Writing, Notational Iconicity, Calculus: On Writing as a Cultural Technique

Sybille Kramer, Anita McChesney

MLN, Volume 118, Number 3, April 2003 (German Issue), pp. 518-537 (Article)

Published by Johns Hopkins University Press
DOI: *https://doi.org/10.1353/mln.2003.0059*

Writing, Notational Iconicity, Calculus: On Writing as a Cultural Technique

Sybille Krämer

1. The Pertinent Issues

Lessing's statement in *Laookon* (XVI), according to which verbal art is bound to temporal succession while pictorial art is bound to spatial simultaneity, canonized the differentiation between word and image once more. The difference between language and image, representation and presentation, the discursive and the iconic became a literary topos in the humanities and has since been adopted in many versions, most recently in Susanne Langer's differentiation between "discursive" and "presentative symbolism" as well as in Nelson Goodman's demarcation of "syntactically dense" and "syntactically disjunctive" symbolic schemata. Even the terms "digital" and "analog" in information technology draw on the same differentiation made by the traditional modes of portrayal. However, the focus here is not on the differentiation itself but rather on the consequences they entail for our conception of writing. Beginning with this presupposition of the divergence between the discursive and the iconic, writing is seen as spatial, fixed speech: it is language and not an image. We will call this assumption the "phonographic doctrine." Such a doctrine excludes phenomena like numerical systems, logical notations, programming languages etc. from being a modality of writing.

The goal of this reflection is to revise the predominant perception of writing as a mere discursive construct by resurrecting a fundamentally visual-iconographic dimension of writing that will be referred to

MLN 118 (2003): 518–537

as "notational iconicity" ("Schriftbildlichkeit"). Writing is a hybrid construct in which the discursive and the iconic intersect. It is only because of its visual potential that an operative use of writing is possible. Attempting to resurrect the implicit iconicity of writing thus means understanding the operative nature of writing as a cultural technique.

2. The Phonographic Doctrine and its Effects

The first step will be to examine certain aspects of the fundamental guidelines for a phonographic understanding of writing. Writing, and phonetic writing in particular, is considered to be a written language and thus to be a medium that is linked to spoken language as its "message." In the words of the handbook on "Schrift and Schriftlichkeit" ("Writing and Its Use") that is considered to be a leading authority in the contemporary debate, writing is "the set of graphic signs by which spoken language is recorded and fixed."[1] Writing is language that has been made visible and thereby fixed. Its ordering system is therefore discursive.

The association of writing and language can even be found in the theories of a radical theoretician of writing, Jacques Derrida.[2] Derrida uses the secondary nature of writing, its dependence on spoken language, as the point of departure for his own procedure of deconstructionism. Derrida, however, reverses writing's dependence on language. For Derrida, writing is the prerequisite of the possibility, but also of the impossibility, for language to constitute a mere system of signs.[3] Yet the phonographic understanding of writing persists nevertheless in this reversed picture. If writing had previously been a manifestation of language, then for Derrida language is a manifestation of writing. Thus, in a philosophy that is devoted to the "linguistic turn," writing takes the place previously occupied by language. This is a position as far removed from images and the imaginary as possible.

[1] Hartmut Günther and Otto Ludwig eds., *Schrift und Schriftlichkeit/Writing and Its Use. Ein interdisziplinäres Handbuch internationaler Forschung* vol. 1 (Berlin/New York: de Gruyter 1994), VIII.

[2] Jacques Derrida, *Grammatologie*, Hanns Zischler and Hans-Jörg Rheinberger trans. (Frankfurt am Main: Suhrkamp 1974; French 1967).

[3] "Die Exteriorität des Signifikanten ist die Exteriorität der Schrift im allgemeinen. Wir werden zu zeigen versuchen, daß es kein sprachliches Zeichen gibt, das der Schrift vorausginge. Ohne diese Exteriorität bricht selbst die Idee des Zeichens zusammen," ibid, 29.

But where is the hidden problem in this constellation? Doesn't the potency of writing depend on its ability to quite literally anchor spoken language in space, a language that is as fluid as it is fleeting, indeed to preserve it, to make it capable of being grasped and exchanged?

This is undoubtedly true. When one understands writing's potential by its interaction with spoken language one can clearly see that this condition occurs not merely through *one* medium but rather through the transference of one medium to another medium, and thus through a medial transition. Writing owes its status as a single medium to the intermediality between *phoné* and *graphé*.[4] However, as long as this intermediality is seen as linguistic *intra*mediality, in other words, as long as writing is seen as the transference of the oral form of language to the graphic form, the graphic-visual dimension of writing is acknowledged only in order to be neutralized in favor of the non-visual discursiveness inherent in language. The obvious result of this neutralization is the doctrine of linearity, or in other words the assumption that writing—and consequentially the text—characterizes itself by embodying a linear and sequential symbolic order. In this context, I cannot discuss the implications of this doctrine on linearity in more detail. Roy Harris[5] and Sabine Groß[6] have already done so in leading texts. The crux of the matter is that the belief in the one-dimensional nature of the written image as a linear series of letters disregards the fact that every written text uses the *two-dimensionality of surfaces*.

Texts, like images, depict a two-dimensional, visible order in space.[7]

[4] Peter Koch, "Graphé. Ihre Entwicklung zur Schrift, zum Kalkül und zur Liste" in Peter Koch and Sybille Krämer eds. *Schrift, Medien, Kognition* (Tübingen: Stauffenburg 1997), 43–82; 47ff.

[5] Roy Harris, "On Redefining Linguistics" in *Redefining Linguistics*, Davis Hayley and Talbot J. Taylor eds. (London/New York: Routledge 1990), 18–52; 39: "Once it is theoretically conceded that language is not confined to oral expression but may also be expressed visually then the principle of linearity has to be abandoned as a foundational principle of linguistics. For visual signs are not necessarily linear."

[6] In contradiction to empirical studies on eye movements during the reading process: an "eindeutige Zuordnung von Nebeneinander und Nacheinander, Statik und Dynamik, hält einer Analyse von Bild- und Textrezeption nicht stand. Selbst die näherungsweise Eindimensionalität des idealen Schriftlesens erweist sich bei genauerer Untersuchung als vielfach gebrochene Linie." Sabine Groß, "Schrift-Bild. Die Zeit des Augenblicks," in *Zeitzeichen*, G.Ch. Tholen ed. (Weinheim: VCH 1990), 238; see also: ibid, *Lese-Zeichen. Kognition, Medium und Materialität im Leseprozeß* (Darmstadt: Wiss. Buchgesellschaft 1994).

[7] Groß, "Schrift-Bild," 236.

Together with simultaneity, this two-dimensionality allows a phenomenon to emerge that is generally overlooked in the examination of alphabetical writing. I am referring to "ideography," which can be understood in terms of what Wolfang Raible calls "visualizing aspects of the content that have no equivalents in the sphere of sound."[8] Even the elementary intervals between words, and also between sentences themselves, lack a physical equivalent in the flow of speech, whereas the pauses in speaking do not correspond to the grammatical structure. Syntactic units and their relations can be differentiated with blanks and punctuation. Capital and non-capital letters make grammatical distinctions visible. In short: grammatical structures can only fully emerge in notational iconicity. Texts can make their "inner" cognitive order visible.[9] The table of contents uses the alphabetic or numerical matrix to articulate the fact that parts of texts not only follow each other sequentially, but also—as elements of the same type—are cognitively situated at the same level. Headings, summaries, and italics offer additional possibilities for making conceptual differences visible in a way that lacks an analogue in the flow of speech. Finally, the relation between texts and footnotes embodies a configuration which cannot even exist without visual aids. "Each footnote is based on the interplay of separating and connecting, which is achieved visually and can only be fully understood, when one 'sees' this relation on the space of the written page."[10] Footnotes create the possibility for writing with many trails, or metaphorically stated, the possibility for a multitude of voices within a text. As we can see, even phonetic writing which is linked to spoken language reveals techniques of depiction that are rooted in two-dimensional, spatial configurations. These techniques contradict the belief that written language refers to spoken language. The text visualizes not the oral phenomena themselves, but rather conceptual contents, such as grammatical categories, as well as relations between thoughts and

[8] Wolfgang Raible, "Von der Textgestalt zur Textheorie. Beobachtungen zur Entwicklung des Text-Layouts und ihre Folgen" in *Schrift, Medien, Kognition. Über die Exteriorität des Geistes*, Peter Koch and Sybille Krämer eds. (Tübingen: Stauffenbeurg 1997), 29–42, 29; see also: ibid, "Die Entwicklung ideographischer Elemente bei der Verschriftlichung des Wissens" in *Vermittlung und Tradierung von Wissen in der griechischen Kultur*, W. Kullmann and G. Althoff eds. (Tübingen: Narr 1993), 15–37.

[9] Wolfgang Raible, *Die Semiotik der Textgestalt* (Heidelberg: Carl Winter 1991), 10ff.

[10] Michael Cahn, "Die Rhetorik der Wissenschaft im Medium der Typographie. Das Beispiel der Fußnote," in *Räume des Wissens. Repräsentation, Codierung, Spur*, H. J. Rheinberger et al. eds. (Berlin: Akademie-Verlag 1997), 91–110; 95–96.

structures for arguments. Phonetic writing harbors the potential for perceptibly representing language as a theoretical entity.

The phonographic belief in writing as an oral language that is visually realized obscures the fact that: (a) texts are a modality of transforming language into spatial iconicity, and that, (b) this "spatial language" can make cognitive entities imaginable, to which language itself belongs if it is treated as a scientific object. Non-perceptual, abstract "logoi" are made accessible to the perceptual register of the "aisthetic," whereas spoken language lacks an analogue for this sensory nature of writing.

However, this fact reveals a further dimension that cannot be grasped by the concept of phonographic writing. As long as writing is defined as a "transcription of spoken language," as a graphically-fixed, spoken language, a further realm of writing-use is overlooked that includes the written signs in mathematics and logic, but also programming languages. In other words, this definition excludes so-called "formal languages" that construct graphical systems *sui generis* and which are all, at best, verbalized retroactively and verbalized only in a limited, fragmentary form.[11] The advantage of conceiving writing as non-phonetic reveals a whole new realm of written phenomena, which will be called "operative writing" in contradistinction to phonetic writing. Calculus is the incarnation of operative writing.[12] This term can be understood as a system of graphical signs comprised of a finite repertoire of discrete elements that serves a dual function. On the one hand, it is a medium for representing a realm of cognitive phenomena. On the other hand, calculus provides a tool for operating hands-on with these phenomena in order to solve problems or to prove theories pertaining to this cognitive realm. Thus, we can, (c) isolate a third type of blindness inherent to the phonographical conception of writing: the omission of operative systems of notation from written phenomena.

[11] Even in linguistics some (albeit few) have defined mathematical-logical notations as forms of language, see: Raible *Die Semiotik der Textgestalt*; ibid, "Die Entwicklung ideographischer Elemente . . ."; Wolfgang Klein "Gesprochene Sprache—geschriebene Sprache" in *Zeitschrift für Literaturwissenschaft und Linguistik* 59 (1985), 9–35.

[12] For more on this understanding of calculus see: Sybille Krämer, *Symbolische Maschinen. Die Idee der Formalisierung in geschichtlichem Abriß* (Darmstadt: Wissenschaftliche Buchgesellschaft 1988); see also: Sybille Krämer, "Kalküle als Repräsentation. Zur Genese des operativen Symbolgebrauches in der Neuzeit" in *Räume des Wissens: Repräsentation, Codierung, Spur*, H. J. Rheinberger, M. Hagner, B. Wahring-Schmidt eds. (Berlin: Akademie Verlag 1997), 112–122.

3. An Alternate Understanding of Writing

If a phonographic understanding of writing necessarily contains the previously mentioned limitations, what might an alternative conceptualization of writing look like? Differentiating three distinct dimensions can help us examine this concept of writing:

(1) Writing as a medium, or the structural aspect. From a medial perspective the significant aspect of writing is its "inter-spatiality," or one could add, its digital nature. How can this media-technological characteristic be more precisely defined in analytic terms?

(2) Writing as a system of symbols, or the referential aspect. If the medium of writing is used as a symbolic system, then this system can make invisible epistemic content visible through its notational iconography. In other words, the symbolic system can bring abstract and theoretical concepts into a perceptual register. Can this act of visualization then also be understood as the constitution of the epistemic concepts that have been made visible?

(3) Writing as cultural technology: the performative aspect. Functioning as cultural techniques, different types of writing correspond to different modes of language-use that cause the referential aspect to be neutralized. How does this open up new realms for cognition and communication?

3.1. Writing as a Medium: On Inter-spatiality as a Structuring Principle

At this point it is necessary to retract an over-simplification. Up until now, this analysis emphasized that writing uses spatiality as a potential for representation. Yet this must be understood more precisely as "*inter-spatiality*," as a spatial modality that depends on spacing and gaps. This distinction provides criteria for differentiating the iconicity of writing from the more common images that work with "dense spatial constellations," in other words without spacing or gaps.

In order to understand this view, one can refer to a concept of writing that, surprisingly enough, has not yet been discovered or elicited response in linguistics or in philosophy,[13] namely the idea of "notation" that Nelson Goodman develops in "Languages of Art." What we have been trying to understand as characteristics of the

[13] An exception is: Martin Fischer, "Schrift als Notation" in *Schrift, Medien, Kognitio*, Peter Koch, Sybille Krämer eds. (Tübingen: Stauffenburg 1997), 83–104.

written medium are described in Goodman's text not in terms of media theory but rather in terms of the theory of the symbolic. For Goodman, a system of symbols must have two distinct characteristics in order to be considered a notation: it must be "disjointed" and it must be "finitely differentiated."[14] "*Disjointness*" ensures that each concrete mark represents exactly one type of sign: written signs form classes of abstractions in which the respective elements do not overlap. The elements within a class, conversely, can represent each other, they can exchange places. "*Finite differentiation*" ensures that written signs are arranged discretely, hence that there is always a gap between two bordering signs. It guarantees that a third sign cannot occupy this place.

Writing is thus a notational medium that, unlike the pictorial medium, works with gaps and/or spacing. This form of the "visibility of spacing" emerges in conjunction with the notions of disjunctiveness and differentiation that are linked to our concept of "inter-spatiality," opening up a modality of visibility that can be described as "syntax-visibility," as a kind of structural visualization. This will be referred to as the notational iconicity ("Schriftbildlichkeit") of writing in order to distinguish it from the pictorial iconicity of conventional images.

The structural elements in this type of iconicity need to be examined in more detail. If we recognize something as the letter "A," is this possible only because having something like a prototype of the letter "A" we recognize the correspondence between type and token in each instance? All attempts to create a universal pattern for the letter A, as well as attempts to work out an idea of the "unity of A" are bound to fail: various forms of an alphabet can always be constructed in which we can effortlessly recognize a letter as "A" even if the physiognomy of this letter does not fulfill the acknowledged visual prototype in any possible way. When we identify letters we are clearly doing something quite different than picturing general types and then comparing these with individual cases at hand. Then, what is it that we are doing?

The letter "A" is individuated in a chain of signs by being "not-B," "not-C," etc. Its identity emerges due to its non-identity with the other marks in the finite repertoire of letters. If we identify two marks as the realization of the same type of sign "A" then this is an imprecise

[14] Goodman 1968, 130ff. For Goodman, however, these characteristics apply not only to writing but also to spoken language.

expression. After all, in both cases it is not the form of a universal type that is the same, but rather the series of operations that select by negation, and that thereby individualize a mark as a certain letter in contradistinction to other letters.

Writing's "notational iconicity" ("Schriftbildlichkeit"), with its traits of being disjunctive and differentiated, is thus a medium that embodies the principle of differentiation and that can implement this process visually. The identity of a sign no longer depends on its concrete physiognomy, but rather exclusively on the *position*—which is characterized by a process of elimination—that it occupies within a configuration as a whole. The point of inter-spatiality that is constitutive for notational iconicity is that it is a principle of visualization that, rather than using shape, uses the "place-within-a-configuration," or in other words, the "place value." This differential iconicity is a trick performed by writing. It gives writing new potential for depiction. This potential will be explored in more detail in the following step.

3.2. Writing as a System of Signs: Constituting the Form of Language through its Notational Iconicity

This next step will look at writing as a system of symbols with which something can be expressed. The aim here is to clearly show that what writing *represents* through the medium of notational iconicity is *constituted* at the same time by this very medium. The act of visualizing the object of reference can be seen as a process of its generation. This is possible insofar as what is depicted in writing are epistemic things, in other words "things of knowledge."[15] While the phonographic understanding of writing is based on the belief that writing refers to spoken language, we argue that writing refers to abstract objects, to more or less theoretical entities that generally remain *invisible*. If this assumption can be maintained, then notational iconicity acquires its potency through the ability to transfer concepts that are merely conceivable and thus invisible to the perceptual register. On a very elementary level, differential iconicity ensures that the things that this representational modality describes, receive the status of a

[15] The discussion of "epistemic things" goes back to the term "epistemisches Ding" and also "Wissenschaftswirkliches" used by Hans-Jörg Rheinberger in *Experiment Differenz Schrift* (Marburg: Basilisken-Presse 1992), 69. The term was originally introduced by Gaston Bachelard.

(differential) *system*. Disregarding all of the complexes and difficulties in the term "system," system is meant here in the basic sense of a totality comprised of elements fulfilling all of the conditions required for a system to emerge that maintains a constant connection between its elements as well as between their transformations. In calling a given phenomenon a system, we imbue it with a *theoretical* characteristic: each phenomenon that is observed in this manner transforms itself through this very descriptive act into an abstract concept. Written structures can make objects-as-systems visible precisely because they can be divided into elements and then reconstructed out of these same pieces. This feature only comes into existence by staging a phenomenon in the medium of writing: only through writing and its specific iconicity can a phenomenon be transformed into a theoretical thing that can then be deemed systematic and analytic. An example can elucidate how this process is to be understood. The example concerns the relation between phonetic writing and language and the fundamental fact that language can only be reconstructed as an arbitrary system of signs if seen as a written language.

Ever since Saussure called language a system,[16] it seems to be a given fact that language can be atomized, in other words, that language is comprised of a repertoire of "final" elements that are themselves indivisible, whether these are termed phonemes, words, or sentences. However, our experience with language-use in no way corresponds to the discrete construction of language. Speaking occurs as a continuum. Certainly there are pauses in the flow of speech, however these pauses do not correspond to phonetic and grammatical sub-divisions. It is just as certain that graphemes form fundamental, divisible elements of our alphabet, as it remains uncertain that individual phonemes form the building blocks of speech—at least, there is no empirical proof of discrete units in verbal speech-flow.[17] This is not surprising. After all, in linguistics phonemes constitute something like a "mute sound." Phonemes are in no way

[16] "Die Sprache bildet ein System von Zeichen" in Ferdinand de Saussure, *Grundfragen der Allgemeinen Sprachwissenschaft*, C. Balley and A. Sechhaye eds., 2nd edition (Berlin: de Gruyter 1967), 18.

[17] "Die Phonologen sind nicht imstande zu zeigen, daß die Unterteilung des Lautstroms in Phoneme eine physikalische Grundlage hat" (192). Notes linguist Florian Coulmas, "Das ABC der Wissenschaft," in *Merkur* 3 (1993), 390–398; see also: Helmut Lüdke, "Die Alphabetschrift und das Problem der Lautsegmentierung" in *Phonetik 20* (1969), 147–176.

auditory stimuli, they function within a network of exclusively structural characteristics, identified by differential relations in the process of selecting a particular phoneme.[18] Many linguists have thus concluded that a phoneme—in contrast to a grapheme—is not an empirical datum, but rather a theoretical construct. Phonemes are seen as an epiphenomenon of letters. This means that the single sound is not a product of speech, but rather results from analyzing spoken language in the medium of writing.

If this assumption can be maintained one gains a new appreciation for the achievements attained with the invention of the phonetic alphabet in ancient Greece: speech is then not only recorded and fixed by writing, but in being represented in the organizational pattern of notational visualization, speech is also isolated, dissected, and individuated at the same time. Phonetic writing therefore not only transcribes language, but also analyzes and interprets it at the same time. Breaking down the flow of speech into abstract, undetectable units that are imperceptible to the senses, produces a scheme, a cartography, through which the sensory richness of oral speech can be spelled out in discrete, abstract linguistic signs.[19] Notational visualization makes the *form* of language visible.

This form can only be seen by disregarding something else. The textual representation of language ignores, first of all, the musicality of speech that is part of the tonal aspect.[20] The artistic practice of the ancient Grecian *musiké* still embodied the unity of word, tone, rhythm, dance, and gesture.[21] The intervention of alphabetic writing divided the *musiké*. The speech phenomenon was stripped of its prosodical qualities, even suspending the function that mimesis and gesture play in understanding: with writing, communication became, for the first time, mere *language-use*. This fissure of music and

[18] Consequentially for Saussure, actual sounds are not a part of language: "Übrigens ist es unmöglich, daß der Laut an sich, der nur ein materielles Element ist, der Sprache angehören könnte," Saussure 1967, 141.

[19] Richard Harder, "Die Meisterung der Schrift durch die Griechen" in *Kleine Schriften*, Walter Marg ed. (Munich: Beck 1960), 81–97.

[20] Corinna Caduff belongs to the few philosophical attempts to regain the musical dimension of language. See Corinna Caduff, "Vom Urgrund zum Supplement. Musik in den Sprachtheorien von Rousseau, Nietzsche und Kristeva," in *Musik und Ästhetik*, 1, 3, 37–54.

[21] On the Greek *musiké* see Thrasybulos G. Georgiades, *Nennen und Erklingen. Die Zeit als Logos* (Göttingen: Vandenhoeckund Ruprecht 1985); see also Hermann Koller, *Musik und Dichtung im alten Griechenland* (Bern: Francke 1963).

language becomes even more apparent in the Greek word for tone (psóphos), which differentiates between the musical tone (phtóngos) and the linguistic sound (phoné).[22]

The relation between the discursive and the pictorial as materialized in phonetic writing produces spoken language as an isolated medium of communication. This act of "producing" is based in the interplay of embodiment and "dis-embodiment." On the one hand, phonetic writing erases the mimetic, gestural, and tonal traces of the human body from language-use; on the other hand, it gives language pure discursive materiality and corporeality. Through this process, the epistemological essence of language achieves a scriptural existence anchored in time and space. Language acquires the status of a thing and/or an object only through this process. The notational iconicity of writing makes the discursiveness of language visible and thus allows it to be schematized. In this regard, writing—to use philosophical jargon—becomes the prerequisite for the possibility of language as a scientific object. Nonetheless, it achieves this status as a "prerequisite for the possibility of 'scientific objectification'" by functioning as a cultural technique.

3.3. An Interjection: Incorporation as a Cultural Anthropological Approach

What does it mean to describe writing as a cultural technique? "Cultural techniques" derive from the semantic field of agriculture and originally referred to technical strategies used to enhance land productivity.[23] In the figurative sense, the techniques of reading, writing, and calculation count as cultural techniques.[24] In our context, we will use the term to identify *strategies for dealing with symbolic worlds*, strategies that are historically and operationally variable and that—in one way or another—are inextricably linked to corporeal routines. Cultural techniques are made routine, semiotic practices that enlarge our capacity for communication and cognition.

"Culture" is commonly understood as the quintessence of compound values and symbolic structures. We will adopt this understanding, while nevertheless shifting the emphasis to the "performative"

[22] Albrecht Riethmüller, "Phoné/vox und Psóphos/sonus bei Aristoteles" in *Colloquia Musicologia, Brno* 1976/1977.

[23] Duden, *Das große Wörterbuch der deutschen Sprache*, vol. 4 (1600).

[24] Brockhaus *Enzyklopädie*, vol. 24, 591.

aspect. "Culture" refers to practices that incorporate non-perceptual phenomena, such as "values" or "sense," into those that have a sensory base in time and space, in other words, those that are discernible. Without incarnation there is no spirit, no meaning, no value, no abstract things—not even God. Cultural practices not only create incorporations, they also pass them on, preserve them, change them, and finally, erase them again. Through embodiment, the immaterial, such as meaning, but also knowledge and information, becomes not only visible and audible, but also becomes, in the most literal sense, *tangible*. This is the trick of semiotic practices. From a medial perspective, semiotics can be reconstructed as a practice of embodiment.

Our use of incorporations oscillates between two poles that can be called "art" and "cultural techniques" or also "imagination" and "calculation." If we connect "art" to the requirements of singularity, complexity of sense, and innovative meaning, then art can only fulfill these requirements because and insofar as it is based in and works with the cultural techniques of making routine, reducing complexity, and neutralizing meaning.[25] Art and cultural techniques are thus no longer types of objects or processes, but are instead complementary methods of stylizing our use of signs. Singularity and regularity, extraordinary and ordinary, fascination and habituation: Cultures' dynamics feed off of this interplay.

At this point it is necessary to correct one aspect of what has been developed thus far. Saying that the imperceptible is embodied and thus becomes discernible appears to almost flawlessly connect to discussions on the incarnation of the ideal that is all too familiar to those in the humanities. Yet the point of embodiment when applied as a cultural-anthropological method is that it gives the idea of "spirit becoming flesh" an *alternate* reading. Not only the immaterial is incorporated in the material, or the non-perceptible in that what can be perceived. Far more, one *medium* is embodied in another *medium* and for this reason the embodied medium becomes discernible as the form of a single medium. Niklas Luhmann made a distinction between medium and form in a way that explains why only forms are

[25] In his media anthropology Pfeiffer also works with the difference between the spectacular and the normal, between stimulation and release. See: K. Ludwig Pfeiffer, *Das Mediale und das Imaginäre. Dimensionen kulturanthropologischer Medientheorie* (Frankfurt am Main: Suhrkamp 1999).

visible while the medium itself remains invisible.[26] The medium constructs a repertoire of loosely-linked elements: the form condenses the medium to a rigid coupling, thus only the form can be seen and not the medium itself. Luhmann also emphasizes that "medium" and "form" are not ontologically fixed phenomena: what is seen as medium and form is exchangeable and depends on the observer's perspective. In the context of the embodiment approach, the significant insight is that Luhmann's differentiation acquires an *intermedial* dimension.

Returning now to the interplay of writing and language, which, through the intermedial dimension of Luhmann's differentiation between medium/form helps to explain two things. First, it explains why the form-of-language-as-a-system is actually manifested in the medium of writing. The systemic nature of writing thus becomes the stage on which language plays a systemic role, in other words, on which it can adopt system-like characteristics. Second, this understanding explains why writing as a medium remains un-thematic and invisible, and will continue to linger latently in the background. These ideas can be carried one step further. The embodiment of writing must first occur in another medium, which can then help shape writing into a form in which it can even emerge as a single medium. This very process occurs with writing through the medium of the computer. Experiences with computer-use might well have first stimulated and provoked a need, but also made it possible, to reflect on "writing." Yet these considerations cannot be explored further at this point. Following this interjection, it is necessary to turn the focus to the cultural-technical perspective of writing.

3.4. Writing as a Cultural Technique: Operative Writing

In the tension between event and repetition, cultural techniques belong on the side of repetition. In contrast to a conception of culture that identifies culture as "created meaning," cultural-technical phenomena show that *creating* and *processing* meaning can only be considered in conjunction with *reducing* and *eradicating* meaning.

[26] Niklas Luhmann, *Die Gesellschaft der Gesellschaft*, 2 vol. (Frankfurt am Main: Suhrkamp 1997), vol. 1, 190–201.

Calculation—if this paradoxical expression can be permitted—can be seen as a form of the "technique of forgetting."[27]

If we understand cultural techniques as operative processes for dealing with symbolic worlds, then the crucial aspect is the de-semantification that is implicit in cultural techniques. A fissure of "operation" and "construction" on the one hand, and "interpretation" and "understanding" on the other, is positioned in such a way that the specifically mechanical, technical aspects of the symbolic cultural practices emerge. The origins of the doctrine of hermeneutics are generally explained as emerging from the spirit of writing and textuality. Yet, an alternate image can be drawn with different accents. Seeing writing as a cultural technique harbors an anti-hermeneutic dimension that is meant to relieve it of some of its burden of interpretation. How is this idea to be understood?

We can explicate this idea with a type of writing in which this "process of de-semantification" is particularly apparent. We will name this process "operative writing" ("operative Schrift"). This modality of writing is commonly known, and misunderstood, as "formal language" and represents one of the fundamental innovations in seventeenth-century science. The achievement of operative writing is that the coupling of representation and operation inherent in this type of writing also incorporates the *de-coupling* of the two. An example from written calculus can elucidate this point.

Long before calculization had advanced to the powerful instrument that it has become in modern science, a form of calculus had established itself in every-day practices. Since the fifteenth century, the decimal place-value system and algorithmic calculus, which is based on this system, have been replacing roman numerals and the use of the abacus. Since the method of writing roman numerals is not organized as calculus, it is impossible to calculate simply and effortlessly with roman numerals, particularly when one needs to calculate extensive numbers. Material aids such as the abacus were required. The spread of the decimal place-value system changed all of this. This system made it possible not only to depict all natural numbers with ten written signs (0, . . . 9), but also to calculate with numbers. The decimal place-value system is both a *medium* for representing numbers and a *tool* for operating with numbers. This invention creates

[27] Sybille Krämer, "Das Vergessen nicht vergessen! Oder: Ist das Vergessen ein defizienter Modus von Erinnerung?" in *Inszenierungen des Erinnerns*, Erika Fischer-Lichte, Gertrud Lehnert eds. *Paragrana* vol. 9 (2000), 251–275; 264ff.

what can be termed a "symbolic machine."[28] Once the simple one-plus-one, one-minus-one, one-times-one, one-divided-by-one, are learned or are provided in a table, it is possible to solve all of the problems in elementary algebra by stereotypically manipulating signs on paper. Numerical calculus can be traced back to mechanical operations with signs.

What does the attribute "mechanical" mean? The rules of calculus apply exclusively to the syntactic shape of written signs, not to their meaning: thus one can calculate with the sign '0' long before it has been decided if its object of reference, the zero, is a number, in other words, before an interpretation for the numeral '0'—the cardinal number of empty sets—has been found that is mathematically consistent.[29] If the one-times-one . . . etc. is given as a written table, then calculation problems can be solved without the person performing calculations even being aware that he or she is not only constructing and deconstructing graphical patterns, but also using *numbers*. More pointedly stated: the spirit can be realized without consciousness and signs can be manipulated without interpretation. This realm separates the knowledge of how to solve a problem from the knowledge of why this solution functions. Knowing recipes and knowing explanations diverge. Precisely this "using without needing to understand" is significant for our use of technical artifacts. The invention of mechanical calculators that accompanies the spread of written calculus in the seventeenth century demonstrates the fact that cognitive operations, in so far as they depend on syntactic manipulation on paper, can also be performed by a real machine. The everyday practice of arithmetic calculus is the precursor of higher mathematics: symbolic algebra, analytical geometry as well as infinitesimal calculus: all these significant innovations of seventeenth-century mathematics are derivatives of the everyday practice of written calculus.[30] And yet, the potency of these calculations is always connected to a move toward de-semantification: the meanings of signs become un-differentiated.

[28] See Sybille Krämer, *Symbolische Maschinen,* 54–71; see also: Sybille Krämer, *Berechenbare Vernunft. Kalkül und Rationalismus im 17. Jahrhundert* (Berlin/New York: de Gruyter 1991), 98–123.

[29] Until the beginning of modern times, the zero was considered to be the sign of a gap in place-value systems: see Johannes Tropfke, *Geschichte der Elementarmathematik*, vol. I: "Arithemtik und Algebra" (Berlin: Walter de Gruyter 1980), 141; mathematicians Stevin (1548–1620) and Wallis (1616–1703) were the first to pose the theoretical question whether zero is a number.

[30] Krämer, *Kalküle als Repräsentation*, 113ff.

Applying this concept to algebra with letters means the following:[31] François Viète's symbolic algebra marks the concrete numerical coefficients of equations with letters (vowels) of the alphabet, just as the unknown coefficients were previously denoted by letters (consonants). His method levels the significant difference between known and unknown numbers to a mere difference in the shape of the letter. Symbolic algebra is thus transformed into the use of a language, or more precisely, into a kind of writing following transformational rules that, for the first time, are universally expressible. To be able to solve an equation is no longer a "secret art form" ("ars magna et occulta"), but rather becomes the form of knowledge of rules that can be taught and learned: an *ars* becomes a *scientia*.[32]

Descartes continues in this tradition with his term "universal quantity," which includes the geometrically measurable size (*magnitudo*) as well as the arithmetical countable size (*multitudo*) without distinguishing between the two. He develops the notion of a universal mathematics (*mathesis universalis*) which creates a unity out of dissimilar scientific phenomena solely by expressing and representing these things in the universal language of mathematics.[33]

Leibniz finally surmounts this use of mathematics as a universal medium for describing quantifiable things by including not only the numerical and the figural but also the logical itself as a possible object of reference in symbolic algebra. He thus transforms symbolic algebra into a formal doctrine of logical calculi. The use of symbols in algebra, as well as in arithmetic, geometry, and logic, is ordered under the art of combination (*ars combinatoria*) as an artistic doctrine of syntactic dealings with signs unable to be interpreted.[34] In the mathematics of infinites, on the other hand,[35] Leibniz uses calculus to successfully characterize his differential and integral calculus as precisely the process of calculation in which the logic of operative

[31] François Viète, *Opera mathematica*, Fr. v. Schooten ed. (1646: Nachdruck Hildesheim 1970), vol. I, 1–12.

[32] Jakob Klein, "Die griechische Logistik und die Entwicklung der Algebra" in *Quellen und Studien zur Geschichte der Mathematik, Astronomie und Physik* 1936, Vol. 3.1 (18–105), Vol. 3.2 (122–235). Klein's work remains the leading study on algebra's "scientification" in its transformation to symbolic algebra.

[33] René Descartes, *Regeln zur Ausrichtung der Erkenntniskraft,* Lüder Gäbe transl. and ed. (Hamburg: Felix Meiner 1979), 13 ff.

[34] See also Krämer, *Symbolische Maschinen*, 269ff.

[35] Gottfried Wilhelm Leibniz, *Historia et Origo calculi differentialis a. G.G. Leibnitio conscripta*, C.I. Gerhardt ed. (Hannover: Hahn'sche Hofbuchhandlung 1846).

functioning rids itself of the interpretative problems of infinitesimal mathematics, independently of the question, for example, whether infinitely small or infinitely large numbers are even actual, existing numbers.[36] We can thus see that operative writing is not only a tool for describing, but also a tool for cognizing, a technique for thinking that enhances intelligence. Long before the computer became a universal medium and a programmable machine, we developed the computer "in ourselves," which is understood here as the cognitive use of algorithmic sign-languages that are freed of the constraints of interpretation.

4. Future Prospects: Digital Writing

Operative writing is by no means the last step in the evolution of the written medium. The computer is generally seen as a universal medium that allows a reciprocal transformation of images, sounds, and writing. It is almost as commonly accepted that the computer, as soon as it has advanced to the status of a leading cultural medium, will supersede the influential role that texts and books had played in "collective memory" up until that point. The transition from the Gutenberg Era to the Turing galaxy is generally seen as a loss of function in writing and textuality.[37] But is this the only possible interpretation? Can the correlation between computer and writing be seen in another way?

As long as we define "writing" through the sound-neutral terms of "disjunctiveness" and "finite differentiation," then no other system of notation meets the requirements of this definition as prototypically as the binary alphabet invented by Leibniz.[38] This is, however, the same digital medium with and on which the computer—embodied in its electrical states—must operate in order to successfully perform

[36] "On n'a point besoin de faire dependre l'analyse mathématique des controverses métaphysiques." See Gottfried Wilhelm Leibniz, *Mathematische Schriften*, C. I. Gernhardt ed., 7 Volumes (Berlin/Halle: 1875–1890; repr. Hildesheim 1965), Vol. 4, 91.

[37] By contrast: Jay David Bolter, W*riting Space. The Computer, Hypertext, and the History of Writing* (Hillsdale: Lawrence Earlbaum 1991); see also: ibid, "Das Internet in der Geschichte der Technologien des Schreibens," in *Mythos Internet*, Stefan Münker Alexander Roesler, eds. (Frankfurt am Main: Suhrkamp 1997), 37–55.

[38] Gottfried Wilhelm Leibniz, *Herrn von Leibniz' Rechnung mit Null und Eins* (Berlin/München: Siemens 3rd edition 1966); on this theory see also: Heinz Gumin, "Die mathematischen Grundlagen der Dualzahlen und ihre Bedeutung für die Technik der Datenverarbeitung" in Leibniz, *Herrn von Leibniz' Rechnung mit Null und Eins*, 33–41.

reciprocal transformations between sound, text, and image. The computer remains a *writing machine*, just as its ability to be pro'gramm'ed ('gramma', greek: 'letter') would lead us to expect. "Writing," however, as understood in its newly acquired sense is far removed from the written manifestation of spoken language.

Let us assume for a moment that "digitalized writing" can be characterized in systematic contrast to "phonetic" and to "operative writing" as its own individual type of writing. Which characteristics, but also which new problems, emerge in the structural, referential, and performative dimensions of the written medium as soon as the modality of writing is at stake which is distinct because it unavoidably depends on the medium of the computer in order to be used and implemented?[39] Is a new cultural technique being born? Answers to this question and also the task of tracing the meaning of "digital writing" require further research. The first contours of these answers emerge if we adopt the established triad: structure-reference-performance.

The structural aspect: The structure of writing that is defined by disjunctiveness and differentiation adopts the principle of inter-spatiality. This constellation-in-space allows us to interpret operative writing as a type of "spatial technique" ("Raumtechnik")[40] in which its iconic potential is rooted. Yet doesn't digital writing draw a distinct boundary for this conception of writing that is, in the broadest possible sense, oriented in and restricted to *space*? A boundary because *temporality*, and not spatiality, is the organizing principle of computer-implemented writing? Can digital writing still even be characterized as a v*isual* structure, in other words, can it still be understood within the principle of "notational *icon*icity" ("Schrift*bild*-lichkeit")? The unique aspect of our study of the symbols belonging to the familiar realm of notational iconicity is that it excludes involvement-as-interaction with symbolic structures. The computer, however, makes it possible not only to operate but literally to *interact* with symbols by implementing *temporality* in the symbolic order, thus furnishing the symbolic universe with attributes of "self-organization" and "reactive-movement." A hint to the effect that the computer

[39] Gernot Grube, *Hypertext als Element einer autooperativen Schrift,* Manuskript Helmholtz-Zentrum für Kulturtechnik (Berlin: Humboldt-Universität 2002).

[40] This term goes back to Werner Kogge's paper named "Schriftbildlichkeit" (2002), which can be found in the manuscript department at the *Helmholtz-Zentrum für Kulturtechnik* at the Humboldt University in Berlin.

actually embodies a new cultural technique can be found in the very fact that it allows this interactive handling of symbolic structures whether these are hypertexts or virtual realities. Each instance of writing that is "staged" and composed only with the help of the computer adopts the character of an "auto-operative-writing" ("autooperative Schrift").[41]

The referential aspect: Writing visualizes theoretical entities and abstract phenomena and thus provides a sensory existence for things that would otherwise not be perceptible. This reference to things that are cognitively invisible acquires a new dimension in digital writing. One can explore more precisely what this means in the context of "scientific visualization" in which computer-generated images emerge through numerical simulations. These innovative techniques of visualization supplement the traditional scientific methods for forming theories and experimenting.[42] The images relevant in this context are disjunctive and finitely differentiated, and are thus fundamentally different from the condensed system of symbols in "common" images. The textual characteristics of this modality of visualization effect what these images refer to: the simulated images are visualizations of numerical values, elements in a process of transformation that includes writing (formulas), numbers (simulation) and images (visualization). Interpretable images referring to excessive amounts of data are created that cannot be interpreted or grasped in their traditional, written form of expression. And yet, these particular data are not acquired by processes of measuring, but rather are generated by the computer itself according to formalized theories. This means, however, that these simulated images are not depictions of complexes of reality, but rather can be seen as "*images of theories*" or as "exemplifications of mathematic models": they represent their own mechanisms of generation.[43]

The performance aspect: When we engage in written calculus, the processes of saving, operating, and representing by and with numbers merge. Operative writing becomes a medium that makes three functions possible simultaneously: work, memory, and representation. This changes with digital writing. If this type of writing is being

[41] This term is created by Grube in *Hypertext als Element einer autooperativen Schrift.*

[42] Gabriele Gramelsberger, *Semiotik und Simulation: Fortführung der Schrift ins Dynamische*, diss., Institut für Philosophie der Freien Universität Berlin (2000).

[43] Ibid, 115ff.

implemented on the computer, the triadic operation-memory-representation can be divided up. This split, however, makes it possible to complete the transition from one function to another by means of a "medial transition" between letters, numbers, and images.

Cultural techniques in writing acquire a new signature with the demands of computer technology, which reveals the boundaries in the notion of notational iconicity ("Schriftbildlichkeit") that is still rooted in spatial relations. The terrain on either side of these boundaries needs to be surveyed. And yet the binary schemata of language *or* image, symbol *or* technique can no longer provide the standard for measuring cultural-technical practices of writing. Writing as a medium is a hybrid construct: it is an intermedial phenomenon.

Anita McChesney, translator.
Freie Universität, Berlin