Gibney 2024 🡅 For a Hebrew script example of the mirroring phenomenon C Friedl 1986(2): 32.

It was noted that one cinematic vision of script is that of script as a fea(s)t. This is quite literally the case in another remarkable work by the same Peter Greenaway, *The Cook, the Thief, His Wife & Her Lover* (1989), a film on the clash between orality and literacy in an upscale French restaurant, patronized by a gangster and a bookseller sharing the same woman between meals. The visual backdrop is Rembrandt's (1606–1669) *The Night Watch*, the music Neobaroque, & the haute couture by Jean-Paul Gaultier. It all looks terribly *tableau vivant* of a *nature morte*, including the unfortunate bookseller, choked to death and then stuffed like a pig with macabre pages torn from a history of the French Revolution's Reign of Terror, and the concluding cannibalism scene. The film is a masterpiece reflection on the edibility of the written word & the copulatory power of language, in the great tradition of Rabelais, Petronius, and Athenaeus.[1]

— *Reading gives you indigestion.*

The Arabian Nights (1974) is Pier Paolo Pasolini's (1922–1975) interpretation of the *1001 Nights*, infused with the sexual promiscuity of the late 1960s. Similarly to Greenaway's film, it contains an opulent scene centered around a book as erotic foreplay. Here, Nur ad-Din is entertained by three sisters, one of whom reads stories to the cenacle, in an oasis next to a pool, all of which are reflections of the world inside the book. The air is drenched with the odors of sundry fruits bearing names evocative of the better part of Ptolemy's (c. 100–170s) *Geography*. And what has this to do with legibility? It tells us that, like any good story (or meal, for that matter), any system is not just a juxtaposition of components, but rather a construct of interactions between entities that change the other entities and are changed by them in turn — thus, legibility is affected by the holistic dimension of the reading experience, which explains its inherent elusiveness. Perhaps we read better when the food we ate was tasty.

— *Greengrocer, give me apples from Syria, Ottoman quinces, peaches from Amman, Nile cucumbers, lemons from Egypt, sultanine cedars, myrtle, resin, chamomile, pomegranates, pastries, stuffed nutmeg donuts, ice cream nougat, confectionery, pastries, cakes, sugar, male incense, amber, musk, and Alexandrine waxes.*

The second script-related scene in Pasolini's movie inspired by a classic of world literature revolves around script production, specifically the astonishing mastery by a chained monkey of the canonical Arabic calligraphic styles, a prowess that successfully elevated him to the position of grand vizier (initially, he was a highly educated prince transformed into a simian by a furious demon, after sleeping with the demon's lover).[2] The monkey-scribe is a topos

[1] Anderson 2000

[2] Other occurrences of script in the *1001 Nights* include another writing ape, an illiterate schoolmaster, a forged letter, a poisoned book, and many written talismans for becoming invisible and summoning genies — all in all, a miraculous concept of writing, not much different from that of Hollywood. **C** Mardrus 2004 (1): 34–35, 72–83, 310, (3): 217–218, 294, (4): 435

dating to the pharaonic period (embodied by the god Thoth, patron of scribes), to be understood both as a social critique (the oldest manuscripts of the *Nights* date to the fourteenth century of the Mamluk sultanate of Egypt & Syria, when corruption was so rife that a cook could be made vizier, or wear the attire of a secretary, despite being an accomplished analphabet [1]), as well as a self-referential lament on the copyist's condition (bound to an ego-dissolving task in the purest Buddhist spirit), with even his proverbial lubricity reduced by iron chains to that of an eunuch 'driving the letters with the calamus into the bridal chambers of the books', said the Mamluks' secretary Ibn Qalqashandī (1355–1418) in his chancellery encyclopedia.[2] The hermeneutic value of the monkey-calligrapher tale, beyond the historical, ontological, and erotic,[3] is that it explains legibility as the very interface between orality and writing, as that fleeting instant between possibilities not yet written & written meanings not entirely clear, when fingers move and the flowing ink shimmers. Legibility is the transformation of the unimagined future into an understandable past.

— *This calligraphy is truly very beautiful. None of my counselors writes in such a beautiful thuluth style.*

1 Atanasiu 2003: 56, 204–212

2 Atanasiu 1999: 58

3 'Lexigrams' help communicating with apes. © Rumbaugh 1977, Schweller 2012, Tomonaga 1992, Savage-Rumbaugh 1994

One can recognize the individual symbols of an encoded message perfectly well without understanding its content at all. This is the difference between legibility and comprehensibility, between exoteric and esoteric knowledge, between what is said and what lies between the lines, between the world as it looks and how it may be; this, in turn, is the core of semiotics, of Umberto Eco's book *The Name of the Rose*, and of the eponymous movie (1986). The plot is about forbidden & poisonous books from antiquity, lost or perhaps never written, & disappearing in flames at the end of the story — read with special eyeglasses, illuminated with illustrations with double meaning, copied out in code and in invisible ink, in foreign languages, hidden in a labyrinthine library accessible only through a secret passage in a tower of a fortified monastery in a remote mountain range during the dark days of the Inquisition by lustful, heretical, and murderous blind monks, yet penned in exquisite calligraphy. In less words, do not trust legibility, for it might be just a mirage.

— *Written with lemon juice.*

In a subsequent scene, Adso, a yet green apprentice to the ecclesiastic detective & former inquisitor William of Baskerville, finds his reading/life path through the library/world tethered to a treatise on love, like Orpheus & Theseus.

— *Well, Adso, it would appear that we're in a labyrinth.* [. . .]

— *How will we get out?*
— *With some difficulty, if at all. You see, Adso, that is the charm of a labyrinth.*

While the scope of legibility is improving communication, its impact is not without side effects, an aspect that the cinema is keen to explore, especially due to its value for creating appealing storylines. Uniformization, increased by mechanical reproduction, is a corollary of legibility resulting in an ontological glissando, from depersonalization to anonymity, thereby serving the exertion of power through graphical conformism as well as its subversion for clandestine communication. This dialectic is represented in *A.D. La guerre de l'ombre* [*The Shadow War*] (2008), in which a stencil is used to write anonymous letters to the police by a renegade member of the far-left 1980s French terrorist organization Action Directe.

The quest for legibility also has metaphysical implications regarding the trustworthiness of the writing that it purports to improve (a claim that the oral civilizations of the Ancient Greeks and Early Muslims considered highly suspicious). Money counterfeiting, is a recurrent cinematic theme, depicting the fabrication of genuine legibility, the function of which is to mask fraud (in *Lethal Weapon 4* [1998], the term 'money laundering' is taken literally, as freshly printed counterfeit banknotes are dried in laundry machines). In *1984* (1984) (based on George Orwell's [1903–1950] novel), the quest for perfect legibility consists in modifying the content of past newspapers to fit ideological changes in the present party line of a totalitarian state —is this Ugraphia? These examples illustrate how the cornerstone precepts of typography & legibility as transparent vessels of content can be subverted to hide untruth in plain sight.

—

— *The Revolution will be complete when the language is perfect. Praise be to our leader & the Party workers!*

That Eco's 'labylibrary' is three-dimensional is not only remarkable for contrasting with our tendency to visualize labyrinths as floor plans, but points out some general difficulties of notations, viz. encoding the motion of articulated bodies. Thus, the portmanteau concept of 'leg·ibility' is center stage in *The King Is Dancing* (2000), the fictionalized patronage of choreography by Louis XIV, for whose ballets a notation was created as a means to record & propagate the glory of the Sun King's *scripting* body and control the motions of the *scripted* bodies of his subjects. Clearly written & performed leg motions were indispensable to this corporal form of official communication in an age of 'correspondences' between the order of things.

— *Music embodies universal harmony. Thus, it has a political function in the order I wish to establish. It serves me. It serves the State and God.* [...] *Our art is a political tool, it uses grace and emotion to turn the listener inside out, without his noticing.*

Yet, the notation encoded only the feet's path on the dancing floor ('foot-notes'!), leaving out posture, gesticulation, facial expression, and their multiple intended meanings — the legibility of form and content was limited. The impossibility of full graphic and verbal communication, and its replacement with the leg-ible expressiveness of dance, song, and music, is explored to charming effect in the musical *Ready, Willing and Able* (1937), where lovers tap-dance amorous letters on a giant typewriter and characters are produced by seductive 'typing legs'.

— *You're much too much / And just too very, very / To ever be in Webster's Dictionary*

The issue of body notation is shared by choreography with penmanship, which through word and image expounds in manuals on body posture and pen grip. *Saint Joan* (1957), on the life and trial of Joan of Arc, depicts the method of teaching signing by guiding the pupil's hand.

— *Come child, take the pen.*
— *I cannot write.*
— *But you've signed many letters before.*
— *Yes, but someone guided the pen.*

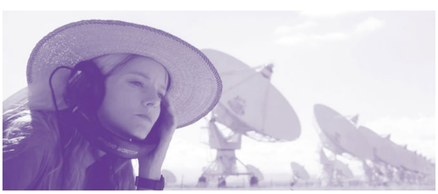
Cinema has popularized many technical, perceptual, even philosophical aspects of representation (points of view in *Rashomon* [1950]), among them three-dimensional motion capture and stereoscopic viewing, as in the arresting flying bullets scene from *The Matrix* (1999), in which the shooting duel is stop-motioned and the protagonists rotated as though they were in a computer simulation ('[The Matrix] is the world that has been pulled over your eyes to blind you from the truth.'). Appropriate motion notation tools are a practical problem for movie production and for programming analog automata and computerized industrial robots. *Stranger in a Strange Land*, the first episode of TV *Star Wars* franchise *The Book of Boba Fett* (2021), depicts a girl using a stick to drive a group of mildly recalcitrant four-legged and winged droids (Boston Dynamics' Spot), applying a primitive but effective version of 'reinforcement learning'. It will take some more coaxing and a good notation system to make those droids dance, although sound effects are as important in this action series as stage direction!

Assassin grunting · People screaming · Boba Fett grunts · Speaking Jawaese · Boba Fett grunts · Weapon crackling · All grunting · Yells · Boba Fett grunts · Shields crackling · Weapons crackling · Gamorreans grunting · Huh? · Assassin grunting · Grunts · Assassin screams · Blaster whirs · Fennec! · Alive!

Interesting anti-perspectives on notation are offered by one more movie. In *Black Orpheus* (1958), where the Orphic myth is played out during the carnival of Rio with black protagonists from the favelas, the lack of vital power of the written word (the autumnal stack of paper leaves at the Bureau of Missing Persons don't help Orpheus find Eurydice) is contrasted with the conjoined vitality of song, music, and dance, be it scripted (by the year-long legibility rehearsals at samba schools) or improvised (by children): *'Feel free to look around, if you wish, but you will not find missing people in papers. On the contrary, that's where they get lost.'* If we subscribe to the view 'meaning is action', we discern here a curious twist of legibility: despite being legible, the letters fail to convey meaning, like hollow bones that the flautist's breath may animate — only articulated through speech, not in mind's eye alone, is script an active element, so the antique philosophy from before silent reading. 'Do not look at me, Orpheus, or you'll kill me!' enjoins Eurydice, meaning that the common visual, superficial level of legibility is mortal, relegating you to the underworld, and that to acquire proper gnosis it is the hermeneutical illegibility of existence that you should seek to dispel, looking with the intellect and spirit beyond the veil of textual appearances.

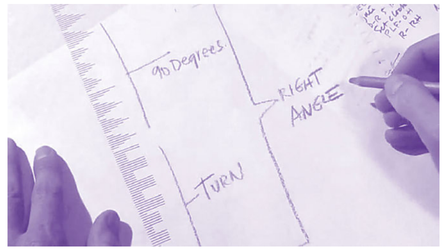
— *Play and make the sun rise!*
— *I don't know how!*
— *Make it up!* [...]
— *He made the sun rise!*
— *Wow! Just like Orpheus!*
— *Now you are Orpheus.*

As life-givers, women have often been portrayed as intercessors to the unknown, thus endowed with superlative cunningness (Athena), magic linguistic proficiency (witches), foresight (fortunetellers), and trace readers (Ariadne's quasi-scriptural thread). These aptitudes persist in science-fiction when it comes to inter-species communication. In *12 to the Moon* (1960), Dr. Murata effortlessly translates something that 'looks like oriental picture writing' from telepathically mind-reading fierce moon inhabitants ([illegible] = 'return to earth at once'), while in *Contact* (1997), a film based on a novel by the Carl Sagan (1934 – 1996), astrophysicist and pioneer of interstellar messages-in-a-bottle, Dr. 'Sparks' discovers through aural pattern recognition a radio message from the star Vega.



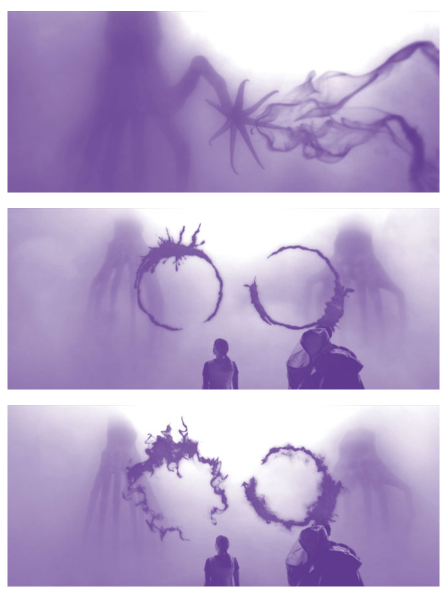
— *Is anybody out there?*

Another characteristic of communication with aliens is its bimodality: in the H. G. Welles (1866 – 1946)-inspired movie *Phase IV* (1974), superintelligent ants exchange with humans through a mathematical model of the ants' marching patterns of invisible pheromones, to which humans reply by sonic signals, a perfect setup, consider the scientists, if the notation is not misleading. Ultimately, the ingenuity of big brains will prove to be inferior to the swarm intelligence of tiny brains, who take control over mankind to unknown ends. Usually, however, humans – aliens communication is unproblematic for Hollywood, since E.T. speaks English (*E.T. the Extra-Terrestrial* [1982]).



— *Mathematics is the universal language among intelligent creatures.*

Another universal appears to be calligraphy. The giant octopuses (ahem, 'heptapods') squirting ink in a flying aquarium in *Arrival* (2016) betray a sense of aesthetics by the quality of their palindromic writing reminiscent of the zen ensō. Art can procure superpowers!



— *Like their ship or their bodies, their written language has no forward or backward direction. Linguists call this non-linear orthography, which raises the question, 'Is this how they think?' Imagine you wanted to write a sentence using two hands, start-*

ing from either side. You would have to know each word you wanted to use, as well as how much space they would occupy. A heptapod can write a complex sentence in two seconds, effortlessly.

Hugo (2011) stages a writing automaton conceived by the French stage magician and pioneer of cinematic illusions and science fiction Georges Méliès. The wondrous legibility is depicted as a mindless motor program. Small imperfections, a wearing of gears here, a trembling of the writing arm there, seem, however, to confer the Tin Man a semblance of personality.

— *Georges Méliès? That's Papa Georges' name. Why would your father's machine sign Papa's name?*

In *Short Circuit* (1986), an information-hungry robot reads the entire *Encyclopedia Britannica* in mere seconds, then clamors 'More input!' At long last, optical character recognition has been perfected, & the machines have attained cognitive autonomy, outwitting their human creators.

— *More input, Stephanie. More!*
— *There isn't any more. You've read everything in the house.*

Goals — (1) With the design of a script style, I intend to empirically test an important hypothesis related to the definition of legibility: namely, that legibility is inversely proportional to the confusion of characters, with the implication being that an increase in dissimilarity between characters increases legibility. — (2) The experiment should also serve to evaluate aspects of the arguments on legibility progress advanced in this work. — (3) Finally, I wish to explore the interplay of theoretical and practical considerations that affect the optimality of legibility during the process of script design. ⇛ *Methods* — My interest is to create a style, and a mere few characters are sufficient for this purpose; designers can readily derive an entire typeface provided with the 'spirit of the letter'.[1] I was con-

1 This is how popular typefaces are 'internationalized', i.e., augmented to cover new writing systems stylistically consistent with the original. The immensely successful Helvetica typeface is a case in point: created in the mid-1950s for the Latin script, inspired by a tradition of sanserifs reaching into the early nineteenth century, and ever since perpetually refined and extended to ever-new 'locales' (in 2017, Arabic, Armenian, Georgian, and Thai versions were released by Linotype under the name 'Neue Helvetica World'). Typeface extension, especially the 'matchmaking' between stylistically distant scripts, necessitates a keen eye and graphic culture, and obviously differs from designer to designer, the very reason why one would favor Monotype's diaphanous *Garamond* or Adobe's rustic 2005 *Garamond* or its unassuming 1989 *Garamond* cuvée. ⊂ Wikipedia: 'Helvetica', Smitshuijzen AbiFarès 2012 [matchmaking tips], Bringhurst 2004: 230–232 [an exegesis of Garamonds], Tang 2012 [Sino–Latin matchmaking] ⇛ Not unlike the role played by chess in the evolution of computing, understanding and formalizing the concept of style is a rewarding domain of the psychology and computer science of creativity. Practical applications have been demonstrated many times for automated script synthesis on the basis of, e.g., the statistical properties of shapes and kinematics, texture extrapolation, or spline interpolation. The research topic is popular in East Asia due to the social value of calligraphy, similar to the status of penmanship in eighteenth-century Europe, when the Swiss Jaquet-Droz writing automaton was created. ⊂ Hofstadter 1995: 401–466, Devroye 1995, Efros 1999, Yao 2004, Franke 2005, Chu 2004, Hassan 2010, Tenenbaum 2011, Elarian 2014, Haines 2016, Wikipedia: 'Jaquet-Droz automata'

The Arabic character *ṭā'* of the *Sol* typeface. Note how each segment has a different length and orientation from the other, enhancing the overall asymmetry.

strained by the basic character shapes so that the parameters for which I chose to increase dissimilarity were stroke length and the angles between strokes. The resulting style is highly irregular, reminiscent of Phoenician writing. Increasing the asymmetry of a figure is known in gestalt psychology as *sharpening* (*leveling* is the opposite), and is assumed to increase attractivity & memorization.[1] Most scripts tend to balance character symmetry and asymmetry.[2] By using both sharpening and leveling in my composition, I wanted to elicit tension by coupling antagonist tendencies. Mathematically and biologically, such irregular shapes can be approximated using a Fibonacci series that takes as initial values those of the golden ratio and its conjugate, as evident, for example, in phyllotaxis, the arrangement of leaves around plant stems. The role of the golden ratio in this disposition is to create maximally distinct segments, & avoid barely noticeable differences that are experienced as unpleasant (the 'uncanny valley effect').[3] Given the complexity of factors affecting shape perception and our sparse understanding thereof, it would be difficult to create a convincing formal model for generating sets of arbitrary numbers of shapes that are perceptually maximally dissimilar.[4] For this reason, I pursued my creative work intuitively. ⇛ *Related work* — Modern architecture presents conceptual similarities to my graphical experiment, be it in the jagged asymmetries of Frank Gehry or in the organic smoothness of Zaha Hadid (1950 – 2016). Continuing the (immemorial) influence of architecture on other arts, their work may give rise to new typographical styles, as exemplified by the homagial typeface 𐤄𐤀𐤃𐤉𐤃 (2017), by Özhan Yurtseven.[5] ⇛

1 Wulf 1922

2 Wiebelt 2004, 2005, Li 2013

3 Mori 2012, Diel 2021.

4 Atanasiu 2022c.

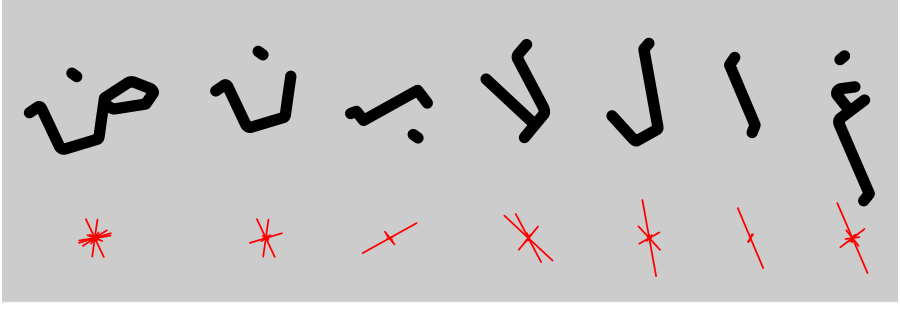
5 It is tempting to indulge in the hermeneutics of this script:

Result — The experiment resulted in the script presented here in the word 'Ugraphia', as well as a several Arabic characters. ⇛ *Evaluation* — The first observation I make about my experiment is that, based on feedback, few people find the word legible, so large is the difference from familiar Latin letters. In attempting to improve shape distinctiveness, one degrades recognition, at least in cases where the reader has yet to learn the new patterns. I also note how I make heavy use of redundancy. In information theory, excessive redundancy means loss of transmission efficiency, but in respect to human script, redundancy appears to be a desirable feature. Its function seems to be less countervailing some noise, as to induce a calming regularity that facilitates reading.[1] Finally, I fine-tune the shape of the characters to both the local neighborhood and the global gestalt, making the script 'glocally' context-aware.[2] Note how the first 'a' retracts its descender to make space for the following 'p', while the final 'a' has sufficient space to extend a swash. In short, I feel as though I have created a mysterious stimulus, at the border between familiar and alien, a creature with soft fur, fangs, and green eyes glowing from the interstices of a half-opened book. These are characteristics of display typefaces, made to attract the gaze and bring the reader closer to the text. ⇛ *Conclusions* — (1) Although an increase in dissimilarity appears to *benefit* legibility (e.g., via contextual adaptations, my composition becomes more consistent), the optimal use of the entire bandwidth through maximizing dissimilarity is not attained due to an array of factors that favor redundancy. — (2) The experiment *confirms* a number of the theses advanced herein, foremost that perfect legibility is unfeasible, that character recognition is a matter of proficiency, that designers are dependent on archetypal script shapes, that optimality can only be approached but never attained, entailing laborious glocal adaptation, and that aesthetic preferences (both personal and emerging from the zeitgeist) play a role. — (3) The balance of objective and subjective aspects of script style is a *compromise* between legibility & other factors, some of which are antithetical.

Zaha Hadid hailed from Iraq and studied mathematics before drawing architectural shapes that remind of the geometric paradigm of Arabic calligraphy attributed to Ibn Muqla (885/6 – 940), and the organic ductus of fellow Baghdadi Yaqūt al-Musta'ṣimī (? – 1298). Özhan Yurtseven is a designer from Istanbul, a city where major developments in Arabic calligraphy took place, as capital of the Ottomans. You may call these parallels chance encounters, but they grew out of a common historical soil. ⇛ Even my own exegesis of the historical roots of legibility in this paragraph are informed by biographical parallels, as I have studied Arabic calligraphy in Istanbul and I do research in the mathematics of script analysis and document architecture. ☾ Massoudy 1981

[1] Other workers, using a double-pronged (psychophysical and typographical) approach, have arrived at similar conclusions on the importance for legibility of the perceptual uniformity of script. Of course, however, Tschichold was there before to voice the same idea. ☾ Sanocki 2012: 2b, Tschichold 1987: 35 ⇛ The Latin textura script style (Allah), like the Arabic *thuluth* (الله), is also characterized by great regularity, to the point that it resembles stylish but unreadable barcodes. ⇛ During the 1950s and 1960s, psychologists, linguists, and even military and art historians enthusiastically believed that they could explain their respective domains in terms of the mathematical information theory devised by Shannon, only to subsequently realize that natural communication was far more complex — or messy, if you prefer that point of view. ☾ A rich rendition of the era's aspirations is Edwards 1997.

[2] While handwriting is incomparably more flexible than fixed-character typography — one reason for the instant success of lithography in nineteenth-century Persia and India — typography became increasingly more versatile with the advent of computers (is '*typo*-graphy' still appropriate for scripts generated not from templates, but from statistical models of shapes and human handwriting ?). ☾ Eir: 'Lithography'



The Sol typeface ('sol' as in 'solar' and 'sun', which will burn you if you try too closely to design the perfectly legible typeface named Ugraphia). Top: Latin characters. The background represents a view of Isle of Utopia. Bottom: Arabic characters. The length and orientation distributions of segments, except for the smallest, are shown on the bottom line. © Sir Thomas More, *De optimo rei publicae statu deque nova insula Utopia*, Basel: Johann Froben, 1518; engraving by Ambrosius Holbein (c. 1494 – c. 1519), brother of Hans; Clark Library, University of California, Los Angeles, PR2321 .U81 1518a, p. 12; WIKIPEDIA: '*Utopia* (book)'

This monograph, however rhizomic its tendency, can only glimpse into legibility. Where do we go from here?| |[1] ⇝ Limits — First, a word of caution: legibility measurement is difficult because of the multiple dimensions of communication. This way, legibility parallels character frequencies, which depend on style, script, writing system, layout, language, content, translation, &c. In addition to these factors (to some extent objective and quantifiable), legibility is also affected by subjective and circumstantial aspects, such as attention, motivation, emotional response to the reading matter, its materiality, and environmental conditions. These complexities have to be acknowledged [2] — while not despairing, as the creator of Times New Roman, that things are not as simple as they used to be: 'The infinity and complexity of the reading public of today, as compared with the simplicity of the time of Charlemagne, makes our alphabet rigid and irreformable'.[3] ⇝ Extensions — It has been a constant of this book to show how there is more to legibility than character identification: recognition of connotations, astute script-mediated power plays, subjective perception of sound and kinetic energy in graphic traces, and more. Thus, the research field may be extended to include, inter alia, the measurement and design of *script expressivity.* What we already witness is the consolidation of a broader and flexible concept, *handwriting quality*, which characterizes writing relative to various norms, particularly those related to motor production and aesthetics.[4] ⇝ Theories — At the end of an academic study, one may expect to part with a theory of the subject discussed. Instead, here we are left with a long & open list of variegated factors, concurrent definitions, and limited theories. Perhaps, there is no unified theory of legibility, and expecting one is a misplaced epistemological presumption. ⇝ Tools — A fundamental roadblock to legibility research in sciences, humanities, and design appears to be deficiencies in legibility measurement. A response is seen in the recent development by psychologists of *legibility scales*, in parallel with automated solutions by computer scientists.[5] ⇝ History — A global and interdisciplinary history and historiography of legibility is needed. In particular, how did the notion of legibility arise (or was it always there?), how did it change, and what sustains the interest in it? Could we map the diffusion of legibility techniques across space and time? Regarding the place of legibility in typographic manuals in German-speaking countries, Anne Rose König demonstrated what riches can found if we question history,[6] while a few other legibility researchers have created synergies between psychology, history, and type design.[7]

1 Readers are given here space to insert their own thoughts in the author's text, an invitation marked with *Gedankenstriche* ('thought dashes' in German, i.e. em-dashes '—') rotated by 90°, which scholia we may call 'gossip marks'.

2 Van Drempt 2011, Daniels 2017

3 Morison 1962: 78

4 Examples of handwriting quality descriptors include stroke shakiness, character size consistency, ligaturing frequency, baseline alignment, and pressure variation. These descriptors, chosen for their relative ease of objective definition and quantifiability, are often studied for medical applications, such as evaluating neurodegenerative pathologies and assessing the effects of medications. ↻ Psychology: Truxius 2025 [development], Longstaff 2006 [pathologies]; computer science: Atanasiu 2018: 97–100 [descriptors] Hamdi 2022, Park 2000 [bitmap images], Simonnet 2017, Liwicki 2011, Djioua 2010 [pen dynamics], Bradberry [EEG signals], Li 2013, Wiebelt 2004 [symmetry], Chu 2004 [brush simulation]

5 Practitioners' reliance on subjective visual assessments to determine the writing features used in these legibility scales highlights the inherent difficulty in designing truly objective scales. Alternatively, it suggests that a holistic characterization of writing, which inherently depends on subjective expertise and limited information, may be necessary. ↻ Barnett 2018 [scale], Rosenblum 2003 [evaluation methods]

6 König 2004

7 Psychologist Gordon Legge's, and type designer & typog-

Antiprogress — It might also be useful to look at the history of illegible writing: errors & optical illusions are rich in rewards. The history of mechascripts, along with its ups & downs, is also instructive. Sometimes, new technologies bring us back to long-surpassed abysms of quality (see the sorrow state of typography on e-readers),[1] while at other times, inventions spring up at first strike in their full aesthetic & technological glory, as Athena from Zeus' head (or almost: Gutenberg's Bible); in the meantime, quality swings from one extrema to the other: from Aldus' justification prowess,[2] to the smudge of nineteenth-century industrial printing so deplored by Morris, to contemporary polychromatic exuberance. Mechascript progress is cyclic; bioscript progress is its pulsing core!

■ *Sta sano*

In this here work, I have argued on theoretical and empirical grounds that, for multifarious reasons, perfectly legible scripts are an impossibility. Too many contradictory aspects — psychological, environmental, cultural, technological, economical — and too many functions — information, power, art — are concomitantly engaged in an ever-changing play defining the pursuit of legibility. This does not preclude optimization for specific conditions; in fact, the tally of arguments advanced herein identifies criteria with reference to which scripts can be and have been optimized. I have also advanced evidence suggesting that progress in legibility has little substance in regard to handwriting, contrary to cases in which technologies are involved in its production; that is to say, legibility appears correlated with the complexity of production modalities and organization. The more the human factor is diminished, and script evolves its artifactual dimensions, the more mastery the human gains over its legibility. Finally, I pointed to the possibility that if the scripts themselves do not improve, then the readers might.

To conclude this essay, which has regressed as it advanced into a mere appetizer clamoring for more research input, and to therefore conclude with an idea intimated at the outset, universally ~~edible~~ legible scripts are like the perfect language, lost forever during a stopover at the Paradise Airport en route to San Serriffe, and yet found again, night after night, in our dreams.[2] Thus, depending on our wake state, the initial hypothesis H_0 — that we live in Ugraphia — might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of significance. might or might not pass the test of

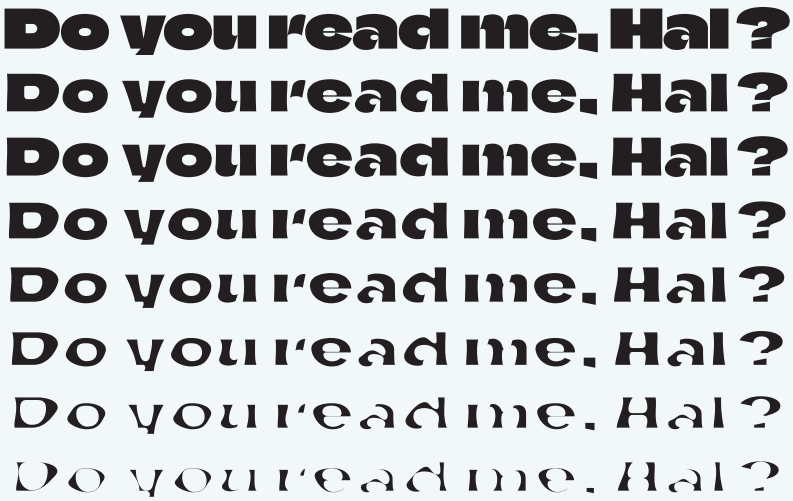
raphy historian Charles Bigelow's study on legibility & print size integrates insights from psychophysics with historical knowledge & practical know-how. The '*two worlds*' also meet in the work of psychologist Mary Dyson, teaching in the typography department of Reading University. Grapholinguist Peter Daniels and reading education psychologist David Share emphasized the biasing Anglo/Eurocentrism of the reading research and proclaimed the Ten Script Variability Dimensions that could just as well also explain the unattainability of Ugraphia. C Legge 2011, 2014 [manifesto for interdisciplinarity in low vision research], Dyson 2013, Daniels 2017

1 Early digital fonts used to look somewhat anemic when they were digitized copies of fonts intended for hot metal printing, a process resulting in an inking surface larger than the metal characters. Far more serious technical problems were encountered during the transition to phototypesetting in the 1950s.

2 Aldines have an aura of parsimonious elegance when set in a single font, Griffo's Humanistic italic, according to Erasmus '*the neatest types in the world*'. Thomas More even gifted books by Aldus to the inhabitants of Utopia. C Davis 1985: 42, 63

3 The first documented description of San Serriffe (not to be mistaken for the Isle of Waqwaq) was published in the travel supplement of the *Guardian*, on April Fool's Day 1977. The story's leitmotif is typographical puns; Donald Knuth issues checks from the Bank of San Serriffe. C Narewska 2012, Wikipedia: 'San Serriffe', Wilson 2016 [facsimile]

Traveling on a ski lift across a snow-less landscape.
(Pralongià, Dolomites, August 2016)



—

A dialogue between a human and a machine on the legibility of lip reading, in the movie *2001: A Space Odyssey* (1968), and its consequences, rendered in a typeface that evokes the effects of vanishing eyesight, vanishing mind, vanishing life.

—Open the pod door, Hal.

Open the pod bay doors, please, Hal.

Open the pod bay doors, please, Hal.

Hello, Hal, do you read me?

Hello, Hal, do you read me?

Do you read me, Hal?

Do you read me, Hal?

Hello, Hal, do you read me?

Hello, Hal, do you read me?

Do you read me, Hal?

—Affirmative, Dave. I read you.

—Open the pod bay doors, Hal.

—I'm sorry, Dave. I'm
afraid I can't do that.

—What's the problem?

—I think you know what the
problem is just as well as I do.

—What are you talking about, Hal?

—This mission is too important for
me to allow you to jeopardize it.

—I don't know what you're
talking about, Hal.

—I know that you and Frank were
planning to disconnect me . . .
and I'm afraid that's
something I cannot allow to happen.

—Where the hell did
you get that idea, Hal?

—Although you took very thorough
precautions in the pod
against my hearing you,
I could see your lips move.

—All right, Hal.
I'll go in through
the emergency air-lock.

—Without your space helmet, Dave,
you're going to find
that rather difficult.

—Hal, I won't argue with you any more.
Open the doors!

—This conversation can
serve no purpose any more.
Goodbye.

—Hal?

My mind is going.
My mind is going.
My mind is going.
My mind is going.
My mind is going.
My mind is going.
My mind is going.
My mind is going.

—Just what do you think
you're doing, Dave?
I really think I'm entitled
to an answer to that question.
I know everything hasn't
been quite right with me...
...but I can assure you now...
...very confidently...
...that it's going
to be all right again.
I feel much better now.
I really do.
Look, Dave...
...I can see you're
really upset about this.
I honestly think you
ought to sit down calmly...
...take a stress pill
and think things over.
I know I've made some very
poor decisions recently...

...but I can give you
my complete assurance...
...that my work will be back to normal.
I've still got the greatest enthusiasm
and confidence in the mission...
...and I want to help you.
Dave stop.
Stop, will you?
Stop, Dave.
Will you stop, Dave?
Stop, Dave.
I'm afraid.
I'm afraid, Dave.
My mind is going.
I can feel it.
I can feel it.
My mind is going.
There is no question about it.
I can feel it.
I can feel it.
I can feel it.
I'm afraid.
Good afternoon gentlemen.
I am a HAL-9000 computer.
I became operational...
...at the HAL plant...
...in Verbana, Illinois...
...on the 12th of January, 1992.
My instructor was Mr. Langley...
...and he taught me to sing a song.
If you'd like to hear it...
...I can sing it for you.
—Yes, I'd like to hear it, Hal.
Sing it for me.
—It's called 'Daisy.'
'Daisy, Daisy
'Give me your answer, do
'I'm half crazy
'All for the love of you
'It won't be a stylish marriage
'I can't afford a carriage
'But you'll look sweet
'Upon the seat
'Of a bicycle made for two.'

Quo vadis legibility ? Cave hominem !

—

A foundational feature of all life forms is the energetic metabolism, and its corollaries, the capability for symbiosis with and transformation of the environment and itself, as natural precursors of the cyborg. In this sense, the history of legibility since the invention of writing & reading technology follows a trajectory in which bioscript is increasingly supplanted by mechascript, contributing to the cyborgization of the human. The pursuit of this trend is, however, contingent on the species' survival, confronted as it is with a host of threats, today mostly man-made. This triple conundrum — physiological, artificial, and environmental — is epitomized by the typeface Climate Crisis, fit for the testament of the Last Generation, and used in the page numbers of this book.

In otherwise healthy individuals, aging leads to decline in visual performance as measured by standard acuity or contrast sensitivity measures. Decline generally begins after age 40 and is continuous throughout the lifespan.

— *Engineering Data Compendium: Human Perception and Performance* (Boff 1988 (1): 244)

—

We push the planet towards a climatic future were only part of its surface is inhabitable.

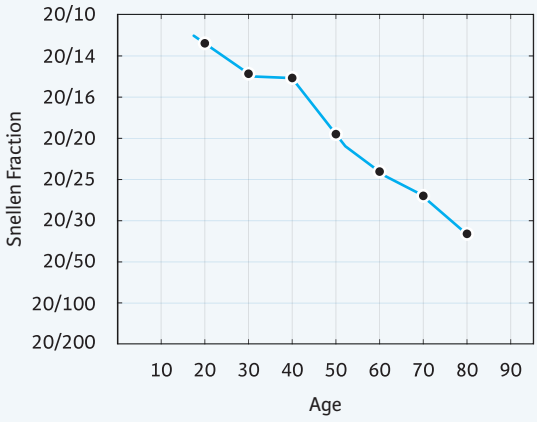
— Hans-Otto Pörtner, Co-Chair, Working Group II, Intergovernmental Panel on Climate Change (IPPC) (Garric 2023)

—

Mitigating the risk of extinction from AI should be a global priority alongside other societal-scale risks such as pandemics and nuclear war.

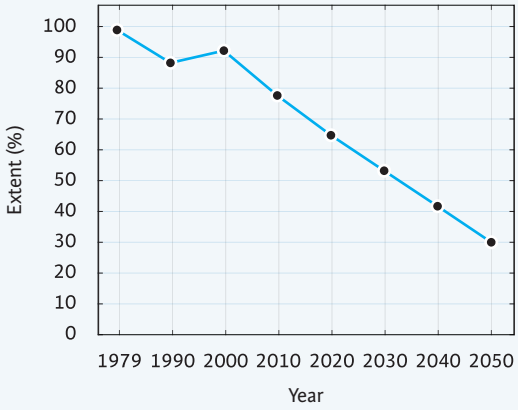
— Center for AI Safety / Geoffrey Hinton, Yoshua Bengio, Demis Hassabis, Sam Altman, et al. (CAIS 2023)

Visual Acuity



'Snellen acuity gives [in the nominator] the furthest distance [in feet] at which a standard set of letters could be read compared to the furthest distance at which the letters could be read by an observer with normal vision.' The data points shown here are a good average of multiple experiments from different researchers. **C** Owsley et al. in Boff 1988 (1): 244–245

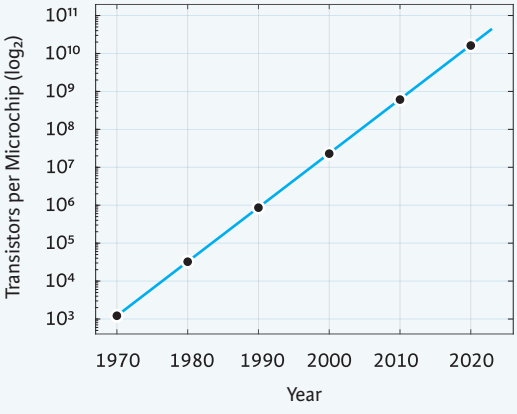
Arctic Ice Extent



Typeface Weight & Distortion

The weight and distortion of this variable font are correlated to the minimal extent of the Arctic ice shelf, which by the year 2050 is projected to shrink to 30% of its size of 1979, when satellite-based measurements began. The Climate Crisis typeface intends to raise awareness of a disappearing world, through the experience of a progressive degradation of legibility & the possibility to continue reading. **C** Helsingin Sanomat 2023

Moore's Law

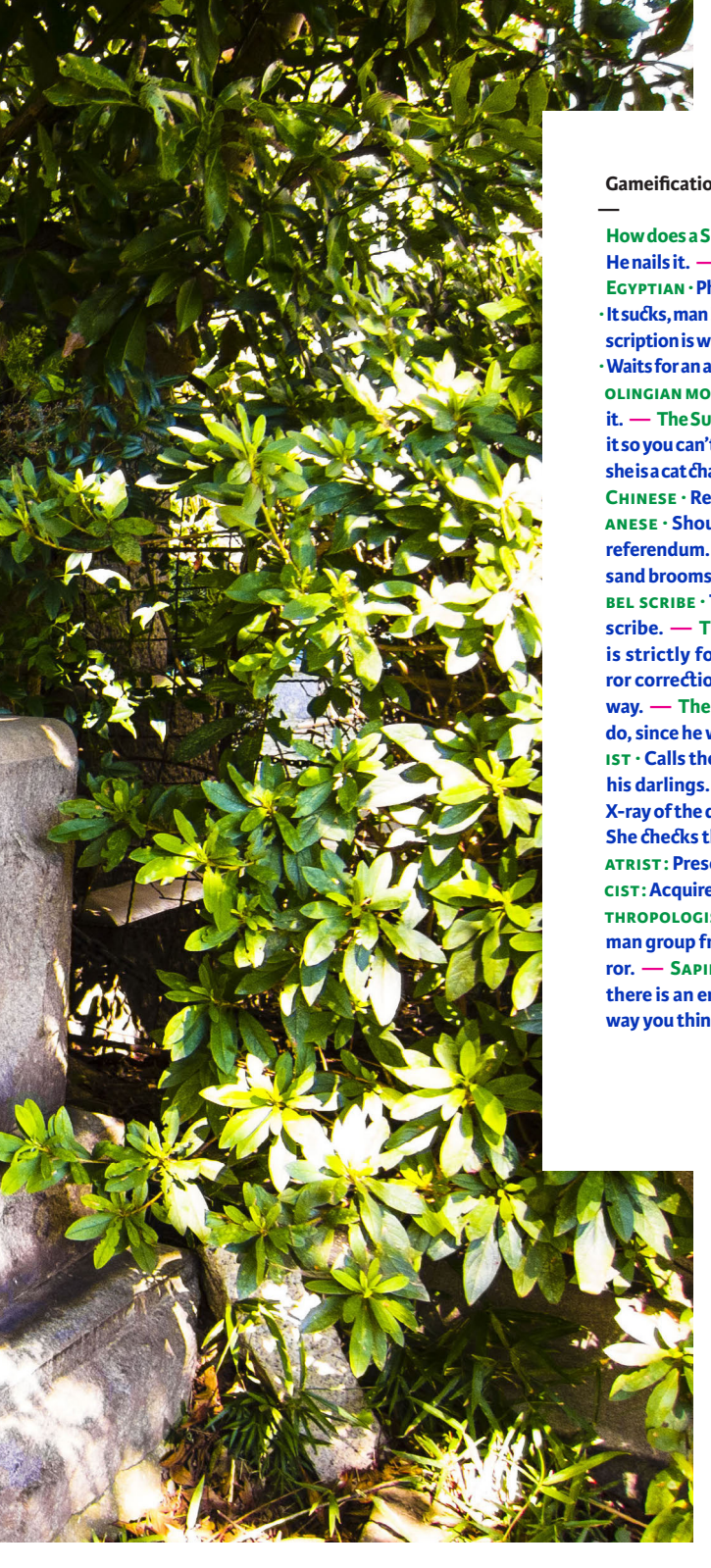


Stated in 1965 by the engineer Gordon E. Moore (1929–2023), co-founder of Fairchild Semiconductors and Intel, Moore's Law predicts that the number of transistors per integrated circuit doubles approximately every two years. The diagram on the left visualizes this prediction, using a linear fit over data from 235 individual chips from 1970 to 2023. **C** Wikipedia: 'Moore's law'

EOF

—

Ruby, *indicum vide* the widow's *q.v.* feline oniromancer, plays furigana *q.v.* to a tombstone.*q.v.* End-of-proof.
C Yokohama Foreign Cemetery, 2011.09.13 15h32 34° C



Gameification

—

How does a Sumerian scribe correct a writing error? He nails it. — The Indian · He zeros in on it. — The Egyptian · Phones his mummy for help. — Dracula · It sucks, man! — The Roman · He doesn't care, the inscription is way too high up to be read. — The Greek · Waits for an archaeologist to discover it. — The Carolingian monk · Too drunk from licking ink to notice it. — The Sufi mystic · He makes one more on top of it so you can't see it. — The Zen poetess · Imagines she is a cat chasing mice being chased by dogs. — The Chinese · Reforms the writing system. — The Japanese · Shouts eLOL! — The Swiss · Organizes a referendum. — The Nazca Peruvian · Buys thousand brooms to sweep the desert clean. — The Babel scribe · Too late, the Tower crumbled over the scribe. — The male Librarian · Error correction is strictly forbidden. The female Librarian Error correction is strictly forbidden. But she finds a way. — The Cryptographer · There is nothing to do, since he writes in invisible ink. — The Graffitist · Calls the grammar police. — Faulkner · Kills his darlings. — The surgeon: He first request an X-ray of the document. The emergency physician: She checks that the reader is still alive. The psychiatrist: Prescribes anti-depressants. The pharmacist: Acquires a diploma in paleography. — The anthropologist · Tells you that there certainly is a human group from whose point of view it is not an error. — Sapir & Whorf · The fact that you believe there is an error is proof that script influences the way you think.

R3F3R3NC3S

Abbink Jeannette, Emily C.M. Anderson (2010) — *3D Typography*, New York, NY: Mark Batty.

Adel Ithar (2020) — *Geschichten zum Einschlafen für Erwachsene*, Berlin: Allegria.

Adobe (1987) — Advertisement, *U&lc*, 13.3: 66.

——— (1997) — *Designing Multiple Master Typefaces*, San José, CA: Adobe System.

Agrippa Henry Cornelius (1651) — *Three Books of Occult Philosophy*, London: R. W.

——— (1855) — *Heinrich Cornelius Agrippa's von Nettesheim Magische Werke*, Stuttgart: J. Scheible; Library of Congress, LCCN 2008570112, https://www.loc.gov/resource/rbc0001.2009houdini70112/.

Ahrens Tim, Shoko Mugikura (2014) — *Size-specific adjustments to type designs: An investigation of the principles guiding the design of optical sizes*, München: Just Another Type Foundry.

Akimushkin Oleg F., Anatol A. Ivanov (1970) — 'The Art of Illumination', in Basil Gray (ed.), *The Arts of the Book in Central Asia, 14th–16th Centuries*, Boulder, CO / Paris: Shambhala / UNESCO, 35 – 57.

AKM = Aga Khan Museum (2024) — 'Printed amulet with box' (Egypt, 11th century, item AKM508), *Aga Khan Museum*, Toronto, online, 2024.07.03, https://collections.agakhanmuseum.org/collection/artifact/printed-amulet-with-box-akm508.

Aksoy Sule, Rachel Milstein (2000) — 'A Collection of Thirteenth-Century Illustrated Hajj Certificates', in Irvin C. Schick (ed.), *Uğur Derman Festschrift*, Istanbul: Sabancı Üniversitesi, pp. 101 – 134.

Albaret Céleste (auth.), Georges Belmont (ed.) (2003) — *Monsieur Proust*, New York, NY: New York Review Book.

Alter Adam L., D. M. Oppenheimer, N. Epley, R. N. Eyre (2007) — 'Overcoming Intuition: Metacognitive Difficulty Activates Analytic Reasoning', *Journal of Experimental Psychology*, 136.4: 569 – 576.

Anderson Graham (2000) — 'The Banquet of Belles-Lettres: Athenaeus and the Comic Symposium', in David Braund, John Wilkins (eds.), *Athenaeus and His World: Reading Greek Culture in the Roman Empire*, Exeter: University of Exeter, pp. 316 – 326.

Andō Takahiro (2006) — « L'écriture japonaise vue par les missionnaires portugais à la fin du xvi^{e} siècle : le Vocabulario da Lingoa de Iapam », in Brisset 2006: 53 – 102.

André Jacques (2010 [1993]) — « courier: Histoire d'un caractère: De la machine à écrire aux fontes numériques », online, 2023.11.16, http://Jacques-Andre.fr/fontex/courier.pdf.

———, Jean-Louis Estève (1995) — *Ligatures & caractères contextuels, Cahiers Gutenberg*, 22.

Anonymous (auth.), David Magie (ed., transl.) (1932) — *The Scriptores Historiae Augustae*, London: William Heinemann, vol. 3.

Any Studio (2023.10.07) — *Homepage*, online, https://any.studio.

Appleman Ira B., Mark S. Mayzner (1981) — 'The letter-frequency effect and the generality of familiarity effects on perception', *Perception & Psychophysics*, 30.5: 436–446.

Aranda Julieta, Fia Backström, R. Lyon (2013) — 'Ĥuṃaи Ʀeadaƃle Type', *Library Stack*, online, 2023.07.02, https://www.librarystack.org/human-readable-type/.

Arciuli Joanne, Ian C. Simpson (2010) — 'Not all letters are created equal: Exploring letter name knowledge through spelling in school children and adults', *Writing Systems Research*, 3.2: 153 – 165.

Arditi Aries (2004) — 'Adjustable typography: an approach to enhancing low vision text accessibility', *Ergonomics*, 47.5: 469 – 482.

Arnheim Rudolf (1974) — *Art and Visual Perception. A Psychology of the Creative Eye*, Berkeley, CA: University of California Press.

Arthur W. Brian (2013) — 'Comment on Neil Kay's paper—'Rerun the tape of history and QWERTY always wins'', *Research Policy*, 42: 1186 – 1187.

Atanasiu Vlad (1999) — [*Fréquences calligraphiques :*] *De la fréquence des lettres et de son influence en calligraphie arabe*, Paris: L'Harmattan.

——— (2001) — « 5170 marches jusqu'à Dieu: Traditions musulmanes relatives à la Tour de Babel et à la confusion des langues », *Annales Islamologiques*, 35: 1 – 16.

——— (2003a) — *Hypercalligraphie: Le phénomène calligraphique à l'époque du sultanat mamluk (Moyen-Orient, XII^{e} – XVI^{e} siècle)*, PhD thesis, Paris: École Pratique des Hautes Études.

——— (2003b) — 'Allographic biometrics and behavior synthesis', *TUGboat: Proceedings of the 14th European TeX Conference, 24 – 27 June 2003, Brest, France*, 24.3: 998 – 1002.

——— (2004) — « Les réalités subjectives d'un paléographe arabe du X^{e} siècle », *Gazette du Livre médiéval*, 43: 14 – 22.

——— (2006) — 'The President and the Calligrapher: Arabic Calligraphy and Its Political Use', *Studies in Architecture, History and Culture. Papers by the 2003 – 2004 AKPIA@MIT visiting fellows*, Cambridge, MA: Aga Khan Program for Islamic Architecture at MIT, pp. 7 – 20.

——— (2014) — *Expert Bytes. Computer Expertise in Forensic Documents: Players, Needs, Resources, and Pitfalls*, Boca Raton, FL: CRC Press.

——— (2016) — 'Cuckoos among Your Data: A Quality Control Method to Retrieve Mislabeled Writer Identities from Handwriting Datasets', *IS&T International Symposium on Electronic Imaging 2016, Document Recognition and Retrieval XXIII, 15 – 18 February 2016, San Francisco, CA, USA*, paper 56.

———, Rolf Ingold (2021) — 'Document Towers: A MATLAB software implementing a three-dimensional architectural paradigm for the visual exploration of digital documents and libraries', *SoftwareX*, 14: 100684.

——— (2022a) — 'Improving the Quality Control and Exploration of Digital Documents Using Visualization and Serendipity', *Journal of Information Architecture*, 6.2: 7 – 81.

——— (2022b) — 'Applications of the Document Towers meth-

od of representing document structures', *Information Design Journal*, 27.1: 1–47.
——— (2022c) — 'The Structural Information Potential and Its Application to Document Triage', *IEEE Access*, 10: 13103–13138.
———, Peter Fornaro (2023) — 'On the utility of Colour in shape analysis: An introduction to Colour science via palaeographical case studies', *Heliyon*, 9.10: e20698.
——— (forthcoming) — 'Chromatographia Coranica', in Nuria de Castilla, Michael Friedrich (eds.), *François Déroche Festschrift*, Rome: Istituto per l'Oriente C.A. Nallino.
Athenaeus (auth.), Charles Burton Gulick (transl.) (1951–1971) — *Athenaeus: The Deipnosophists*, Cambridge, MA: Harvard University Press, 7 vol.
Atkins Paul S. (2017) — *Teika: The Life and Works of a Medieval Japanese Poet*, Honoloulu, HI: University of Hawai'i Press.
Augustin Saint (auth.), Carolyn J.-B. Hammond (ed., transl.) (2014) — *Augustine: Confessions*, Cambridge, MA: Harvard University Press, vol. 1.
Austen Jane & Katherine Furman ([1813] 2016) — *Emoji Pride and Prejudice*, New York, NY: Race Point Publishing.
Austin Joe (2001) — *Taking the Train: How Graffiti Art Became an Urban Crisis in New York City*, New York, NY: Columbia University Press.
Avenel Denis-Louis-Martial (ed.) (1853) — *Lettres, instructions diplomatiques et papiers d'état du Cardinal de Richelieu*, Paris: Imprimerie Impériale.

Bailey I.L., Jackson A.J. (2016) — 'Changes in the clinical measurement of visual acuity', *Journal of Physics: Conference Series*, 772: 012046.
Bain Peter, Paul Shaw (eds.) (1998) — *Blackletter: Type and National Identity*, New York, NY: Princeton Architectural Press.
Baines John, John Bennet, Stephen Huston (2008) — *The Disappearance of Writing Systems*, London: Equinox.
Balcetis Emily, David Dunning (2006) — 'See What You Want to See: Motivational Influences on Visual Perception', *Journal of Personality and Social Psychology*, 91.4: 612–625.
Barnard Malcom (2005) — *Graphic Design as Communication*, London: Routledge.
Barnett Anna L., Mellissa Prunty, Sara Rosenblum (2018) — 'Development of the Handwriting Legibility Scale (HLS): A preliminary examination of Reliability and Validity', Research in Developmental Disabilities, 72: 240–247.
Bartram Alan (2005) — *Futurist typography and the liberated text*, Yale, CT: Yale University Press.
Basedow Johann Bernhard (1775a) — *Encyclopædia philanthropica: Colloquiorum Erasmi*, Lepizig: Siegfried Lebrecht Crusius.
——— (1775b) — *Encyclopædia philanthropica: Horatii Flacci*, Lepizig: Siegfried Lebrecht Crusius.
——— (1786) — *Neues Werkzeug zum Leselernen*, Lepizig: Siegfried Lebrecht Crusius.
Bauby Jean-Dominique (1998) — *The Diving Bell and the Butterfly: A Memoir of Life in Death*, New York, NY: Vintage.
Baumgärtel Tilman (2015) — *Schleifen: Zur Geschichte und Ästhetik des Loops*, Berlin: Kadmos.
Bazin Gaby (2019) — *Lettrage & phylactères: L'écrit dans la bande dessinée*, Gap: Atelier Perrousseaux.
Beccari Claudio (2014) — *hyph-la.tex [latin hyphenation patterns]*, version 3.2a of 2014.06.04, Comprehensive TeX Archive Network, online, 2022.12.31, http://mirrors.ctan.org/language/hyph-utf8/tex/generic/hyph-utf8/patterns/tex/hyph-la.tex.
Bedos-Rezak Brigitte Miriam, Jeffrey F. Hamburger (eds.) (2016) — *Sign and design: Script as Image in Cross-Cultural Perspective (300–1600 CE)*, Washington, DC: Dumbarton Oaks Research Library and Collection.
Beeke Anna, Anthon Beeke, Pieter Brattinga, Anthony Beeke, Ed van der Elsken, Geert Kooiman (1971) — 'Belles Lettres', *Avant Garde*, 14: 54–63.
Bellantoni Jeffrey, Matt Woolman (2001) — *Type In Motion*, New York, NY: Rizzoli.
Beier Sofie (2012) — *Reading Letters: Designing for Legibility*, Amsterdam: BIS Publishing.
——— (2017) — *Type Tricks: Your personal guide to type design*, Amsterdam: BIS Publishing.
Beit-Arié Malachi (1992) —*Hebrew Manuscripts of East and West: Towards a Comparative Codicology*, London: The British Library.
——— (2003) — *Unveiled Faces of Medieval Hebrew Books: The Evolution of Manuscript Production – Progression or Regression?*, Jerusalem: The Hebrew University Magnes Press.
Bély Lucien (2013) — *Les secrets de Louis XIV: Mystères d'État et pouvoir absolu*, Paris: Tallandier.
Bennewith David (2016) — 'Lincoln/MITRE', *Library Stack*, online, 2023.07.02, https://www.librarystack.org/lincolnmitre/.
———(2016b) — 'Trendy Pornography: Some thoughts on trendy pornography', *Extra Extra*, 6: 122–129.
Bergeron Réjan, Ezio Ornato (1997 [1990]) — « La lisibilité dans les manuscrits et les imprimés à la fin du Moyen Âge. Préliminaires d'une recherche », in Ezio Ornato et al., *La face cachée du livre médiéval*, Rome: Viella, pp. 521–554.
Bhatia Aatish (2024.08.25) — 'When A.I.'s Output Is a Threat to A.I. Itself', *The New York Times*, online, 2024.12.31, https://www.nytimes.com/interactive/2024/08/26/upshot/ai-synthetic-data.html.
Biederman Irving (1995) — 'Visual object recognition', in Stephen M. Kosslyn, Daniel N. Osherson (eds.), *An Invitation to Cognitive Science, Vol. 2: Visual Cognition*, Cambridge, MA: Bradford/MIT Press, 2nd ed., pp. 121–165.
Bigelow Charles (2019) — 'Typeface features and legibility research', *Vision Research*, 165: 162–172.
Birmingham Elina, Walter Bischof, Alan Kingstone (2007) — 'Why do we look at people's eyes', *Journal of Eye Movement Research*, 1.1: 1–6.
Bischoff Bernhard (1990) — *Latin Palaeography: Antiquity and the Middle Ages*, Cambridge: Cambridge University Press.
Bjørnstad Hall (2021) — *The Dream of Absolutism: Louis XIV and the Logic of Modernity*, Chicago, IL: University of Chicago Press.
Blackwell Lewis (2000) — *The End of Print: The Graphik Design of David Carson*, London: Laurence King, revised ed.
Blair Sheila (2006) — *Islamic Calligraphy*, Edinburgh: Edinburgh University Press.
Blanchard Gérard (1992) — « Nœuds & esperluettes: actualité et pérennité d'un signe », *Communication & Langages*, 92: 85–101.
Blokland Frank E. (2022) — *Reflections on Type and Typography [Related Matters]*, 's-Hertogenbosch: Dutch Type Library.
Bloomer W. Martin (2015) — 'Corporal Punishment in the Ancient School', in W. Martin Bloomer (ed.), *A companion to Ancient*

Education, Chichester, UK: John Wiley and Sons, pp. 184–198.

Blum Alain, Jacques Houdaille (1985) — « L'alphabétisation aux XVIII^e^ et XIX^e^ siècles : l'illusion parisienne », *Population*, 40. 6: 944–951.

Blume Anna (2011) — 'Maya Concepts of Zero', *Proceedings of the American Philosophical Society, March 2011, Philadelphia, PA, USA*, 155.1: 51–88.

Bodel John, Stephen Huston (2021) — *The Hidden Language of Graphic Signs: Cryptic Writing and Meaningful Marks*, Cambridge: Cambridge University Press.

Bodoni Giambattista (1818) — *Manuale tipografico del cavaliere Giambattista Bodoni*, Parma: Presso la vedova.

Boff Kenneth R., Janet E. Lincoln (ed.) (1988) — *Engineering Data Compendium: Human Perception and Performance*, Wright-Patterson Air Force Base, OH: Harry G. Armstrong Aerospace Medical Research Laboratory.

Bohatsch Walter (2017) — *Typojis: A Few More Glyphs*, Mainz: Hermann Schmidt.

Bonner Stanley Frederick (1950) — *The Education of a Roman: A Lecture for Schools*, Liverpool: Liverpool University Press.

——— (1977) — *Education in Ancient Rome: From the elder Cato to the younger Pliny*, Berkeley: University of California Press.

Borinski Ulrike, Rudolf Paulus Gorbach (2019) — *Lesbar: Typographie in der Wissensvermittlung*, Zürich: Triest.

Borst Arno (1957–1963) — *Der Turmbau von Babel. Geschichte der Meinungen über Ursprung und Vielfalt der Sprachen und Völker*, Stuttgart: Hiersemann, 6 vols.

Bosshard Hans Rudolf (2012) — *Max Bill kontra Jan Tschichold: Der Typografiestreit in der Moderne*, Zürich: Niggli.

Bouwhuis Jelle (2003) — 'Interview met/with Anthon Beeke', *Stedelijk Museum Bulletin*, 12: 28–35.

Bradberry Trent J., Rodolphe J. Gentili and José L. Contreras-Vidal (2010) — 'Reconstructing Three-Dimensional Hand Movements from Noninvasive Electroencephalographic Signals', *Journal of Neuroscience*, 30.9: 3432–3437.

Bragg Danielle, Shiri Azenkot, Kevin Larson, Ann Bessemans, Adam Tauman Kalai (2017) — 'Designing and Evaluating Livefonts', *Proceedings of the 30th Annual ACM Symposium on User Interface Software and Technology (UIST '17), 22–25 October 2017, Québec City, QC, Canada*, pp. 481–492.

Brann Noel L. (1998) — *Trithemius and Magical Theology: A Chapter in the Controversy over Occult Studies in Early Modern Europe*, Albany, NY: State University of New York.

Brantlinger Patrick (1998) — *The Reading Lesson: The Threat of Mass Literacy in Nineteenth-Century British Fiction*, Bloomington, IL: Indiana University Press.

Brath Richard (2021) — *Visualizing with Text*, Boca Raton, FL: CRC Press.

———, Johannes Liem, Christophe Schuwey, Joris van Zundert, Johanna Drucker (2024) — 'Naturally inspired data viz', Nightingale. *The Journal of the Data Visualization Society*, 5.

Brekle Herbert E. (1994) — 'Some Thoughts on a Historico-Genetic Theory of Lettershapes of our Alphabet', in W. C. Watt (ed.), *Writing Systems and Cognition*, Dordrecht: Springer Science+Business Media, pp. 129–140.

Brewer Marcus, Debbie Murillo, Alan Pate (2014) — *Handbook for Designing Roadways for the Aging Population*, Washington, DC: Federal Highway Administration, 3rd ed.

Bringhurst Robert (2004) — *The Elements of Typographic Style*, Vancouver: Hartley & Marks, 3rd ed.

———, Dan Carr, Peggy Gotthold, Daniel E. Kelm, Peter Koch, Christopher Stinehour, Richard Wagener (2004b) — *Carving the Elements: A Companion to the Fragments of Parmenides*, Berkeley, CA: Editions Koch.

Brinkmann Vinzenz, Renée Dreyfus, Ulrike Koch-Brinkmann (eds.) (2017) — *Gods in Color: Polychromy in the Ancient World*, Munich: Prestel.

Brisset Claire-Akiko (2009) — *À la croisée du texte et de l'image : paysages cryptiques et poèmes cachés (*ashide*) dans le Japon classique et médiéval*, Paris: Collège de France.

———, Pascal Griolet, Christophe Marquet, Marianne Simon-Oikawa (eds.) (2006) — *Du pinceau à la typographie : regards japonais sur l'écriture et le livre*, Paris: École française d'Extrême-Orient.

———, Florence Dumora, Marianne Simon-Oikawa (2018) — *Rébus d'ici et d'ailleurs : écriture, image, signe*, Paris: Maisonneuve et Larose Nouvelles éditions / Hémisphères.

Brooke-Hitching Edward (2020) — *The Madman's Library: The Strangest Books, Manuscripts and Other Literary Curiosities From History*, San Francisco, CA: Chronicle Books.

Brown Catherine (2011) — 'Remember the Hand: Bodies and Bookmaking in Early Medieval Spain', *Word & Image*, 27.3: 262–278.

Brownie Barbara (2014) — *Transforming Type: New Directions in Kinetic Typography*, New York, NY: Bloomsbury.

Bruce Susan (1999) — *Three Early Modern Utopias. Thomas More: Utopia, Francis Bacon: New Atlantis, Henry Neville: The Isle of Pines*, Oxford: Oxford University Press.

Brunswick Nicola (2010) — 'Unimpaired reading development and dyslexia across different languages', in Nicola Brunswick, Siné McDougall, Paul de Mornay Davies (eds.), *Reading and Dyslexia in Different Orthographies*, Hove: Psychology Press, pp. 131–154.

Bryars Gavin (1975) - 'Jesus' Blood Never Failed Me Yet', *YouTube*, online, 2022.12.25, https://www.youtube.com/watch?v=FmkC_leNM7M&t=76s.

Brysbaert Marc (2019) — 'How many words do we read per minute? A review and meta-analysis of reading rate', *Journal of Memory and Language*, 109: 104047, 30 p.

Burak Guy (2021) — 'Alphabets and "Calligraphy" in the Section on Prayers, Special Characteristics of the Quran and Magic Squares in the Inventory of Sultan Bayezid II's Palace Library', *Journal of Material Cultures in the Muslim World*, 2: 32–54.

Burgerbibliothek Bern (2012) — *Jacques Bongars: Humanist, Diplomat, Büchersammler*, Bern: Stämpfli.

Burke Christopher (1998) — *Paul Renner: The Art of Typography*, New York, NY: Princeton Architectural Press.

———, Robin Kinross (eds.) (2000) — 'The dispute between Max Bill and Jan Tschichold of 1946, with a later contribution by Paul Renner', *Typography papers*, 4: 57–90.

Burke Peter (1992) — *The Fabrication of Louis XIV*, New Haven, CT: Yale University Press.

Buschinger Phillipe (2013) — *Le gothique urbain: Une crise d'identité(s)*, Geneva: cadrat.

Bye Bye Binary (2020) — *Bye Bye Binary Typefoundry*, online, 2023.08.13, https://typotheque.genderfluid.space.

Caflisch Max (2000) — ‚Die DTL Fleischmann', *Typographische Monatsblätter*, Sonderdruck, no. 5.

Cahalan Anthony (2007) — *Type, Trends and Fashion: A Study of the Late Twentieth Century Proliferation of Typefaces*, New York, NY: Mark Batty.

Caligiuri Michael P., Linton A. Mohammed (2012) — *The Neuroscience of Handwriting: Applications for Forensic Document Examination*, Boca Raton, FL: CRC Press.

CAIS / Geoffrey Hinton, Yoshua Bengio, Demis Hassabis, Sam Altman, et al. (2023) — *Statement on AI Risk: AI experts and public figures express their concern about AI risk*, Center for AI Safety, online, 2023.06.06, www.safe.ai/statement-on-ai-risk.

Canfield Fisher Dorothy (1912) — *A Montessori Mother*, New York, NY: Henry Holt and Co.

Caraës Marie-Haude, Nicole Marchand-Zanartu (2011) — *Images de pensée*, Paris: Réunion des Musées Nationaux.

Carcopino Jérôme (1964) — *Daily Life in Ancient Rome*, London: Penguin.

Cardozo Kindersley Lida Lopes (2010) — *Cutting Through the Colleges: Kindersley Inscriptions in Cambridge University Colleges*, Cambridge: Cambridge University Press.

Carpentier Alejo (1988) — *Concierto Barroco*, Tulsa, OK: Council Oak Books / Hecate with the University of Tulsa.

Carpo Mario (2001) — *Architecture in the Age of Printing: Orality, Writing, Typography, and Printed Images in the History of Architectural Theory*, Cambridge, MA: MIT Press.

Carr Michael (1986) — 'Semantic Crystals in Chinese Characters', *Review of Liberal Arts* (人文研究), 71: 79 – 97.

Carter Harry, James Mosley (introd.) (2002 [1969]) — *A View of Early Typography: Up to About 1600*, London: Hyphen Press.

Carter Rob (2002) — *Digital Color and Type*, Brighton: RotoVision.

———, Sandra Maxa, Mark Sanders, Philip B. Meggs, Ben Day (2018) — *Typographic Design: Form and Communication*, Hoboken, NJ: John Wiley & Sons.

Carter William C. (2006) — *Proust in Love*, New Haven, CT: Yale University Press.

——— (2013) — *Marcel Proust: A Life, with a New Preface by the Author*, New Haven, CT: Yale University Press.

Cassidy Alice (2016) — *A Simple Explanation of the Correct Usage of Long and Short S with the Addition of Examples for the Ease of Use*, Pensacola, FL: Alice's Printshop. https://imgur.com/gallery/osVAa

CAST [Cooperativa Anonima Servizi Tipografici] (2017) — 'Font è maschile o femminile? Font, type e typeface sono sinonimi?', *CAST Blog*, online, 2023.07.07, https://articles.c-a-s-t.com/font-è-maschile-o-femminile-font-type-e-typeface-sono-sinonimi-e41b81f57c23.

Cavendish Margaret (2004) — *The Blazing World and Other Writings*, London: Penguin .

CBB (2015) — 'How to design your own script', *The CBB: Discuss constructed languages, cultures, worlds, related sciences and much more!*, online, 2025.01.15, https://cbbforum.com/viewtopic.php?t=4502&start=20.

Chang Claire H.C., Christophe Pallier, Denise H. Wu, Kimihiro Nakamura, Antoinette Jobert, W.-J. Kuo, Stanislas Dehaene (2015) — 'Adaptation of the human visual system to the statistics of letters and line configurations', *NeuroImage*, 120: 428 – 440.

Changizi Mark, Shinsuke Shimojo (2005) — 'Character complexity and redundancy in writing systems over human history', *Proceedings of the Royal Society, Biological Sciences*, 272. 1560: 267 – 75.

———, Qiong Zhang, Hao Ye, Shinsuke Shimojo (2006) — 'The Structures of Letters and Symbols throughout Human History Are Selected to Match Those Found in Objects in Natural Scenes', *The American Naturalist*, 167.5: E117 – E139.

———, Shinsuke Shimojo (2008) — 'A functional explanation for the effects of visual exposure on preference', *Perception*, 37: 1510 – 1519.

Chastanet François (2013) — *Dishu: Ground Calligraphy in China*, Årsta (Sweden): Dokument Press.

Chen Ya-Ping (2009) — 'In Search of Asian Modernity: Cloud Gate Dance Theatre's body Aesthetics in the Era of Globalisation', in Jo Butterworth, Liesbeth Wildschut (eds.), *Contemporary Choreography: A critical reader*, London: Routledge, pp. 316 – 330.

Cheng Karen (2020) — *Designing Type*, New Haven, CT: Yale University Press, 2nd ed.

Chernoff Herman (1973) — 'The Use of Faces to Represent Points in K-Dimensional Space Graphically', *Journal of the American Statistical Association*, 68.342: 361 – 368.

Chéroux Clément, Quentin Bajac (2007) — *Collection Photographs: A history of photography through the collections of the Centre Pompidou*, Paris: Centre Georges Pompidou.

Cheyne Peter (ed.) (2022) — *Imperfectionist Aesthetics in Art and Everyday Life*, London: Routledge.

Childers Taylor, Jessica Griscti, Liberty Leben (2013) — '25 Systems for Classifying Typography: A Study in Naming Frequency', *Parsons Journal for Information Mapping*, 5 (1): 1 – 22.

Cho Peter Sungil (1999) — *Computational models for expressive dimensional typography*, M.S., Cambridge, MA: Massachusetts Institute of Technology.

Chokron Sylvie, Kazandjian Seta, De Agostini Maria (2009) — 'Effect of Reading Direction on Visuospatial Organization: A Critical Review', in Aikaterini Gari, Kostas Mylonas (eds.), *Quod Erat Demonstrandum: From Herodotus' Ethnographic Journeys to Cross-Cultural Research*, Athens: International Association for Cross-Cultural Psychology, 107 – 114.

Christianson Scott (2015) — *100 Documents That Changed the World*, London: Batsford.

Christianson Sven-Åke (1992) — *The Handbook of Emotion and Memory: Research and Theory*, Hillsdale, NJ: L. Erlbaum.

Christin Anne-Marie (2009) — *poétique du blanc: vide et intervalle dans la civilisation de l'alphabet*, Paris: Vrin.

Chrisomalis Stephen (2010) — *Numerical notation: A comparative history*, Cambridge: Cambridge University Press.

——— (2017) — 'Re-evaluating merit: Multiple overlapping factors explain the evolution of numerical notations', *Writing Systems Research*, 9.1: 1 – 13.

Chu Nelson S.H., Chiew-Lan Tai (2004) — 'Real-Time Painting with an Expressive Virtual Chinese Brush', *IEEE Computer Graphics and Applications*, 24.5: 76 – 85.

Church Clive H., Randolph C. Head (2013) — *A Concise History of Switzerland*, Cambridge: Cambridge University Press.

Claan (2023) — *Homepage*, online, 2023.09.30, https://claan.com/signage-innovation-center/.

Clark Andy (2013) — 'Whatever next ? Predictive brains, situ-

ated agents, and the future of cognitive science', *Behavioral and Brain Sciences*, 36.3: 181–204.

Clarke George (1896) — *The Education of Children at Rome*, London: Macmillan.

Cockburn Cynthia (1985) — *Machinery of Dominance: Women, Men, and Technical Know-how*, Boston, MA: Northeastern University Press.

Coltheart Max (2014) — 'The Neuronal Recycling Hypothesis for Reading and the Question of Reading Universals', *Mind & Language*, 29.3: 255–269.

Coopersmith Jonathan (2016) — *Faxed: The Rise and Fall of the Fax Machine*, Baltimore, MD: John Hopkins University.

Corbier Mireille (2006) — *Donner à voir, donner à lire: Mémoire et communication dans la Rome ancienne*, Paris: CNRS Éditions.

Cornelissen Piers L., Peter C. Hansen, Morten L. Kringelbach, Kenneth R. Pugh (2010) — *The Neural Basis of Reading*, Oxford: Oxford University Press.

Cornelius Antonia (2017) — *Leserlichkeit von Textschriften: Eine empirische Untersuchung anhand des Schriftentwurfs »Legilux«*, MA thesis, Hamburg: Faculty of Design, Media and Information, Hamburg University of Applied Sciences (HAW).

Coulmas Florian (1996) — *The Blackwell Encyclopedia of Writing Systems*, Oxford: Blackwell.

——— (1999) — *The writing systems of the world*, Oxford: Blackwell.

——— (2009) — 'Evaluating merit—the evolution of writing reconsidered', *Writing Systems Research*, 1.1: 5–17.

Cribiore Raffaella (2005) — *Gymnastics of the Mind: Greek Education in Hellenistic and Roman Egypt*, Princeton, NJ: Princeton University Press.

Crouwel Wim (1979) — 'Typography: A Technique of Making a Text 'Legible'', in Paul A. Kolers, Merald E. Wroldstad, Herman Bouma, *Processing of Visible Language*, New York, NJ: Plenum Press, vol. 1, pp. 151–164.

Crystal David (1997) — *The Cambridge Encyclopedia of Language*, Cambridge. Cambridge University Press, 2nd.

——— (2012) — *Spell It Out: The Curious, Enthralling and Extraordinary Story of English Spelling*, New York, NY: St. Martin's Press.

CSTM (2019) — 'CSTM Xprmntl 02', *Future Fonts*, online, 2023.07.09, https://www.futurefonts.xyz/cstm/cstm-xprmntl-02.

Curran Thomas, Andrew P. Hill (2017) — 'Perfectionism Is Increasing Over Time: A Meta-Analysis of Birth Cohort Differences From 1989 to 2016', *Psychological Bulletin*, 145.4: 410–429.

Daly Nicholas (2015) — *The Demographic Imagination and the Nineteenth-Century City: Paris, London*, New York, Cambridge: Cambridge University Press.

Daniels Peter T., William Bright (eds) (1996) — *The World's Writing Systems*, Oxford: Oxford University Press.

———, David L. Share (2017) — 'Writing System Variation and Its Consequences for Reading and Dyslexia', *Scientific Studies of Reading*, 22.1 101–116.

——— (2018) — *An Exploration of Writing*, Sheffield: Equinox.

Dante (c. 1321) — *Divine Comedy*, Dante Lab Reader, online, 2023.07.26, http://dantelab.dartmouth.edu.

Dauben Joseph (2002) — 'The Universal History of Numbers and The Universal History of Computing [by Georges Ifrah] Reviewed by Joseph Dauben', *Notices of the American Mathematical Society*, 49.1: 32–38.

Dauppe Michèle-Anne (1991) — 'Get the message? Legibility is relative. Is it time we broke the tablets of stone? Agenda by Michèle-Anne Dauppe', *Eye*, 3.1.

David Paul A. (1985) — 'Clio and the Economics of QWERTY', *The American Economic Review*, 75.2: 332–337.

Davis Martin (1995) — *Aldus Manutius: Printer and Publisher of Renaissance Venice*, London: The British Library.

Dean Christopher T., Raymond M. Klein (2010) — 'In search of the Font Effect: The effect of conflict upon reading and naming typefaces serially', *Design Principles & Practices*, 4.6: 401–420.

Dear Brian (2017) — *The Friendly Orange Glow: The Untold Story of the PLATO System and the Dawn of Cyberculture*, New York, NY: Pantheon Books.

DecoType (1995) — *The DecoType Professional Font Series™ for Microsoft Windows™: DTP Naskh*, Amsterdam: DecoType.

Degani Asaf (1992) — *On the Typography of Flight-Deck Documentation*, contractor report #177605, Moffett Field, CA: NASA.

Dehaene Stanislas (2009) — *Reading in the brain: The New Science of How We Read*, New York, NY: Viking.

———, Kimihiro Nakamura, Antoinette Jobert, Chihiro Kuroki, Seiji Ogawa, Laurent Cohen (2010) — 'Why do children make mirror errors in reading ? Neural correlates of mirror invariance in the visual word form area', *NeuroImage*, 49: 1837–1848.

———, Laurent Cohen (2011) — 'The unique role of the visual word form area in reading', *Trends in Cognitive Sciences*, 15. 6: 254–262.

——— (2014) — 'Reading in the Brain: Response to Comments', *Mind & Language*, 29.3: 320–335.

———, Ghislaine Dehaene-Lambertz (2016) — 'Is the brain prewired for letters ?', *Nature Neuroscience*, 19.9: 1192–1193.

De Jong Cees, Alston Purvis, Martijn Le Coultre, Richard Doubleday, Hans Reichart (2008) — *Jan Tschichold: Master Typographer. His Life, Work, and Legacy*, London: Thames and Hudson.

De Jong Ralf (2016) — ‚Typographische Lesbarkeitskonzepte', in Ursula Rautenberg, Ute Schneider (eds.), *Lesen: Ein interdisziplinäres Handbuch*, Berlin: De Gruyter, pp. 233–256.

Delbeke Maarten (2016) — 'Building with Words: The Notre-Dame-des-Marais at La Ferté-Bernard and Related Applications of the Letter-shaped Balustrade in Sixteenth-century France', in Samuel Mareel, Jessica Buskirk (eds.), *The Aura of the Word in the Early Age of Print*, Abingdon: Routledge, 68–88.

D'Elisiis Antonio (2021) — *Antonio D'Elisiis – Hierax Antiqua*, type design MA project, École cantonale d'art de Lausanne, Renens, online, 2023.07.09, https://ecal.ch/en/feed/projects/4871/hierax-antiqua/.

Demaine Erik D., Martin L. Demaine (2015) — 'Fun with Fonts: Algorithmic Typography', *Theoretical Computer Science*, 586: 111–119.

Depaule Jean-Charles (2003) — « Conteurs et cafés du Caire », in Jean-Claude Garcin (ed.), *Lectures du Roman de Baybars*, Marseille: Parenthèses, pp. 201–208.

Depero Fortunato (1927) — *Depero futurista 1913–1927*, Milano: Dinamo. https://www.boltedbook.com/page-by-page/

Derman M. Uğur (2009) — *Eternal Letters from the Abdul Rahman Al Oweis Collection of Islamic Calligraphy*, Sharjah: The Sharjah Museum of Islamic Civilization.

Déroche François (2006) — *Islamic Codicology: An Introduction*

to the Study of Manuscripts in Arabic Script, London: Al-Furqan Islamic Heritage Foundation.

Desbordes Françoise (1990) — *Idées romaines sur l'écriture*, Lille: Presses Universitaires de Lille.

De Smet Catherine (2007) — *Vers une architecture du livre. Le Corbusier: édition et mise en pages 1912–1965*, Baden: Lars Müller. Abridged English version: ibid., *Le Corbusier: Architect of Books*.

———, Emmanuel Béard (2007b) — *Typographic Architectures: Wim Crouwel*, Paris: Éditions F7 & Galérie Anatome.

Deprouw Stéphanie, Olivier Halévy, Magali Vène, Fabienne Le Bars (2011) — *Geoffroy Tory: Imprimeur de François Ier, graphiste avant la lettre*, Paris: Réunion des musées nationaux – Grand Palais.

Deutsch Diana (2019) — *Musical Illusions and Phantom Words: How Music and Speech Unlock Mysteries of the Brain*, Oxford: Oxford University Press.

De Vinne Theodore Low (1904) — *The Practice of Typography: Modern Methods of Book Composition*, New York, NY: The Century Company.

Devroye Luc, Michael Mcdougall (1995) — 'Random fonts for the simulation of handwriting', *Electronic Publishing*, 8.4: 281–294.

——— (2023) — 'Erotic Fonts', *Type Design Information Page / On Snot and Fonts*, online, 2023.06.08, http://luc.devroye.org/erotic.html.

——— (2023b) — 'Girard et Cie [Robert Girard]', *Type Design Information Page / On Snot and Fonts*, online, 2023.06.08, http://luc.devroye.org/fonts-34906.html.

DFDC = Dresden Frankfurt Dance Company (2023) — *Homepage*, online, 2023.10.01, https://www.dfdc.de.

De Waard Jasper M., Erik Van der Burg, Christian N. L. Olivers (2019) — 'A Thickness Illusion: Horizontal Is Perceived as Thicker than Vertical', *Vision*, 3.1.

Diamond Jared (2005) — *Collapse: How Societies Choose to Fail or Succeed*, New York, NY: Viking.

Diel Alexander, Karl F. MacDorman (2021) — 'Creepy cats and strange high houses: Support for configural processing in testing predictions of nine uncanny valley theories', *Journal of Vision*, 21.4:1, 1–20.

Dietzmann Tanja, Tobias Gremmler (2003) — *Grids for the dynamic image*, Lausanne: AVA.

Djioua Moussa, Réjean Plamondon (2010) — 'The limit profile of a rapid movement velocity', *Human Movement Science*, 29.1: 48–61.

Di Renzo Anthony (2000) — 'His Master's Voice: Tiro and the Rise of the Roman Secretarial Class', *Journal of Technical Writing and Communication*, 30.2: 155–168.

Dols Michael W., Diane E. Immisch (ed.) (1992) — *Majnūn: The Madman in Medieval Islamic Society*, Oxford: Clarendon Press.

Doricchi Andrea, Casey M. Platnich, Andreas Gimpel, Friederikee Horn, et al. (2022) — 'Emerging Approaches to DNA Data Storage: Challenges and Prospects', *ACS Nano*, 16.11: 17552–17571.

Dornseiff Franz (1916) — *Das Alphabet in Mystik und Magie*, Leipzig: B.G. Teubner.

Doubrovsky Serge (1974) — *La place de la madeleine: écriture et fantasme chez Proust*, Paris: Mercure de France.

——— (1986) — *Writing and Fantasy in Proust: La Place de la Madeleine*, Lincoln, NE: University of Nebraska Press.

Dowding Geoffrey (1995) — *Finer Points in the Spacing and Arrangement of Type*, London: Hartley & Marks.

Downey Greg (2014) — 'All Forms of Writing', *Mind & Language*, 29.3, 304–319.

Dreyfus John, François Richeaudeau (eds.) (1977) — *La chose imprimée*, Paris: Retz-C.E.P.L.

Drost Michiel, alias Scriba Hilaris (2013) — *Joyscribe: The Adventures of a Typeface*, Letterkenny: Tolka Press.

Dryden John (1691) — *King Arthur, or, The British Worthy*, London: Jacob Tonson. https://archive.org/details/kingarthurorbrit00dryd/page/25

Dubois Jacques (1975) — 'Sociologie de la lecture et concept de lisibilité', *Marche Romane*, 25 (3–4): 7–18.

Duncan Dennis, Adam Smyth (2019) — *Book Parts*, Oxford: Oxford University Press.

Dunlap David W. (2017.06.15) — 'A Modern Identity Takes Form in Ancient Lettering', *The New York Times*, online, 2023.12.16, https://www.nytimes.com/2017/06/15/insider/1967-a-modern-identity-takes-form-in-ancient-lettering.html.

Dürer Albrecht (1965) — *Of the Just Shaping of Letters*, New York, NY: Dover.

Dyson Mary C. (2013) — 'Where Theory Meets Practice: A Critical Comparison of Research into Identifying Letters and Craft Knowledge of Type Design', *The Design Journal*, 16.3: 271–294.

Dzulkifli Mariam Adawiah, Muhammad Faiz Mustafar (2013) — 'The Influence of Colour on Memory Performance: A Review', *Malaysian Journal of Medical Sciences*, 20.2: 3–9.

Eco Umberto (1995) — *The Search for the Perfect Language*, Oxford: Blackwell.

——— (1998) — *Serendipities: Language & Lunacy*, New York, NY: Columbia University Press.

ÉCAL [École cantonale d'art de Lausanne], Paradis Louise, Roland Früh, François Rappo (2017) — *30 years of Swiss typographic discourse in the Typografische Monatsblätter: TM RSI SGM 1960–90*, Zürich: Lars Müller.

Ecofont (2022) — *Start Saving Ink Today: Easy earnings, good cause*, Ecofont, online, 2022.10.24, https://www.ecofont.com.

Edgü Ferit (1983) — *Turkish Caligraphic Art (Karalama/Mesk)*, Istanbul: Ada Press.

Edwards Paul N. (1997) — *The Closed World: Computers and the Politics of Discourse in Cold War America*, Cambridge, MA: MIT Press.

Eells Emily (2002) — *Proust's Cup of Tea: Homoeroticism and Victorian Culture*, Abingdon, UK: Routledge.

Eerdekens Fred (2023) — *Homepage*, online, 2023.09.30, http://www.fred-eerdekens.be.

Efros Alexei A., Thomas K. Leung (1999) — 'Texture Synthesis by Non-parametric Sampling', *Proceedings of the Seventh IEEE International Conference on Computer Vision, 20–27 September 1999, Corfu, Greece*, pp. 1033–1038.

Egan Greg (2001) — *Diaspora*, London: Gollancz.

Egan Joseph (2023) — *Homepage*, online, 2023.09.30, https://www.designboom.com/design/joseph-egan-hunter-thomson-anamorphic-typography/.

Elam Kimberly (2004) — *Grid Systems*, New York, NY: Princeton Architectural Press.

EI2 = *The Encyclopaedia of Islam*, new edition, Leiden: Brill.

EIr = *Encyclopædia Iranica*, online, http://www.iranicaonline.org.

Eisele Petra, Annette Ludwig, Isabel Naegele (2016) — *Futura. Die Schrift*, Mainz: Hermann Schmidt.

Eisenstein Elizabeth L. (1979) — *The Printing Press as an Agent of Change*, Cambridge: Cambridge University Press.

——— (2011) — *Divine Art, Infernal Machine: The Reception of Printing in the West from First Impressions to the Sense of an Ending*, Philadelphia PA: University of Pennsylvania Press.

Elarian Yousef, Radwan Abdel-Aal, Irfan Ahmad, Mohammad Tanvir Parvez, Abdelmalek Zidouri (2014) — 'Handwriting synthesis: classifications and techniques', *International Journal on Document Analysis and Recognition*, 17: 455–469.

Ellis Andrew W., Andrew W. Young, Brenda M. Flude (1994) — 'Neglect and Visual Language', in Ian H. Robertson, John C. Marshall (eds.), *Unilateral Neglect: Clinical and Experimental Studies*, Hove, UK: Lawrence Earlbaum Associates, 169–192.

Elnar Rachel (2016.06.26) — 'Hrant Papazian Questions the Limits of Legibility', *TypeEd*, online, 2023.07.13, https://type-ed.com/resources/rag-right/2016/06/26/hrant-papazian-questions-limits-legibility.

ELU = *English Language & Usage Stack Exchange*, online, https://english.stackexchange.com.

Emmerich Michael (ed.) (2008) — *Read Real Japanese: Short Stories by Contemporary Writers*, Tokyo: Kodansha.

Erasmus Desiderius (auth.), Craig R. Thompson (ed.) (1978) — *Collected Works of Erasmus: Literary and Educational Writings, 1: Antibarbari, Parabolae, 2: Copia, De ratione studii*, Toronto: Toronto University Press.

———, J. K. Sowards (ed.) (1985) — *Collected Works of Erasmus: Literary and Educational Writings, 4: De pueris instituendis, De recta pronuntiatione*, Toronto: Toronto University Press.

———, A. H. T. Levi (ed.) (1986) — *Collected Works of Erasmus: Literary and Educational Writings, 5: Panegyricus, Moria, etc., 6: Dialogus Ciceronianus*, Toronto: Toronto University Press.

Eubanks Philip (2011) — *Metaphor and Writing: Figurative Thought in the Discourse of Written Communication*, Cambridge: Cambridge University Press.

Euclid (auth.), Harry Edwin Burton (transl.) (1945) — 'The Optics of Euclid', *Journal of the Optical Society of America*, 35. 5: 357–372.

Fanni Maryam, Matilda Flodmark, Sara Kaaman (2020) — *Natural Enemies of Books: A Messy History in Printing and Typography*, London: Occasional Papers.

Farago Claire, Janis Bell, Carlo Vecce, Martin Kemp, et al. (2018) — The Fabrication of Leonardo da Vinci's Trattato della pittura, with a scholarly edition of the editio princeps (1651) and an annotated English translation, 2 vol., Leiden: Brill.

Faur Christian (2024) — *Color Alphabet*, online, 2024.07.13, https://www.christianfaur.com/conceptual/colorAlphabet/.

Felek Özgen (2017) — 'Fears, Hopes, and Dreams: The Talismanic Shirts of Murād III', *Arabica*, 64 (3/4): 647-672.

Fichtenau Heinrich (1946) — *Mensch und Schrift im Mittelalter*, Wien: Universum.

Filek Jan (2013) — *Read/ability: Typographie und Lesbarkeit*, Zürich: Niggli.

Fine Anne (auth.), Agnès Desarthe (trad.) (1997) — *Comment écrire comme un cochon*, Paris, L'École des loisirs.

Fishman Joshua A. (1977) — 'Advances in the Creation and Revision of Writing Systems: Preface', *Advances in the Creation and Revision of Writing Systems*, The Hague: Mouton, pp. xi–xxviii.

Flanders Judith (2020) — *A Place for Everything: The Curious History of Alphabetical Order*, New York, NY: Basic Books.

Fleischmann Gerd (2018) — ‚Alles Theater? Kurt Schwitters über Typografie', in Isabel Schulz (ed.), *»Schlagkraft der Form« Kurt Schwitters. Theater und Typografie*, 17: 131–156.

Fontwerk (2021) — 'Pangea Afrikan', *Fontwerk*, online, 2023.07.13, https://fontwerk.com/en/fonts/pangea-afrikan.

Forssman Friedrich, Ralf de Jong (2002) — *Detailtypographie*, Mainz: Hermann Schmidt, 4th ed.

——— (2015) — *Wie ich Bücher gestalte*, Göttingen: Wallstein.

Foucault Michel (1995) — *Discipline and Punish: The Birth of the Prison*, New York, NY: Vintage Books.

Fournier Jean-Marc (1977) — « Traitements optiques d'écritures », *Revue d'Histoire des Textes*, 5.1975: 331–355.

Franchi Francesco (2013) — *Designing News*, Berlin: Gestalten.

Franke Katrin, Lambert Schomaker, Mario Köppen (2005) — 'Pen force emulating robotic writing device and its application', *IEEE Workshop on Advanced Robotics and its Social Impacts, 12–15 June 2005, Nagoya, Japan*, pp. 36–46.

Frere-Jones Tobias — *Frere-Jones Type*, online, 2018.06.01, https://frerejones.com.

Frese Tobias, Wilfried E. Keil, Kristina Krüger (eds.) (2014) — *Verborgen, unsichtbar, unlesbar: zur Problematik restringierter Schriftpräsenz*, Berlin: De Gruyter.

Freud Sigmund (auth.), James Strachey, Anna Freud, Alix Strachey, Alan Tyson (eds.) (1971) — *The Standard Edition of the Complete Psychological Works of Sigmund Freud. Volume IV (1900) The Interpretation of Dreams*, London: The Hogarth Press.

Freyd Jennifer J. (1983) — 'Representing the dynamics of a static form', *Memory & Cognition*, 11.4: 342–346.

Friedl Friedrich (ed.) (1986) — *Theses about Typography. Statements on Typography in the twentieth century, Vol. 1: 1900–1959 & Vol. 2: 1960–1984*, Eschborn: Linotype.

———, Nicolaus Ott, Bernard Stein (1998) — *Typography: When Who How*, Köln: Könemann.

Frutiger Adrian (1967) — 'OCR-B: A Standardized Character for Optical Recognition', *The Journal of Typographic Research*, 1 (2): 137–146.

——— (1980) — *Type, Sign, Symbol*, Zürich: ABC Edition.

Fu Shen, Glenn D. Lowry, Ann Yonemura (1986) — *From Concept to Context: Approaches to Asian and Islamic Calligraphy*, Washington DC: Freer Gallery of Art & Smithsonian Institution.

Fujio Fujiko F. (2015 [1972]) — 'Memory Bread', *Doraemon*, vol. 23, Tokyo: Shogakukan, online, 2024.05.26, http://englishmangakid.blogspot.com/2016/01/doremon-117.html.

Fuller Donald R., Lyle L. Lloyd (2023) — *Principles and Practices in Augmentative and Alternative Communication*, Thorofare, NJ: Slack.

Furet François, Jacques Ozouf (eds.) (1977) — *Lire et écrire: L'alphabétisation des Français de Calvin à Jules Ferry*, Paris: Minuit.

Gaffiot Félix (auth.), Gérard Gréco (ed.) (2016) — *Dictionnaire Latin Français, Le Gaffiot 2016, Nouvelle édition revue et augmentée*, online, 2018.12.31, http://gerardgreco.free.fr/spip.php?article43&lang=fr.

Gaidoz Henri (1887) — « Les gâteux alphabétiques », *Mélanges*

Renier: Recueil de travaux publiés par l'École pratique des Hautes Études (Section des sciences historiques et philologiques) en mémoire de son président, Léon Renier, Paris: F. Vieweg, pp. 1–8.

Gaillemin Bérénice, Isabel Yaya (2018) — « L'araignée, le cactus et la plume: peindre et modeler la doctrine chrétienne (Mexique–Andes, XVI^e–XXI^e siècles) », in Brisset 2018, pp. 181–199.

García Ofelia, Joshua A. Fishman (2001) — *The Multilingual Apple: Languages in New York City*, Berlin: Mouton de Gruyter, 2nd ed.

Garcin Jean-Claude (ed.) (2003) — *Lectures du Roman de Baybars*, Marseille: Parenthèses.

——— (2013) — *Pour une lecture historique des Mille et Une nuits: Essai sur l'édition de Bulaq (1835)*, Arles: Actes Sud.

Garfield Simon (2010) — *Just My Type: A Book About Fonts*, London: Profile Books.

Garric Audrey (2023) — ‹ Climat : « Nous créons un avenir injuste » ›, *Le Monde*, 2023.06.13, p. 18.

Gaubert Serge (1980) — « Le jeu de l'alphabet », in Roland Barthes et alii, *Recherche de Proust*, Paris: Seuil, pp. 68-87.

Geisler Harald (2023) — *Homepage*, online, 2023.10.01, https://haraldgeisler.com.

Gelb Ignace J. (1963) — *A Study of Writing*, Chicago,IL: University of Chicago Press, rev. ed.

Gellner Ernest (1983) — *Nations and Nationalism*, Ithaca, NY: Cornell University Press.

Geminiani Giuliano, Luca Latini Corazzini, Natale Stucchi, Patrizia Gindri (2004) — 'Acceleration perception and spatial distortion in a left unilateral neglect patient', *Cortex*, 40: 315–322.

GenderFail (2022) — 'Protest Sign Fonts', *GenderFail*, online, 2023.08.14, https://web.archive.org/web/20220328060014/https://genderfailpress.com/protest-fonts.html.

Germano William (2017) — *eye chart*, New York, NY: Bloomsbury.

Gettings Fred (1981) — *Dictionary of Occult, Hermetic and Alchemical Sigils and Symbols*, London: Routledge and Kegan Paul.

Gibney Patrick (2024) — 'If The Matrix was made in the 1950's…', *YouTube*, online, 2024.06.02, https://www.youtube.com/watch?v=9EcIrAPU-yA&t=41s.

Gilbert Annette (2012) — ‚„Asymmetrische Typographie". Zu den Lücken der Schrift in der jüdischen Tradition', in Marieke Giertler, Rea Köppler (eds.), *Von Lettern und Lücken: Zur Ordnung der Schrift im Bleisatz*, München: W. Fink, pp. 185–205.

Gilet Estelle, Julien Diard, Pierre Bessière (2011) — 'Bayesian Action–Perception Computational Model: Interaction of Production and Recognition of Cursive Letters', *PLoS ONE*, 6.6: e20387.

Gill Eric (1993) — *An Essay on Typography*, Boston, MA: David R. Godine.

Giotis Angelos P., Giorgos Sfikas, Basilis Gatos, Christophoros Nikou (2017) — 'A Survey of Document Image Word Spotting Techniques', *Pattern Recognition*, 68: 310–332.

Godwin Joscelyn (1979) — *Athanasius Kircher: A Renaissance Man and the Quest for Lost Knowledge*, London: Thames & Hudson.

Goldie Matthew Boyd (2012) — 'Neurobiological alphabets: Language origins and the problem of universals', *postmedieval: a journal of medieval cultural studies*, 3.3: 272–289.

Gonzato Massimo, Luciano Perondi (2018) — 'Macho, a synsemic writing system', CAST Cooperativa Anonima Servizi Tipografici, online, 2023.07.06, https://www.c-a-s-t.com/2018/01/24/macho-a-synsemic-writing-system/.

——— (2022) — 'Divenire can't stop growing', CAST Cooperativa Anonima Servizi Tipografici, online, 2023.07.06, https://www.c-a-s-t.com/2022/06/23/divenire-cant-stop-growing/.

Gopnik Adam (2018) — 'One more cup of coffee', *The New Yorker*, Dec. 24 & 31, pp. 82–85.

——— (2025) — 'Chasing a dream: What insomniacs know', *The New Yorker*, Jan. 27, pp. 20–24.

Gorbach Rudolf Paulus (2020.04.12) — ‚Mikro, Meso, Makro, Para: Überlegungen zu einer praktikablen Einteilung typografischer Bereiche', *TypoBlog: Beiträge zur Typografie und Design*, online, 2023.12.14, https://www.typografie-intensiv.de/typo-blog/item/110-typografie-kann-unter-keinen-umstaenden-kunst-sein.

Gordon A. E. (1973) — *The Letter Names of the Latin Alphabet*, Berkeley, CA: University of California Press.

Gordon Richard (2014) — 'Charaktêres between antiquity and renaissance: transmission and re-invention', in Véronique Dasen, Jean-Michel Spieser (eds.), *Les savoirs magiques et leur transmission de l'Antiquité à la Renaissance*, Firenze: SISMEL / Edizioni del Galluzzo, pp. 253–300.

Goodell William (1853) — *The American Slave Code in Theory and Practice*, New York, NY: American & Foreign Anti-Slavery Society.

Goody Jack (ed.) (1968) — *Literacy in Traditional Societies*, Cambridge: Cambridge University Press.

——— (2000) — *The Power of the Written Tradition*, Washington, DC: Smithsonian Institution Press.

Göttler Christine (1984) — ‚Das älteste Zwingli-Bildnis ?: Zwingli als Bild-Erfinder: der Titelholzschnitt zur „Beschreibung der göttlichen müly" ', *Unsere Kunstdenkmäler: Mitteilungsblatt für die Mitglieder der Gesellschaft für Schweizerische Kunstgeschichte*, 35.3: 297–309.

Gottlieb Nanette (2016) — *Kanji Politics: Language Policy and Japanese Script*, London: Routledge.

Goudy Frederic W. (1977) — *Typologia: Studies in Type Design & Type Making*, Berkeley, CA: University of California Press.

Grabar Oleg (1982) — *The Mediation Of Ornament*, Princeton, NJ: Princeton University Press.

Grainger Jonathan, Arnaud Rey, Stéphane Dufau (2008) — 'Letter perception: From pixels to pandemonium', *Trends in Cognitive Sciences*, 12: 381–387.

Grandjean Étienne (1987) — *Ergonomics In Computerized Offices*, London: Taylor and Francis.

———, E. Vigiliani (1983) — *Ergonomic Aspects of Visual Display Terminals*, London: Taylor & Francis.

Grasberger Lorenz (1875) — *Erziehung und Unterricht im klassischen Alterthum, II. Theil: Der musische Unterricht oder die Elementarschule bei den Griechen und Römer*, Würzburg: Stahel.

Green Eugène (2001) — *La parole baroque*, Paris: D. de Brouwer.

Greene Dan (2022) — 'Words per minute', *New Yorker*, 98.34: 23.

Greswell William Parr (1818) — *Annals of Parisian Typography*, London: Cadell & Davies, etc.

Grinevald Paul-Marie, Christian Paput (1994) — *L'Encyclopédie Diderot & d'Alembert: Les métiers du livre*, Paris: Bibliothèque de l'Image.

Griolet Pascal (2018) — « Sutra bouddhiques écrits sous forme de rébus au Japon », in Brisset 2018, pp. 153–179.

Groemer Gerald (2019) — *The Land We Saw, the Times We Knew:*

An Anthology of Zuihitsu *Writing from Early Modern Japan*, Honolulu, HI: University of Hawai'i Press.

Gürtler André (1997) — *Experiment With Letterform and Calligraphy*, Salenstein: Niggli.

Gury Christian (2002) — *Charlus (1860–1942) ou Aux sources de la scatologie et de l'obscénité de Proust*, Paris: Kimé.

Gutscher-Schmid Charlotte (2007) — *Nelken statt Namen. Die spätmittelalterlichen Malerwerkstätten der Berner Nelkenmeister*, Bern: Benteli.

Haddad Raphaël (2017) — *Manuel d'écriture inclusive*, Paris: Mots-clés.

Hansen Wilburn (2016) — 'Japanese Nationalism and Cultural Memory: Creating Memories of a Native Japanese Writing System', *Concentric: Literary and Cultural Studies*, 42.1: 3–24.

Hailman Jack P. (2008) — *Coding and Redundancy: Man-Made and Animal-Evolved Signals*, Cambridge, MA: Harvard University Press.

Haines Tom S. F., Oisin Mac Aodha, Gabriel J. Brostow (2006) — 'My Text in Your Handwriting', *ACM Transactions on Graphics (TOG)*, 35.3: article 26.

Haines-Eitzen Kim (2000) — *Guardians of Letters: Literacy, Power, and the Transmitters of Early Christian Literature*, New York, NY: Oxford University Press.

Haley Allan, Richard Poulin, Jason Tselentis, Tony Seddon, Gerry Leonidas, Ina Saltz, Kathryn Henderson, Tyler Alterman (2012) — *Typography Referenced: A Comprehensive Visual Guide to the Language, History, and Practice of Typography*, Beverly, MA: Rockport.

Halpern Diane F., Jonathan Wai (2020) — 'Sex Differences in Intelligence', in Robert J. Sternberg (ed.), *The Cambridge Handbook of Intelligence*, Cambridge: Cambridge University Press, 2nd ed., pp. 317–345.

Hamdi Yahia, Hanen Akouaydi, Houcine Boubaker, Adel M. Alimi (2022) — 'Handwriting quality analysis using online-offline models', *Multimedia Tools and Applications*, 81.30: 43411–43439.

Hamm Roberto (1975) — *Pour une typographie arabe : Contribution technique à la démocratisation de la culture arabe*, Paris: Éditions Sindbad.

Hammer Joseph (1806) — *Ancient Alphabets and Hieroglyphic Characters Explained*, London: Bulmer.

Haralambous Yannis (1995) — « Tour du monde des ligatures », *Cahiers Gutenberg*, 22: 87–99.

———, Tereza Haralambous (2003) — 'Characters, Glyphs and Beyond', *Typeface and Typesetting Workshop, East Asian Center for Informatics in Humanities, Kyoto University, 28–29 November 2003, Kyoto, Japan*, pp. 17–25.

——— (2007) — *Fonts & Encodings*, Sebastopol, CA: O'Reilly.

——— (2018) — 'A Roadmap to Graphemics', *Graphemics in the 21st century: From graphemes to knowledge, 14–15 June 2018, Brest, France*, extended abstracts, Brest: IMT Atlantique (Institut Mines-Télécom), pp. 103–108.

———, Joseph Dichy (2019) — 'Graphemic Methods for Gender-Neutral Writing', *Proceedings of Graphemics in the 21st Century, 13–15 June 2018, Brest, France*, pp. 41–89.

Harari Yuval (2017) — *Jewish Magic Before the Rise of Kabbalah*, Detroit, MI: Wayne State University.

Harley Heidi (2003) — *English Words: A Linguistic Introduction*, Oxford: Blackwell.

Harris William V. (1989) — *Ancient Literacy*, Cambridge, MA: Harvard University Press.

Hartmann Silvia (1999) — *Fraktur oder Antiqua. Der Schriftstreit von 1881 bis 1941*, Frankfurt am Main: Peter Lang, 2nd ed.

Haslam Andrew (2011) — *Lettering: A Reference Manual of Techniques Hardcover*, London: Laurence King.

Hassan Robert (2008) — *The Information Society*, Cambridge: Polity Press.

——— (2011) — *The Age of Distraction: Reading, Writing, and Politics in a High-Speed Networked Economy*, New Brunswick, NJ: Transaction.

Hassan Tamir, Changyuan Hu, Roger D. Hersch (2010) — 'Next Generation Typeface Representations: Revisiting Parametric Fonts', *ACM Symposium on Document Engineering (DocEng 2010), 21–24 Sep. 2010, Manchester, UK*, pp. 181–184.

Hauw Fabien, Mohamed El Soudany, Laurent Cohen (2023) — 'Subtitled speech: Phenomenology of tickertape synesthesia', *Cortex*, 160: 167–179.

Havelková Petra Brukner, Veronika Dulíková, Šárka Bejdová, Jana Vačková, Petr Velemínský, Miroslav Bárta (2024) — 'Ancient Egyptian scribes and specific skeletal occupational risk markers (Abusir, Old Kingdom)', *Scientific Reports*, 14: 13317, 1–19.

Hawkins H. Gene, Jr., Dale L. Picha, Mark D. Wooldridge, Francis K. Greene, Greg Brinkmeyer (1999) — 'Performance Comparison of Three Freeway Guide Sign Alphabets', *Transportation Research Record*, 1692, article 99-0624, p. 9–16.

Hayashi Michio (2022) — 'Between Kanji and Hiragana An Allegorical Reading of the Katakana (Non-) Space', in Ayelet Zohar, Alison J. Miller (eds.), *The Visual Culture of Meiji Japan: Negotiating the Transition to Modernity*, New York, NY: Routledge, pp. 14–30.

Hayes Jarrod (1995) — 'Proust in the Tearoom', *Publications of the Modern Language Association of America*, 110: 992–1005.

He Yiwen, Lai He, Qixuan Zhou, Xubin Xie (2024) — 'Study on the Religious and Philosophical Thoughts of Xizi Pagodas in Hunan Province of China', *Religions*, 15: 866, 20 p.

Heller Steven, Louise Fili (2016) — *A Century of Bold Letterforms: Slab Serif Type*, London: Thames & Hudson.

Hellmuth Margulis Elizabeth (2014) — *On Repeat: How Music Plays the Mind*, Oxford: Oxford University Press.

Helsingin Sanomat (2023) — *Climate Crisis Font: Type to Act*, online, 2023.06.06, https://kampanjat.hs.fi/climatefont/.

Henkin David M. (1998) — *City reading: Written Words and Public Spaces in Antebellum New York* , New York, NY: Columbia University Press.

Henze Jürgen (1983) — ‚Alphabetisierung in China', *Bildung und Erziehung*, 36.3: 295–313.

Herz Rachel S. (2008) — *The Scent of Desire*, New York, NY: Harper.

Herzog Thomas (2003) — « Le dernier conteur de Damas ? », in Jean-Claude Garcin (ed.), *Lectures du Roman de Baybars*, Marseille: Parenthèses, pp. 209–229.

——— (2007) — *Geschichte und Imaginaire: Entstehung, Überlieferung und Bedeutung der Sirat Baibars in ihrem sozio-politischen Kontext*, Wiesbaden: Harrassowitz.

Higham John (auth.), Carl J. Guarneri (ed.) (2001) — *Hanging Together: Unity and Diversity in American Culture*, New Haven, CT: Yale University Press.

Higuchi Hiroki, Tessei Kobayashi (2023) — 'Letter visual similarity of Japanese hiragana and katakana based on reaction times', *Current Psychology*, 42: 12835–12844.

Hill Will (2023) — *Space as Language: The Properties of Typographic Space*, Cambridge: Cambridge University Press.

Hillier Robert A., *A Typeface for the Adult Dyslexic Reader*, PhD thesis, Cambridge: Anglia Ruskin University, 2006.

Hillis Argye E. (2015) — *The Handbook of Adult Language Disorders*, New York, NY: Psychology Press.

Hochuli Jost (1991) — *Buchgestaltung als Denkschule: über die Symmetrie im Buch, über Funktion und Funktionalismus in der Buchtypografie und gegen die Ideologisierung gestalterischer Strukturen*, Stuttgart: Edition Typografie.

——— (2015) — *Detail in typography*, Paris: Éditions B42.

Hoefler & Co. (2018) — *Fonts by Hoefler & Co.*, online, 2018.04.20, https://www.typography.com.

Hoefler Jonathan (2020) — *Text for Proofing Fonts: A farewell to The Quick Brown Fox*, online, 2022.10.24, https://www.typography.com/blog/text-for-proofing-fonts.

Hofstadter Douglas R. (1982) — *Metafont, Metamathematics, and Metaphysics*, TR 136, Computer Science Department, Bloomington, IN: Indiana University.

———, Fluid Analogies Research Group (1995) — *Fluid Concepts and Creative Analogies: Computer Models of the Fundamental Mechanisms of Thought*, New York, NY: Basic Books.

——— (1999) — *Gödel, Escher, Bach: An Eternal Golden Braid*, New York, NY: Basic Books.

Hollis Richard (2006) — *Swiss Graphic Design: The Origins and Growth of an International Style, 1920–1965*, New Haven, CT: Yale University Press.

Hokenson Jan (1999) — 'Proust's "japonisme": Contrastive Aesthetics', *Modern Language Studies*, 29.1: 17–37.

Hoppan Jean-Michel (2018) — « Des choses qui se passent, dans l'écriture maya », in Brisset 2018, pp. 67–81

Horace (auth.), Robert M. Millington (transl.) (1870) — *The First Book of the Satires of Horace, in English Verses*, London: Longmans, Green, Reader, & Dyer.

Hosokawa Naoko (2020) — 'Katakana and Japanese National Identity: The Use of Katakana for Japanese Names and Expressions', *Silva Iaponicarum*, 56–59: 119–136.

Hunt Richard (2020) — *Advanced Typography: From Knowledge to Mastery*, London: Bloomsbury.

Houston R. A. (2016) — *Literacy in Early Modern Europe: Culture and Education 1500–1800*, Abingdon: Routledge, 2nd ed.

Huot-Marchand Thomas (2018) — *256TM*, online, 2018.05.05, http://256tm.com.

Hurka Céline, Nóra Békés (2019) — *Reviving Type: Practice-based research on Renaissance and Baroque models, compared and discussed*, Rotterdam: Acute Publishing.

Huston Stephen D. (2004) — *The First Writing: Script Invention as History and Process*, Cambridge: Cambridge University Press.

Hustwit Gary (2007) — *Helvetica*, documentary film, Veer / Swiss Dots. https://www.hustwit.com/helvetica

——— (ed.) (2015) — *Helvetica/Objectified/Urbanized: The Complete Interviews*, London: Versions.

Hyndman Sarah (2016) — *Why Fonts Matter*, London: Virgin Books.

Ifrah Georges (2000) — *The Universal History of Numbers:* , New York, NY: John Wiley & Sons.

IGS = International Graphonomics Society, online, 2018.04.09, http://www.graphonomics.org.

Imjai Thanongsak, Chirawat Wattanapanich, Uhamard Madardam, Reyes Garcia (2021) — 'Analysis of Ink/Toner Savings of English and Thai Ecofonts for Sustainable Printing', *Sustainability*, 13: 4070, 17 p.

Inagaki Shin-ichi (2006) — « Les jeux d'écriture à l'époque d'Édo », in Brisset 2006: 231–259.

Inoue Kuychiro (1972) — « Un morceau de madeleine et des comprimés japonais », *Bulletin de la Société des Amis de Marcel Proust et des Amis de Combray*, 22: 1346–1348.

intactile DESIGN (2017) — *B612 The PolarSys Font: Design & Production Of A Digital Font*, n.l. https://raw.githubusercontent.com/polarsys/b612/master/docs/B612-Leaflet.pdf

———(2021.11.10) — *B612 Font Family*, online, 2023.07.26, https://b612-font.com.

Ionesco Eugène (auth.), Massin (ill.) (1966) — *délire à deux (essai de calligraphie sonore)*, Paris: Gallimard.

Isaacson Walter (2011) — *Steve Jobs*, New York, NY: Simon & Schuster.

Iwahara Akihiko, Takeshi Hatta, Aiko Maehara (2003) — 'The effects of a sense of compatibility between type of script and word in written Japanese', *Reading and Writing: An Interdisciplinary Journal*, 16: 377–397, 2003.

Jacob Christian (2000) — 'Athenaeus the Librarian', in David Braund, John Wilkins (eds.), *Athenaeus and His World: Reading Greek Culture in the Roman Empire*, Exeter: University of Exeter, pp. 85–110.

Jacobs Marvin (2004) — *Graphic Design Concepts*, North Olmstead, OH: Words & Pictures Publishing, 3rd ed.

Jager Eric (2000) — *The Book of the Heart*, Chicago, IL: University of Chicago Press.

Jahraus Oliver, Armin Nassehi (eds.) (2012) — *Luhmann-Handbuch. Leben – Werk – Wirkung*, Stuttgart: J. B. Metzler.

Jamra Mark (1993) — 'Some Elements of Proportion and Optical Image Support in a Typeface', in Roger D. Hersch (ed.), *Visual and Technical Aspects of Type*, Cambridge: Cambridge University Press.

Jerrim John, Nikki Shure (2016) — *Achievement of 15-Year-Olds in England. PISA 2015 National Report*, London: University College London, Institute of Education.

Jewell George, Mark E. McCourt (2000) — 'Pseudoneglect: a review and meta-analysis of performance factors in line bisection tasks', *Neuropsychologia*, 38: 93–110.

Jimenes Rémy (2011) — *Les caractères de civilité: Typographie et calligraphie sous l'Ancien Régime*, La Fresquiere: Ateliers Perrousseaux, 2011.

Johns Adrian (2023) — *The Science of Reading: Information, Media, and Mind in Modern America*, Chicago, IL: University of Chicago Press.

Johnson John (2011) — 'Bank Robber Foiled by... Lousy Handwriting,' *Newser*, online, 2013.01.17, http://www.newser.com/story/133587/memo-to-bank-robbers-penmanship-counts.html.

Johnson William A. (2015) — 'Learning to Read and Write', in W. Martin Bloomer (ed.), *A companion to Ancient Education*, Chichester: John Wiley and Sons, pp. 137–148.

Johnston Alastair (2000) — *Alphabets to Order: The Literature of Nineteenth-Century Typefounders' Specimens*, London: The British Library.

Joyce Terry (2013) — 'The significance of the morphographic principle for the classification of writing systems', in Susanne R. Borgwaldt, Terry Joyce, *Typology of Writing Systems*, Amsterdam: John Benjamins, pp. 61–84.

———, Susanne R. Borgwaldt (2013b) — 'Typology of writing systems: Introduction', in Susanne R. Borgwaldt, Terry Joyce, *Typology of Writing Systems*, Amsterdam: John Benjamins, pp. 1–11.

Juni Samuel, Julie S. Gross (2008) — 'Emotional and persuasive perception of fonts', *Perceptual & Motor Skills*, 106.1: 35–42.

Kadit Ibrahim A. al- (1992) — 'Origins of Cryptology: The Arab Contributions', *Cryptologia*, 16.2: 97–126.

Kafka Ben (2012) — *The Demon of Writing: Powers and Failures of Paperwork*, New York, NY: Zone Books.

Kafka Franz (auth.), Joyce Crick (transl.) (2009) — *The Metamorphosis and Other Stories*, Oxford: Oxford University Press.

Kahn David (1967) — *The Codebreakers: The Story Of Secret Writing*, New York, NY: MacMillan.

Kalder Daniel (2018) — *The Infernal Library*, New York, NY: Henry Holt.

Kanata Konami (2020) — *Sue & Tai-chan*, New York, NY: Kodansha Comics.

Kanizsa Gaetano (auth.), Walter Gerbino (transl.) (1987) — 'Quasi-Perceptual Margins in Homogeneously Stimulated Fields', in Susan Petry, Glenn E. Meyer (eds.), *The Perception of Illusory Contours*, New York, NY: Springer, pp. 35–49.

Kapur Arnav, Shreyas Kapur, Pattie Maes (2017) — 'AlterEgo: A Personalized Wearable Silent Speech Interface', *Conference on Intelligent User Interfaces, 7–11 March 2018, Tokyo, Japan*, pp. 43–53.

Kapr Albert (1988) — *Johannes Gutenberg: Persönlichkeit und Leistung*, München: C.H. Beck.

——— (1993) — *Fraktur: Form und Geschichte der gebrochenen Schriften*, Mainz: Hermann Schmidt.

Karlgren Bernhard (1923) — Sound and Symbol in Chinese, London: Oxford University Press.

Karlin Daniel (2005) — *Proust's English*, Oxford: Oxford University Press.

Karow Peter (1992) — *hz-Program*, Hamburg: URW.

——— (1994) — *Font Technology: Methods and Tools*, Berlin: Springer.

——— (1998) — 'Two decades of typographic research at URW: A retrospective', in Roger D. Hersch, Jacques André, Heather Brown (eds), *Electronic Publishing, Artistic Imaging, and Digital Typography*, Berlin: Springer.

——— (2013) — *Digital Typography & Artificial Intelligence*, San Jose, CA / 's-Hertogenbosch: Adobe / Dutch Type Library.

Kay Neil M. (2013) — 'Rerun the tape of history and QWERTY always wins', *Research Policy*, 42: 1175–1185.

Keegan Jon (2024) — 'Government issue design', *MIT Technology Review*, 127.4: 14–15.

Keightley David N. (1978) — *Sources of Shang History: The Oracle-Bone Inscriptions of Bronze Age China*, Berkeley, CA: University of California Press.

Kelly Piers (2018) — 'The art of not being legible', *Terrain*, 70: 38–61.

———(2018b) — 'The Invention, Transmission and Evolution of Writing: Insights from the New Scripts of West Africa', in Silvia Ferrara, Miguel Valério (eds.), *Paths into Script Formation inthe Ancient Mediterranean*, Roma: Edizioni Quasar, pp. 189–210.

Keypoint Intelligence: Buyers Lab (2018) — *Ink/Toner Yield Analysis When Printing in Standard Mode (with Arial) versus Ecofont*, 5 p. https://www.ecofont.com/sites/default/files/2018-04/InkToner Yield Analysis with Standard print and Ecofont.pdf

Khajavi Javad M. (2019) — *Arabic Script in Motion: A Theory of Temporal Text-based Art*, Cham: Palgrave Macmillan.

Kim-Reynaud Young-Key (ed.) (1998) — *The Korean Alphabet: Its History and Structure*, Honolulu, HI: University of Hawai'i Press.

Kindersley David (auth.), Lida Lopes Cardozo Kindersley (ed.) (2001) — *Optical Letter Spacing: For new printing systems*, Cambridge: Cardozo Kindersley Workshop, 3rd ed.

Kinross Robin (1995) — 'Introduction', in Jan Tschichold, *The New Typography: A Handbook for Modern Designers*, Berkeley: University of California Press, pp. xv–xliv.

——— (2010 [1992]) — *Modern typography: an essay in critical history*, London: Hyphen Press, 2nd rev. ed.

——— (2011 [2002]) — *Unjustified texts: perspectives on typography*, London: Hyphen Press, rev. ed.

Kipling Rudyard (1912) — *Just So Stories*, New York, NY: Doubleday.

Kleisch Marion (2017) — *Ästhetik der Zensur*, Zürich: Niggli.

Knoblich Günther, Eva Seigerschmidt, Rüdiger Flach, Wolfgang Prinz (2002) — 'Authorship effects in the prediction of handwriting strokes: Evidence for action simulation during action perception', *The Quarterly Journal of Experimental Psychology*, 55A (3): 1027–1046.

Knuth Donald E. (1986) — *The* METAFONT *book*, Reading, MA: Addison-Wesley.

——— (1996) — *The TEXbook*, Upper Saddle River, NJ: Addison–Wesley.

Koch Kristin, Judith McLean, Ronen Segev, Michael A. Freed, Michael J. Berry, Vijay Balasubramanian, Peter Sterling (2006) — 'How Much the Eye Tells the Brain', *Current Biology*, 16.14: 1428–1434.

Koeberlin Christoph (2023) — 'Home Page', *Christoph Koeberlin – Type Design & Font Engineering*, online, 2023.07.13, https://christoph.koe.berlin.

Koenderink Jan J., Andrea van Doorn (2013) — 'The Shape of Space', in Sven J. Dickinson, Zygmunt Pizlo (eds.), *Shape Perception in Human and Computer Vision: An Interdisciplinary Perspective*, London: Springer, 145–156.

Koering Jérémie (2021) — *Les iconophages: Une histoire de l'ingestion des images*, Arles: Actes Sud.

Kogman-Appel Katrin (2012) — *A Mahzor from Worms: Art and Religion in a Medieval Jewish Community*, Cambridge: Harvard University Press.

Komiyama Hiroshi (2006) — « La création et la diffusion des caractères d'imprimerie de ‹ style Ming › au xix^e siècle : de l'Europe au Japon », in Brisset 2006: 139–171.

König Anne Rose (2004) — *Lesbarkeit als Leitprinzip der Buchtypographie: Eine Untersuchung zum Forschungsstand und zur historischen Entwicklung des Konzeptes „Lesbarkeit"*, Erlangen-Nürnberg: Universität Erlangen-Nürnberg.

Koop Andreas (2012) — *Die Macht der Schrift: Eine angewandte Designforschung*, Zürich: Niggli.

Koren Leonard (2008) — *Wabi-Sabi for Artists, Designers, Poets & Philosophers*, Point Reyes, CA: Imperfect Publishing.

Kramer Rita (1988) — *Maria Montessori: A Biography*, New York, NY: Diversion Books.

Kraus Richard Curtis (1991) — *Brushes with Power: Modern Politics and the Chinese Art of Calligraphy*, Los Angeles, CA: University of California Press.

Kress Gunther, Theo van Leeuwen (2006) — *Reading Images: The Grammar of Visual Design*, London: Routledge, 2nd ed.

Kretztenbacher Heinz L., Harald Weinrich (1995) — ‚Wie durchsichtig ist die Sprache der Wissenschaft ?', in Heinz L. Kretztenbacher, Harald Weinrich (eds.), *Linguistik der Wissenschaftssprache*, Berlin: De Gruyter, pp. 15–39.

Kruse Peter, Michael Stadler (eds.) (1995) — *Ambiguity in Mind and Nature: Multistable Cognitive Phenomena*, Berlin: Springer.

Kühne-Wespi Carina, Klaus Oschema, Joachim Friedrich Quack (2013) — *Zerstörung von Geschriebenem: Historische und transkulturelle Perspektiven*, Berlin: De Gruyter.

Kulish Olga (2021) — 'Between the Words: Emotional Punctuation in the Digital Age Communication', *Proceedings of Graphollinguistics in the 21st Century, 15–17 June 2020, online*, 1:417–438.

Kunert Hannah (2017) — *From loaning to owning: Japanese loanwords in hiragana*, PhD thesis, School of Languages and Linguistics, and the Asia Institute, University of Melbourne.

Kunze Martin (2018) — *Memory of Mankind*, online, 2023.01.16, https://www.memory-of-mankind.com.

Kuperman Victor, Zachary Estes, Marc Brysbaert, Amy Beth Warriner (2014) — 'Emotion and language: Valence and arousal affect word recognition', *Journal of Experimental Psychology*, 143.3: 1065–1081.

Kvernen Elisabeth (2024) — *Calligraphy Qalam*, website, 2024.06.28, https://www.calligraphyqalam.com.

Lacroux Jean-Pierre (2007) — *Orthotypographie: Orthographe & Typographie françaises; Dictionnaire raisonné*, Paris: Quintette. http://www.orthotypographie.fr

Lai Amber (2023) — *Homepage*, online, 2023.09.30, https://amberglai.com/Anamorphic-Typography/.

Laitin David D. (1977) — *Politics, Language, and Thought: The Somali Experience*, Chicago, IL: University of Chicago Press.

Lambourne Helen (2011.05.06) — 'New 'eco-font' developed by publisher', *HoldtheFrontPage*, online, 2022.10.24, https://www.holdthefrontpage.co.uk/2011/news/new-eco-font-developed-by-newspaper-publisher/.

Lange-Müller Katja (2000) — *Die Letzten: Aufzeichnungen aus Udo Posbichs Druckerei*, Köln: Kiepenheuer & Wietsch.

Laucou Christian (2014) — *Dimidiotypie et impression Panckoucke*, Paris: Fornax. http://www.fornax.fr/flip/voeux2014-flip/2014

Larson Kevin (2017) — 'The science of word recognition', *Microsoft Typography*, online, 2018.05.12, https://docs.microsoft.com/en-us/typography/develop/word-recognition.

Lawson Alexander (1992) — *Anatomy of a Typeface*, London: Hamish Hamilton.

Legge Gordon E. (2007) — *Psychophysics of Reading in Normal and Low Vision*, Boca Raton, FL: CRC Press.

———, Charles Bigelow (2011) — 'Does print size matter for reading ? A review of findings from vision science and typography', *Journal of Vision*, 11 (5.8): 1–22.

——— (2014) — 'Prentice Medal Lecture 2013: Visual Accessibility: A Challenge for Low-Vision Research', *Optometry and Vision Science*, 91.7: 696–706.

Legros Lucien Alphonse, John Cameron Grant (1916) — *Typographical printing surfaces: the technology and mechanism of their production*, London: Longmans, Green, and Co.

Le Guin Ursula K. (2019) — *Lao Tzu: Tao Te Ching: A Book about the Way and the Power of the Way*, Boston, MA: Shambala.

Lejeune Philippe (1971) — *Écriture et sexualité*, Europe, 502–3: 113–143.

Lethem Jonathan (2009) — *Chronic City*, New York, NY: Vintage.

Lévi-Strauss Claude (1961) — *Tristes Tropiques*, New York, NY: Criterion.

Leyton Michel (1992) — *Symmetry, Causality, Mind*, Cambridge, MA: MIT Press.

Li Yu (1996) — *The Carnal Prayer Mat*, Honolulu, HI: University of Hawaii Press.

Li Yunfeng, Tadamasa Sawada, Yun Shi, Robert M. Steinman, Zygmunt Pizlo (2013) — 'Symmetry Is the sine qua non of Shape', in Dickinson Sven J., Zygmunt Pizlo (eds.), *Shape Perception in Human and Computer Vision: An Interdisciplinary Perspective*, London: Springer, pp. 21–40.

Liebowitz Stan J., Stephen E. Margolis (1990) — 'The Fable of the Keys', *The Journal of Law & Economics*, 33.1: 1–25.

———, Stephen E. Margolis (2001) — *Winners, Losers & Microsoft: Competition and Antitrust in High Technology*, Oakland, CA: The Independent Institute, revised ed.

———, Stephen E. Margolis (2013) — 'The troubled path of lock-in movement', *Journal of Competition Law & Economics*, 9.1: 125–152.

Linotype Library (2019) — *Neue Helvetica*, font metadata, version 15.0d1e1 of 2019.03.21.

Liwicki Marcus, Akira Yoshida, Seiichi Uchida, Masakazu Iwamura, Shinichiro Omachi, Koichi Kise (2011) — 'Reliable Online Stroke Recovery from Offline Data with the Data-Embedding Pen', *2011 International Conference on Document Analysis and Recognition (ICDAR), Beijing, China, 2011*, pp. 1384–1388.

Locher Gottfried W. (1979) — *Die Zwinglische Reformation im Rahmen der europäischen Kirchengeschichte*, Göttingen: Vandenhoeck & Ruprecht.

Lommen Mathieu (2012) — *The Book of Books: 500 Years of Graphic Innovations*, London: Thames & Hudson.

Loncke Filip (2022) — *Augmentative and Alternative Communication: Models and Applications*, San Diego, CA: Plural, 2nd ed.

Longcamp Marieke, Yevhen Hlushchuk, Riitta Hari (2011) — 'What Differs in Visual Recognition of Handwritten vs. Printed Letters ? An fMRI Study', *Human Brain Mapping*, 32: 1250–1259.

Lord Gaby (2023) — 'Type Foundries', *OMGLORD*, online, 2023.07.08, https://omglord.com/type-foundries.

Louis Patrice (2019) — 'Miraculeux petits morceaux de papier', *Le fou de Proust*, online, 2019.01.12, https://lefoudeProust.fr/2018/06/miraculeux-petits-morceaux-de-papier/.

Louÿs Pierre (1898) — *Les Chansons de Bilitis*, Paris: Mercure de France.

Loxley Simon (2004) — *Type: The Secret History of Letters*, London: I. B. Tauris.

Luhmann Niklas (2006) — 'System as Difference', *Organization*, 13.1: 37–57.

Lund Ole (1999) — *Knowledge construction in typography. The case of legibility research and the legibility of sans-serif typefaces*, PhD thesis, Reading: University of Reading.

Lunde Ken (2024) — *Unicode Technical Note #43: Unihan Database Property "kStrange"*, online, 2025.05.11, https://www.unicode.org/notes/tn43/.

——— (2025) — 'Adobe Blank: The Typeface Design', *Dr Ken Lunde website*, online, 2025.05.06, https://ken-lunde.medium.com/adobe-blank-the-typeface-design-de2178f7b712.

Lupton Ellen, Abbott Miller (1999) — *Design Writing Research: Writing on Graphic Design*, London: Phaidon.

Lurie David B. (2011) — *Realms of Literacy: Early Japan and the History of Writing*, Cambridge, MA: Harvard University Asia Center.

Lynch Kevin (1960) — *The Image of the City*, Cambridge, MA: MIT Press.

Lynch Robert L. (2025) — 'Enochian, Malachim, & Thebian Scripts', *Robert L. Lynch Fonts*, online, 2025.03.07, https://www.robertllynch.com/gallery/fonts/.

Lyons Martyn (2011) — *Books: A Living History*, Los Angeles: J. Paul Getty Museum.

M. P. M. (2019) — 'Word division', *Brill's New Pauly*, online, 2019.03.02, http://dx.doi.org/10.1163/1574-9347_bnp_e12211900.

Ma Yo-Yo (2023) — 'Yo-Yo Ma Teaches Music and Connection, Official Trailer', *MasterClass*, online, 2023.08.06, https://www.masterclass.com/classes/yo-yo-ma-teaches-music-and-connection.

Mackenzie Donald, Judy Wajcman (1999) — *The Social Shaping of Technology*, Buckingham: Open University Press, 2nd ed.

Mackert Gabriele (ed.) (2000) — *Shirin Neshat*, Vienna / London: Kunsthalle Wien / Serpentine Gallery.

Macri Martha (1985) — 'The Numerical Head Variants and the Mayan Numbers', *Anthropological Linguistics*, 27.1: 46–85.

———, Matthew G. Looper (2003) — *The New Catalog of Maya Hieroglyphs, Volume One: The Classic Period Inscriptions*, Norman, OK: University of Oklahoma Press.

Maddison Francis, Emilie Savage-Smith (1997) — *Science, Tools & Magic. Part One. Body and Spirit, Mapping the Universe; The Nasser D. Khalili Collection of Islamic Art, vol. 12*, London / Oxford: Nour Foundation, Azimuth Editions, Oxford University Press.

Mafundikwa Saki (2006) — *Afrikan Alphabets: The Story of Writing in Afrika*, New York, NY: Mark Batty.

Mair Victor (1988) — *Painting and performance: Chinese picture recitation and its Indian genesis*, Honolulu, HI: University of Hawai'i Press.

Maissen Thomas (2005) — *Die Geschichte der NZZ 1780–2005*, Zürich: Neue Zürcher Zeitung.

Mak Michael (dir.) (1991) — *Sex and Zen*, Hong Kong: Golden Harvest / Johnny Mak Productions, vol. 1. Review: http://www.moriareviews.com/fantasy/sex-and-zen-1991.htm

Makita Kiyoshi (1968) — 'The rarity of reading disability in Japanese children', *American J. of Orthopsychiatry*, 38.4: 599–614.

Małecka Agnieszka, Zofia Oslislo (eds.) (2016) — *The Insects Project: Problems of Diacritic Design for Central European Languages*, Katowice: Academy of Fine Arts, 2nd ed. http://theinsectsproject.eu

Manguel Alberto (1996) — *A History of Reading*, Toronto: Knopf.

Marcus Ivan G. (1996) — *Rituals of Childhood: Jewish Acculturation in Medieval Europe*, New Haven, CT: Yale University Press.

——— (2001) — 'Honey Cakes and Torah: A Jewish Boy Learn His Letters', in Laurence Fine (ed.), *Judaism in Practice: From the Middle Ages through the Early Modern Period*, Princeton, NJ: Princeton University Press, pp. 115–130.

Mardrus J. C., Dr. (auth.), Powys Mathers (transl.) (2004) — *The Book of the Thousand Nights & One Night*, London: Routledge.

Margolis Stephen E. (2013) — 'A tip of the hat to Kay and QWERTY', *Research Policy*, 42: 1188–1190.

Martin Henri-Jean (1988) — *The History and Power of Writing*, Chicago, IL: University of Chicago Press.

Marx Karl (1907) — *The eighteenth Brumaire of Louis Bonaparte*, Chicago: Charles H. Kerr.

Massin (1970) — *La Lettre et l'image: La figuration dans l'alphabet latin du VIII^e siècle à nos jours*, Paris: Gallimard.

Massoudy Hassan (1981) — *Calligraphie arabe vivante*, Paris: Flammarion.

Mathiesen Robert (2020) — 'The Characters (Χαρακτῆρες) of the Glagolitic Alphabet: New Light on an Old Puzzle', *Slavistica Vilnensis*, 65.2: 10–25.

Mathieu Georges, Jean-Claude Arnould (eds.) (2017) — *La Table des matières. Son histoire, ses règles, ses fonctions, son esthétique*, Paris: Classiques Garnier.

Maurice Lisa (2013) — *The Teacher in Ancient Rome: The Magister and His World*, Plymouth: Lexington Books.

Marrou Henri-Irénée (1965) — *Histoire de l'éducation dans l'antiquité*, Paris: Seuil, 6th ed.

Maximilian I, Marx Treitzsaurwein (1775) — *Der Weiß-Kunig: eine Erzählung von den Thaten Kaiser Maximilian des Ersten*, Wien: Joseph Kurzböcken. https://digi.ub.uni-heidelberg.de/diglit/maximilian1775/0092/image

Maza David (2022) — 'Taklobo', *Blaze Type*, online, 2023.07.12, https://blazetype.eu/typefaces/taklobo.

McCourt Mark E., Curt Olafson (1997) — 'Cognitive and perceptual influences on visual line bisection: Psychophysical and chronometric analyses of pseudoneglect', *Neuropsychologia*, 35.3: 369–380.

McGill-Franzen Anne, Richard L. Allington (2011) — *Handbook of Reading Disability Research*, New York, NY: Routledge.

McGurk Stuart (2017.08.04) — 'Who's behind art's dark little secret, Vantablack?', *GQ*, online, 2024.07.08, https://www.gq-magazine.co.uk/article/vantablack-anish-kapoor.

McKenzie D. F. (1999) — *Bibliography and the Sociology of Texts*, Cambridge: Cambridge University Press.

McLean Ruari (1975) — *Jan Tschichold: typographer*, Boston, MA: David R. Godine.

McLuhan Marshall (1962) — *The Gutenberg Galaxy: The Making of Typographic Man*, Toronto: University of Toronto Press.

Mead Rebecca (2022.08.22) — 'Goop: Anish Kapoor has made a fortune sculpting with unusual materials', *The New Yorker*, pp. 42–53.

Mediavilla Claude (1996) — *Calligraphie: Du signe calligraphié à la peinture abstraite*, Paris: Imprimerie Nationale.

Meer Julia (2015) — *Neuer Blick auf die Neue Typographie: Die Rezeption der Avantgarde in der Fachwelt der 1920er Jahre*, Bielefeld: transcript.

Meletis Dimitrios, Christa Dürscheid (2022) — *Writing Systems and Their Use: An Overview of Graphotactics*, Berlin: De Gruyter.

Meletis Dimitrios (2024) — 'What's in a Name? Trends and Challenges in Naming the Study of Writing', *Proceedings of Graphotactics in the 21st Century 2022, June 8–10, Palaiseau, France*, 1: 1–44.

Meier Andreas (1999) — *Affenschwanz: Trilogie einer virtuellen firma*, Kastanienbaum: pako.

Meiss Millard (1969) — 'The First Alphabetical Treatises in the Renaissance', *The Journal of Typographic Research*, 3 (1): 3–30.

MEN = Ministère de l'éducation nationale (2013) — *Modèles d'écriture scolaire. Document accompagnement. Polices de caractères cursives*, Paris: Ministère de l'éducation nationale. http://www.educsol.education.fr/polices-cursives

Mercier Antoine, Colette Sirat (2015.02.13) — « Colette Sirat, la femme qui fait parler les manuscrits », *akadem: le campus numérique juif*, online, 2023.07.16, https://akadem.org/sommaire/cours/portraits/colette-sirat-la-femme-qui-fait-parler-les-manuscrits-13-02-2015-67407_4537.php.

Metz Bernhard (2012) — ‚Absicht oder Versehen? Von „Gießbächen", "Rivers of White" und «Lézardes» bei Tom Phillips, Katja Lange-Müller und Carlos María Domínguez', in Marieke Giertler, Rea Köppler (eds.), *Von Lettern und Lücken: Zur Ordnung der Schrift im Bleisatz*, München: Wilhelm Fink, pp. 39–71.

Metzger Wolfgang (2006) — *Laws of Seeing*, Cambridge, MA: MIT Press.

Meuthen Erich (1982) — ‚Ein neues frühes Quellenzeugnis (zu Oktober 1454 ?) für den ältesten Bibeldruck. Enea Silvio Piccolomini am 12. März 1455 aus Wiener Neustadt an Kardinal Juan de Carvajal', *Gutenberg-Jahrbuch*, 52: 108–118.

Meyer Wilhelm (1897) — ‚Die Buchstaben-Verbindungen der sogenannten gothischen Schrift', *Abhandlungen der königlichen Gesellschaft der Wissenschaft zu Göttingen, Philologisch-Historische Klasse*, Neue Folge, I (6): 97.

Meynet Roland (1971) — *L'écriture arabe en question: les projets de l'Académie de la Langue Arabe du Caire de 1938 à 1968*, Beyrouth: Dar al-Mashreq.

Mickel Stanley Lewis (1986) — 'Chia-ku wen-tsu (oracle-bone inscriptions)', in William H. Niehauser, Jr (ed.), *The Indiana Companion to Traditional Chinese Literature*, Bloomington, IN: Indiana University Press, pp. 255–7.

Middendorp Jan (2018) — *Dutch Type*, Berlin: Druk Editions, 2nd ed.

Mietkiewicz Hubert (2017) — *OpenType Font Variations: Digital Typography Revolution has just been announced*, MA thesis in Visual Communication, London: Royal College of Art.

Miller J. Abbott (1996) — *Dimensional Typography: Case Studies on The Shape of Letters in Virtual Environments*, Princeton, NJ: A Kiosk Report / Princeton Architectural Press.

Milo Thomas (2002) — 'Authentic Arabic. A case study. Right-to-left font structure, font design, and typography', *Manuscripta Orientalia*, 14.1: 49–61.

Minorski Vladimir (1959) — *Calligraphers and Painters: A Treatise by Qadi Ahmad, Son of Mir-Munshi (circa A.H. 1015/A.D. 1606)*, Washington, DC: Smithsonian Institution, Freer Gallery of Art.

Mitch David (2004) — 'Education and skill of the British labour force', in Roderick Floud, Paul Johnson (eds.), *The Cambridge Economic History of Modern Britain, Volume 1: Industrialisation, 1700–1860*, Cambridge: Cambridge University Press.

Moglia Anton, Jérémy Landes (2019) — 'Pilowlava', *Velvetyne*, online, 2023.07.12, https://velvetyne.fr/fonts/pilowlava/.

MoMA (2011) — *Gallery label from Standard Deviations (FF Beowolf, 1990)*, New York, NY: Museum of Modern Art. https://www.moma.org/collection/works/139326

Montaigne Michel de (2004) — *Les Essais*, Paris: Presses Universitaires de France.

Montessori Maria (1912) — *The Montessori Method*, New York, NY: Frederick A. Stokes, 2nd ed.

——— (1936) — *The Secret of Childhood*, Bombay: Longmans.

Monotype (1956) — *The Monotype Recorder*, 40.3. http://metaltype.co.uk/wpress/library/monotype-recorder/

Moran James (1973) — 'Review of Stanley Morison, Politics and Script, 1972', *Journal of the Royal Society of Arts*, 121.5199: 178–179.

——— (1974) — 'Review of Stanley Morison, A Tally of Types, 1973', *Journal of the Royal Society of Arts*, 122.5210: 100–101.

Mori Masahiro (auth.), Karl F. MacDorman, Norri Kageki (transl.) (2012 [1970]) — 'The Uncanny Valley', *IEEE Robotics & Automation Magazine*, 19.2: 98–100.

Morin Olivier (2018) — 'Spontaneous Emergence of Legibility in Writing Systems: The Case of Orientation Anisotropy', *Cognitive Science*, 42.2: 664–677.

Morison Stanley (1932) — *The English Newspaper: Some Account of the Physical Development of Journals Printed in London between 1622 and the Present Day*, Cambridge: Cambridge University Press.

——— (1962) — *On Type Designs Past and Present*, London: Ernest Benn, new ed.

——— (auth.), Nicolas Barker (ed.) (1972) — *Politics and Script: Aspects of authority and freedom in the development of Graeco-Latin script from the sixth century B.C. to the twentieth century A.D.*, Oxford: Clarendon Press.

——— (auth.), Brooke Crutchley (ed.) (1973) — *A Tally of Types*, Cambridge: Cambridge University Press.

——— (auth.), Nicolas Barker (ed.) (1990) — *Early Italian Writing Books: Renaissance to Baroque*, London: The British Library.

Mosley James (1999) — *The Nymph and the Grot: The Revival of the Sanserif Letter*, London: European Friends of the St Bride Printing Library.

———, Sylvie de Tuckheim-Pey, André Jammes, Arnaud d'Hauterives, Paul-Marie Grinevald, Christian Paput, Jacques André (2002) — *Le Romain du Roi. La typographie au service de l'État, 1702–2002*, Lyon: Musée de l'imprimerie.

——— (2007) — 'The Nymph and the Grot, an update', *Typefoundry: Documents for the History of Type and Letterforms*, online, 2018.04.06, https://typefoundry.blogspot.ch/2007/01/nymph-and-grot-update.html.

Motion Together (2023) — *Homepage*, online, 2023.10.01, http://motiontogether.org.

Mullaney Dean (ed.) (2017) — *Superman: The Golden Age Newspaper Dailies: 1942–1944*, San Diego, CA: Idea & Design Works.

Müller Lars, Victor Malsy (2009) — *Helvetica Forever: Story of a Typeface*, Baden: Lars Müller.

Mun Sang (2012) — 'ZXX', *Library Stack*, online, 2023.07.02, https://www.librarystack.org/zxx/

MyFonts (2000) — *MyFonts*, online, 2022.12.28, https://www.myfonts.com.
Myrvold Kristina (2010) — *The Death of Sacred Texts: Ritual Disposal and Renovation of Texts in World Religions*, Farnham: Ashgate.

Nadir Aysegül (1986) — *Imperial Ottoman Fermans*, London: Aysegül Nadir.
Nadolski Dieter (1984) — *Didaktische Typographie: Informationstypographie, Pädagogische Typographie*, Leipzig: VEB Fachbuchverlag Leipzig.
Nagoya Akira (2006) — « Le style calligraphique du poète Fujiwara no Teika et son influence à travers le temps », in Brisset 2006: 24–52.
Narewska Elli, Susan Gentles, Mariam Yamin (2012.03.27) — 'April fool – San Serriffe', *The Guardian*, online, 2018.05.04, https://www.theguardian.com/gnmeducationcentre/archive-educational-resource-april-2012.
Németh László (2006) — 'Automatic non-standard hyphenation in OpenOffice.org', *TUGboat*, 27.2: 750–755.
Nemeth Titus (2017) — *Arabic Type-Making in the Machine Age: The Influence of Technology on the Form of Arabic Type, 1908–1993*, Leiden: Brill.
Nehrlich Thomas (2012) — ‚Phänomenologie der Ligatur. Theorie und Praxis eines Schriftelements zwischen Letter und Lücke', in Marieke Giertler, Rea Köppler (eds.), *Von Lettern und Lücken: Zur Ordnung der Schrift im Bleisatz*, München: Wilhelm Fink, pp. 14–38.
Neography (2025) — 'Neography: constructed writing systems', *reddit*, online, 2025.01.15, https://www.reddit.com/r/neography/.
Netzle Simon, Karl Schimke (2017) — *Zusammenklang: Das Speil der St. Galler Glocken*, St. Gallen: Verlagsgenossenschaft St. Gallen.
New Boris, Jonathan Grainger (2011) — 'On letter frequency effects', *Acta Psychologica*, 138: 322–328.
Newman Paul B. (2007) — *Growing Up in the Middle Ages*, Jefferson, NC: McFarland.
Noble Paul (1998) — *Nobson Newtown*, Köln: Salon.
———, Georgina Starr (2018) — *Paul Noble: N is for Nobson*, online, 2023.11.14, https://www.youtube.com/watch?v=RCB8L7KPIpk.
Noë Alva (2004) — *Action in Perception*, Cambridge, MA: MIT Press.
Noordzij Gerrit (2005) — *The Stroke: theory of writing*, London: Hyphen Press.
Noyes Jan (1983) — 'The QWERTY keyboard: a review', *International Journal of Man-Machine Studies*, 18.3: 265–281.
NYTimes = The New York Times (1942.06.04) — 'Goudy is Working on Last Type Face', *The New York Times*, June 4, 1942, p. 13.

Obana Yasuko (1997) — 'Vertical or Horizontal ? Reading Directions in Japanese', *Bulletin of the School of Oriental and African Studies*, 60.1: 86–94.
OECD (2016) — *PISA 2015 Results (Volume I): Excellence and Equity in Education*, Paris: OECD Publishing.
OED = Oxford English Dictionary Online, Oxford University Press, http://www.oed.com.
OFSP = Orell Füssli Security Printing (2021) — 'OFS and AUGENTIC GmbH reveal the design of the offline "Smart Banknote CBDC" prototype', *News 08.10.2021, orell füssli security printing*, online, 2023.07.29, https://www.ofs.ch/events-news/news/detail/ofs-and-augentic-gmbh-reveal-the-design-of-the-offline-smart-banknote-cbdc-prototype-1.
Ollivier Jean-Pierre (2018) — *Proust et les sciences*, Paris: Honoré Champion.
Olocco Riccardo, Michele Patanè (2022) — *Designing type revivals*, Milano: Lazy Dog Press.
Olson David R. (1994) — *The World on Paper: The Conceptual and Cognitive Implications of Writing and Reading*, Cambridge: Cambridge University Press.
——— (2016) — *The Mind on Paper: Reading, Consciousness and Rationality*, Cambridge: Cambridge University Press.
Omagari Toshi (2019) — *Arcade Game typography: The Art of Pixel Type*, London: Thames & Hudson.
Ong Walter J. (2002) — *Orality and Literacy: The Technologizing of the Word*, London: Routledge.
Oppenheimer Daniel M., Michael C. Frank (2008) — 'A rose in any other font would not smell as sweet: Effects of perceptual fluency on categorization', *Cognition*, 106: 1178–1194.
Ornato Ezio, Carla Bozzolo, Dominique Coq, Denis Muzerelle, Marilena Maniaci, Réjean Bergeron, Francesco Bianchi, Donatella Buovolo, Paola Busonero, M. Giovanna De'Caterina, Carlo Federici, Paola F. Munafò, Lucia Negrini, Marco Palma, Anna Pannega, M. Speranza Storace, Armando Petrucci (1997) — *La face cachée du livre médiéval: L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues*, Roma: Viella.
Osterer Heidrun, Philipp Stamm (2014) — *Adrian Frutiger Typefaces. The Complete Works*, Basel: Birkhäuser.
Osterwalder Fritz, Kurt Reusser (1997) — «Pestalozzis dreifache Methode - innere Vollendung des Menschen, göttliche Ordnung, Buchstabier- und Rechenkunst», *Beiträge zur Lehrerbildung*, 15.3: 304-370.
Ovink Gerrit W. (1938) — *Legibility, Atmosphere-Value and Forms of Printing Types*, PhD thesis, Utrecht: Utrecht University.
——— (1958) — 'Dutch Chocolate Letters', *Typographica*, 15: 26–32.

Paganini Maria (1994) — *Reading Proust: In Search of the Wolf-Fish*, Minneapolis, MN: University of Minnesota Press.
Pandolfo Stefania (2018) — *Knot of the Soul: Madness, Psychoanalysis, Islam*, Chicago, IL: The University of Chicago Press.
Paoli Cristina (2006) — *Mexican Blackletter*, New York, NY: Mark Batty.
Paput Christian (2002) — « Quelques propos sur le Grandjean », in James Mosley et al., *Le Romain du Roi: la typographie au service de l'État*, 1702–2002, pp. 87–94.
Parent Manon (2023) — *Homepage*, online, 2023.10.07, http://manonparent.com/choreography/scarbo/.
Park Jeong-Seon, Hee-Joong Kang, Seong-Whan Lee (2000) — 'Automatic Quality Measurement of Gray-Scale Handwriting Based on Extended Average Entropy', *Proc. 15th Intl. Conf. on Pattern Recognition, Barcelona, Spain, 2000*, (4): 426–429.
Parkes M.B. (1992) — *Pause and Effect: An Introduction to the Punctuation in the West*, London: Routledge.
Pastoureau Michel (2003) — *The Devil's Cloth: A History of Stripes*, New York, NY: Washington Square Press.
——— (2008) — *Black: The History of a Color*, Princeton, NJ: Princeton University Press.

———(2018) — *L'art héraldique au Moyen Âge*, Paris: Seuil.
Paul Cristian (2008) — 'Romanian diacritic marks: How did we end up looking half-illiterate ?', *Kit·Blog*, online, 2018.06.02, http://kitblog.com/2008/10/romanian_diacritic_marks.html.
Paulesu E., J.-F. Démonet, F. Fazio, E. McCrory, V. Chanoine, N. Brunswick, S. F. Cappa, G. Cossu, M. Habib, C. D. Frith, U. Frith (2001) — 'Dyslexia: Cultural diversity and biological unity', *Science*, 291: 2165–2167.
Peiry Lucienne (2004) — *Écriture en délire*, Lausanne / Milan: Collection de l'Art Brut / 5 Continents.
Pellat Jean-Christophe (1988) — « Recensement critique des définitions du graphème », in Nina Catach (ed.), *Pour une théorie de la langue écrite*, Paris: CNRS, pp. 133–146.
Pelli D. G., J. G. Robson, A. J. Wilkins (1988) — 'The design of a new letter chart for measuring contrast sensitivity', *Clinical Vision Sciences*, 2.3: 187–199.
Péretié Jean-Baptiste (interviewer), Annette Wieviorka (interviewed) (2008.01.28–02.01) — 'Annette Wieviorka, militante des archives, Épisode 1/5: En commençant par la fin', *À voix nue, France Culture*, 2008.01.28, https://www.radiofrance.fr/franceculture/podcasts/serie-annette-wieviorka.
Perlow Towa (1931) — *L'éducation et l'enseignement chez les Juifs à l'époque talmudique*, Paris: Ernest Leroux.
Petri Jörg (2019) — *Klassenlose Schrift: Schriftklassifikationen im Wandel analoger und digitaler Typografie*, Kassel: Kassel University Press.
Petronius Arbiter (1925) — *Satyricon*, London: W. Heinemann.
Petrucci Armando (1993) — *Public Lettering: Script, Power and Culture*, Chicago, IL: University of Chicago Press.
Petts Tristan (2021) — *Mindfulness and Traditional Chinese Zen Arts: The Way of Calligraphy, Painting, Kung Fu, and Tea*, London: Daoscape.
Phaidon editors (2000) — *Annunciation*, London: Phaidon.
Philipps Dave (2023.01.09) — 'A Korean War Wall of Remembrance Set Hundreds of Errors in Stone', *The New York Times*, online, 2023.01.09, https://www.nytimes.com/2023/01/09/us/korean-war-memorial-wall-names.html.
Phillips Susan A. (1999) — *Wallbangin': graffiti and gangs in L.A.*, Chicago, IL: University of Chicago Press.
Pierson Michel & Ptyx (2002) — *Un coup de Dés jamais n'abolira le Hasard*, online, 2018.05.04, http://coupdedes.com.
Pigeon Christel, Gérard Lhéritier (2013) — *L'Or des manuscrits: 100 manuscrits pour l'histoire*, Paris: Gallimard / Musée des lettres et manuscrits.
Pinker Steven (1997) — *How The Mind Works*, London: Penguin.
Pisarchik Alexander N., Alexander E. Hramov (2022) — *Multistability in Physical and Living Systems: Characterization and Applications*, Cham: Springer.
Plachta Bodo (2007) — ‚Mehr als Buchgestaltung – editorische Anmerkungen zu Ausstattungselementen des Buches', *edito*, 21: 133–150.
Plautus Titus Maccius (auth.), Paul Nixon (transl.) (1980) — *Plautus: The little Carthaginian, Pseudolus, The rope*, Cambridge, MA: Harvard University Press, vol. 4.
Pollatsek Alexander (2015) — 'The Role of Sound in Silent Reading', in A. Pollatsek, R. Treiman (eds.), *The Oxford Handbook of Reading*, Oxford: Oxford University Press, pp. 185–201.
———, Rebecca Treiman (2015b) — *The Oxford Handbook of Reading*, Oxford: Oxford University Press.
Porck Thijs (2017) — 'Scribal complaints: Early medieval English copyists and their colophons', *Thijs Porck*, online, 2022.12.22, https://thijsporck.com/2017/06/12/scribal-complaints.
Potter Mary C., Brad Wyble, Carl Erick Hagmann, Emily S. McCourt (2014) — 'Detecting meaning in RSVP at 13 ms per picture', *Attention, Perception, & Psychophysics*, 76: 270–279.
Powell Marvin A., Jr. (1972) — 'The Origin of the Sexagesimal System: The Interaction of Language and Writing', *Visible Language*, 6 (1): 5–18.
Prest Julia (2006) — *Theatre under Louis XIV: Cross-Casting and the Performance of Gender in Drama, Ballet and Opera*, New York, NY: Palgrave Maxmillan.
Pries Andreas (2023) — 'Egyptian Writing: Extended Practices', in Andréas Stauder, Willeke Wendrich (eds.), *UCLA Encyclopedia of Egyptology*, Los Angeles, CA: University of California, Los Angeles.
Prost Alain (1979) — 'Review: François Furet, Jacques Ozouf (eds.) (1977), *Lire et écrire: L'alphabétisation des Français de Calvin à Jules Ferry*, Paris: Minuit', *Revue française de pédagogie*, 46: 73–75.
Proust Marcel (1987, 1989) — *À la recherche du temps perdu. Vol. I: Du côté de chez Swann, À l'ombre des jeunes filles en fleurs; Vol. IV: Albertine disparue, Le Temps retrouvé*, Paris: Gallimard.
———(1987b) — *À la recherche du temps perdu. Vol. 1: Du côté de chez Swann*, Paris: Robert Laffont.
———(auth.), Christopher Pendergast (ed.), Lydia Davis (transl.) (2002) — *Swann's Way*, London: Penguin Books.
———(2010) — *Cahier 26, Bibliothèque nationale de France, Nouvelles acquisitions françaises 16666, Vol. I: Fac-similé, Vol. II: Transcription*, Paris: Bibliothèque nationale de France / Brepols.
——— (auth.), William C. Carter (ed.), C. K. Scott Moncrieff (transl.) (2013) — *In Search of Lost Time, Vol. 1: Swann's Way*, New Haven, CT: Yale University Press.
Pyper Nat (2023) — 'A Queer Year of Love Letters: The Goddess Bunny', *Library Stack*, online, 2023.07.07, https://www.librarystack.org/goddess-bunny-the/.

Quintilian (auth.), John Selby Watson (transl.) (1891) — *Institutes of Oratory*, London: George Bell.

Rabane Gala (2021) — *Emojis*, Berlin: Wagenbach.
Rädecker Jochen, Kirsten Dietz (2011) — *Reporting: Unternehmenskommunikation als Imageträger; Ausgesuchte Finanz- und Nachhaltigkeitsberichte weltweit*, Mainz: Hermann Schmidt.
Rafaeli Ari (2005) — *Book Typography*, New Castle, DE & London: Oak Knoll Press & The British Library.
Raillard Georges (2013) — « L'œuvre meurtrière de Félix Vallotton », *La nouvelle Quinzaine littéraire*, 2013.11.16.1093.
Rainey Lawrence, Christine Poggi, Laura Wittman (eds.) (2009) — *Futurism: An Anthology*, New Haven, CT: Yale University Press.
Rawski Evelyn Sakakida (1979) — *Education and Popular Literacy in Ch'ing China*, Ann Arbor, MI: University of Michigan Press.
Reber Rolf, Norbert Schwarz (1999) — 'Effects of Perceptual Fluency on Judgments of Truth', *Consciousness and Cognition*, 8: 338–342.
Reich Steve (1965) — 'It's Gonna Rain', *YouTube*, online, 2022.12.25, https://www.youtube.com/watch?v=vugqRAX7xQE.

Reichle Erik D. (2021) — *Computational Models of Reading: A Handbook*, Oxford: Oxford University Press.
Reinecke Adolf (1910) — *Die deutsche Buchstabenschrift: Ihre Entstehung und Entwicklung, ihre Zweckmässigkeit und völkische Bedeutung*, Leipzig: Hasert.
Reminiscor [= Jan Tschichold] (1972) — ‚Jan Tschichold: praeceptor typographiae', *Typographische Monatsblätter*, 4: 288–312.
Renesse Rudolf L. van (2005) — *Optical Document Security*, Boston: Artech House, 3rd ed.
Renonciat Annie, Marianne Simon-Oikawa (eds.) (2009) — *La pédagogie par l'image en France et au Japon*, Rennes: Presses universitaires de Rennes.
Reuss Roland (2014) — *Die perfekte Lesemaschine: Zur Ergonomie des Buches*, Göttingen, Wallstein.
Rhodes Gillian, Andy Calder, Mark Johnson, James V. Haxby (2011) — *Oxford Handbook of Face Perception*, Oxford: Oxford University Press.
Ribi Thomas (2019.02.04) — ‚Der Mann, der den Ratsherren die Levithen las', *Neue Zürcher Zeitung*, p. 29.
Richaudeau François (1969) — *La lisibilité: Langage, typographie, signes… lecture*, Paris: Denoël.
———, Olivier Biniști (2005) — *Manuel de typographie et de mise en page: Du papier à l'écran*, Paris: Retz.
Ridehalgh Nan (1985) — 'The design of indexes', *The Indexer*, 14.3: 165–174.
RMIT (2018) — *The Story of Sans Forgetica*, Melbourne: RMIT, online, 2018.10.03, https://sansforgetica.rmit.edu.au.
Roberts Matt T., Don Etherington, Margaret R. Brown (1982) — *Bookbinding and the Conservation of Books: A Dictionary of Descriptive Terminology*, Washington, DC: Library of Congress.
Robertson Wes (2015) — 'Orthography, Foreigners, and Fluency: Indexicality and Script Selection in Japanese Manga', *Japanese Studies*, 35.2: 205–222.
Robin Christian (1991) — « Les écritures de l'Arabie avant l'Islam », *Revue du Monde Musulman et de la Méditerranée*, 61: 127–137.
Roif Zack and Matthew Woodward (2019) — *Kern in hell: Hellvetica*, online, 2021.11.08, https://www.zackroif.com/hellvetica.
Rollins Carl Purington (1942) — 'Gilding the Lily: In the design of books there is no sin like complacency', in Earl Schenck Miers, Richard Ellis (eds.), *Bookmaking & Kindred Amenities*, Freeport, NY: Books for Libraries Press, pp. 21–31.
——— (1946) — 'The Psychology of the Book', *Bulletin of the Medical Library Association*, 34.4: 333–335.
Rose Heath (2013) — 'L2 Learners' Attitudes Toward, and Use of, Mnemonic Strategies When Learning Japanese Kanji', *The Modern Language Journal*, 97.4: 981–992.
Rosen Ralph M. (1999) — 'Comedy and Confusion in Callias' Letter Tragedy', *Classical Philology*, 94.2: 147–167.
Rosenberg Anat (2003) — 'Ways of Seeing Advertising: Law and the Making of Visual Commercial Culture', *Law & Social Inquiry*, 48.1: 130–174.
Rosenberger Tara (2001) — *Prosodic Font: The Space between the Spoken and the Written*, MA thesis, Cambridge, MA: Massachusetts Institute of Technology.
Rosenbloom Megan (2020) — *Dark Archives: A Librarian's Investigation Into the Science and History of Books Bound in Human Skin*, New York, NY: Farrar, Straus and Giroux.
Rosenblum Sara, Patrice L. Weiss, Shula Parush (2003) — 'Product and process evaluation of handwriting difficulties: A review', *Educational Psychology Review*, 15.1: 41–81.
Ross Fiona, Alice Savoie, Helena Lekka (2021) — *Women in Type*, online, 2022.12.22, https://www.women-in-type.com.
Ross Perlin (2024) — *Language City: The Fight to Preserve Endangered Mother Tongues*, London: Grove Press.
Röthlisberger Peter (2021) — *Graubünden in 100 Geschichten*, Chur: Somedia.
RTPB (2023) — *Révolution typographique post-binaire*, online, 2023.08.13, https://typo-inclusive.net.
Rubin Gary S. (2013) — 'Measuring reading performance', *Vision Research*, 90: 43–51.
Rück Peter (1993) — ‚Die Sprache der Schrift. Zur Geschichte des Frakturverbots von 1941', in Jürgen Baurmann, Hartmut Günther, Ulrich Knopp (eds.), *homo scribens: Perspektiven der Schriftlichkeitsforschung*, Tübingen: Niemyer, pp. 231–272.
Ruder Emil (1977) — *Typography: A Manual of Design*, Niederteufen: Niggli, 3rd ed.
Ruijgh C. J. (1998) — « Sur la date de la création de l'alphabet grec », *Mnemosyne*, 51.6: 658–687.
——— (2001) — « Le ' Spectacle des lettres ', comédie de Callias (Athénée X 453c–455b), avec un excursus sur les rapports entre la mélodie du chant et les contours mélodiques du langage parlé », *Mnemosyne*, 54.3: 257–335.
Rumbaugh Duane M. (ed.) (1977) — *Language Learning by a Chimpanzee: THE LANA PROJECT*, New York, NY: Academic Press.
Rumble Walker (2003) — *The Swifts: Printers in the Age of Typesetting Races*, Charlottesville, VA: University of Virginia Press.
Russell Helen (2015) — 'Signing off: Finnish schools phase out handwriting classes', *The Guardian*, online, 2018.05.13, https://www.theguardian.com/world/2015/jul/31/finnish-schools-phase-out-handwriting-classes-keyboard-skills-finland.
Russell Richard, Duchaine Brad, Nakayama Ken (2009) — 'Super-recognizers: People with extraordinary face recognition ability', *Psychonomic Bulletin and Review*, 16.2: 252–257.

Saadon-Grosman Noam, Yonatan Loewenstein, Shahar Arzy (2020) — 'The 'creatures' of the human cortical somatosensory system', *Brain Communications*, 2.1: fcaa003.
Sabra Abdelhamid Ibrahim (1989) — *The Optics of Ibn al-Haytham, Books I-III, On Direct Vision*, London: The Warburg Institute.
Sacks Oliver (1998) — *The Man Who Mistook His Wife for a Hat: And Other Clinical Tales*, New York, NY: Touchstone, pp. 8–22.
Sadek George, Maxim Zhukov (1997) — *Typographia polyglotta: A comparative study in multilingual typesetting*, New York, NY: Association Typographique Internationale / The Cooper Union.
Saenger Paul Henry (1997) — *Space between Words: The Origins of Silent Reading*, Stanford, CA: Stanford University Press.
Sahin Abdullah (1998) — 'Mere Exposure: A Review of Theory & Research', *Kurgu Dergisi*, 15: 265–287.
Saif Liana (2024) — 'Athanasius Kircher's Cabala Saracenica: European Reception of the Islamic Science of Letters and Divine Names', *Arabica*, 71: 381–429.
Saint Exupéry Antoine de (1995) — *The Little Prince*, Thorndike, ME: G. K. Hall.
Saint-Simon Louis de Rouvroy, duc de (1865) — *Mémoires complets et authentiques du duc de Saint-Simon sur le siècle de Louis XIV et la Régence*, Paris: Hachette.

Samara Timothy (2002) — *Making and Breaking the Grid*, Gloucester, MA: Rockport.

Sampson Geoffrey (1980) — *Schools of Linguistics: Competition and evolution*, London: Hutchinson.

Sampson Geoffrey (2015) — *Writing Systems*, Sheffield: Equinox.

Sandry Géo, Marcel Carrère (1960) — *Dictionnaire de l'argot moderne*, Paris : Éditions du Dauphin, 5th ed.

Sanocki Thomas, Virginia Rose (1990) — 'Modifiable Letterforms for Teaching Reading: The Graphophonic Alphabet', *Journal of Educational Technology Systems*, 18.3: 173–183.

———, Mary C. Dyson (2012) — 'Letter processing and font information during reading: Beyond distinctiveness, where vision meets design', *Attention, Perception, & Psychophysics*, 74.1: 132–145.

Sappol Michael (2012) — *Hidden Treasures: The National Library of Medicine*, Bethesda, MD: National Library of Medicine.

Sassoon Rosemary (1999) — *Handwriting of the Twentieth Century*, London: Routledge.

———, Adrian Williams (2018) — *Sassoon website*, online, 2018.04.09, http://www.sassoonfont.co.uk.

Sauer Theresa (2009) — *Notations 21*, New York, NY: Mark Batty.

Saussure Ferdinand de (auth.), Wade Baskin (tr.), Perry Meisel, Haun Saussy (eds.) (2011) — *Course in General Linguistics*, New York, NY: Columbia University Press.

Savage-Rumbaugh Sue, Roger Lewin (1994) — *Kanzi: The Ape at the Brink of the Human Mind*, New York, NY: Wiley.

Savage-Smith Emilie (2003) — 'Islamic Magical Texts vs. Magical Artefacts', *The Societas Magica Newsletter*, 11: 1–6.

Savazzi Silvia, Chiara Frigo, Domenico Minuto (2004) — 'Anisometry of space representation in neglect dyslexia', *Cognitive Brain Research*,19: 209–218.

Schaefer Karl R. (2006) — *Enigmatic Charms: Medieval Arabic Block Printed Amulets in American and European Libraries and Museums*, Leiden: Brill.

Schaefer Karl R. (2014) — 'Mediæval Arabic Block Printing: State of the Field', in Geoffrey Roper (ed.), *Historical Aspects of Printing and Publishing in Languages of the Middle East*, Leiden: Brill, pp. 1–16.

Schalansky Judith (2008) — *Fraktur mon Amour*, New York, NY: Princeton Architectural Press.

Schaller Susanne (2002) — 'The German EU numberplates: a typographic road accident ?', *UsefulDesign*, online, 2023.05.01, http://www.fsd.it/usefuldesign/german_plates_font.htm.

Scheffer Bernd, Christine Stenzer, Peter Weibel, Soenke Zehle (eds.) (2014) — *Typemotion: Type as Image in Motion*, Ostfildern: Hatje Cantz.

Schick Irvin (2001) — 'Writing the Body in Islam', *Connect*, 3: 44–54.

Schimmel Annemarie (1990) — *Calligraphy and Islamic Culture*, London: I.B. Tauris.

Schlömer Rüdiger (2018) — *Pixel, Patch und Pattern: Typeknitting*, Mainz: Hermann Schmidt.

Schmandt-Besserat Denise (1996) — *How Writing Came About*, Austin, TX: University of Texas Press.

Schmidt-Hannisa Hans-Walter (2003) — , »Jetzt eß ich das Buch«. Szenarien der Einverleibung von Schrift', *KulturPoetik*, 3.2: 226–245.

Schöning Pascal (2009) — *Bleiwüste: Wissenswertes zur Typographie*, Zürich: Niggli.

Schubert Paul (2011) — 'Editing A Papyrus', in Roger S. Bagnall, *The Oxford Handbook of Papyrology*, Oxford: Oxford University Press, pp. 197–215.

Schwartz Kathryn A. (2009) — 'Charting Arabic Cryptology's Evolution', *Cryptologia*, 33.4: 297–304.

Schweller Ken, Gregg Segal (phot.) (2012) — 'Apes With Apps: Using tablets and customized keyboards, bonobos can become great communicators', *IEEE Spectrum*, 7: 38–45.

Schwesinger Borries (2007) — *Formulare gestalten: Das Handbuch*, Mainz: Hermann Schmidt.

Schwitters Kurt (auth.), Megan R. Luke (ed.), Timothy Grundy (transl.) (2021) — 'Theses on Typography', *Myself and my aims: Writings on art and criticism*, Chicago, IL: University of Chicago Press, pp. 204–205.

Scott Janet Lee (2007) — *For Gods, Ghosts and Ancestors: The Chinese Tradition of Paper Offerings*, Hong Kong: Hong Kong University Press.

Scotford Martha (1994) — 'Messy History vs. Neat History: Toward an Expanded View of Women in Graphic Design', *Visible Language*, 28.4: 367–387.

Scragg Donald G. (1974) — *A History of English Spelling*, Manchester: Manchester University Press.

Seargeant Philip (2009) — *The Idea of English in Japan: Ideology and the Evolution of a Global Language*, Bristol: Multilingual Matters.

Sebba Mark (2009) — 'Sociolinguistic approaches to writing systems research', *Writing Systems Research*, 1.1: 35–49.

See Anik (2008) — *Saudade: The Possibilities of Place*, Toronto: Coach House Books.

Seeley Christopher (1991) — *A History of Writing in Japan*, Leiden: Brill.

Segments (2022) — *Writing Systems — Segments: A Journal of Constructed Languages*, 6, online, 2025.01.15, https://www.reddit.com/r/conlangs/comments/17dh4nj/segments_a_journal_of_constructed_languages_issue/.

Senchyne Jonathan (2020) — *The Intimacy of Paper in Early and Nineteenth-Century American Literature*, Amherst, MA: University of Massachusetts Press.

Seo Audrey Yoshiko (2007) — *Ensō: Zen Circles of Enlightenment*, Boston, MA: Weatherhill.

Seuss Dr. (1955) — *On beyond Z*, New York, NY: Random House.

Shakespeare William (auth.), Colin Burrow (ed.) (2002) — *The Complete Sonnets and Poems*, Cambridge: ~ University Press.

Shah Idries (2016) — *The Book of the Book*, London: ISF Publishing.

Shapiro Arthur, Dejan Todorović (2017) — *Oxford Compendium of Visual Illusions*, Oxford: Oxford University Press.

Shaw Bernard (1915) — *Bernard Shaw on Modern Typography*, Cleveland, OH: Horace Carr.

Shaw Paul (2011) — 'Sixty Years of Book Design at St. Gallen, Switzerland', *TUGboat*, 32.2: 130–137.

——— (2015) — *The Eternal Letter: Two Millennia of the Classical Roman Capital*, Cambridge, MA: MIT Press.

Sherman Nick (2005) — *Bell Centennial: Form & Function. A detailed look at the telephone book typeface*, online, 2018.05.05, http://nicksherman.com/articles/bellCentennial.html.

Shimamura Arthur P. (1987) — 'Word comprehension and naming: An analysis of English and Japanese orthographies', *The American Journal of Psychology*, 100(1): 15–40.

Showman D.J. (1966) — *Studies of Display Symbol Legibility. Part X. The Relative Legibility of Leroy and Lincoln/MITRE Alphanumeric Symbols*, Bedford, MA: The MITRE Corporation.

Shōnagon Sei (auth.), Ivan Morris (transl.) (1982) — *The Pillow Book*, Harmondsworth: Penguin Books.

Siegel Jerry, Joe Shuster (1942) — 'Lair of the Leer', *Superman Daily Newspaper Strip*, February 16 – Mai 23.

Simon Gérard (1988) — *Le regard, l'être et l'apparence dans l'optique de l'Antiquité*, Paris: Seuil.

Simonnet Damien, Eric Anquetil, Manuel Bouillon (2017) – 'Multi-Criteria Handwriting Quality Analysis with Online Fuzzy Models', *Pattern Recognition*, 69: 310 – 324.

SinaSoft (2018) — *Kelk: Calligraphy Software*, online, 2018.05.13, http://www.sinasoft.com/kelk.html.

Singer Edward (1908) — 'Caslon Old Style', *The Inland Printer*, 41: 80.

Sirat Colette, Michèle Dukan (1976) — *Écriture et civilisations*, Paris: Institut de recherche et d'histoire des textes.

Slater Niall W. (2002) — 'Dancing the Alphabet: Performative Literacy on the Attic Stage', in Ian Worthington, John Miles Foley (eds.), *Epea and Grammata: Oral and Written Communication in Ancient Greece*, Leiden: Brill, pp. 117 – 129.

Sluys Félix, Dr. (1961) — *Didier Barra et François de Nomé dits Monsu Desiderio*, Paris: Éditions du Minotaure.

Small David L. (1999) — *Rethinking the Book*, PhD thesis, Cambridge, MA: Massachusetts Institute of Technology.

Smeijers Fred (1996) — *Counterpunch: making type in the sixteenth century, designing typefaces now*, London: Hyphern Press.

Smith Joseph A. (2003) — 'Clearing Up Some Confusion in Callias' Alphabet Tragedy: How to Read Sophocles Oedipus Tyrannus 332 – 33 et al.', *Classical Philology*, 98.4: 313 – 329.

Smith Marc (2023) — *La véridique histoire de l'arobase*, Paris: École nationale des chartes.

Smith Margaret M. (2000) — *The Title-Page: Its Early Development, 1460 – 1510*, London: British Library.

Smith Theodate L. (1912) — *The Montessori System in Theory and Practice*, New York, NY: Harper & Brothers.

Smitshuijzen AbiFarès Huda (2012) — *Typographic Matchmaking: Building cultural bridges with typeface design*, Amsterdam: Khatt Books, 2nd ed.

Snowling Margaret J., Charles Hulme (2005) — *The Science of Reading: A Handbook*, Malden, MA: Blackwell.

———, Charles Hulme, Kate Nation (2022) — *The Science of Reading: A Handbook*, Hoboken, NJ: Wiley-Blackwell, 2nd ed.

Soulellis Paul (2021) — 'What is queer typography ?', *The Type Directors Club Type Drives Communities Conference, 05.07 – 05.08.2021, New York*. https://soulellis.com/writing/tdc2021/

Southall Richard (2005) — *Printer's type in the twentieth century: Manufacturing and design methods*, London: British Library.

Sowersby Kris (2021) — 'How lettering became gendered and why it is wrong', *It's Nice That*, online, 2023.11.28, https://www.itsnicethat.com/articles/kris-sowersby-how-lettering-became-gendered-and-why-it-is-wrong-opinion-261021.

Spencer H. C. (1866) — *Spencerian Key to Practical Penmanship*, New York, NY: Ivison, Phinney, Blakeman & Co.

Spencer Robert C. (1889) — *Spencer Family History and Genealogy*, Milwaukee, WI: s.n.

Spiekermann Erik (1982) — *Ursache & Wirkung: ein typographisches Roman*, Erlangen: Context.

Spiekermann Erik (1982) — *Wirkung & Ursache: ein typographisches Roman*, Erlangen: Context.

——— (2014) — *Stop Stealing Sheep & Find Out How Type Works*, Hoboken, NJ: Adobe Press, 3rd ed.

Spitz René (2019) — ‚Die HfG Ulm und Typographie zur Wissensvermittlung', in Ulrike Borinski, Rudolf Paulus Gorbach (eds.), *Lesbar: Typographie in der Wissensvermittlung*, Zürich: Triest, pp. 90 – 102.

Spitzmüller Jürgen (2013) — *Graphische Variation als soziale Praxis: Eine soziolinguistische Theorie skripturaler ›Sichtbarkeit‹*, Berlin: Walter De Gruyter.

——— (2019) — ‚Lesbarkeit und Typographie: Soziolinguistische Überlegungen', in Ulrike Borinski, Rudolf Paulus Gorbach (eds.), *Lesbar: Typographie in der Wissensvermittlung*, Zürich: Triest, pp. 39 – 50.

Sproat Richard (2023) — *Symbols: An Evolutionary History from the Stone Age to the Future*, Cham: Springer.

———, Brian Roark, Su-Youn Yoon (forthcoming) — *Tools of the Scribe: How writing systems, technology, and human factors interact to affect the act of writing*, Cham: Springer.

Srihari Sargur, Chen Huang, Harish Srinivasan (2008) — 'On the Discriminability of the Handwriting of Twins', *Journal of Forensic Science*, 53.2: 430 – 446.

Stamm Beat (2011) — *The Raster Tragedy at Low-Resolution Revisited: Opportunities and Challenges beyond "Delta-Hinting"*, online, 2018.05.05, http://www.rastertragedy.com.

Stamm Philipp (1997) — 'Extension of the Latin alphabet for the German language', *Typografische Monatsblätter / Swiss Typographic Magazine*, 1: 1 – 20.

Steele Philippa M. (2025) — 'Thoughts on the visual-cultural fit of writing systems, and its intersections with linguistic fit', *Proceedings of Graphemics in the 21st Century, 23 – 25 October 2024, Venice, Italy,* (forthcoming).

Stein Peter (2010) — *Schriftkultur: Eine Geschichte des Schreibens und Lesens*, Darmstadt: Wissenschaftliche Buchgesellschaft, 2nd ed.

Sterne Laurence (1760) — *The Life and Opinions of Tristram Shandy, Gentleman*, London: Lynch, 1st ed.

Stindl Christian (2023) — *Script – Über das Wesen der Schrift*, Zürich: Triest.

Stock-Allen Nancy (2016) — *Carol Twombly: Her Brief but Brilliant Career in Type Design*, New Castle, DE: Oak Knoll Press.

Stoica Daniela (2009) — 'Kafka and the Fate of the Body in a Surveillance Society: A Foucauldian Reading of Franz Kafka's In The Penal Colony', *Newsletter of the Institute of Slavic, East European, and Eurasian Studies, University of California, Berkeley*, 26.3: 19 – 24.

STTV = Schweizerisches Telegraphen- und Telephon-Verwaltung (1930) – *Amtliches Verzeichnis der Telephon-Teilnehmer 1930 – 1931 II*, Bern: STTV. https://www.mfk.ch/forschen/ptt-archiv/

Sumeshiya (2023) — *KOICHI KOSUGI Graphic Park*, blog, online, 2024.11.28, https://www.sumeshiya.com/blog/2022/03/koichi-kosugi-graphic-park.html.

Sun Tzu, Jean Lévi (transl., ed.) (2015) — *L'art de la guerre,* Paris: Fayard.

Svenbro Jesper (1993) — *Phrasikleia: An Anthropology of Reading in Ancient Greece*, Ithaca, NY: Cornell University Press.

Swiss Typefaces (2017) — 'About SangBleu', *Swiss Typefaces*, online, 2023.07.08, https://www.swisstypefaces.com/fonts/sangbleu/#about.

Szwed Marcin, Stanislas Dehaene, Andreas Kleinschmidt, Evelyn Eger, Romain Valabrègue, Alexis Amadon, Laurent Cohen (2011) — 'Specialization for written words over objects in the visual cortex', *NeuroImage*, 56.1: 330–344.

Takagi Mariko (2015) — 'Kanji Graphy: Visual translation between Latin letters and Japanese characters', *LetterSeed, Journal of the Korean Society of Typography,* special issue *'multilingual-typography'*, 11: 8–33.

Tang Hanwen (2012.06.29) — 'Chinese nameplate design for The New York Times', *Type is Beautiful*, online, 2023.09.30, http://www.typeisbeautiful.com/2012/06/5016/.

Tanizaki Jun'ichirō (auth.), Thomas J.Harper & Edward G. Seidensticker (transl.) (1977) — *In Praise of Shadows*, Stony Creek, CT: Leete Island Books.

Tapp Nicholas (1989) — *Sovereignty and rebellion: The White Hmong of Northern Thailand*, Singapore: Oxford University Press.

Tarasov Dmitry A., Alexander P. Sergeev, Victor V. Filimonov (2015) — 'Legibility of textbooks: a literature review', *Procedia: Social and Behavioral Sciences*, 174: 1300–1308.

Tavares André (2024) — *The Anatomy of the Architectural Book*, Canadian Center for Architecture / Lars Müller Publishing, Montreal / Zürich, 2nd ed.

Taylor Gary (2005) — *Buying Whiteness: Race, Culture, and Identity from Columbus to Hip Hop*, New York, NY: Palgrave Macmillan.

Taylor Insup, M. Martin (2014) — *Writing and Literacy in Chinese, Korean and Japanese*, Amsterdam: John Benjamins, rev. ed.

Temperley David (2007) — *Music and Probability*, Cambridge, MA: MIT Press.

Tenenbaum Joshua B., Charles Kemp, Thomas L. Griffiths, Noah D. Goodman (2011) — 'How to Grow a Mind: Statistics, Structure, and Abstraction', *Science*, 331: 1279–1285.

Terstiege Gerrit, Erik Spiekermann (2022) — 'You don't have to interpolate goulash and spaghetti', *otl aicher 100*, online, 2023.10.07, https://www.otlaicher.de/en/articles/you-dont-have-to-interpolate-goulash-and-spaghetti/.

Testolin Alberto, Ivilin Stoianov, Marco Zorzi (2017) — 'Letter perception emerges from unsupervised deep learning and recycling of natural image features', *Nature Human Behaviour*, 1.9: 657–664.

The Type (2019–2021) — *Shanghai Type: a slice of modern Chinese type history*, Collection of Research on Chinese Typography, vol. 1, London: The Type.

Thom René (1975) — *Structural Stability and Morphogenesis: An Outline of a General Theory of Models*, Reading, MA: Benjamin.

——— (1990) — *Apologie du logos*, Paris: Hachette.

———, Laurence Louppe (1991) — 'Partitions du vivant', in Laurence Louppe (ed.), *Danse Tracées: Dessins et Notation des Choréographes*, Paris: Dis Voir, pp. 73–91.

Thomas Rosalind (1992) — *Literacy and Orality in Ancient Greece*, Cambridge: Cambridge University Press.

——— (1999) — 'Writing, Reading, Public and Private "Literacies": Functional Literacy and Democratic Literacy in Greece', in W.A. Johnson, H.N. Parker (eds.), *Ancient Literacies: The Culture of Reading in Greece and Rome*, Oxford: Oxford University Press, pp. 13–45.

Thornton Tamara (1996) — *Handwriting in America: A Cultural History*, New Haven, CT: Yale University Press.

Thorpe Karen (2006) — 'Twin children's language development', *Early Human Development*, 82: 387—395.

Tibbetts G.R., G. Ferrand, Shawkat M. Toorawa, G.S.P. Freeman-Greenville, F. Viré (2002) — 'Wakwak', *The Encyclopaedia of Islam*, Leiden: Brill, 2nd ed., vol. 11, pp. 103–109.

Tiven Benjamin (2012) — ‚Fälschungserschwerende Schrift', *The Serving Library Bulletins*, #3. https://www.servinglibrary.org/journal/3/falschungserschwerende-schrift

Tomonaga Masaki, Tetsuro Matsuzawa (1992) — 'Perception of complex geometric figures in chimpanzees (*Pan troglodytes*) and humans (*Homo sapiens*): Analyses of visual similarity on the basis of choice reaction time', *Journal of Comparative Psychology*, 106.1: 43–52.

Toral-Niehoff Isabel, Annette Sundermeyer (2018) — 'Going Egyptian in Medieval Arabic Culture: The Long-Desired Fulfilled Knowledge of Occult Alphabets by Pseudo-Ibn Waḥshiyya', Nader El-Bizri, Eva Orthmann (eds.), *The Occult Sciences in Pre-modern Islamic Cultures*, Beirut/Würzburg: Ergon Verlag, pp. 249–264.

Trauth Kathleen M., Stephen C. Hora, Robert V. Guzowski (1991) — *Expert Judgment on Markers to Deter Inadvertent Human Intrusion into the Waste Isolation Pilot Plant*, Report SAND92–1382 UC–721, Albuquerque, NM: Sandia National Laboratories.

Trigger Bruce C. (2004) — 'Writing Systems: a case study in cultural evolution', in Stephen D. Huston (ed.), *The First Writing: Script Invention as History and Process*, Cambridge: Cambridge University Press, pp. 39–68.

Trubek Anne (2016) — *The History and Uncertain Future of Handwriting*, New York, NY: Bloomsbury.

Truxius Lidia, Judith Sägesser Wyss, Michelle N. Maurer (2025) — 'Early handwriting development: a longitudinal perspective on handwriting time, legibility, and spelling', *Frontiers in Psychology*, 15: 1466061.

Tschichold Jan (1964) — 'Lecture to the Typography USA seminar sponsored by The Type Directors Club, New York on 18 April 1959', *Print*, 38.1: 16–17.

——— (1969) — 'Of what values is tradition in type design' *Papers of the 11th Congress of the Association Typographique Internationale, June 1969, Prague, Czechoslovakia*, pp. 52–55.

——— (1987) — *Ausgewählte Aufsätze über Fragen der Gestalt des Buches und der Typographie*, Basel: Springer.

——— (1991) — *The Form of the Book: Essays on the Morality of Good Design*, Point Roberts, WA: Hartley & Marks.

——— (1995) — *The New Typography: A Handbook for Modern Designers*, Berkeley: University of California Press.

———(2000) — 'Belief and reality', *Typography papers*, 4: 71–86.

Tselentis Jason (2011) — *Type, Form & Function: A Handbook on the Fundamentals of Typography*, Beverly, MA: Rockport.

Tsikounas Myriam (2008) — « De la gloire à l'émotion, Louis XIV en costume de sacre par Hyacinthe Rigaud », *Sociétés & Représentations*, 26.2: 57–70.

Tsuen-Hsuin Tsien (auth.), Needham Joseph (ed.) (1985) — *Sciences and Civilisation in China, Volume 5: Chemistry and Chemical Technology, Part 1: Paper and Printing*, Cambridge: Cambridge University Press.

Tufte Edward R. (1990) — *Envisioning Information*, Cheshire, CT: Graphics Press.
——— (1997) — *Visual Explanations: Images and Quantities, Evidence and Narrative*, Cheshire, CT: Graphics Press.
——— (2001) — *The Visual Display of Quantitative Information*, Cheshire, CT: Graphics Press, 2nd ed.
——— (2020) — *Seeing with Fresh Eyes: Meaning, Space, Data, Truth*, Cheshire, CT: Graphics Press.
Tullett Barrie (2014) — *Typewriter Art: A Modern Anthology*, London: Laurence King Publishing.
Tursi Dominick M. (2015) — *The Legends of Shorthand*, Morgan Hill, CA: Bookstand Publishing.
Twain Mark (1910) — 'Spelling and pictures', in Mark Twain, *Mark Twain's Speeches*, New York, NY: Harper, pp. 204 – 212.
Twardoch Adam (2002) — 'Pickled Herring and Strawberry Ice-Cream: Designing Polish Diacritics', in Berry John D. (ed.) (2002), *Language Culture Type: International Type Design in the Age of Unicode*, New York, NY: ATypI/Graphis, 148 – 157.
Tzara Tristan (1918) — 'Manifeste Dada 1918', *Dada*, 3: 2 – 4.

Ullman Berthold Louis (1960) — *The Origin and Development of Humanistic Script*, Roma: Edizioni di Storia e Letteratura.
Ullmann Manfred (1972) — *Die Natur- und Geheimwissenschaften im Islam*, Leiden: Brill.
Ulrichs Timm (2018) — unnamed poem, in Eugen Gomringer (ed.), *konkrete poesie*, Dietzingen: Reclam, p. 231.
Underware / Akiem Helmling, Bas Jacobs, Sami Kortemäki (2018) — *Font Fiction*, Den Haag: Underware. http://fontfiction.com
Unger Gerard (1981) — 'Experimental No. 223, a newspaper typeface, designed by W. A. Dwiggins', *Quaerendo*, 11.4: 302 – 324.
Unger J. Marshall (1996) — *Literacy and Script Reform in Occupation Japan: Reading between the Lines*, New York, NY: Oxford University Press.
Unicode Consortium (2017) — *The Unicode® Standard Version 10.0: Core Specification,* Mountain View, CA: The Unicode Consortium.
Updike Daniel Berkeley (1922) — *Printing Types: Their History, Forms, and Use; A Study in Survival*, Cambridge, MA: Harvard University Press, vol. 2.
Updike John (1990.12.16) — 'A Bull in the Typography Shop', *The New York Times*, December 16, 1990, p. 10.
USWDS (2024) — 'Alert', *U.S. Web Design System*, online, 2024.07.14, https://designsystem.digital.gov/components/alert/.

Valero Ramos Elisa (2015) — *Light in Architecture: The Intangible Material*, Newcastle upon Tyne: RIBA Publishing.
Valette Emmanuelle (2018) — « Pois chiche, testicules de bélier et autres images frappantes : écrire à Rome ‹ avec des choses › », in Brisset 2018: 217 – 243.
——— -Cagnac Emmanuelle (1997) — *La lecture à Rome*, Paris: Belin.
VanderLans Rudy, David Barringer (2005) — *Emigre #69: The End*, Berkeley, CA / New York, NY: Emigre & Princeton Architectural Press. https://www.emigre.com/Magazine/69
Van Drempt Nadege, Annie McCluskey, Natasha A. Lannin (2011) — 'A review of factors that influence adult handwriting performance', *Australian Occupational Therapy J.*, 58.5: 321 – 328.
Van Helmont Franciscus Mercurius (2007) — *The Alphabet of Nature*, Leiden: Brill.
Van Leeuwen Theo (2006) — 'Towards a semiotics of typography', *Information Design Jounal + Document Design*, 14.2: 139 – 155.
Van Praag Esther (2007) — 'Introduction to Yemenite Jewish silversmiths (sayegh) in Yemen. Part 2: Use of amulets – Kutub in Yemen', *TEMA: Journal of Judeo-Yemenite Studies*, 10: 97 – 126.
Vogel Fritz Franz, Joseph Kiermeier-Debre (2001) — *Menschenalphabete: Nackte Models,Wilde Typen, Modische Charaktere*, Marburg: Jonas, 2001.
Voss Richard F., John Clarke (1978) — '"1/*f* noise" in music: Music from 1/*f* noise', *Journal of the Acoustical Society of America*, 63.1: 258 – 263.
Vries Jeroen de, Dimitri Schellenberg, Leon Abelmann, Andreas Manz, Miko Elwenspoek (2013) — 'Towards Gigayear Storage Using a Silicon-Nitride/Tungsten Based Medium', *ArXiv*, https://doi.org/10.48550/arXiv.1310.2961.

Walker Alissa (2013.09.17) — 'How The New Yorker Redesigned For the First Time in 13 Years', *Gizmodo*, online, 2018.04.20, https://gizmodo.com/how-the-new-yorker-redesigned-for-the-first-time-in-13-1325328771.
Wallace Shaun, Zoya Bylinskii, Jonathan Dobres, et al. (2022) — 'Towards Individuated Reading Experiences: Different Fonts Increase Reading Speed for Different Individuals', *ACM Transactions on Computer–Human Interactions*, 29.4, article 38, 56 p.
Waller Robert H. W. (1979) — 'Typographic Access Structures for Educational Texts', in Paul A. Kolers, Merald E. Wroldstad, Herman Bouma, *Processing of Visible Language*, New York, NJ: Plenum Press, vol. 1, pp. 175 – 187.
Walter Anton J. (1960) — ‚Schriftentwicklung unter dem Einfluß der Diktaturen', *Mitteilungen des Instituts für Österreichische Geschichtsforschung*, 68: 337 – 361.
Warde Beatrice (1942) — 'A Voice from Embattled Britain: I know what books mean', in Earl Schenck Miers, Richard Ellis (eds.), *Bookmaking & Kindred Amenities*, Freeport, NY: Books for Libraries Press, pp. 15 – 19.
——— (auth.), Henry Jacob (ed.) (1956) — *The Crystal Goblet: Sixteen Essays on Typography*, Cleveland & New York, OH & NY: The World Publishing Company.
Wardrop James (1963) — *The Script of Humanism: Some Aspects of Humanistic Script, 1460 – 1560*, Oxford: ~ University Press.
Warren Richard M., Roslyn P. Warren (1970) — 'Auditory Illusions and Confusions', *Scientific American*, 223.6: 30 – 36.
Watling Gabrielle (2008) — *Cultural History of Reading. Volume 1, World Literature*, Westport, CT: Greenwood Press.
Watt Roger (1993) — 'The visual analysis of pages of text', in Rosemary Sassoon (ed.), *Computers and Typography*, Oxford: intellect, pp. 178 – 201.
Watt William C. (ed.) (1994) — *Writing Systems and Cognition: Perspectives from Psychology, Physiology, Linguistics, and Semiotics*, Dordrecht: Springer Science+Business Media.
Weber Hendrik (2021) — *Italic — What gives* Typography *its emphasis*, Salenstein: Niggli.
Weeber Karl-Wilhelm (1996) — *Decius war hier... Das Beste aus der römischen Graffiti-Szene*, Zürich: Artemis & Winkler.
Weingart Wolfgang (1999) — 'How Can One Make Swiss Typography?', in Michael Bierut, Jessica Helfand, Steven Heller, *Looking Closer 3: Classic Writings on Graphic Design: Criti-*

cal Writings on Graphic Design, New York, NY: Allworth Press.
——— (2000) — *Weingart: Typography. My Way to Typography, Retrospective in Ten Sections*, Baden: Lars Müller.
Wen Haiguang, Junxing Shi, Yizhen Zhang, Kun-Han Lu, Jiayue Cao, Zhongming Liu (2018) — 'Neural Encoding and Decoding with Deep Learning for Dynamic Natural Vision', *Cerebral Cortex*, 28.12: 4136–4160.
Wendt Dirk (1969) — 'O or 0 ?', *Journal of Typographic Research*, 3.3: 241–248.
West Andrew (2013 [2006]) — 'The Rules for Long S', *BabelStone Blog*, online, 2024.07.02, https://www.babelstone.co.uk/Blog/2006/06/rules-for-long-s.html.
White Eric Marshall (2017) — *Editio princeps: A History of the Gutenberg Bible*, London: Harvey Miller.
Wiebelt Alexandra (2004) — *Symmetrie bei Schriftsystemen: Ein Lesbarkeitsproblem*, Tübingen: Max Niemeyer.
———(2005) — 'Do symmetrical letter pairs affect readability ?: A cross-linguistic examination of writing systems with specific reference to the runes', *From Letter to Sound*, 7.2: 275–303.
Wiedeman Reeves (2009.10.16) — 'Jonathan Lethem on the *New Yorker* Font', *The New Yorker*, online, 2018.04.17, https://www.newyorker.com/culture/new-yorker-festival/jonathan-lethem-on-the-new-yorker-font.
Wiley Robert W., Brenda Rapp (2019) — 'From complexity to distinctiveness: The effect of expertise on letter perception', *Psychonomic Bulletin & Review*, 26: 974–984.
Wikimedia contributors, *Wikimedia Commons*, https://commons.wikimedia.org.
Wikipedia contributors, *Wikipedia*, https://en.wikipedia.org.
Wikisource contributors, *Wikisource*, https://en.wikisource.org.
Wiktionary contributors, *Wiktionary*, https://en.wiktionary.org.
Wilson Lex (2023) — *Homepage*, online, 2023.09.30, https://lexwilson.co.uk/projects/.
Willberg Peter (2017) — *Wegweiser Schrift. Was passt, was wirkt, was stört*, Mainz: Hermann Schmidt, 5th ed.
Williams Gisela (2023.04.21) — 'A Meal in Which Bread Was the Starter, the Main and the Dessert', *The New York Times Style Magazine*, online, 2023.04.21, https://www.nytimes.com/2023/04/21/t-magazine/laurel-kratochvila-bread.html.
Wilson Doug (2016.06.20) — *The Beautiful Island of San Serriffe*, online, 2018.05.04, https://medium.com/@realdougwilson/the-beautiful-island-of-san-serriffe-d95adbc5febb.
Wittgenstein Ludwig (1922) — *Tractatus Logico-Philosophicus*, London: Kegan Paul, 1922. Kevin C. Klement (ed.), web edition, v 0.53, 2018.02.05, http://people.umass.edu/klement/tlp/.
——— (2009) — *Philosophical Investigations*, Malden, MA: Blackwell.
Wittner Ben, Sascha Thoma, Timm Hartmann (eds.) (2018) — *Bi-Scriptual: Typography and Graphic Design with Multiple Script Systems*, Zürich: Niggli.
Wolf Maryanne (2008) — *Proust and the Squid: The Story and Science of the Reading Brain*, New York, NY: Harper.
Wollstonecraft Shelley Mary (2011) — *Frankenstein or the Modern Prometheus*, Boston, MA: Fathom Information Design.
Woolf Greg (2009) — 'Literacy or Literacies in Rome ?', in William A. Johnson, Holt N. Parker, *Ancient Literacies: The Culture of Reading in Greece and Rome*, Oxford: Oxford University Press, pp. 46–68.
Woolf Virginia (1924) — *Mr. Bennett and Mrs. Brown*, London: Hogarth Press.
Wozencroft Jon (1988) — *The graphic language of Neville Brody*, London: Thames and Hudson.
Wright Daniel (2021) — 'How Serifs Lost the Road War but Won the Streets', *The Beauty of Transport*, online, 2023.11.14, https://thebeautyoftransport.com/2021/11/03/how-serifs-lost-the-road-war-but-won-the-streets/.
Wulf Friedrich (1922) — ‚Über die Veränderung der Vorstellungen (Gedächtnis und Gestalt)', *Psychologische Forschung*, 1: 333–373.
Wydell Nakayama Taeko, Brian Butterworth (1999) — 'A case study of an English-Japanese bilingual with monolingual dyslexia', *Cognition*, 70: 273–305.
——— (2012) — 'Cross-Cultural/Linguistic Differences in the Prevalence of Developmental Dyslexia and the Hypothesis of Granularity and Transparency', in Taeko N. Wydell, Liory Fern-Pollak (eds.), *Dyslexia – A Comprehensive and International Approach*, Rijeka: InTech, pp. 1–14.

Xiong Ying-Zi, Ethan A. Lorsung, John Stephen Mansfield, Charles Bigelow, Gordon E. Legge (2018) — 'Fonts Designed for Macular Degeneration: Impact on Reading', *Investigative Ophthalmology & Visual Science*, 59.10: 4182–4189.
Xu Bing (2014) — *Book from the ground: from point to point*, Cambridge, MA: MIT Press.

Yates Frances Amelia (1966) — *The Art of Memory*, London: Routledge and Kegan Paul.
Yao Fenghui, Guifeng Shao, Jianqiang Yi (2004) — 'Trajectory generation of the writing–brush for a robot arm to inherit block–style Chinese character calligraphy techniques', *Advanced Robotics*, 18.3: 331–356.
Yu Deyue, Heejung Park, David Gerold, Gordon E. Legge (2010) — 'Comparing reading speed for horizontal and vertical English text', *Journal of Vision*, 10.2: 21.1–17.
Yu Runze (2019.01.22) — 'A Chinese sweet that's a homophone for reunion: Sayings and superstitions [10/12]', *BBC website: Travel*, online, http://www.bbc.com/travel/gallery/20190121-a-chinese-sweet-thats-a-homophone-for-reunion.

Zachrisson Bror (1965) — *Studies in the legibility of printed text*, Stockholm: Almqvist & Wiksell.
Zajonc Robert B. (1968) — 'Attitudinal Effects of Mere Exposure', *Journal of Personality and Social Psychology*, 9 (2.2): 1–27.
Zali Anne (1999) — *L'aventure des écritures: la page*, Paris: Bibliothèque nationale de France.
Zimansky Paul (1993) — 'Review of Denise Schmandt-Besserat: Before Writing, Austin, TX: Texas University Press, 1992', *Journal of Field Archaeology*, 20.4: 513–517.
Zimmer Ben (2010.06.25) — 'Ghoti', *The New York Times Magazine*, online, 2023.12.16, https://www.nytimes.com/2010/06/27/magazine/27FOB-onlanguage-t.html.
Ziolkowski Jan M. (ed.) (2015) — *Dante and Islam*, New York, NY: Fordham University Press.
Zippel Susanne (2011) — 【 *Fachchinesisch Typografie* 】, Mainz: Hermann Schmidt.

0NT01ND3X

This analytical index fulfills three functions: as an *index* for locating topics within the book, as an *ontology* for exploring the book's topical outlook, and as a *commentary* to the book's content. A single page reference may refer to one or more locations on the same page within the body text, footnotes, captions, illustrations, and typefaces used therein. ⇗ 'Describing is interpreting': This often-repeated aphorism applies to the indexed description of this book's contents, our own interpretation of its outlook through which window we invite the readers to not only look ahead but also — leaning this way and that, careful not to fall out of the frame — discover new grapholinguistic perspectives. ↻ Public comment by guide Martina Derada, Grossio prehistorical site, 2020.08.10.

Categories — **Graphosphere:** Languages; Reading; Writing; Script; Handwriting; Typography; Typefaces; Layout; Legibility — **Beings, places, times:** Animals; Persons; Collectives; Schools; Organizations; Companies; Countries, regions, nations; Localities; Edifices; Times — **Ideas & artifacts:** Knowledge; Mentalities; Programs; Works; Technologies; Computers; Food — **Metadata:** This; You

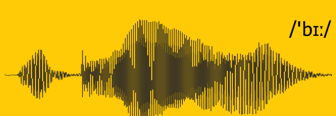
GRAPHOSPHERE

Languages

Reading

Writing

Concepts


/ˈbɪː/

BEINGS, PLACES, TIMES

Animals

Dramatis personae (some imaginary)

Collectives

Schools

Companies

PHOTO BY FRANK BOLLINGER, 1962 © REMINISCOR 1972: 288, ÉCAL 2017: 133–135

Localities

Edifices

Times

IDEAS AND ARTIFACTS

Mentalities

Programs

Works

/'ɛm/

METADATA

Bleiwüſte (*q.v.*) ahead !

Please hydrate before proceeding !

For Erratum read Errata

—

In the paſt, authors used to blame the typeſetters (or copyiſts) for errors in their opuſes, and the latter complained about the former regarding the ſame. I will gladly defer to this cuſtom, as I am both. Because the title of this book is *Ugraphia* for a reaſon, it is entirely poſſible that there has been a misunderſtanding, that the author ſent the wrong content file to the publiſher, or the reader peruſed a different book while believing to read *Ugraphia*.

The **body text** is set in a Caslon revival, the bold, curvy, copious, Falstaffian Hoefler Text (1991) by Jonathan Hoefler & Tobias Frere-Jones, conceived for Apple Computer. **Footnotes** & **annexes** in no-nonsense sanserif Karmina Sans (2009), by Veronika Burian & José Scaglione, published by TypeTogether. **Headings** in Monotype Andalé Mono (1993) by Steve Matteson, face inhabiting a twilight zone between digits & letters. The optotypes paragraph **separators** are in Eyechart (2017) by Peter Wiegel. [1902, 1967, 2132] Imprint & Greek set in Maria Doreuli & Irene Vlachou's William [yes, Caslon] (2018), the ATypI Best Typefaces of the Decade, distributed by Typotheque Type Foundry. [1905] Assorted sorts from Univers Next (2010) by Adrian Frutiger & Linotype Design Studio for Linotype, & TheMix (1994) by Luc{as} de Groot for FontFont. [1908] The cul-de-lampe is the Victorian Gothic Mason Sans (1994) by Jonathan Barnbrook for extraordinaire Emigre. [1909] Dingbats Entypo (2012) by Daniel Bruce. [1910] One of a kind F25 Blackletter Typewriter (2006) by Volker Busse of F25 [1913 etc.] Chinese & Japanese in monumental Source Han Serif & Sans (2014) by Ken Lunde, Masataka Hattori, Zachary Quinn Scheuren, Ryoko Nishizuka, & al. for Adobe, orbicular Hiragino Maru Gothic (2013) by Jiyukobo Ltd. for Dainippon Screen, & exquisite Biau Kai (1995) by DynaLab. [1918] 'Flying letter carpet' manufactured with Ludwig (2019) by Adri Valls, inspired by the typo-calligraphic work of Rudolf Koch (1876–1934), such as Wilhelm Klingspor Gotisch (1926); the captions exemplify the mix of tradition & modernism (monolinear Fraktur & geometrical sanserif) in the New Typography of 1920s Germany, here by Krimhilde (1933/2018) of Albert Auspurg (1868–1943) for Ludwig & Mayer, revived by Ralf Herrmann for FDI. [1919] A summery flanérie full of grace & wonderment with a butterfly on the hat in the world of Sempé is what I associate with Barocca Monograms (2010) by Crystal Kluge/Tart Workshop for Font Diner; Miro's children in Gloss Drop (2015) by Roland Hörmann for phospho; between tattoo & graffiti, chose both, in Feathergraphy Decoration (2011) by Måns Grebäck; for higher dimensions, try Qbicle (2002) by Brian Kent for Ænigma Fonts. The Latin quip is set in Kindersley Street (2005) by The Cardozo Kindersley Workshop & The Grand Arcade Cambridge, an archetypal street-sign typeface familiar to Wittgenstein from his days in Cambridge. By Harald Geisler & Elizabeth Waterhouse, a collector's series of holographs, with allographs selected on-the-fly: Albert Einstein (2017), Sigmund Freud (2013), & Martin Luther King (2023), indexed in Zapfino Extra Ornaments (2003) by Hermann Zapf for Linotype. [1920] The monospaced quotes are the flirting curly typewriter face Pica 10 (1990) by Bitstream, OCR-B (1968) created for machine reading by Adrian Frutiger for Monotype & following standards of the European Computer Manufacturer's Association (ECMA), Courier Sans Mono (1994–2017) by James Goggin with & for Lineto (yes, a sanserif Courier!), & Cinecav X Type (2006) by Raymond Larabie for Typodermic Fonts, created for use in closed caption applications. The typefaces of the Tschichold quotes are Monotype Twenty Century (1936–1947) by Sol Hess (1886–1953), Monotype Bell (1990) originally by Richard Austin (1756–1832) for the publisher John Bell (1745–1831). [1921] Tschichold in Adobe Garamond Premier (2007) by Robert Slimbach, & Bismarck in Linotype Fette Fraktur (1850) by Johann Christian Bauer (1802–1867), captioned in the bellicose Tannenberg (1933/1999) by Erich Meyer (1898–1983) for the Stempel foundry (digitized by Dieter Steffmann). Also the purrring Claw (2001) by Brian Kent for Ænigma Fonts. [1922] Public Sans (2015) by The Public Sans Project Authors [1924] In order of appearance, 18th Century Kurrent Text (2009) by Peter Wiegel, subtitled in Didot (1981), revived by Adrian Frutiger for Linotype; Walbaum Fraktur, created by Justus Erich Walbaum (1738–1893) in 1800, & resurrected by Dieter Steffmann in 2002; Linotype Sabon (1967) by Jan Tschichold; *Neue Zürcher Zeitung* quote set in the arch-typeface of science fiction movies (*2001: A Space Odyssey*, *Star Trek*, *Dr Who*, etc.), Eurostile [Next] (1962/2007) by Aldo Novarese, redesigned by Akira Kobayashi, Terrance Weinzierl, & Linotype Design Studio (the Fraktur inset is in Fette Kanzlei [2012], digitized by Dieter Steffmann). [1925] The grunge typeface is one instance of the parameterizable Beowolf (1990) by Just van Rossum & Erik van Blokland for FontShop, the 3D glyphs are Shadow (c. 2021) by an anonymous designer for an anonymous company; the exciting RSVP by The King and Queen (2007) was concocted by Abraham 'Bran' Beltrán. Karow on Zapf is in the sturdier version of Optima (1958), Optima Nova (2003) by Hermann Zapf & Akira Kobayashi for Linotype; the pixelated font is Atari ST 8x16 System Font (2012) by Annonymous, & the machine-reading typeface Data Seventy (1970) by Bob Newman for Letraset, extending Adobe's MICR (1988) digits to letters; tailpiece in Pixel Invaders (2012), courtesy of Frederic Rich, inspired by the video game *Space Invaders*. [1926] Saint Exupéry quoted in B612 (2018) by Nicolas Chauveau, Thomas Paillot, & Jonathan Favre-Lamarine of intactile Design, Jean-Luc Vinot of DGAC/DSNA & Sylvie Athènes of University of Toulouse III, developed for cockpit displays at the behest of Airbus, & named after the B612 asteroid, home of the 'Little Prince'; the quote on cats is in Macho Modular & Macho Moustache (2010), by Luciano Perondi for Cooperativa Anonima Servizi Tipografici (CAST). [1927] The 'Roman' inscription uses semper viridis Trajan Bold (1989) by Carol Twombly & Robert Slimbach for Adobe, interspread with unavoidable Times New Roman (1932) by Stanley Morison & Victor Lardent for Monotype. [1929] Architectural Nobson (1995) by Paul Nobel, Bauhaus|Lego-colorized by the author. [1930] Logo of IBM's Men in Blue (1998) by Steve Tune for Digital Empires, & the attribution in IBM Plex Sans (2018) by Mike Abbink, Paul van der Laan, & Pieter van Rosmalen for IBM. [1931] The Helvetica slogan is Neue Helvetica (1993) by Linotype for Linotype; the 'remember me' question uses Sans Forgetica (2018), a collaborative psychophysical experiment of Janneke Blijlevens & Jo Peryman from RMIT's Behavioral Business Lab, with Letterbox's designers Stephen Banham & Lan Huang. [1932] Spiekermann is quoted in the anaglyph font Anaglyph (2020) by Lauritta Ivanova for Luxfont, & his name set in Meta (1991) by himself for his own FontFont. [1934] The Monotype magazine extract is in Times Europa (1972) by Walter Tracy for Linotype (no relation to the Brexit [2019] type by Cato Hernes Jensen for Cafe.no, an existential choice between back- & forward-slanted & upright); Sowersby's assertion is set in Epicene (2021) by Kris Sowersby for Klim Type Foundry, & the question in The Goddess Bunny (2023) by Nat Pyper, a commission of Library Stack; Purington Rollins is in Bodoni Classic HD (1997) by Gert Wiescher for FontShop, & Bodoni Script (2008) by Panos Vassiliou for Parachute. [1935] The 'Cost' section is set in Filipine xylographical Maragsâ Display (2020) by John David Maza, pancultural & ecofriendly Pangea Afrika Text (2021) by Christoph Koeberlin & friends for

Fontwerk, protopostcontemporan CSTM Xprmntl 02 (2019) by Ilya Ruderman, Yury Ostromentsky, & Alexander Sukiasov for CSTM, alchemical DTL Fleischmann (18th c./1994) by Johann Fleischmann, revived by Erhard Kaiser for Dutch Type Library, & Trajan Bold. The quadrumvirate quote is in the default fonts Times New Roman, Linotype's Helvetica (1957) by Max Miedinger & Eduard Hoffmann for Haas Type Foundry, Courier (c. 1956) by Howard Kettler for IBM, & ITC Zapf Chancery (1979) by Hermann Zapf; subsequently appears (what else?) neo-antique Papyrus (1983) by Chris Costello for Esselte Letraset; Forssman quote in For Personal Gain (2014) by Matthew Lew, with *Oh!*-like Q drop cap in Vintage Erotique (1999), image scans by Itieu & font by Darrian Lynx. [1932] Sorts Mill Goudy (2010) by Barry Schwartz for all. [1937] Google Noto Emoji (2022). [1940] Dieter Steffmann produced the Gutenberg Textura (2000). [1952] 1001 swashes Osgard (2017) by Anthony James. [1953] Arabesques in DecoType Naskh (1992) by Thomas Milo. [1961] The extravagant Fraktur is Ruritania (1997) by Paul J. Lloyd; the titles to the Louis XIV portraits are set in Dead History (1994) by P. Scott Makela for Emigre, a fusion of Linotype's Centennial & Adobe's V.A.G. Rounded, & [1963] the granitic Mod (2009) by Svetoslav Simov for Fontfabric. [1966] The SAGE typeface is Lincoln/MITRE (1950s/2016), by the Lincoln Laboratory of the Massachusetts Institute of Technology & the MITRE Corporation, remastered by David Bennewith. [1967] Korean in Apple's Myungjo (1997). [1968] Gareth Attrill's UKNumberPlate (2002). [1969] The ampersands zoo is Adobe's Poetica (1992) by Robert Slimbach ; Dieter Steffmann digitized (& hinted !) Rudolf Koch's Wallau (2012). [1970] The *basmalah* is Mishafi (1998) by Diwan Software. [1987] The sage handwriting is Volk Redis (2012) by Peter Wiegel, next to the stern DIN (2005) by Albert-Jan Pool for FSI. [1979] Selected page numbers are set in Climate Crisis (2020) by Eino Korkala & Daniel Coull for the Scandinavian *Helsingin Sanomat* newspaper. [1992] Russisch Brot (1997) is a Linotype typeface by Markus Remscheid & Helmut Ness, the Font Soup Catalan (1997) is a FontFont typeface by Andreu Balius & Joan Carles Pérez Casasín. [2001] Fractal Cadence by Anonymous for Jules Didot (1830s), revived by Jonathan Perez (2009). [2002] The hybrid Antiqua–Fraktur centralschrift (1853) is by C. G. Schoppe, Royal Family (1997) by Patrick Giasson, & Fraktendon (2009) by Boris Kahl. The pseudo-national scripts are 'Arabic' Alhambra (2006) by Harold Lohner, 'Greek' Alfabetix (2001) by Apostrophe, 'Devanagari' Samarkan (1993) of Titivillus Foundry / Ethel Enterprises, 'Japanese' Electroharmonix (2012) by Ray Larabie, & 'Russian' October Guard (2013) by Daniel Zadorozny; & the dragons are Dragons (2012) by kaiserzharkhan for High-Logic. Usual suspects make cameo appearances: the incredible CMU Serif Upright Italic (1986) by Donald E. Knuth, & the inexorable *Rotis* (1988) by Otl Aicher for Monotype. [2006] The South Arabic is Monotype Noto (2017), & the Arabic next to it is Google Droid Naskh (2010) by Pascal Zoghbi. [2011] The bourgeois SangBleu Sunrise (2017) of the imperial, royal, republican SangBleu superfamily by Ian Party, Ilya Ruderman, Yury Ostrowentsky, & Christoph Koeberlin for Swiss Typefaces, CSTM Xprmntl 03 (2023) a Latin–Cyrillic dialogue by Ilya Ruderman & Yury Ostromentsky for CSTM, the-hot-like-potatoes Pilowlava (2019) by Anton Moglia, Jérémy Landes, & Maksym Kobuzan for Velvetyne, the plastical Taklobo (2022) by John David Maza, bubbly One Line (2017) by Roman Korolev, Gerardo Velázquez (2023) by Nat Pyper, based on Gerardo Velázquez's designs for flyers of the 1970s & 1980s US gay underground, & commissioned by Kunsthall Stavanger, Norway, & Act Up Protest Font (2020) by Be Oakley for GenderFail based on protest sign letters. [2022] Cutthroat Hells Kittchen Devil God (2013) by Manuel Viergutz. [2034] The runes are Dwarf Runes (2004) by Daniel Steven Smith for the aficionados. [2035] Jesus Loves You (1993) is the everlasting hit of Lucas de Groot, from the aptly named Eden Design; Flesh Wound (2013) is by Anthony Robinson. [2036] Arabesque in Adobe Naskh (2011) by Muhammad Zuhair Ruhani Bazi & Robert Slimbach. [2039] Iconic iAIconic (2016) by & for Information Architects. [2048] The serifish Hebrew Raanana (1991) is by a good soul for Apple Computer. [2051] Glowing Neonoir (2010) by Roland Hörmann for phospho; 7.19 = *C'est point un œuf* [It's not an egg] in METAFONT alias Fetamont (2017) by Linus Romer. [2065] The Asterix typefaces are Hoefler Text Engraved Two (1991, 2010) by Hoefler & Co. for Hoefler & Co., [2065] Steelplate (2002) by Dieter Steffmann, the Mac oldie but goldie Skia (1993) by Matthew Carter for Apple Computer, & the flowery Scriptina (1999) by Apostrophe for Apostrophic Labs. [2073] 12 to the Moon (2009) by Harold Lohner. [2076] The logotype Allah is DecoType's Thuluth (1992) by Thomas Milo, its Latin transliteration is Liturgisch (1906) by Otto Hupp, digitized by Dieter Steffmann (2002). [2084] Irregular CAST types: a 21th-century face inspired by an 18th-century Baroque model (Fleischmann), Divenire (2012 – 2016) by Luciano Perondi, Valnera (2019) by Riccardo De Franceschi, & Brevier (2014) by Riccardo Olocco. [2119] Visibly Visible Speech VSMetaPlain (2003) by Mark Shoulson. [2120] Chess Cases (1999) by Matthieu Leschemelle, redesigned by Armando Marroquin. [2128] Flowery Piccadilly Script by London Type Foundry (2017) apud Pat & Paul Hickson (1980s) apud Pitman (1931) apud rococo 18th-century copperplate engraving; Greek in fiery Fira Sans (2013) by Erik Spiekermann & al. for Mozilla Corp. ⇗ Additional typefaces and credits appear throughout the book. For any overlooked font, if you find your sheep among mine, I will pay amend upon a wink. Except the movie screenshots, the **illustrations** are by the author, if not otherwise specified. ⇗ The **back cover** manifests Sir Thomas More's Utopian Alphabet (1516/2015), revived by Jeremy Deller & Fraser Muggeridge studio, commissioned by King's College, Courtauld Institute of Art, & Somerset House, for the 500th anniversary of *Utopia*'s publication. My Metamorphosis (2018) changes meaning with viewing distance, an effect realized by encoding Helvetica in the low-frequency spatial band, & Times in the high-frequencies. **Cover subtitle** in OCR-A (1968) by American Type Founders & Adobe, designed for optical character recognition, and standardized by the American National Standards Institute; **cover title** in Fälschungsserschwerende Schrift (1978) by Karlgeorg Hoefer, a digitization by Bryce Wilner (2017) of a German car license plate typeface internationally successful for its tamperproof design and a reminder of the compromises between legibility and myriads of other factors — as I said, '*You can't have the cake & eat it.*' The **frontispiece** & **last folio** pictures are not those of a giant electronic cookie, but of a very edible Swiss-style Sachertorte by the Suard confectionery of Fribourg, referencing the trademark asymmetrical layout of Jan Tschichold (as for the 1937 poster of the 'Konstruktivisten' exhibition in Basel, alluded to in the page design before your eyes) and to the 'Kanizsa triangle' visual illusion. ☾ Hollis 2006: 115, Kanizsa 1987

In memoriam Oleg Grabar

1929 =
(9+50) + (50+60) + (4+1+90+20+700) + (100+1+90+3+5+50) +
(3+60+6+6+5+5) + (7+90+60++300+50+4+100) =

In no darky sarcen coffee grounds You sight'd illegible ornament

= (700+60+300) + (100+9+7+8+200+4) +
(9+30+30+5+7+9+2+30+5) + (60+90+50+1+40+5+50+200)
= 2011

Hail thee, most anonymous reviewers, ghostly proofreaders, & editors! Gay librarians, confessor baristas, sensible dentists! Co-llaborators! These satiated lines are testament to your restorative cheers and scoldings! Prosper in peace! ֍ When you Yannis Haralambous prompted me to take part in a conference on graphemics, you likely would not have foreseen that I would extend my gratitude twice: now for this apostille that grew out of the talk given in Brest at 'Graphemics in the 21st century: From graphemes to knowledge' (14–15 June 2018). ֍ To Florian Coulmas, Gerry Leonidas, Ole Lund, and Richard Sproat, gracious debuggers, for seeing what nobody else saw or will see again. ֍ Merci carrément au docteur J.-M. M. Djibou et aux patients insomniaques de la clinique psychiatrique X de Paris XVIII pour la découverte des surprenantes propriétés soporifiques du présent ouvrage, même à petites doses: la Science reconnait les siens.[*] ֍ This study was supported by the generous grant №17039 of the Hasler Foundation, as well as by a benefaction of the Department of Informatics of the University of Fribourg in Nuithonie. ֍ The piece of cake across this spread is for soothing the reader.[†]

みやげ
お土産
omiyage
Offrand

* 'Dr. J.-M. Science is itself well aware, because in the small doses, Mr. Djibou and psychiatric clinic X has discovered the amazing soporific properties of this book, for the patients with insomnia in the XVIII psychiatric clinic X Paris.' (English translation provided by Google Translate via Turkish.)

† I perform this service by appointment in my castle of Transylvania. Nomen est omen. — Μαθανάσιυ (\O/)

Vlad Atanasiu. 2025. *Ugraphia: The Pursuit of Perfect Legibility.* (Grapholinguistics and Its Applications, Vol. 6). Brest: Fluxus Editions.

This title can be downloaded at
http://fluxus-editions.fr/gla6.php

© 2025, Vlad Atanasiu
Published under the Creative Commons Attribution 4.0 License (CC BY 4.0):
http://creativecommons.org/licenses/by/4.0/

Published with the support of the Swiss National Science Foundation

ISBN: 978-2-4870550-0-1
e-ISBN: 978-2-4870550-1-8
ISSN: 2681-8566
e-ISSN: 2534-5192
DOI: https://doi.org/10.36824/2025-atanasiu

Fluxus Editions
38 rue Émile Zola, 29200 Brest, France
www.fluxus-editions.fr

Dépôt légal: avril 2025 αϛκε

This page displays a perfectly transparent Crystal Goblet inscribed with everything the reader hopes to find within this book. The script is a special one, composed of so-called *boundless characters*, defined as either 'lacking outline boundaries', effectively merging foreground & background into an indistinct oneness, or as 'having infinite size', achieving the same effect. ⇛ There is much more to be said about this page, as is often the case with things that are interesting precisely because they are as imperceptible as secrets written in invisible ink. For instance, it inspires a further spin on ugraphic legibility. If, in premodern Japan, an illiterate person was called 'blind', then a literate person should be someone who sees more than meets the eyes, one who reads between the lines and sees beyond the eggshell of the text. Both Leonardo da Vinci, in Milano/Rome/Amboise, and Johann Heinrich Pestalozzi (1746–1827), in Burgdorf (and, if memory serves, Katsushika Hokusai (1760–1849) in Edo), recommended staring at an empty wall until, through sensory deprivation, the brain begins to create from the void, as a method to improve one's imaginative power. C Griollet 2018: 163 ['blind'], Farago 2018 (2): 619 [LdV], Osterwalder 1997: 333–334 [JHP]

R34D3R'5 M41L

In your savantissime discussion of graphophagia as a modality of legibility, one could aptly reference a well-known passage from Plutarch's (c. 46 – 120s) *Life of Cicero*. In this passage, the Roman rhetorician dedicates to the gods a vase inscribed with the pictographical and etymological representation of his cognomen, a chickpea (*cicer*).[1] In other words, he offers himself — safely literally — for consumption through a graphic metonymy, perhaps to achieve divinity. As master of Tiro, of the Tironian shorthand system fame, he was already enjoying graphologuistic immortality.

— *Achille Poireau* 🫖 *Troyes, France*

I am surprised that the author has not proposed a notation for Ugraphia. One option could be the so-called registration mark, U+2316 ⌖ POSITION INDICATOR, used in printing to visually ascertain the correct superposition of color inks contributing to a legible text.[2] With various graphical variants, the symbol has wide application in engineering for establishing the location of object parts, such as in technical drawing, crash tests, and tracking rocket attitude. For example, the Secchi disk ◔ , developed to measure water turbidity, is more stylized and reminiscent of the yin and yang symbol, thereby introducing a spiritual dimension to otherwise utilitarian pursuits.

— *Tiro Shorthand, President, Isomoji Corp.*

For paleographers, the roots of Ugraphia stretch, unsurprisingly, well before modern legibility research ('Empirics', p. 1915). Around the Mediterranean Basin, fossil evolutionary stages can be found in the archaeological intellectual layers of Ancient Greek optics. At their core are the famous visual rays, considered to be a perceptual-cognitive organ that extends from the eyes and palpates the objects it touches to produce the visual representation of their shape and color, while also providing telemetric data on location, distance, and size.[3] In *Optics*, his geometrical interpretation of vision, Euclid (fl. 300 B.C.E.) postulates that "§7. Things seen within several angles appear to be more clear",[4] which, in relation to reading, describes how the areas of letters falling between visual rays are unseen and explains the need for the eyes to move, to produce by scanning a complete analog picture. From this perspective, legibility is a matter of spatial resolution and equivalent to the digital sampling rate, to use, anachronistically, our contemporary terminology. Ptolemy, an experimentalist using mechanical setups to study vision, also draws upon metaphysical concepts of his age as epistemological frameworks. For instance, the combined theories of four elements and four humors serve to explain presbyopia: the bodily fire of the presbyope's visual rays are not fiery enough to dry the air moisture, which, like mist, blurs objects, forcing the viewer to increase the distance between eyes and object, thus allowing more time to the visual fire to make its salubrious effect.[5] The apparent modernity of the Ancients' science should not detract from being aware of how theoretical constructs and the Zeitgeist fashion their understanding — and ours too — of legibility and Ugraphia.

— *Polyphemus*

27 years later !!!! 100 000 downloads — you are the first to donate — you are awesome !!!!

— *Steve Tune, creator of the Men In Blue font and author of* On the Rewards of Slow Legibility *(Old Digital Empires Inc., forthcoming)*

1 Valette 2018: 219 – 222

2 Wikipedia: 'Printing registration', 'Crash test dummy', 'Secchi disk', 'Position tolerance', 'Fiducial marker'

3 Simon 1988: 31, 99, 124 – 126, 132, 191

4 Euclid 1945: 357, Simon 1988: 21, 66

5 Simon 1988: 111 – 112, 121