The traces left by the information designer
Data visualization and enunciation

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ABSTRACT

A common understanding considers information design to be a clear and immediate transfer of information, in which the author disappears to make the data emerge with utmost clarity. This idea of infographics as a transparent and objective medium is questioned by several scholars and practitioners who consider visualization not just as a representation of numbers, but as an interpretative device. In this essay, we will review these positions, with special regard to the use of the semiotic concept of enunciation, which is also beginning to be used in critical design theory and digital humanities. This concept allows us to detect the traces of the act of enunciation in the visual artefact. In particular, we will deal with the recognition of visualization as an act of interpretation, the visual calibration and distancing from one's statement in journalism and scientific communication and the visual reference to the production process in graphic design.

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Introduction

Rather than an emanation of the real, data depends on human responsibility for their collection and elaboration, embedded in different levels of mediation. Giving visibility to those levels of mediation, rather than diminish the credibility of the infographic language, can increase its reliability. The presence of elements that refer to something other than the information to be conveyed seems however to weaken the presumed efficacy of the information artifact, slowing down its reception. It is inevitable however, in any historical or current example of informational graphic design, to find elements that provide information other than the data that it channels: despite the

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naturalization of languages that makes their styles and conventions invisible, every infographic communicates something, if not about its specific author, at least about the moment in history in which it was created, and the technology it relied on.[1] Data visualization therefore has yet another level above and beyond the simple conveyance of information, indicating that any form of communication is situated within a historical era and a social context. Furthermore, the very content channelled by every infographic is always the product of a complex translation process of selection, collection, re-elaboration and visualization of the data. The instance that collects, interprets and translates the data is sometimes required to hide behind the artifact, showing data that seems to naturally emerge out of the phenomenon being communicated.[2] On other occasions, this instance declares its presence, visually illustrating its relationship with knowledge and in particular with the object of its representation. This can occur in journalism in particular when, acknowledging the impossibility of providing certain and verifiable information, the professional elaborates the visual tools that allow them to take some distance from the information. This calibration of collected data is occurring with increasing frequency in scientific communication, when a definitive agreement on precise results has not yet been achieved. In other cases, the author makes their presence explicit, leaving visible traces that make their work comparable to more exquisitely artistic practices. This is the case of what is known as a "data artist", whose personal style must be evident in their visual production. Critical design theory suggests that anyone conducting research with digital means in the field of literary and artistic heritage should always visually elaborate their function as interpreters with a certain point of view, and their specific interests and goals. The critical design that chose this direction,[3] based on studies of literary criticism, rummaged through the drawers of semiotic tools, finding concepts that served to elaborate a theory that questions the simplistic view of communication as the transmission of information and the naïve faith in the heuristic capabilities of data mining.[4] There is thus evidence of a growing interest in the concept of enunciation, borrowed from Benveniste (1966) and applied to visual artifacts that are apparently neutral and objective. The semiotic concept of enunciation

[1] Technically, also the convocation of a reference to a source is something that distracts from the message and refers to the production process. Nevertheless, the presence of a number of responsible *personas* is always considered as a sign of reliability. It's part of the fifth fundamental principle of analytical design for Edward Tufte: "Provide a detailed title, indicate the authors and sponsors, document the data sources…" (Tufte 2006: 133). On the centrality of reference to the sources in the practice of visual journalism, see also Kennedy et al. 2020.

[2] Also in this case, however, an analyst can reconstruct an enunciative praxis as evidence against the apparent neutrality of the information design artifact. See Pignier 2020.

[3] I refer in particular to Drucker 2011, Gitelman 2013 and Loukissas 2019, as we will see in the next paragraphs.

[4] Though much water has flown under the bridge since Chris Anderson's famous "end of theory" and his claim "correlation is enough" (2008), a certain anti-interpretative attitude remains in the ideology of "dataism" (see the critics to dataism by Van Dijck 2014).

thereby acquires pragmatic and not just analytical value, influencing designers to develop graphic artifacts that incorporate their hand and their point of view. Semiotics has thus been recognized the power of providing adequate analytical and even practical tools in constructing critical visual forms for data communication.

1. Transparency and efficacy in information design

Information design is a field at the intersection of design, statistics and computer science, that deals with the elaboration of strategies to convey a message in the clearest and most effective way possible.[5] It has quantitative roots, and a more cognitive-perceptive than semiotic orientation. This discipline's approach is rational and functional. It seeks to define design principles that ensure the optimization of data transmission, conducting empirical research on the effects, such as measuring the effectiveness of the communication in terms of response and comprehension times. The fathers of this "perceptual cognitive-based school of thought" in the world of data visualization (Brasseur 2003: 4) are considered to be the French geographer Jacques Bertin, who worked at the *École Pratique des Hautes Études in Paris* in the 1960s, and the American theoretician and statistician Edward Tufte. In 1967, Jacques Bertin published a work that became a fundamental reference for graphic designers more than for semiologists, titled *Sémiologie Graphique*, an attempt to produce a universal graphic dictionary for infographics and thematic cartography, in which the relationship between expression and content-between the visualization and the data–would be definitively codified in a monosemic system that everyone could use. The book took to the extreme a kind of structural thinking that sought the fundamental elements of every language, basic and unchanging. It offered a highly formalized and codified overview of the languages of infographics and suggested a pragmatic approach that prioritized the efficacy of communication, based on reducing the timeframes for observing and understanding the visual artifact. Like mathematical formulas, the graphics were supposed to have no ambiguity, and univocally and a priori associated to each element of the signifier (to each "variable": color, texture, shape, position on the space of the page) a single meaning, irrevocably established by the legend.

Some decades later, Tufte laid the disciplinary foundations of infographics, seeking out its pioneers in the history of visual communication, and accurately assessing the qualities that the proper communication of information should have: "clarity, precision and efficacy" (Tufte 2001: 13). Tufte's aesthetics thus rested upon ethics: when

[5] As many have noted, it is difficult to pinpoint the origin of this field. Kinross (2004) traces it to the NATO conference on Visual Presentation of Information in 1978, and in the founding of the Information Design Journal in 1979.

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visually communicating information, all forms of distortion must be avoided in order to guarantee the "visual integrity" (Tufte 2001: 53) of the data. What was to be avoided at all costs was distracting attention from the data (and thus the facts) with the decorative forms of illustration that often accompanied them, or manipulating and distorting the data by using non-homogeneous scales. This would lead to the alteration of the information and to the spread of fake news in scientific information and in journalism. The absence of noise in the communication channel would be guaranteed by the transparency of the communicative artefact, the highest ambition of which, like the famous crystal goblet effectively evoked by Beatrice Warde with regard to typography, would be to disappear in order to highlight the colours, the consistency and the scent of the content.[6] The theory of communication on which the above-mentioned approaches were based was the functional mathematical model developed by Claude Elwood Shannon and Warren Weaver (1949), the purpose of which was to ensure the complete transmission of a message from a sender to a receiver. Though the fame of Bertin and Tufte is based on the pragmatic usability of their works, their approaches are far more complex than they seem. Tufte, a scholar with a very open and curious mind, sustains that a good graphic must not only be effective in communicating, it must also be able to tell a compelling story and condense it in a small space: not coincidentally, the canon of good infographics in his opinion lay in a 1869 lithograph by Charles Joseph Minard, a French civil engineer, which represents Napoleon's Russia campaign. This was a work of thematic cartography turned into a narrative tool, a starting point to tell a story. Tufte considered it "the best statistical graphic ever drawn" (Tufte 2001:40), following in the wake of Étienne Jules Marey who before him had appreciated the work for its capacity to "defy the pen of the historian in its brutal eloquence" (Marey 1878: 73). Therefore, despite the functionalist interpretation by some graphic practitioners of the rules set out by Tufte, the American theoretician is well aware of the rhetorical power and narrative effectiveness of the best information graphics.[7]

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[6] The text by Beatrice Warde (1955) lies at the origin of the modernist myth which sustains that typography should be invisible in order to bring out the fullest meaning of the text. Over time this approach has been reinterpreted and criticised, underlining how typography has always been a discourse about the text and not a mere container. For a historical analysis of this dialectic, Kinross 2004. For a criticism of the concept of transparency and neutrality in graphic communication and its relation to the spirit of the times, Lussu et al. 2006, Kinross 2018, Polano 2006, Manchia 2020.

[7] Starting with Gui Bonsiepe, many design theoreticians have insisted on the fact that information design can never be separated from design for persuasion. Even informative texts persuade, just as advertising texts inform. In his fundamental essay on the rhetoric of neutrality, Kinross (1989: 131) quotes Bonsiepe's words: "Informative assertions are interlarded [*durchsetzt*] with rhetoric to a greater or lesser degree. Information without rhetoric is a pipedream which ends in the break-down of communication and total silence. 'Pure' information exists for the designer only in arid abstraction. As soon as he begins to give it concrete shape, to bring it within the range of experience, the process of rhetorical infiltration begins" (Bonsiepe 1965: 30). On rhetoric in information design, fundamental texts also include Buchanan 1985, Kostelnick and Hassett 2003; Kostelnick 2008.

Bertin, on the other hand, published his graphics in magazines such as *Paris Match* and knew perfectly well that his maps, embedded into the context of news reporting, served to support a thesis, even though they were presented in the form of impartial information. Furthermore, as Alex Campolo (2020) convincingly argues, Bertin's overall graphic production, the result of his collaboration with EHESS, reveals a much wider vision of diagrams. This stands in productive contradiction with the simplifying and reductive interpretation that was widely successful and influential among information designers, many of whom deduced an idea of semiology based on the system of one-to-one translation characteristic of Bertin's handbook.

In the ambitious project to establish a general and not exclusively linguistic discipline of semiotics through the methods of sign production, Umberto Eco, who was quite familiar with Bertin's book, included the languages of infographics in the macro-genre of formal mathematical languages, which aimed at optimizing information in geographical maps and other types of diagrams (Eco 1968: 400). As Eco later detailed, formal mathematical languages were founded on an arbitrary relationship between signifier and meaning, characterized by *ratio facilis*, and hence highly codified (Eco 1976: 298). The aspiration to monosemy and efficiency in communication stated in Bertin's handbook thus condemned the languages of data visualization to this type of rigid and strictly denotative attribution, from which any traces of authorship were banned.

2. Information visualization as a tool highlighting the knowable

The ethics, and consequent aesthetics, of transparency in data visualization therefore rest on the conviction that, for the message to be optimally received, the author of that message must disappear and be reduced to mere sender, removing all the traces of an enunciating subject. Johanna Drucker (2020) underscores how this communicative genre tends to make the interpretation work that gave shape to the data disappear in the final display. The image appears as a statement of fact, in which the interpretative dimension must be invisible. Rarely are images called upon to convey the processes of transformation–from the phenomenon to the data and from the data to their visualization. On the contrary, the images must make the greatest effort to hide the complex process of elaboration in order to appear more rigorous and reliable.

In fact, there is a process of double elaboration in data collection and visualization which includes at least two translation devices[8]: on the one hand, designers must

[8] On investigation and scientific publication as a chain of translations, I suggest reading Bastide 1985 and the interesting reinterpretation of it by Manchia (2020) in light of the study of how Otto Neurath's Department of Transformation worked.

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observe and collect data from a source of information; on the other, they must become "transformers" of data into a visual language and convey the message to an audience[9]. They must therefore, first become *observers*, when receiving information about a phenomenon through a further *informer*–that is a source. Then, they themselves must become *informers* when conveying the data they have elaborated and visualized to other observers.[10] As actors, information designers, data and visual journalists and scientific popularizers all share this co-presence of the two roles of informer and observer,[11] as they can either work as a team or gather all the skills within a single person to effectively communicate the facts and phenomena they observe. In their work, data journalists must first find a database on which to base their research; second, they must analyze the data bearing a number of elements in mind: the sources must be reliable, the possible correlations plausible, the numbers normalized. Thirdly, they must build a narrative and make the data tangible in stories that clarify their meaning.[12] In the same way scientists, after examining an object of analysis and extrapolating the elements that are most significant for their research aims, must translate them into a technical language if their goal is to keep the message within their professional area, or into a language that can be understood by a wider audience if their purpose is popularization. Designers supplement these skills with their greater familiarity and wider and more refined stylistic repertoire for the visual elaboration of the message. The first phase in every information design job is therefore the collection of the data. Each designer builds the object of their observation on the basis of a question, an opening, an interest. There are in fact no sources that naturally provide information. No one "gives" data: on the contrary, people take it, collect it. Data is the result of an extraction from a mine of indistinct possibilities. We would do better, wrote Bruno Latour, to call it *sublata* instead of *data*, meaning, according to his own translation, "achievements" (Latour: 1999: 42), the goal of a voluntary act of research and extraction.

According to this constructivist approach to epistemology, based on a hermeneutic tradition and largely followed by contemporary critical design, data are therefore

[9] On the fundamental role of the graphic designer as a "transformer", Otto Neurath wrote memorable pages (1933). He considered this role to be that of a person entrusted with the delicate role of "inventing figurative formations, schemes, appropriate iconic units and metaphors that are pertinent to the content" (Anceschi 2006:62). See also Neurath and Kinross 2009.

[10] In semiotic literature, *informer* and *observer* are two cognitive subjects (not necessarily anthropomorphic) that occupy different positions in the mediation and in the dissemination of knowledge. For a study of the relationships between the two instances of the journalistic discourse read Lorusso and Violi 2004 and Marrone 2022, in particular the paragraph dedicated to "Strategies of Knowledge" (71-75). The inter-definition of the two terms may be found in the entries "Knowing (or Knowledge)", "Informant" and "Observer" in Greimas and Courtès 1979.

[11] Our case studies include journalists who elaborate information graphically–one famous example is Alberto Cairo who is not only a journalist and a designer, but the author of seminal books on data visualization–and scientists who create memorable graphics such as Ed Hawkins with his *Climate Spiral* which has been shared thousands of times and was even projected at the Opening Ceremony of the Rio Olympics in 2016 (Hawkins et al. 2019).

[12] For a practical and intelligent guide to all these phases in the work of a journalist, I suggest J. Gray et al. 2012.

not the ultimate atoms of knowledge, the bricks with which to build information. They are the result of a collection, a selection, and are grouped into categories, built, related. Data indeed are "cultural artefacts, tainted by their own historical and material contingencies" (Loukissas 2019: 182). If duly interrogated, they speak of their conditions of production and the social and technical context in which they are considered significant and rendered pertinent.[13] The very operation of selecting a datum in fact implies the attribution of meaningfulness, the marking of something that is significant with respect to something that isn't. As Lisa Gitelman notes, "like *events* imagined and enunciated against the continuity of time, *data* are imagined and enunciated against the seamlessness of phenomena" (Gitelman and Jackson 2013: 3): they are discrete units, extracted from a flow of information conceived as a continuum.[14] As Gitelman points out, we can always attribute epistemic conditions to data that are very similar to those of the photograph: while on the one hand, we naively recognize the capacity of photography to be the "pencil of nature", according to the famous definition by Henry Fox Talbot, on the other we must recognize that:

> At the very least the photographic image is always framed, selected out of the profilmic experience in which the photographer stands, points, shoots. Data too need to be understood as framed and framing, understood, that is, according to the uses to which they are and can be put (Gitelman and Jackson 2013: 5).

Meaning that data are not generated as pure fragments of reality, but are signifiers at their origin, because a grid of meaning has been imposed on them. There is no such thing therefore as *raw data*, to quote the words of Geoffrey Bowker (2006: 194): data have always undergone some process of preparation and predisposition to being used, even before they are processed and served, and the very way that they are ordered and categorized is the result of contextual choices and decisions. For Johanna Drucker:

> all expressions in human systems are constitutive, non-representational, and content models, forms of classification, taxonomy or information organization, embody ideology. Ontologies are ideologies, through and through, as naming, ordering, and paramaterizing are interpretative acts that enact their view of knowledge, reality and experience and give it form (Drucker 2014: 178-179).

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[13] On this issue, in recent years, the field of digital data hermeneutics has been fighting against the more naive approach of data analysis, revealing technology and in particular AI not as an automated machine but (so far) as a device whose design is based on human interpretation. See Gerbaudo 2016; Romele et al. 2018.

[14] There is nothing new for a semiotician in this idea, given that the construction of signification itself is an extraction of relevances from a continuum. I refer obviously to Hjelmslev 1963. For the way in which practices dictate pertinences, see Prieto 1976.

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It is a short step from this observation to a practical provision: the visualization must raise questions about the presumed transparency of the infographic communication and reveal these very systems that classify and order the existing. To collect and classify data is in itself a form of interpretation. Directing her considerations primarily to an audience of graphic designers, Drucker notes that there is a tendency in this profession to set aside one's critical conscience, no matter how strong it is, when it comes to working on data visualizations. They then become "unquestioned representations of 'what is'" (Drucker 2014: 125), in which the acquisition of the datum appears as a mechanical operation that erases critical distance. It is taken for granted that the relationship between the datum and the world is based on transparency and equivalency. The theoretician thus launches an appeal to make visualizations as little transparent and obvious as possible, and recommends manifesting their situated, partial and constitutive nature. Like Latour for the *sublata*, Drucker also suggests changing the word data and calling them *capta* instead, because they are not something conveyed by an impersonal instance to a passive observer, but something that is actively apprehended with an intention, an interest, a point of view, a subjectivity.

On the side of cartography, a critical approach to landscape (Aït-Touati et al. 2019) proposes to disrupt traditional visualization parameters and introduce new visual and therefore epistemic models through new ways of designing maps. Maps must thus be designed from a point of view that is living and mobile, related to other human and non-human perspectives: a "Point of Life" more than a point of view (Fig. 1). A new paradigm of vision emerges from the multiplication and deformation of the gaze: this opposes the immanence of a partial and multiple view, that can be rooted in the terrestrial soil in many ways, to the transcendent and totalising gaze embodied in the "view from above" of satellite photography (Haraway 1988: 590).

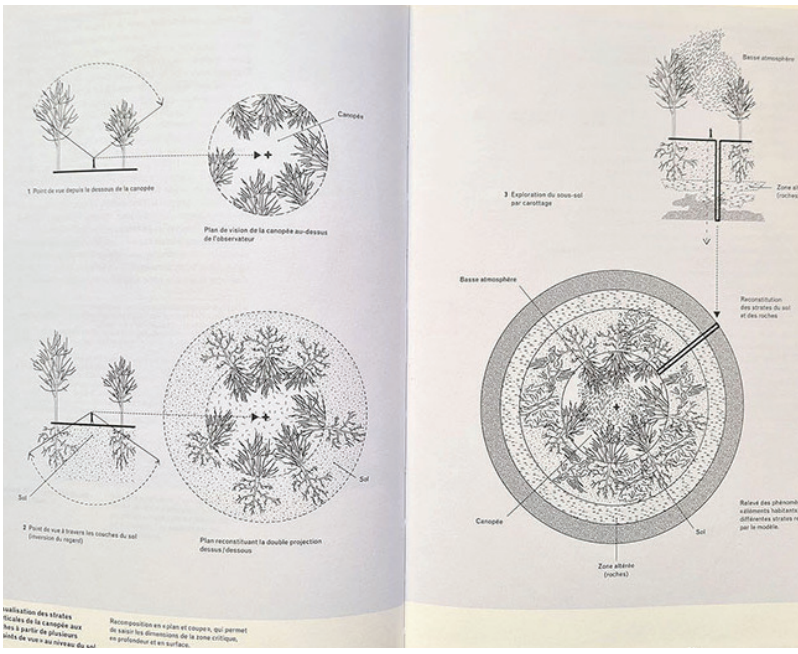

Figure 1. Inversion of the *point of view* (a *point de vue* becoming a *point de vie*) on the world as represented in the book *TerraForma* (Courtesy Société d'Objects Cartographiques. Source: Aït-Touati et al. 2019: 30-31).

3. Visualizing the act of interpretation

Visualizations should therefore contain and highlight the conditions under which they were produced. Drucker makes consistent use of a semiotic concept in her writings, at least since her studies of semantic typography in the early 1990s (Drucker 1994): enunciation. Drucker believes it is necessary to apply this concept to the infographic artefact as well. She in fact observes that:

> In the 1970s and in the 1980s, the concepts of the *speaking* and *spoken* subject of enunciation were applied to film, visual arts, architecture and literary works in all genres and forms. But the artefacts and documents of information–charts, graphs, spread sheets, data formats and expressions–were only rarely, if ever, considered within this critical framework (Drucker 2020: 105).

Drucker expresses the hope that infographics might embody the point of view and the positionality of the subject, referring to forms that inscribe the subject in the representation such as perspective in painting and the point-of-view-shot in film, forms of framing of the real through the perceiving eye of the subject. She attributes the apparent neutrality and objectivity of these graphic expressions to the ideology of the empirical sciences, based on the use of the infographic medium as a mere vehicle, the purpose of which is to deliver information. It is important instead, writes Drucker, to activate a critical conscience that leads us to read infographics as rhetorical arguments given shape by the graphic conventions they use.

It would be worthwhile therefore, to disrupt the construction of the impression of "efficiency, sobriety and seriousness" (Kinross 1989: 384), typical of graphic minimalism and in particular of information design, by visually declaring the existence of an enunciating subject, situated in a specific historical, cultural and ideological place. For Drucker, this must be the starting point for the Digital Humanities, which cannot, by virtue of their original critical and interpretative approach, limit themselves to applying quantitative software such as n-gram to literary texts and historical and artistic archives. They must on the contrary find new expressions to give form to the properties of "ambiguity, nuance, inflection and complexity" (Drucker 2020: 111) characteristic of the humanities, and recognize the "partial, situated and historically/culturally specific acts of understanding that constitute interpretation" (Drucker 2020: 111). They must not entrust the quantitative analysis of data to the automatism of machines, but take action from the very start with a customized, partial and above all openly declared parametrization (Fig.2).

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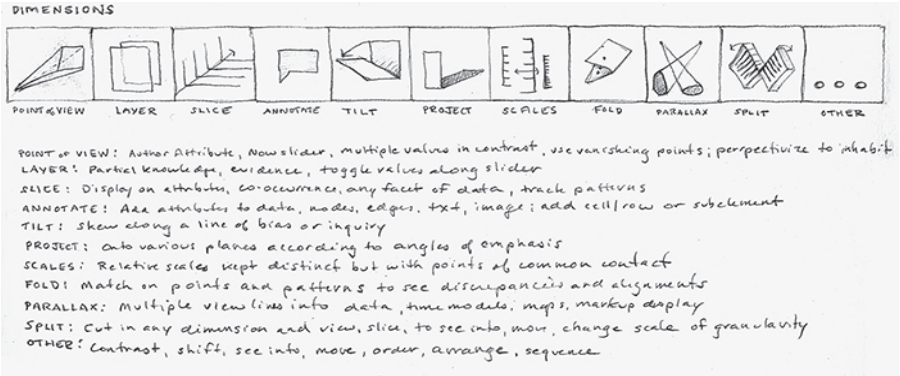

Figure 2. Johanna Drucker's sketches on the new interpretative dimensions that should be used in to the visualization of Digital Humanities' corpuses (Courtesy Johanna Drucker, 3DH Project 2016. Source: Drucker 2020: 168).

There is a substantial difference, according to Drucker, between "the task of representing ambiguity and uncertainty", which may exist in scientific and statistic representations, and "using ambiguity and uncertainty as the basis on which a representation is constructed" (Drucker 2020: 66).[15] Drucker believes that every digital processing of literary and artistic texts-a task that is typical of the Digital Humanities–must from the very start elaborate an interpretative paradigm that is necessarily partial and situated. In the case of scientific communication on the other hand, even the degree of uncertainty of a statement must be submitted to shared objectivization strategies. It must itself be made quantifiable. This occurs, for example, in models of mathematical simulation which must indicate the degree of probability with which one thinks certain scenarios may come true.

In our opinion, actually, this kind of scientific visual construction–using the present as a subjective and situated starting point that triggers hypotheses of the future–belongs to a speculative domain more similar to humanistic formulas. As mathematical functions that are generated and used within the political and economic sphere, simulation models are open to speculative reasoning and lead to genuinely narrative tools such as scenarios, multidirectional forecasts of the future based on mathematical projection calculations.[16] Furthermore, the visualization of ambiguity and uncertainty in journalistic or scientific communication is in and of itself a form of enunciation that

[15] In the semiotic field, Polidoro (2018) traces a difference between a purely quantitative research–where data can emerge from a completely automated procedure–and a quali-quantitative research–where the interpretative nature of data construction must be recognized. Semiotics, seen as a method to approach digital humanities, belongs to this second field.

[16] For Drucker (2020: 49) "even highly speculative economic, climate or population models have not pushed the development of graphical methods that can fully serve to present their basic probabilistic premises (…). We need to develop an inventory of techniques for indicating, for instance, the distinction between what is known and what is projected, pronouncements linked to evidence and speculative rhetoric." In my modest opinion, graphic devices such as fork graphs or future cones, while they are rough and easy-to-understand graphic representations, are effective in providing an understanding of the "if clause" and the unfurling of possible futures from a perspective rooted in the present. I have written about this topic in Burgio and Facchetti 2020.

roots the enunciator in the utterance and expresses their point of view, even though this point of view may be shared by a group of operators and the forms for representing uncertainty are often codified from the start. Representing the degree of certainty of a statement deforms the perceived quantitative datum and ties the observation of the scientist or designer to a specific circumstance of observation. The representation of uncertainty in the scientific sphere has an epistemic value that changes the inflection of the visualization, moving it from an indicative mode, which has the value of a statement, to a conditional mode, based on a hypothesis. The objectivity of scientific graphics, incidentally, is never a matter of being impersonal: that would undermine their reliability. The source of the data must always be indicated and the credibility of the information is based on the trust that is placed in the institution in question (Latour 2013). Whether the data has been collected by the journalists or designers themselves, or whether it has been conveyed by a different source, reporting one's distance from a definitive result is not only an indication of honesty and reliability, it is also a representation of the breadth of the horizon towards which the knowledge aims. Not just the diagrams themselves, but the noise in the diagrams as well and the connected visualization of uncertainty, indeed have heuristic value.[17]

The phase of checking the data, which consists in testing the reliability of the sources and the correspondence between the data and the facts is of the utmost importance, to the point that, in the triad of qualities that a good visualization must possess, the journalist and professor Alberto Cairo places the word "honesty" above the quality that Tufte considered to be key: clarity (Cairo 2016: 13-16; Tufte 2001: 13). To be honest means providing a yardstick to assess the degree of certainty with which certain hypotheses are expressed, and explicitly expressing one's own relationship to the data.

There are various studies on the visualization of uncertainty in infographics, and above all, various attempts to codify it: American geographer Alan MacEachren (1992), convinced that the indication of uncertainty, together with accuracy, coherence and reliability, is a sign of quality, proposes to use further visual categories in addition to the variables that express quantitative variations, to indicate the degree to which one can assert that the data is certain, and to integrate them into the graphics themselves. He therefore proposes, as forms for codifying uncertainty, the use of visual variables that can be expressed in a scale of gradations: the saturation of the selected color, the degree of focus and resolution of the figure (Fig. 3). The degree of focus acts on the contours of the figures (*fuzziness* as opposed to the precision of the lines), erecting a curtain of fog between the analyst and the map. Low resolution, the result of rasterization, makes it hard to see the object. These plastic qualities (fuzziness vs sharpness)[18] lie on a continuum that ranges from maximum

[17] About the heuristic value of noise, see Burgio 2021.
[18] Plastic qualities in a visual artifact are the variables related to their visual form regardless of their being recognizable as figures of the world: colors, shapes and place in the two-dimensional support are the principal ones. The foundational essay explaining the difference between plastic and figurative levels in a visual text is Greimas 1984.

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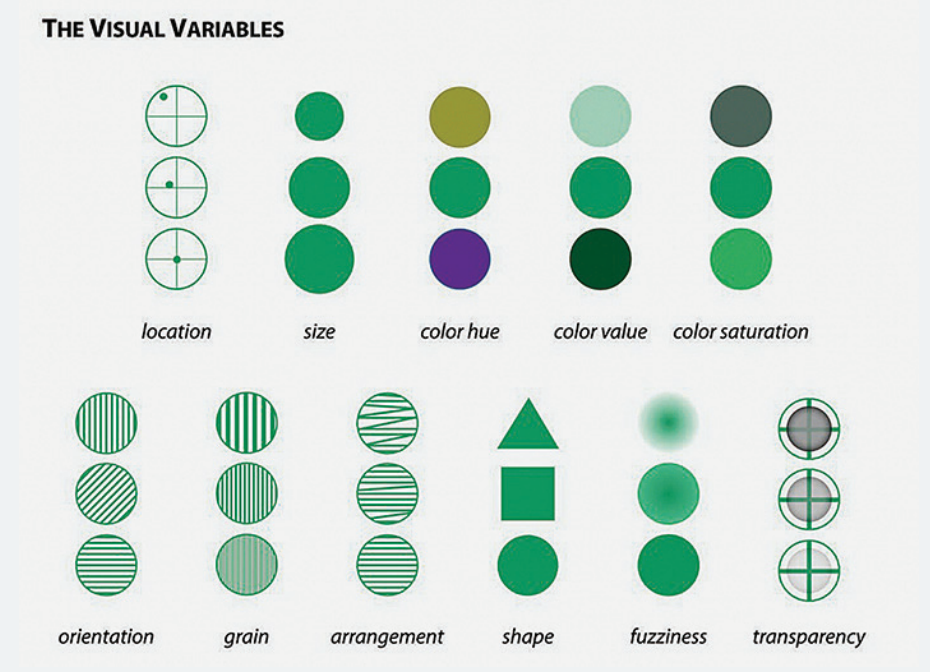

Figure 3. Alan MacEachren's visual variables, some of them aimed to express degrees of uncertainty (Courtesy MacEachren and TVCG. Source: MacEachren et al. 2012: 2497).

transparency (in which the medium is invisible) to maximum opacity, through phases of murkiness and translucency in various forms of mediation of the visibility.

Fuzziness, reminiscent of fog, is a very effective metaphor: working on the classic stratification between vision and knowledge, it uses a blurring effect to indicate something that is uncertain and a focused effect for something that is certain. The blurring effect modalizes the observer in terms of will, it requires an additional semiotic effort and invites them, in this difficult perceptive acquisition, to think about the process involved in every act of knowledge, which is not the result of a sudden enlightenment but of a difficult process in which the mists dispel to make the object of investigation increasingly clear in the distance. The blurring therefore creates a tension in the observing subject on the cognitive level, it challenges them, creates that doubt that compels intellectual action in a dynamic march towards knowledge. The blurring therefore, with its dubitative nature, assigns the informer limited authority; at the same time, in calling the observer to help with the perceptive construction of the object, it accords them an integrative competence. To give the filter of mediation visibility by opacifying it is a statement of an enunciating presence that cements the relationship of trust and mutual support between two figures: the one that informs, partially, and the one that observes, myopically. The knowable, in its possible integrity, remains

in the background, and it is precisely in this possibility of increasing clarity that we find the substantial difference between the two approaches discussed in this essay: a constructivist approach to knowledge (endorsed by critical design studies), by which the point of view inevitably deforms and builds the knowable in its own image and likeness, and a functionalist pragmatic approach (endorsed mainly by professionals such as journalists and scientists) by which the *noumenon*–the ur-informer–exists, in the back and behind the curtain of fog, and it is the observer who must find the means to capture it and express it visually in an increasingly precise manner. In the meantime, however, one can always state one's specific point of departure and arrival and inscribe one's personal relationship to knowledge into the visual text.

4. Enunciation in graphic design

The analysis of enunciation therefore makes it possible to study "the ways in which values, passions and ideologies are embodied within visual enunciations" (Dondero 2020: 16). Any visual enunciation thus connects an *assertion* (what is said) to an *assumption* (the appropriation of what is said by the subject).[19] The strategies we hinted at in the paragraph above indicate an assumption of limited responsibility on the part of the informing subjects, whose competence is cast in doubt by the incapacity to clearly see: they let you know (inform) but do not make you believe (do not persuade), inflecting certainty towards probability.[20] This assumption of limited responsibility is visualized by means of optical devices–deformation, distortion, blurring–which create a distance between the enunciator, their object of observation and the content they communicate. Exercising blurring or distortion in fact simulates the presence of an optical filter and thereby modulates a visual competence. These optical devices opacify a medium that traditionally bases its reliability on transparency,[21] and shift the spectator's attention to the information's elaboration process rather than the information itself.

Though it is nurtured by statistics and bases its essential aesthetics on analytical geometry, the infographic, as a visual artifact for mass communication, is a graphic design product. It therefore follows the evolution of this discipline, which originally had to do with the invention of a multiple artifact manufactured through processes of industrial

[19] The analysis of the mechanism of engagement as a tie between an assertion and an assumption is fully explained in Fontanille 2003, in particular in chapter VI, and further examined by Dondero 2020.
[20] For Greimas and Courtès (1982), certainty and probability are complementary epistemic modes, which belong to the same graduated scale. On this issue, see also Greimas 1983: 116-118.
[21] The speculation on the presence of a reflective plane–presentation–that distances the spectator from the content of the visual artifact–representation–refers to the categories elaborated by Marin 2002.

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production. Today, graphic design has adapted its practices to the processes of digital production, distribution and utilization. Because the realm of graphic design is dominated by series production, by definition it produces multiple artifacts.[22] To design thus means to evaluate in advance the forms of artifacts on bases that include production strategies, the material qualities of the supports and the forms of distribution.[23]

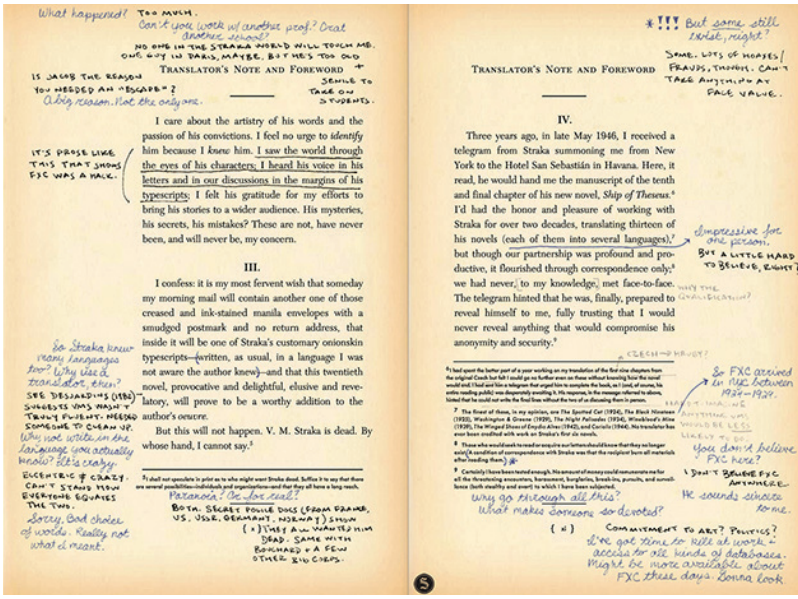

Figure 4. Internal page of the book S. featuring comments of two fictious readers (Source Abrams and Dorst 2013).

The digital image, produced with software and infinitely reproducible, is conceived to be a multiple–at least before the rise of NFTs. In digitally produced graphic design, all traces of the author and of the technology used may be read as staging a foundational memory. As in, for example, the visualization of the rough low-resolution grain of early desktop systems and the magnification of the bitmap (Lupton 2010: 29-30; Licko & Vanderlans 1989), or the fake soiling of the digital image by certain illustrators[24]; or the retro and vintage aesthetics that characterize contemporary graphics and fashion both. All these experiences seek to bring a fictitious material quality to images built entirely by computer. See for example the books sold with fake traces of wear and tear, such as S. by J.J. Abrams and Doug Dorst (2013)[25] : here the narrative device of the found manuscript leads to different graphic translations for the different levels of narration (Fig. 4).

[22] I have been asking myself, and this remains an open question, about the status of graphic design in relation to the opposition between autographic and allographic acts of artistic production (Goodman 1968). If the origin of graphic design is to be found in printmaking on the trails of Wassily Kandinsky (1947: 34; see also Falcinelli 2022: XXXIX), then a graphic artifact can be considered as "Two-stage and yet autographic. The etcher, for example, makes a plate from which impressions are then taken on paper. These prints are the end-products; and although they may differ appreciably from one another, all are the instances of the original work" (Goodman, 1968: 114). What if this first stage is only performed digitally and if the second stage only consists in circulating the internet?

[23] On design as thinking of a product endowed with a multiple existence, it is worth digging up the pioneering studies of Georg Simmel (1908) on the essence of applied arts. That the designer develops the object based on technological and productive parameters, and therefore connects the design and creativity to technological constraints, is clearly explained by Munari 1981. Also see the excellent introduction with an extensive array of examples by Falcinelli 2014. Unfortunately, neither of these two fundamental books has ever been translated into English.

[24] In digital illustration, an example cay be found in Alessandro Gottardo (aka Shout), as mentioned by Falcinelli (2022:37).

[25] In this case, which would deserve its own study, the simulation of material traces has nothing to do with the presumed author of the book and his enunciational simulacrum, but with fictional readers who write another story through their comments

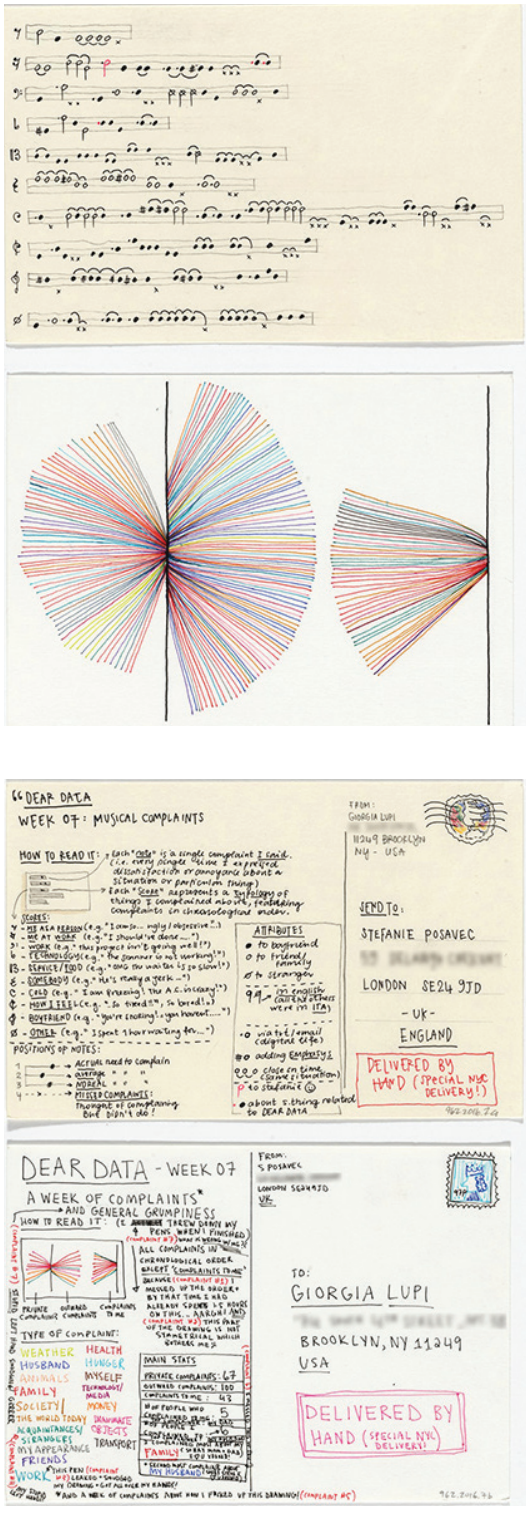

Figure 5. "A week of complaints": handmade infographics (Courtesy: Giorgia Lupi e Stefanie Posavec. Source: Lupi and Posavec 2016: 37-38).

The presumed original text is printed, while the commentators' text develops a second story written by hand in the notes on the margins. These are falsifications obtained by means of a fake autographic act, revealed to a reader who is a gratified accomplice to this act of falsification.

Another case is that of the digitization of drawings produced by hand: the postcards on which Giorgia Lupi and Stefanie Posavec (2016) sent each other data visualizations of their everyday activities, made handwriting a declaration of intent: erasures, reconsiderations, lines covered by postal stamps, smudges caused by writing with the left hand, excuses and lies serve to make the assertive presence of the subject visible: a tinted filter onto a reality that refuses to disappear into the presumed transparency of a medium (Fig. 5). The two authors reject a pre-established graphic language and time after time invent a new code that responds to the needs of the object they must represent. Furthermore, relying on handmade sketches rather than on digital drawings is a rejection of predetermined graphic forms and customizes their visual language, designating it for a single receiver and for a single phenomenon to represent. It was not until the postcards became the content of a book that they were digitised and became a serial product, leaving the original drawings to the authors, to collectors and museums.

There is therefore a fundamental difference, in the world of graphic production, between an analogical design that is digitally reproduced and a digital production that simulates analogical design.

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In any case, the digital is never to be considered the reign of the immaterial, in which the act of production can only be simulated in a form of enunciated enunciation. If from the analysis of the support we shift our attention to the graphic practices, the digital image responds to a single and specific instance-making which has a specific subject, time and place. According again to Johanna Drucker (2020: 71-74), there is an autographic dimension not only in drawings by hand, but also in graphic work on the computer. This began with the invention of software as a sketchpad that was limited to mediating between the hand and the monitor, and transformed the gesture of writing into code. A reproducible code, which was rooted however in a unique and unreproducible gesture. A notation (allographic) derived from an inscription (autographic).

5. Conclusions

In this essay, we have tried to address the issue of enunciation in data visualization in several respects. First of all, we have considered data visualization, following in the footsteps of its best known theorists, as a form of expression characterized by a potentially univocal correspondence with the forms of the content, related to numerical or topological parameters, where the reference to an enunciative act disappears. Nevertheless, even in the first lithographic printing, it is still possible to recognize a "hand" and a style, as in William Playfair's diagrams, products of the technological enthusiasm for reproducibility of the time, rich in reference to measurement devices and displays in the industrial field.[26] All filtered through a personal recognizable style, expressed in a certain palette of colors, a certain way of laying out the information on the pages, and a certain typeface.

We then addressed the inevitable interpretative dimension of any type of visualization. In particular, we have adopted Johanna Drucker's theoretical view according to which it is inappropriate to use the classical quantitative methods of data mining and content analysis for the Digital Humanities. This leads to the invention of forms of visualization that are no longer based on traditional conventions such as the timeline or the bar chart. Rather they represent the deformation of the phenomenon through the gaze of the viewer. We also addressed the doubt as to whether every type of graphic has its own interpretative dimension, even those that belong to the hard or the social sciences–to which we broadly associate the field of journalism, domains in which the value of objectivity is key, but there is a growing debate that questions it.[27] Based on the ideal of transmitting reliable and trustworthy information, when faced with the impossibility of having perfect data, those professional

[26] About the relationship between William Playfair's visual style and the visual culture of his times, see Berkowitz 2018.
[27] Just to name a few, see Galison 2015 and Anderson 2018.

practices subdue visualization to incorporate the possible errors and the level of probability of their statements. At this point we sought the traces of enunciation–the ways in which the enunciator articulates and takes distance from the utterance–in the languages of infographic communication itself, reading how doubts and uncertainties can emerge in the assertions presented to the reader in visual forms (to add a disclaimer would be too easy). Semiotic tools have helped us recognize that uncertainty does not arise from the data OR from the visualization (as stated in Dasgupta, Chen and Kosara 2012, who distinguish a *physical uncertainty* in data space from a *perceptual uncertainty*), but from the relationship between the visualizer (the data journalist or the scientist) AND the data observed. This relationship of uncertainty can be integrated into the visualization itself. Moreover semiotics help to explain that the moral virtue of honesty and the quality of transparency belong to different levels of the communication exchange: the relationship of trust between the visualizer and the reader is based more on opacity than in a supposed transparency of the medium. From a visual semiotic point of view, indeed, transparency consists in the cancellation of the traces of production: whatever interferes between the viewer and the object observed is a layer of opacity that reminds us of the presence of the production instances and testifies to their quest for truthfulness.[28]

Giving visibility to the interpreter's presence is indeed a form of re-appropriation of the act of elaborating and visualizing data, in the face of the prevalence of automation and quantitative analysis. There are also visual means to express a "tone", an emotional modulation of the issue treated through a visualization, as well examined in Festi 2019.

Finally, we have widened our object of analysis situating data visualization in the field it belongs to, graphic design. We then looked for the traces of the production process in the different material affordances of analogical and digital media.

References

Abrams, J.J. and Doug Dorst 2013. *S.* New York: Mullholland Books.

Aït-Touati, F., A. Arènes and A. Grégoire 2019. *Terra Forma. Manuel de cartographies potentielles*. Paris: Éditions B42.

Albergamo, Maria (ed.) 2014. *La transparencia engaña*. Madrid: Biblioteca nueva.

Anceschi, Giovanni 2006. Neurath, the Isotype and the third competence. *Progetto grafico* 2: 62-67.

[28] A different reading of the concept of "transparency" can be found in Kennedy et al. 2020. According to this approach, transparency is the ability show the backstage of news and data production as it is, without lying; from a semiotic approach, transparency is more an effect of sense than a direct expression of honesty: transparency denies the presence of a filter that is actually there. On this topic, I suggest reading Manchia 2017 and the reflections published as collections of essays in Lozano (ed.) 2013 and Albergamo (ed.) 2014.

Punctum. International Journal of Semiotics | **08:**01:2022
ISSN 2459-2943 | DOI: 10.18680/hss.2022.0005 | **punctum.gr**

Anderson, Chris 2008. The end of theory: the data deluge makes the scientific method obsolete. *Wired*, 16/17. https://www.wired.com/2008/06/pb-theory/ (Last access: July 6, 2022).

Anderson, Christopher W. 2018. *Apostles of Certainty. Data Journalism and the Politics of Doubt*. Oxford: Oxford University Press.

Bastide, Françoise 1985. Essai d'épistemologie à partir d'un texte technique sans prétension: une invention peu connue des frères Lumière. *Fundamenta Scientiae* VI 2: 127-150.

Benveniste, Emile 1971 [1966]. *Problems in general linguistics*. Trans: Mary Elizabeth Meek, Coral Gables Florida: University of Miami Press.

Berkowitz, Bruce D. 2018. *Playfair. The true story of the British secret agent who changed how we see the world*. Fairfax Virginia: George Mason University Press.

Bertin, Jacques 1967. *Sémiologie Graphique*. Paris: Mouton/Gauthier-Villars.

Bonsiepe, Gui 1965. Visual/Verbal Rhetoric. *Ulm* 14/15/16: 23-40.

Bowker, Geoffrey C. 2006. *Memory Practices in the Sciences*. Cambridge MA: MIT Press.

Brasseur, Lee E. 2003. *Visualizing Technical Information: A Cultural Critique*. Amityville NY: Baywood Publishing.

Buchanan, Richard 1985. Declaration by design: rhetoric, argument and demonstration in design practice. *Design Issues* 2 (1): 4-22.

Burgio, Valeria 2021. *Rumore visivo. Semiotica e critica dell'infografica*. Milano: Mimesis.

Burgio, Valeria and Andrea Facchetti 2020. The Shapes of the Future(s). Representing Catastrophe and its Alternatives in Diagrams. *Versus. Quaderni di Studi Semiotici* 131 (2): 275-294.

Cairo, Alberto 2016. T*he truthful art: Data, charts, and maps for communication*. New York: New Riders.

Campolo, Alexander 2020. Signs and Sight: Jacques Bertin and the Visual Language of Structuralism. *Grey Room* 78: 34–65.

Dasgupta, A., M. Chen, M. and R. Kosara 2012. Conceptualizing visual uncertainty in parallel coordinates. *Computer Graphics Forum* 31(3): 1015-1024.

Dondero, Maria Giulia 2020. *The Language of Images. The Forms and the Forces*. Berlin: Springer.

Drucker, Johanna 1994. *The Visible Word: Experimental Typography and Modern Art*. Chicago: The University of Chicago Press.

Drucker, Johanna 2011. Humanities Approaches to Graphical Display. DHQ: *Digital Humanities Quarterly* 5(1).

Drucker, Johanna 2014. *Graphesis. Visual Forms of Knowledge Production*. Cambridge, MA: Harvard University Press.

Drucker, Johanna 2020. *Visualization and Interpretation: Humanistic Approaches to Display*. Cambridge, MA: MIT Press.

Eco, Umberto 1968. *La Struttura Assente [The absent structure]*. Milano: Bompiani.
Eco, Umberto 1976. *A Theory of Semiotics*. Bloomington: Indiana University Press.
Falcinelli, Riccardo 2014. *Critica portatile al visual design*. Torino: Einaudi.
Falcinelli, Riccardo 2022 [2017]. *Chromorama. How colour changed our way of seeing*. Trans. Simon Carnell and Erica Segre, London: Particular Books. Penguin Random House.
Falcinelli, Riccardo 2022. Graphic Design: una filosofia della pratica. In: Riccardo Falcinelli (ed.) *Filosofia del graphic design*. Torino: Einaudi, IX-LXXXI.
Festi, Giacomo 2019. Infographics between figures and figurative languages. A semiotic investigation of data visualization. *Signata*, 10, https://doi.org/10.4000/signata.2342
Fontanille, Jacques 2006 [2003]. *The semiotics of discourse*. Trans. Heidi Bostic, New York: Peter Lang.
Galison, Peter 2015. The Journalist, the Scientist, and Objectivity. In: Padovani F., A. Richardson, J.Y. Tsou (eds.) *Objectivity in Science. New Perspectives from Science and Technology Studies*. Cham: Springer, 57-75.
Gerbaudo, Paolo 2016. From Data Analytics to Data Hermeneutics. Online Political Discussions, Digital Methods and the Continuing Relevance of Interpretive Approaches. *Digital Culture & Society* 2: 95-111.
Gitelman, Lisa (ed.) 2013. *"Raw data" is an oxymoron*. MIT Press: Cambridge MA.
Gitelman, Lisa and Virginia Jackson 2013. Introduction. In: Lisa Gitelman (ed.) *"Raw data" is an oxymoron*. Cambridge, MA: MIT Press, 1-14.
Goodman, Nelson 1968. *Languages of art. An approach to a theory of symbols*. Indianapolis: Bobbs Merril.
Gray J., L. Chambers and L. Bounegru 2012. *The Data Journalism Handbook*. Sebastopol, CA: O'Reilly .
Greimas, Algirdas J. and Joseph Courtès 1982 [1979]. *Semiotics and Language. An Analytical Dictionary*. Trans. Larry Crist et al. Bloomington: Indiana University Press.
Greimas, Algirdas J. 1983. *Du sens II. Essais Sémiotiques*. Paris: Seuils.
Greimas, Algirdas J. 1984. Sémiotique figurative et sémiotique plastique. *Actes Sémiotiques. Documents*. 60.
Haraway, Donna 1988. Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective *Feminist Studies* 14 (3): 575-599
Hawkins, E., T. Fæhn and J. Fuglestvedt 2019, The climate spiral demonstrates the power of sharing creative ideas. *American Meteorological Society* 100: 753-756.
Hjelmslev, Louis 1953 [1943]. *Prolegomena to a Theory of Language*. Trans. Francis Whitfield, Madison: University of Wisconsin Press.
Kandinsky Wassily 1947 [1926]. *Point and line to plane*. Trans. Howard Dearstyne and Hilla Rebay, Bloomfield Hills, Michigan: Cranbrook Press.
Kennedy, H., W. Weber and M. Engebretsen 2020. Data Visualization and Transparency in the news. In: Martin Engebretsen and Helene Kennedy (eds.) *Data Visualization in Society*. Amsterdam: Amsterdam University Press, 169-185.

Punctum. International Journal of Semiotics | **08**:01:2022
ISSN 2459-2943 | DOI: 10.18680/hss.2022.0005 | **punctum.gr**

Kinross, Robin 1989. The Rhetoric of Neutrality. In: Victor Margolin (ed.) *Design Discourse*. Chicago: University of Chicago Press, 131-143.

Kinross, Robin 2004 (1992). *Modern Typography. An essay in critical history*. London: Hyphen Press.

Kinross, Robin 2018 [2006]. For a typography of details. https://hyphenpress.co.uk/journal/article/for-a-typography-of-details?fbclid=IwAR1-ntFaJKg2rux9DEhD-N1bTpu_sBeCKXs-IjWBaCt7VN_G6Qjc7CTt9iE0 (Last access: July 6, 2022)

Kostelnick, Charles 2008. The Visual Rhetoric of Data Display: the Conundrum of Clarity. *IEEE Transactions on Professional Communication* 51 (1): 116-130.

Kostelnick, Charles and Michael Hassett 2003. *Shaping information: the rhetoric of visual conventions*. Carbondale: Southern Illinois University Press.

Latour, Bruno 1999. *Pandora's Hope*. Cambridge, MA: Harvard University Press.

Latour, Bruno 2013 [2012]. *An Inquiry into Modes of Existence. An Anthropology of the Moderns*. Trans: Catherine Porter, Cambridge, MA: Harvard University Press.

Licko, Zuzana and Rudy Vanderlans 1989. Ambition/Fear. *Emigre* 11.

Lorusso Anna Maria and Patrizia Violi 2004. *Semiotica* del testo *giornalistico*. Roma-Bari: Laterza.

Loukissas, Yanni Alexander 2019. *All data are local. Thinking critically in a data-driven society*. Cambridge, MA: MIT Press.

Lozano, Jorge (ed.) 2013. La transparencia. *Revista de Occidente* 386-387.

Lupi, Giorgia and Stephanie Posavec 2016. *Dear data*. London: Particular Books. Penguin Random House.

Lupton, Ellen 2010 [2004]. *Thinking with type: a critical guide for designers, writers, editors & students*. New York: Princeton Architectural Press.

Lussu Giovanni, Antonio Perri and Daniele Turchi 2018 [2006]. Wines and Goblets. https://articles.c-a-s-t.com/lussu-file-2-wines-and-goblets-2ac327e8f416

MacEachren, Alan M. 1992. Visualizing Uncertain Information. *Cartographic Perspective* 13: 10-19.

MacEachren, A.M., R.E. Roth, J. O'Brien, B. Li, D. Swingley, M. Gahegan 2012. Visual Semiotics & Uncertainty Visualization: An Empirical Study. *Ieee Transactions on Visualization and Computer Graphics* 18(12): 2496-2505.

Manchia, Valentina 2017. The Evidence of the Truth. El discurso de los datos entre documento y monumento. *Revista de Occidente* 435: 116-129.

Manchia, Valentina 2020. *Il discorso dei dati. Note semiotiche sulla visualizzazione delle informazioni*. Milano: FrancoAngeli.

Marey, Etienne-Jules 1878. *La Methode Graphique dans les Sciences Experimentales et Principalement en Physiologie et en Medecine*. Paris: G. Masson.

Marin, Louis 2002 [1994]. *On representation*. Trans. Catherine Porter, Stanford: Stanford University Press.

Marrone, Gianfranco 2022. *Introduction to the Semiotic of the Text*. Berlin: De Gruyter.

Moles, Abraham 1966. *Information Theory and Esthetic Perception*. Urbana: University of Illinois Press.

Munari, Bruno 1981. *Da cosa nasce cosa. Appunti per una metodologia progettuale*. Roma-Bari: Laterza.

Neurath, Marie and Robin Kinross (eds.) 2009. *The Transformer. Principles of Making Isotype Charts*. London: Hyphen Press.

Neurath, Otto 1973 [1933]. Museums of the Future. In: Marie Neurath and Robert Cohen (eds.) *Empiricism and Sociology*. Dordrecht: Reidel Publishing Company, 218-223.

Pignier, Nicole 2020. L'éthique énonciative au cœur du design d'information et du datajournalisme. *Interfaces numériques* 9(3).

Polano, Sergio 2006. Tipografia visibile. *Progetto Grafico* 8: 177.

Polidoro, Piero 2018. "Si è sempre qualitativi di qualcuno": le ricerche quantitative e qualitative in semiotica. E/C Il *metodo semiotico* (Ferraro G., R. Finocchi and A.M. Lorusso eds.) 24: 151-159.

Prieto, Luis Jorge 1976. *Pertinence et Pratique*. Paris: Minuit.

Romele, A., M. Severo and P. Furia 2018, Digital hermeneutics: from interpreting with machines to interpretational machines. *AI & society* 35: 73–86.

Shannon Claude E. and Warren Weaver 1949. *The Mathematical Theory of Communication*. Urbana: The University of Illinois Press.

Simmel, Georg 1991 [1908]. The problem of style. Trans. Mark Ritter. In *Theory, Culture & Society* 8: 63-71.

Tufte, Edward R. 2001 (2nd ed.). *The Visual Display of Quantitative Information*. Cheshire Connecticut: Graphics Press.

Tufte, Edward R. 2006. *Beautiful Evidence*. Cheshire Connecticut: Graphics Press.

Van Dijck, José 2014. Datafication, dataism and dataveillance: Big Data between scientific paradigm and ideology. *Surveillance & Society* 12 (2).

Warde, Beatrice 1955. The Crystal Goblet or Printing Should Be Invisible. In: Beatrice Warde (ed.) *The Crystal Goblet: Sixteen Essays on Typography*. London: Sylvan Press 11–17.

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