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## Abstract

As digital humanists have adopted visualization tools in their work, they have borrowed methods developed for the graphical display of information in the natural and social sciences. These tools carry with them assumptions of knowledge as observer-independent and certain, rather than observer co-dependent and interpretative. This paper argues that we need a humanities approach to the graphical expression of interpretation. To begin, the concept of *data* as a given has to be rethought through a humanistic lens and characterized as *capta*, taken and constructed. Next, the forms for graphical expression of capta need to be more nuanced to show ambiguity and complexity. Finally, the use of a humanistic approach, rooted in a co-dependent relation between observer and experience, needs to be expressed according to graphics built *from* interpretative models. In summary: all data have to be understood as capta and the conventions created to express observer-independent models of knowledge need to be radically reworked to express humanistic interpretation.


## Introduction

As digital visualization tools have become more ubiquitous, humanists have adopted many applications such as GIS mapping, graphs, and charts for statistical display that were developed in other disciplines. But, I will argue, such graphical tools are a kind of intellectual Trojan horse, a vehicle through which assumptions about what constitutes information swarm with potent force. These assumptions are cloaked in a rhetoric taken wholesale from the techniques of the empirical sciences that conceals their epistemological biases under a guise of familiarity. So naturalized are the Google maps and bar charts generated from spread sheets that they pass as unquestioned representations of “what is”. This is the hallmark of realist models of knowledge and needs to be subjected to a radical critique to return the humanistic tenets of constructed-ness and interpretation to the fore. Realist approaches depend above all upon an idea that phenomena are *observer-independent* and can be characterized as *data*. Data pass themselves off as mere descriptions of a priori conditions. Rendering *observation* (the act of creating a statistical, empirical, or subjective account or image) as if it were *the same as the phenomena observed* collapses the critical distance between the phenomenal world and its interpretation, undoing the basis of interpretation on which humanistic knowledge production is based. We know this. But we seem ready and eager to suspend critical judgment in a rush to visualization. At the very least, humanists beginning to play at the intersection of statistics and graphics ought to take a detour through the substantial discussions of the sociology of knowledge and its developed critique of realist models of data gathering[1] At best, we need to take on the challenge of developing graphical expressions rooted in and appropriate to interpretative activity. 1

Because realist approaches to visualization assume transparency and equivalence, as if the phenomenal world were self-evident and the apprehension of it a mere mechanical task, they are fundamentally at odds with approaches to humanities scholarship premised on constructivist principles. I would argue that even for realist models, those that presume an observer-independent reality available to description, the methods of presenting ambiguity and uncertainty in more nuanced terms would be useful. Some significant progress is being made in visualizing uncertainty in data 2

models for GIS, decision-making, archaeological research and other domains.[2] But an important distinction needs to be clear from the outset: the task of representing ambiguity and uncertainty has to be distinguished from a second task – that of using interpretations that arise in observer-codependence, characterized by ambiguity and uncertainty, as the basis on which a representation is constructed. This is the difference between putting many kinds of points on a map to show degrees of certainty by shades of color, degrees of crispness, transparency etc., and creating a map whose basic coordinate grid is constructed *as an effect* of these ambiguities. In the first instance, we have a standard map with a nuanced symbol set. In the second, we create a non-standard map that expresses the constructed-ness of space. Both rely on rethinking our approach to visualization and the assumptions that underpin it.

3 To overturn the assumptions that structure conventions acquired from other domains requires that we re-examine the intellectual foundations of digital humanities, putting techniques of graphical display on a foundation that is humanistic at its base. *This requires first and foremost that we reconceive all data as capta*. Differences in the etymological roots of the terms data and capta make the distinction between constructivist and realist approaches clear. *Capta* is "taken" actively while *data* is assumed to be a "given" able to be recorded and observed. From this distinction, a world of differences arises. Humanistic inquiry acknowledges the situated, partial, and constitutive character of knowledge production, the recognition that knowledge is constructed, *taken*, not simply given as a natural representation of pre-existing fact.

4 My distinction between data and capta is not a covert suggestion that the humanities and sciences are locked into intellectual opposition, or that only the humanists have the insight that intellectual disciplines create the objects of their inquiry. Any self-conscious historian of science or clinical researcher in the natural or social sciences insists the same is true for their work. Statisticians are extremely savvy about their artifices. Social scientists may divide between realist and constructivist foundations for their research, but none are naïve when it comes to the rhetorical character of statistics. The history of knowledge is the history of forms of expression of knowledge, and those forms change. What can be said, expressed, represented in any era is distinct from that of any other, with all the attendant caveats and reservations that attend to the study of the sequence of human intellectual events, keeping us from any assertion of progress while noting the facts of change and transformation. The historical, critical study of science is as full of discussions of this material as the humanities.

5 Thus the *representation* of knowledge is as crucial to its cultural force as any other facet of its production. The graphical forms of display that have come to the fore in digital humanities in the last decade are borrowed from a mechanistic approach to realism, and the common conception of data in those forms needs to be completely rethought for humanistic work. To reiterate what I said above, the sheer power of the graphical display of "information visualization" (and its novelty within a humanities community newly enthralled with the toys of data mining and display) seems to have produced a momentary blindness among practitioners who would never tolerate such literal assumptions in textual work.

6 The polemic I set forth here outlines several basic principles on which to proceed differently by suggesting that what is needed *is not a set of applications to display humanities "data" but a new approach that uses humanities principles to constitute capta and its display*. At stake, as I have said before and in many contexts, is the authority of humanistic knowledge in a culture increasingly beset by quantitative approaches that operate on claims of certainty. Bureaucracies process human activity through statistical means and when the methods grounded in empirical sciences are put at the service of the social sciences or humanities in a crudely reductive manner, basic principles of critical thought are violated, or at the very least, put too far to the side. To intervene in this ideological system, humanists, and the values they embrace and enact, must counter with conceptual tools that demonstrate humanities principles in their operation, execution, and display. The digital humanities can no longer afford to take its tools and methods from disciplines whose fundamental epistemological assumptions are at odds with humanistic method.

7 This paper is a call to imaginative action and intellectual engagement with the challenge of rethinking digital tools for

visualization on basic principles of the humanities. I take these principles to be, first, that the humanities are committed to the concept of knowledge as interpretation, and, second, that the apprehension of the phenomena of the physical, social, cultural world is through constructed and constitutive acts, not mechanistic or naturalistic realist representations of pre-existing or self-evident information. Nothing in intellectual life is self-evident or self-identical, nothing in cultural life is mere fact, and nothing in the phenomenal world gives rise to a record or representation except through constructed expressions. The rhetorical force of graphical display is too important a field for its design to be adopted without critical scrutiny and the full force of theoretical insight. Let me suggest what that means for the visualization of informational, temporal, and spatial phenomena.

## Data as capta: from information visualization to graphical expressions of interpretation

8 If I set up a bar chart or graph, my first act is to draw a set of one or more axes and divide them into units. The conventional forms of the graphical display of information, “data”, make use of a formal, unambiguous system of standard metrics. Charts use simple (if often misleading) geometric forms that lend themselves to legible comparison of values, proportions, or the exhibition of state changes across time. Lines, bars, columns, and pie charts are the common and familiar forms. They render *quantitative* relations with a transparency that seems natural, so that, for instance, if we look at the changes in population across a series of years for a particular location, we can simply accept that from one year to the next rises or drops occurred in the numbers of persons alive in X city in X country at X time. A pie chart showing percentage of resource allocation from national budgets seems completely transparent, self-evident even. A bar chart could compare daylight hours at different longitudes, or the average size of men and women in different countries, or the number of hospital beds in different institutions in a single geographical location and not raise a skeptical eyebrow, right? Yes, but the rendering of statistical information into graphical form gives it a simplicity and legibility that hides every aspect of the original interpretative framework on which the statistical data were constructed. The graphical force conceals what the statistician knows very well — that no “data” pre-exist their parameterization. *Data are capta*, taken not given, constructed as an interpretation of the phenomenal world, not inherent in it.

9 To expose the constructedness of data as capta a number of systematic changes have to be applied to the creation of graphical displays. That is the foundation and purpose of a *humanistic approach* to the qualitative display of graphical information. Read that last formulation carefully, *humanistic approach* means that the premises are rooted in the recognition of the *interpretative* nature of knowledge, that the *display* itself is conceived to *embody qualitative expressions*, and that the information is understood as *graphically constituted*. Each of these factors contains an explicit critique of assumptions in the conventional “visual display of quantitative information” that is the common currency.

10 Let me work through a specific case to show how each of these principles — humanistic approach, qualitative display, and graphical information — can be demonstrated. As an example, we can use that bar chart mentioned above, one that compares the percentage of men and women in various national populations at the present time.


**Figure 1.** A basic bar chart compares the number of men (top bar) and the number of women (bottom bar) in seven different nations, A through F, at the present time (2010). The assumptions are that quantities (number), entities (nations), identities (gender) and temporality (now) are all self-evident. Graphic credit Xárene Eskandar.

Certain issues immediately arise. A standard critique of data introduces reservations about the appearance of certainty such a chart presents. What counts as a nation? Are transient and immigrant populations documented? What kind of time span counts as “at the present time” within which these populations are counted? If the basic bar chart would have looked like a series of bands showing discrete categories of information in finite and certain numbers (all due statistical caveats noted), what are the problems? Gender definition assumes a simple binary distinction of men and women, an assumption much debated and highly problematic (gender can be understood as a factor of behavior, physiological changes, social expectations, dress, etc., and nation as a function of permeability of borders, citizenship patterns, naturalization rules, immigration regulations, quotas and border policies). So the bar chart reifies several categories, naturalizing them as discrete and fixed: national populations, time span, and gender defined as a simple binary. The representation can only be modified by changing the terms and premises on which it is constructed. What would a representation of gender by sliding scale look like? How would permeable boundaries to nations whose populations cross each others borders be shown? How would they dissolve the bar chart’s basic structure? How would notions of the present be defined? 11

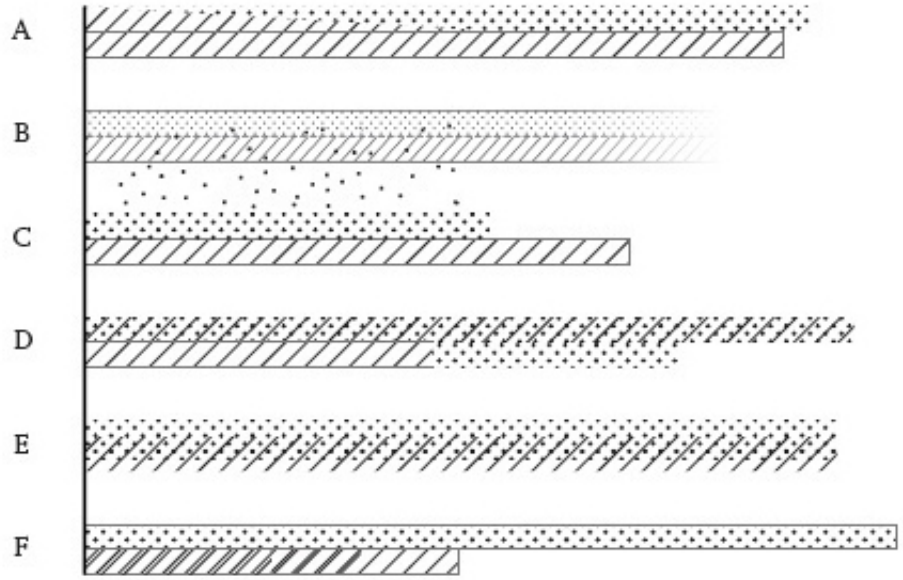


**Figure 2.** In this chart gendered identity is modified. In nation A, the top bar contains a changing gradient, indicating that "man" is a continuum from male enfant to adult, or in countries E and D, that gender ambiguity is a factor of genetic mutation or adaptation, thus showing that basis on which gendered individuals are identified and counted is complicated by many factors. In country F women only register as individuals after coming of reproductive age, thus showing that quantity is a effect of cultural conditions, not a self-evident fact. The movement of men back and forth across the border of nations B and C makes the "nations" unstable entities. Graphic credit Xárene Eskandar.

12 The point I'm making is that the basic categories of supposedly quantitative information, the fundamental parameters of chart production, are already interpreted expressions. But they do not present themselves as categories of interpretation, riven with ambiguity and uncertainty, because of the *representational* force of the visualization as a "picture" of "data". For instance, the assumption that gender is a binary category, stable across all cultural and national communities, is an assertion, an argument. Gendered identity defined in binary terms is not a self-evident fact, no matter how often Olympic committees come up against the need for a single rigid genital criterion on which to determine difference. By recognizing the always interpreted character of data we have shifted from data to capta, acknowledging the constructed-ness of the categories according to the uses and expectations for which they are put in service. Nations, genders, populations, and time spans are not self-evident, stable entities that exist a priori. They are each subject to qualifications and reservations that bear directly on and arise from the reality of lived experience. The presentation of the comparison in the original formulation grotesquely distorts the complexity — but also, the basic ambiguity — of the phenomenon under investigation (gender, nations, populations). If the challenge we are facing were merely to accommodate higher levels of complexity into a data representation model, that would require one set of considerations and modifications. But the more profound challenge we face is to accept the ambiguity of knowledge, the fundamentally interpreted condition on which data is constructed, in other words, the realization of my refrain–that all data is capta.

13 The humanistic aspect of this approach should be obvious — that knowledge created with the acknowledgement of the fundamentally constructed nature of its premises is not commensurate with principles of certainty guiding empirical or realist methods. Humanistic methods are counter to the idea of reliably repeatable experiments or standard metrics that assume observer independent phenomena. By definition, a humanistic approach is centered in the experiential,

subjective conditions of interpretation. Phenomena and their observers are co-dependent, not necessarily in equal measure. A viewer gazing on a sublime landscape or recording migrations at a large scale may be more affected by the phenomena than the phenomena is by the observation. Theoretical physicist Werner Heisenberg never suggested that the relation of intervening observer and effect on phenomena were symmetrical, merely that they were codependent, when he introduced the concept of uncertainty in the early 20th century.

14 Creating bar charts with ambiguity and degrees of uncertainty or other variables in them might cause champions of legibility and transparency some unease, but the shift away from standard metrics to metrics that express interpretation is an essential move for humanists and/or constructivists across disciplines. To emphasize the expressive quality of interpretation, I'm going to characterize constructed information as *subjective* – expressing the marks of its inflection in some formal way. The shift to expressive metrics and graphics is essential in changing from the *expression of subjective information* to the *subjective expression of perceived phenomena*, but subjectivity and inflection are not the only features of interpretative approaches. Capta is not an expression of idiosyncracy, emotion, or individual quirks, but a systematic expression of information understood as constructed, as phenomena perceived according to principles of interpretation. To do this, we need to conceive of every metric "as a factor of X", where X is a point of view, agenda, assumption, presumption, or simply a convention. By qualifying any metric as a factor of some condition, the character of the "information" shifts from self-evident "fact" to constructed interpretation motivated by a human agenda.[3]

15 The standard elements of graphic display for statistical information are simple and limited: scale divisions, coordinate lines, scale figures, circles, rectangles, curves, bars (or columns or percentages of pie charts or other forms) and labels (numbers and terms), signs of movement, flow, or state change (arrows, vectors, paths). The ordering and arrangement of elements within a chart create another level of information, relational information. Relational information is graphically produced – the ordering of elements by size, by color, by alphabetical order, by texture, shape or other feature happens in graphical space. The resulting arrangement has a semantic value produced by features of proximity, grouping, orientation, apparent movement, and other graphical effects.

16 Now take these basic elements of graphical display and rethink them according to humanistic principles:

17 In conventional statistical graphics, the scale divisions are equal units. In humanistic, interpretative, graphics, they are not.

18 In statistical graphics the coordinate lines are always continuous and straight. In humanistic, interpretative, graphics, they might have breaks, repetitions, and curves or dips. Interpretation is stochastic and probabilistic, not mechanistic, and its uncertainties require the same mathematical and computational models as other complex systems.

19 The scale figures and labels in statistical graphics need to be clear and legible in all cases, and all the more so in humanistic, interpretative, graphics since they will need to do quite a bit of work.

20 Perhaps the most striking feature distinguishing humanistic, interpretative, and constructivist graphical expressions from realist statistical graphics is that the curves, bars, columns, percentage values would not always be represented as discrete bounded entities, but as conditional expressions of interpretative parameters–a kind of visual fuzzy logic or graphical complexity. Thus their edges might be permeable, lines dotted and broken, dots and points vary in size and scale or degree of ambiguity of placement, and so on. These graphical strategies express interpreted knowledge, situated and partial, rather than complete. They can be employed as systematically as other charting elements, though part of my intention is to disturb the grounds of certainty on which conventions of statistical legibility are based. Point of view systems introduced into graphs and charts will make evident a perspectival position with respect to their information, an inner standing point in the graphical rendering of space. This is true of all cartographic projections. Every map contains within its coordinate system for graphical expression, a set of assumptions about the place from which the map is drawn. Information spaces drawn from a point of view, rather than as if they were observer independent, reinsert

the subjective standpoint of their creation into the graphical expression. Finally, any point or mark used as a specific node in a humanistic graph is assumed to have many dimensions to it – each of which complicates its identity by suggesting the embedded-ness of its existence in a system of co-dependent relations. Information entities, or units, are thus understood as fictional abstractions serving a purpose. But their potential to be read again in relation to any number of other equally significant relations can be made evident. This approach destroys the ground on which standard metrics are used to abstract quantitative information from human circumstances. Humanistic premises replace notions of statistical concepts of self-identity with entangled co-dependence and contingencies.

All of this may sound unduly complicated to someone merely wanting to count the number of pupils enrolled in a group, calculate the number of pencils needed, or to show budgetary expenditures on a per capita basis in the classroom, for example. But this example — an instance of administrative and bureaucratic management — shows that such crudely conceived numeric statistics are useful only in the most reductive circumstances. They tell us nothing about whether the pencils can be used, whether the pupils are prepared or disposed to their work, or whether the budgets will have any effect on learning outcomes or any of the many other factors that come into play in assessments based on metrics extracted from lived experience. But each metric — number of X or Y — is actually a number as a factor of a particular intellectual assumption or decision: pupils as a factor of seats in a room, birthdates, population, illness, etc. pencils as a factor of resource allocation, and so on. All metrics are metrics about something for some purpose. 21

Any humanistic study based on statistical methods, even the simplest techniques of counting, has to address the assumption involved in the categories on which such techniques (“how many of X”) are based. Take another example from work in data mining or “distant reading” as it is known in the digital humanities: counting the number of novels published in a given year. This involves an enormous number of interpretative decisions – each of which has more intellectual dimensions than any numeric assessment could. 22

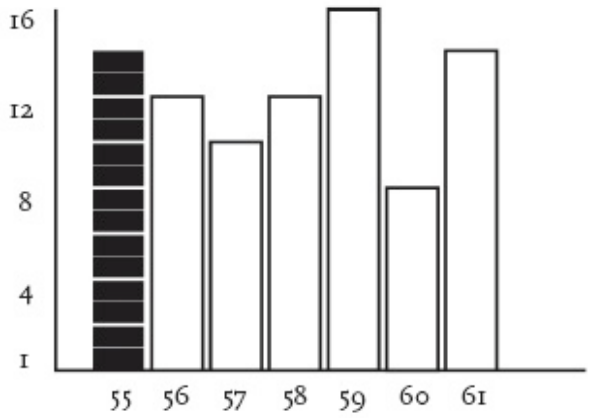


**Figure 3.** A chart shows the number of new novels put into print by a single publisher in the years 1855-1862.

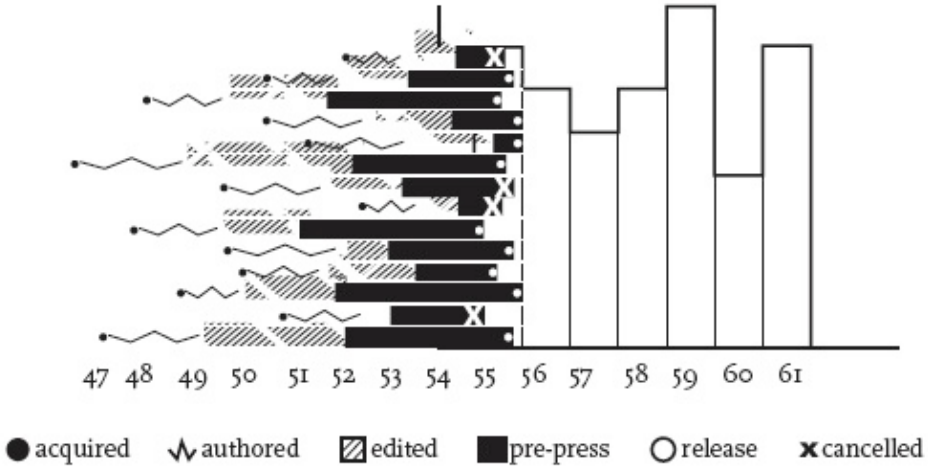


**Figure 4.** The "appearance" in 1855 of fourteen novels is shown in relation to the time of writing, acquisition, editing, pre-press work, and release thus showing publication date as a factor of many other processes whose temporal range is very varied. The date of a work, in terms of its cultural identity and relevance, can be considered in relation to any number of variables, not just the moment of its publication. Graphic credit Xárene Eskandar.

For instance, what is a novel, what does "published" mean in this context (date of appearance, editing, composition, acquisition, review, distribution), and how was the "year" determined. Statistical methods come into play *after* these decisions have been made, counting objects whose identity was established by *interpretative decisions*. Many aspects of constructed-ness are in play. But the graphical presentation of supposedly self-evident information (again, formulated in this example as "the number of novels published in a year") conceals these complexities, and the interpretative factors that bring the numerics into being, under a guise of graphical legibility. I cannot overstate the perniciousness of such techniques for the effect of passing construction off as real, and violating the very premises of humanistic inquiry. 23

The challenge is to design graphical expressions suited to the display of interpreted phenomena: information *about subjective user-dependent metrics*, *subjective displays of information*, and *subjective methods* of graphical expression. The term *subjective* is used as shorthand for interpretative construction, for the registration of point of view, position, the place from which and agenda according to which parameterization occurs. Subjectivity is not the same as individual inflection or mere idiosyncracy, but is meant to put codependent relations of observer and phenomena (in contrast to presumptions of objectivity, or observer-independent phenomena). 24

The display of information about inflection of affective experience can easily use standard metrics. For example, a chart that shows mood changes or degrees of attraction or any other information related to subjectivity can be created with standard metrics and visual conventions. 25

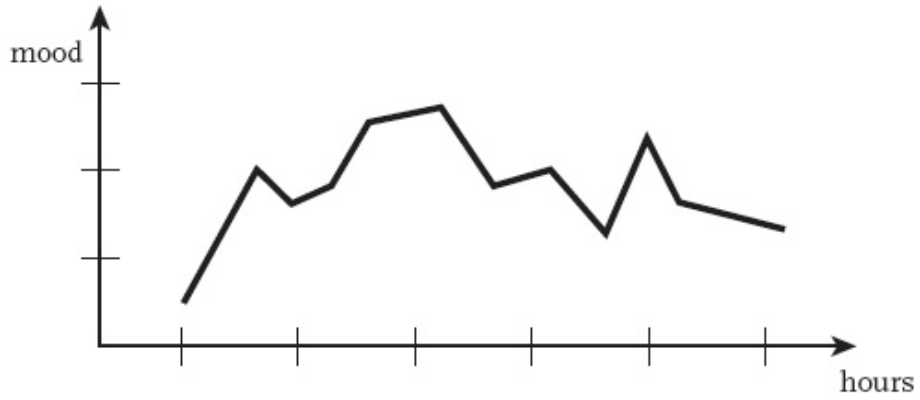


**Figure 5.** A chart of data about affect – the record of positive and negative feelings in the course of an afternoon. Standard metrics are used and a graphical display of the quantized experience appears. Graphic credit Xárene Eskandar.

The next task is more complicated. Subjective information, that is information whose constitution exhibits its subjective character, deviates from the standard norms by using graphic variables such as intensity of tone, size, color, or other feature to embody its qualities. Subjective information can use graphical means to show its inflected character, demonstrating its deviation from standard norms in the way the display looks, or, in dynamic displays, *the way it acts*. One might imagine skittish points on an unstable grid to display the degrees of anxiety around a particular event or task, for instance, or points that glow hot or cold depending on the other elements that approach them. That would be a *subjective — even affective — display of information*. 26

Creating a display whose structure arises from *subjective methods* of graphical expression extends this last example to the design of the basic visual structure. 27

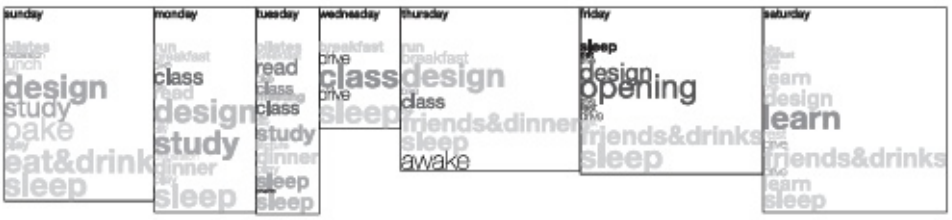


**Figure 6.** A chart in which the subjective information shapes the metric. The activities are given tonal values, size, and weight in order to create a mass or volume that then determines the dimensions of the "day" which they constitute. The box "day" does not have an a priori dimension that is used to contain the elements, it is created as an effect of the elements. This is a distinctly different approach to metrics. The chart is generated to express the co-dependent relation of viewer and experience rather than to display user experience as if it were independent of observation. The temporal dimensional of each day depends upon the relations among events, moods, and activities, but not predictably. The shape of the days is made by the creation of the list. Graphic credit Xárene Eskandar.

A subjective grid to show anxiety might have a widely varying set of spacings to show that the information on display is 28

constituted as a variable of some other aspect of experience (number of family members present at an event, for instance). Recognizing that such subjective methods are anathema to the empirically minded makes me even more convinced that they are essential for the generation of graphical displays of interpretative and interpreted information.

29 The basic principle underlying such graphical displays is that capta marks its interpreted status. Interpreted knowledge is situated, observer co-dependent, and partial. Its variables are, in theory, infinite, but they are always present in some degree or measure by virtue of the performative and participatory character of interpretative information. Interpretation depends upon and is an expression of an individual reading in a particular set of circumstances and never presumes to completeness or observer independence. The requirements for legibility increase with these unfamiliar graphics, and they will need labeling to make explicit the justifications for their non-normative seeming appearance. I'm not advocating idiosyncracy, or intellectual solipsism, but a systematic approach to graphics that is appropriate to its principles.

30 These humanistic principles can be readily applied to the graphical display of temporal and spatial information. So I will turn my attention in these next two sections to some of the principles on which temporality and spatiality can also be given graphical expression through humanistic approaches.

## Time as Temporality

31 Since antiquity, human conceptions of time have divided between those that consider time a given, an a priori existing container within which events occur, and those who consider time an effect of occurrences in temporal relation to each other. I take the latter view. The relational structure of temporality is always constituted according to inflections and variables. Not all days are equal. Or all minutes. Or all hours. Time understood as temporality can be succinctly stated as follows: *Temporality = time as a factor of X* where *X* is any variable (fear, speed, anxiety, foreshadowing, regret, reconsideration, narration, etc.).

32 Humanists deal with the representation of temporality *of* documents (when they were created), *in* documents (narrated, represented, depicted temporality), the construction of temporality *across* documents (the temporality of historical events), and also the shape of temporality that emerges *from* documentary evidence (the shape of an era, a season, a period or epoch). They need a way to graph and chart temporality in an approach that suits the basic principles of interpretative knowledge.

33 Conceptions of temporality in humanities documents do not conform to those used in the social and empirical sciences. In empirical sciences, time is understood as continuous, uni-directional, and homogenous. Its metrics are standardized, its direction is irreversible, and it has no breaks, folds, holes, wrinkles, or reworkings. But in the humanities time is frequently understood *and represented* as discontinuous, multi-directional, and variable. Temporal dimensions of humanities artifacts are often expressed in relational terms – before such and such happened, or after a significant event. Retrospection and anticipation factor heavily in humanistic works, and the models of temporality that arise from historical and literary documents include multiple viewpoints.

34 The temporal modeling project Bethany Nowviskie and I designed almost ten years ago made use of these basic insights in order to create a graphical application that was the working proof of a concept. We were intent on demonstrating that a graphical model could be created intuitively as an interpretation and then used to generate structured data as a result. Inverting the sequence of intellectual events was a radical move for digital humanities, especially at the time, suggesting that graphical knowledge could be primary, leading an interpretation, rather than always and only functioning to display what was already known (or assumed to be known). We wanted to demonstrate that visual spaces could be a primary site of intellectual work. Of course, that added yet another level of unfamiliarity to our already complex project – and many even in our immediate community were unsettled by elastic or stretchy timelines, multiple points of view from within the system, or other novel seeming conventions meant to serve for interpretation of literary and historical artifacts.

Briefly summarized, the original Temporal Modelling project aimed at creating a set of conceptual primitives for the modeling of temporal relations. These included graphical expressions meant to meet the needs of multiple points of view, reworking events according to a changed position within a temporal sequence, and a set of what we called inflections. Inflections, a kind of legend for marking points, intervals, or events (our basic units) with a quality or attribute, were divided into semantic and syntactic types. Semantic inflections were given their characteristics independently, as entities, and the vocabulary of attributes included degrees of intensity and other qualities. Syntactic inflections were characterized as relational, marking the effect of one event, point, or interval or another. 35

Methods for graphing the elastic or “rubber-sheet” timelines meant to show the subjective variations in temporality can be derived from catastrophe theory, chaos diagrams, and the visualizations of stochastic and complex systems. 36

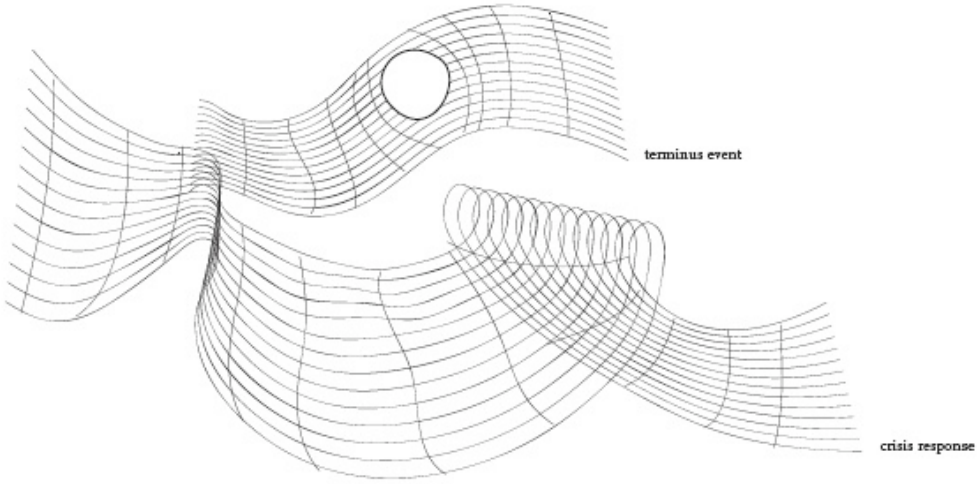


**Figure 7.** Models of events as temporal folds along a line of crisis. The first is a simple fold, showing an event as a combination of stresses warping a plane. An upper branch of consequences peels off towards an abrupt termination while the lower branch curve back to allow a retrospective view of the event’s unfolding back onto an earlier moment. Graphic credit Xárene Eskandar.

These visualizations express the topological and systemic complexity necessary to model the number of variables (of coordinates, forces, and the changing relations of variables) present in the experience of events, and/or analysis of their representation in humanistic documents (e.g. novels, films, letters, etc.). Some of the features of our earlier design, such as the dynamic behaviors of syntactic relations, could not be expressed in a standard Cartesian coordinate system (such as the one on which XML output is generated), even though dynamic and performative syntactic relations can be made operational by using vectors or forces.

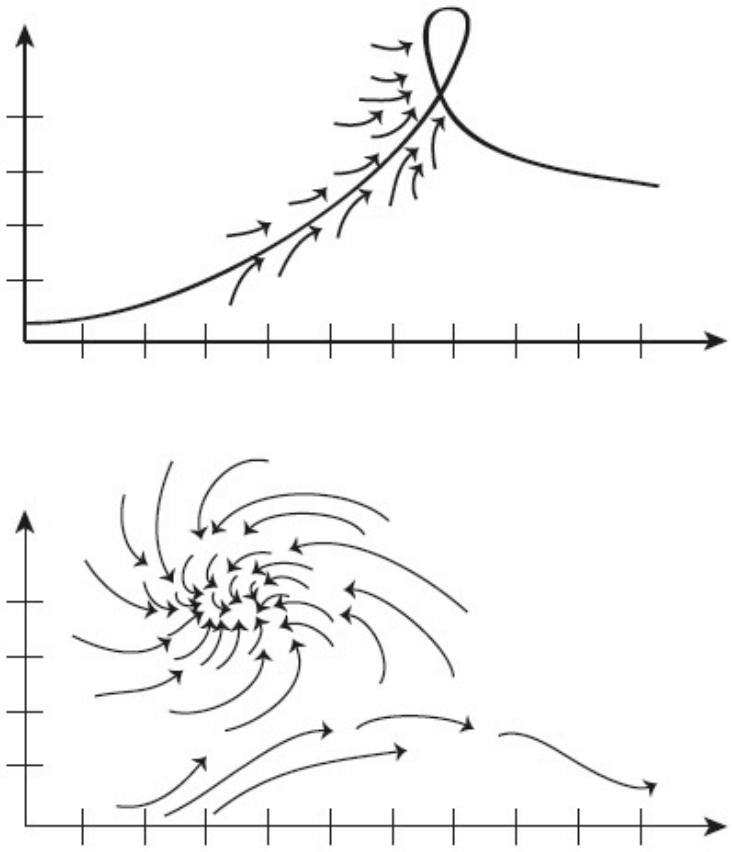

**Figure 8.** Two models of an event reaching a crisis with stress factors shown as vectors. The first shows the event as a fold, the second shows it as a vortex. Graphic credit Xárene Eskandar.

But even standard coordinate systems, such as the conventions of perspectival drawing, allow for the interpretative quality temporal experience to be expressed more fully than is possible with standard timelines. A parallax view, in which prospective anticipation is gradually replaced with retrospective reassessment, can be generated with a slider that animates the dynamic transformation in the value, identity, and relation of temporal events. In such a view, temporal events expressed as a set of conditions, rather than givens. The slider indicates a point of view, a perspective from which the experience of temporality originates in an individual.

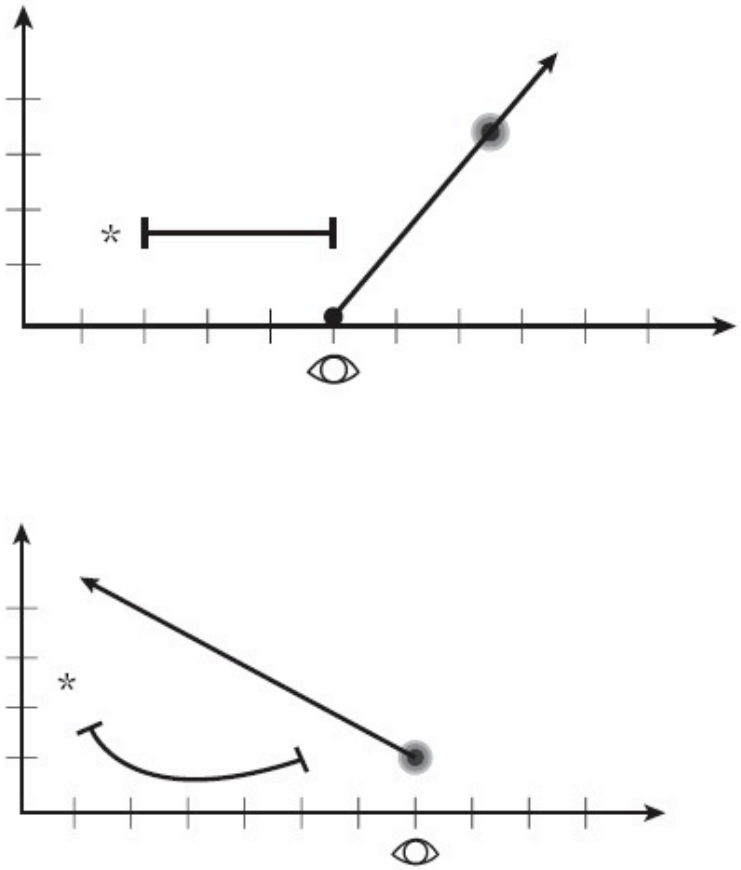

**Figure 9.** A linear model of parallax showing anticipation and retrospective assessment of an event. The "event" is the combination of the moods of the "eye" individual, indicated by the anticipatory arrow and then the retrospective view (lower arrow) across the bar and star that mark a moment and a duration in the temporal span. The event is warped in the retrospective view. The metric might be altered as an effect, though it is not in this depiction. The "eye" is a now-slider, as per the old temporal modeling design, and its position on the bottom line indicates the position of the observer within the course of even. Graphic credit Xárene Eskandar.

By breaking the relentlessly regular grid, the potential for graphing temporal modeling as a complex system of events is greatly enhanced. The relational, and co-dependent quality of temporal events finds its expression in these more sophisticated models

Several fundamental principles can now guide these designs. These principles of non-continuous, non-homogenous, and multi-directional *temporality*, as well as the point of view parallax, refine the reductive crudeness of models linked to standard a priori metrics of uni-directional, continuous, homogenous *time*. In this refinement temporality is conceived according to the basic formulation mentioned above: time as a function of x (temporality= time $^{(x)}$). In these formulations, x is any of the (theoretically infinite) variables that inflect the model (mood, events, influences, events, constraints, etc.). Because temporality is an act of form-making (constructivist), not an act of expressing pre-existing or a priori phenomena (realism), the sequence of intellectual events in this formulation insists on temporality (and, likewise, spatiality as the result of constitutive relations among temporal and spatial phenomena. The full realization of this approach requires a multi-dimensional, complex, model of space and time and imaginative realizations as graphical expression.

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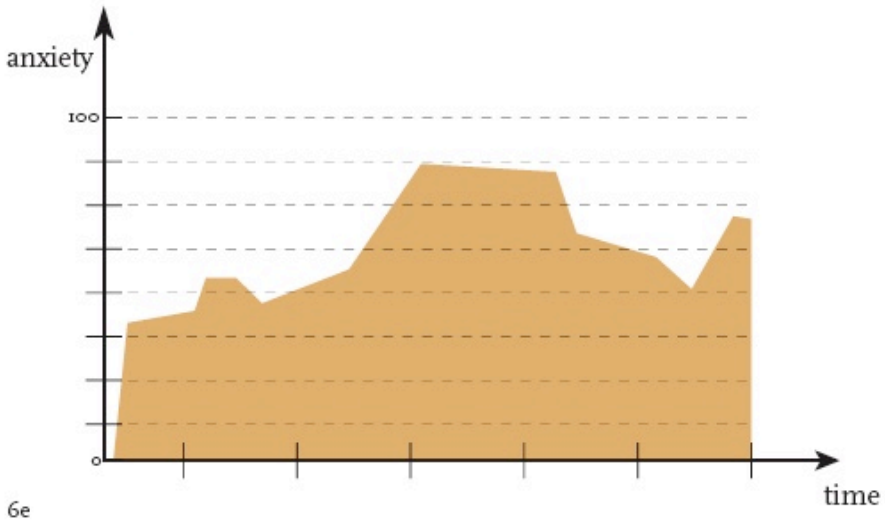


**Figure 10.** In the first image, anxiety (measured subjectively but charted on a standard metric) is charted against time, also depicted with standard intervals. The change from one state to another (changes in degrees of anxiety) is shown in a continuous line. Graphic credit Xárene Eskandar.

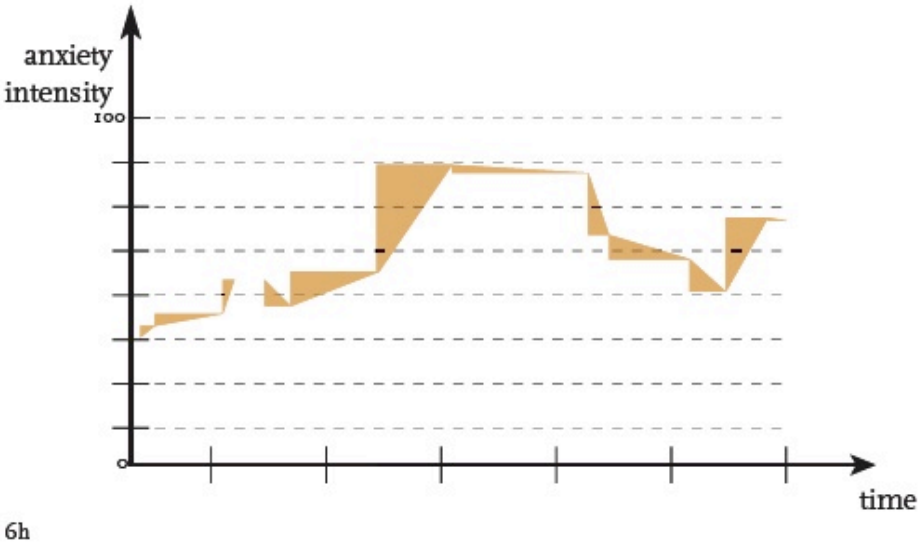


**Figure 11.** The difference between one state and the next is used to generate a graphical form that is expresses the changes from one moment to another. Graphic credit Xárene Eskandar.

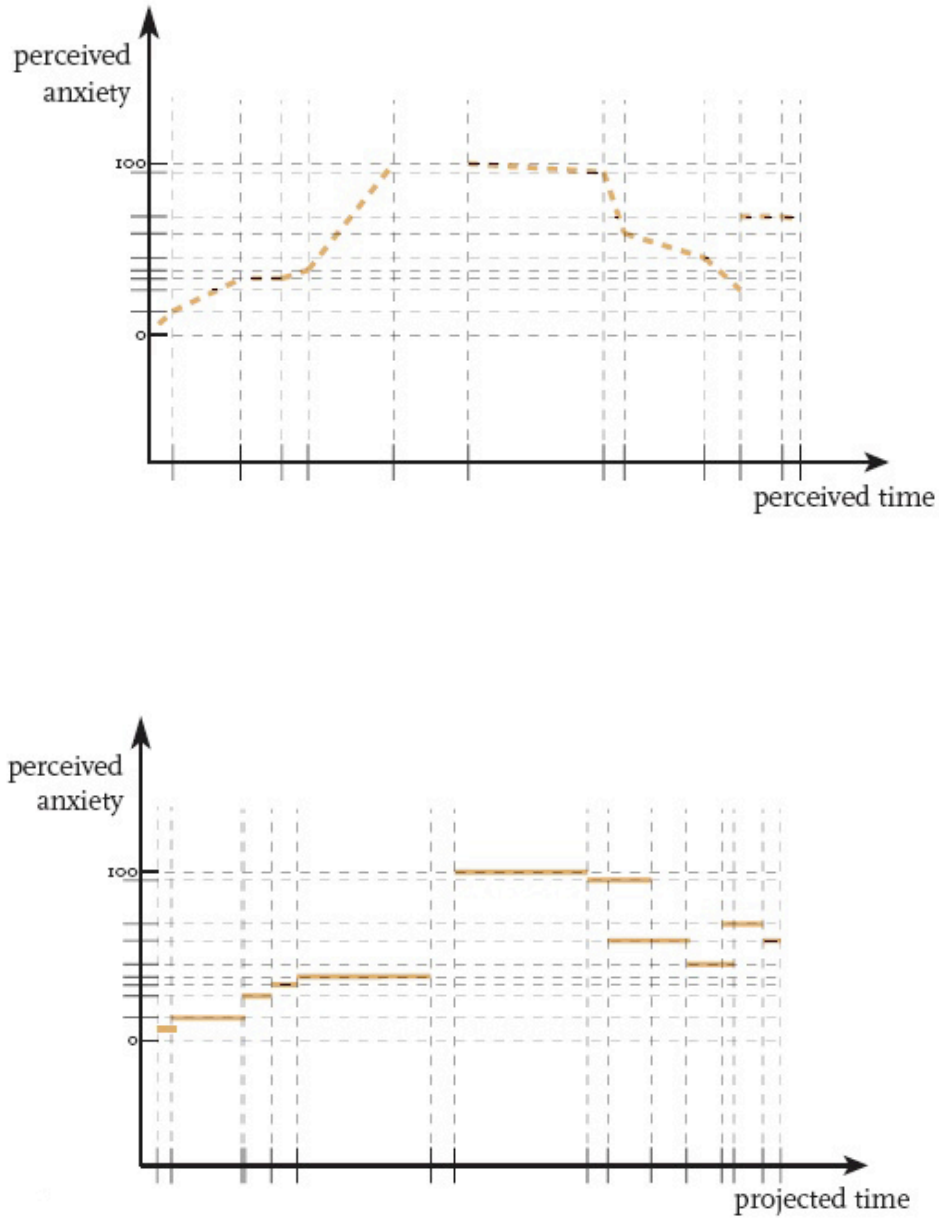


**Figure 13.** The differences between states are projected onto the anxiety and time axes to create a metric that is the effect of perception, rather than an a priri given. By rotating the angles that marked changes of levels of anxiety into a position parallel to the time line, the metrics can be changed as a projection of these lines (whose lengths were generated by a combination of duration and change of intensity of anxiety) onto the temporal axis, thus moving from a "perceived" time to a "projected" time. The result is a set of transformations from an uninflected, supposedly observer independent "time" and "anxiety" to one created as an effect of the experience of time on its expression. Graphic credit Xárene Eskandar.

## Space as Spatiality

The discussion of space corresponds exactly to that of time, and the distinctions between the conception of space as an a priori given and that of space as relationally constituted marks the same philosophical division of approaches as those that are used in charting or understanding time and temporality. Likewise, spatiality is to be understood as space as a function of x (spatiality= space $^{(x)}$).[4] 38

To give graphical expression to these ideas requires using non-standard metrics, intuitive and subjective principles of design. They are meant as provocations to the larger project of creating more systematic renderings of humanistic phenomena, introducing basic transformations of the graphical fields we created for time lines into mapping and GIS applications. Precedents for such renderings can be found–e.g. Francis Galton's rendering of space as a function of travel time. Galton's problem, formulated in the mid 19th century, takes into account that most statistical phenomena are observer-dependent and situated, and can't be separated from the various dependencies that bear upon the creation of data. Galton, in other words, recognized that in many circumstances, data were capta. The statistical description of phenomena depend upon the observer's circumstances. A more recent demonstration of these principles is a map designed by Tom Carden. His dynamic interface redraws the London Underground map as function of time of travel from any selected station to any other station.[5] 39

Subjective parameters are even more difficult to inscribe, since they cannot, by definition, be based on simple consensual standards. We can easily understand these distortions– space as a result of travel time. But how could we visualize the spatial distortions introduced by variables such as fearfulness, anxiety, anticipation, distraction, or dalliance and thus render space as *spatiality, space as a factor of x*? Some variable is always in play in the experience of space as well as its representation, so space is also always constructed according to a specific agenda and a situated experience etc. While this is the common experience of the phenomenal world, representations of spatiality have lagged behind, dominated by the navigational or descriptive systems of standard mapping whose conventions are well known and recognized, and which partake of and impose the dominant realist model. 40

In proposing a new model for humanities' work, I am suggesting that the subjective display of humanistic phenomena can be applied across the domains with which we are concerned at at least four basic levels of interpretation or knowledge production. 41

1. Modelling phenomenological experience in the making of humanities (data as capta, primary modeling, the representation of temporal and spatial experience); 42
2. Modeling relations among humanities documents i.e. discourse fields (a different metric is needed to understand dates on diplomatic documents in the spring of 1944 than one needed to constitute understanding of those dated to the same period of the spring of 1950 etc.);
3. Modeling the representations of temporality and spatiality that are in humanities documents (narrative is the most obvious);
4. Modeling the interpretation of any of the above (depicting or graphing the performative quality of interpretation).

Let me describe a concrete example and see how it can be understood across these four different models. Take the first instance, the modeling of a phenomenon. Three people are waiting for a bus, how long does it take? One is late for work and anxious, one is in desperate need of a bathroom, and the other does not want to go to the afterschool program. How can the variations in perception be expressed? Recent experiments on the way time is understood in relation to different circumstances and tasks have made this experiential variable apparent to psychologists. So, the initial graphical expression of the humanistic phenomenon requires a variable metric, an elastic timeline, even a field that might fold or break under extreme circumstances.

When we shift from modeling experience to find graphical expressions for the representation of experience, the complexity of the problem increases. The modeling of time in documents, in relation to the duration of the documents 43

(time of telling) and the experiences they recount (the time of the told) as well as the relations among these and possible external temporal references, forms a subset of linguistic and narrative analyses. The graphical forms to represent these are generally inadequate to the complexity of the textual or visual (and/or filmic and audio) documents.

Modelling the temporal relations among documents about temporal experience (imagine letters, emails, text messages, or diary entries from these various bus riders, only some of which is date stamped), gives rise to yet further ambiguities and complexities. A letter sent that was delayed, email re-routed, messages held in suspense on a server will change the temporal effect. For instance, letters or emails arranging family events and travels over the holidays contain many temporal values that are contingent on each other and often in constant flux as plans are being made. The temporal sequence and the date stamps are not one and the same, a temporal relation of the exchanges might include messages that cross in mid-stream, and whose temporal sequence does not match the simple alignment with dates on a line. 44

Plans change, travel times are altered, arrivals and departures re-arranged, moods shift, frustrations intensify, disappointments or unexpected surprises arise in relation to the sequence of events. An email recounting something that occurred “yesterday” in relation to a date stamp might also contain more vaguely identified “earlier” and “before” statements that put events into a relative sequence without explicitly identifying when these occurred. As the telling unfolds, these relations may change in the writer’s expression and perception, so that the textual description of a recollected event continues to shift its place in the temporal order. Who was supposed to do what when and who was depending on which order of events? By the time holiday travels and expectations are sorted out, each family member has a very distinct view of what happened when and how the sequence of lived events occurred and where. Was the bus station large or small, far or near to any other spot in the itinerary, or located in a familiar landscape. How was the space experienced as a function of time spent in it? These constructions of temporality and spatiality from within documents, across documents or a discourse field, and of phenomena are all created with time/space as functions of interpretation. The act of interpreting a series of documents creates its own temporality, that of the production of a reading, that is not the same as the telling or the told within the documents, but an independent phenomenon. An interpretation has its own temporality ad spatiality. 45

We can construct a concrete example of spatiality that parallels this example of temporality, and also depends on temporal models. For instance, imagine an open stretch of beach, relatively unconstrained and unconstructed. When a sailing ship is washed up at a certain point on the beach, not only that point, but the space around it, becomes transformed. The presence of the wreck creates a huge impact, and the space almost palpably bends, compresses, expands, and warps around it, with waves of resonance rippling outward from that point. 46

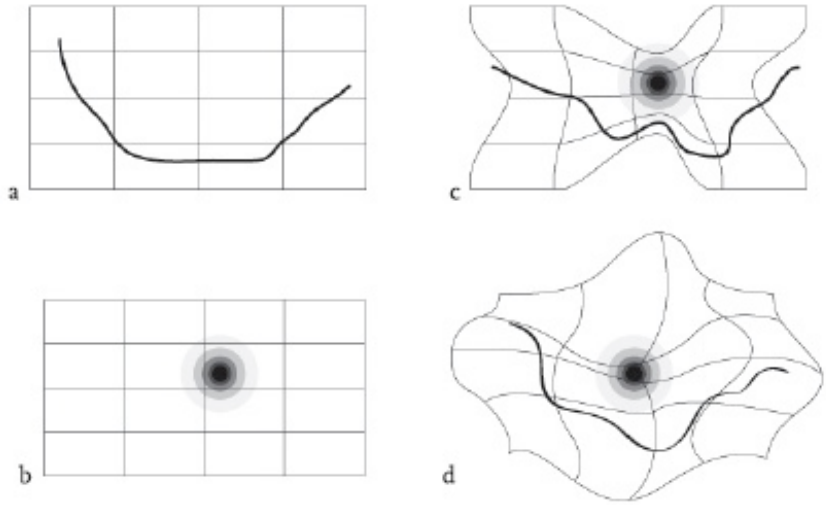


**Figure 14.** In this example, a geographical space (a stretch of beach) is affected by a change in the state or circumstance. First we see the space mapped according to a regular Cartesian coordinate system. Then the grid is inflected by the arrival of a beached ship, around which the beach bends because the sense of each spot as relative equal is distorted by the attention that the ship commands. The space acquires one inflection after another as graffiti marks the ship, a chain link fence goes up with a police notice, footprints create a pattern in the sand, pathways for observation re-route pedestrian traffic etc. The "space" of the beach is transformed physically and in terms of attention getting and effect so that it is no longer a set of equal and neutral elements of a rational spatial system, but one that must be expressed with graphical distortions that show these inflections. Graphic credit Xárene Eskandar.

Police barriers are set up and suddenly make that bit of beach into a highly charged site. Additional fences create zones of potential transgression and prohibition, lines in the literal sand that when crossed by graffiti artists and taggers, vandals and looters, introduce a whole set of spatial relations governed by different rules and expectations. The space of and around the shipwreck becomes a hot point, a zone, an arena of complex spatial negotiations and marked coordinates, each differently charged depending on the players and circumstances (law enforcement, owners, passersby, taggers at night, in early morning, broad daylight etc.). Even more than the open, indeterminate space of the beach, this spot becomes an area of shifting values and interpretation. Space, always marked, has become explicitly so, and the spatial relations demarcate regions of authority and behavior whose dimensions are not in strict correspondence to physical space. The same amount of physical space half a mile down the beach has none (or few) of these dimensions. Can we still locate the wreck on a Cartesian grid available through any GPS system? Of course, the two approaches, constructivist and realist, don't cancel each other out. But they are not equivalent. The GPS standards locate the spot within those coordinates, but say nothing about the constituted space as a phenomenon created by these many variables. We have many adequate models for the first mode of visualization, but very few for the constructivist approach grounded in an interpretative mode of experience.

Take another example, a map tracing a journey between London and Prague in the 1810s.[6]; How does the space change dimensions to reflect hazard, delays, dalliances, terrain changes, interruptions of war and political strife, danger, weather, or illness? A legend or set of labels or markings could indicate these inflections of the space simply by putting symbols on a map. That would be the registration of *subjective data* on a conventional map. But mapping conventions don't morph the landscape to accommodate the effects of fear, anger, or violence. Now change the map, distort its proportions so that it becomes a terrain shaped by fear, by obstacles, by disruptions and confusions.

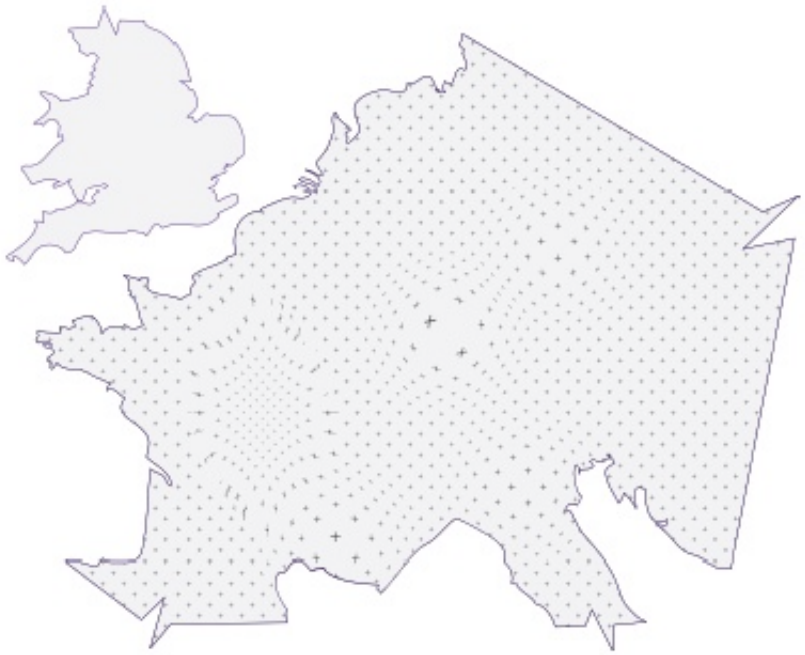

**Figure 15.** Geographical terrain warped by the experience of travel so that the standard distances are distorted by the effects of difficulty, fear, delays, and other factors. The map shows the landscape as an effect of experience rather than a standard ground on which to depict experience. In the second instance, the points on the metric grid are warped by the impact of an event, or events, that have simply reordered the standard grid. Graphic credit Xárene Eskandar.

That is a subjective expression. The two approaches are radically different. In the second instance, space is an effect of spatial relations, spatiality is expressed as a factor of disturbance, and it might be expressed as a factor of many variables occurring across a temporal extension (fear, anxiety, confusion, anger, disorientation).

The challenge of representing large corpora of texts and immense archives also requires attention, in part because the conventions of wayfinding and navigation that are part of print media and its institutional structures are not yet reworked in a digital environment meant to address the shifts in scale and experience brought on by new media. On top of the challenge of representing repositories and their use, we can point to another challenge –that of giving graphical expression to interpretations built on and out of documents, or collections of documents. These present different challenges than the humanistic interpretation of temporal, spatial, and informational phenomena, but depend upon the basic recognition that subjective and co-dependent principles must govern their design. The conventional graphical features of texts that inscribe interpretation include all of the features of layout and format, typography, and design that organize and structure its presentation on the page, screen, or other surface or medium. The features that inscribe interpretation in archives are those that embody or express the imprint of the point of view according to which the archive takes shape. These include classification systems, nomenclature, hierarchies and categories of organization and ordering, systems of search and access, information architecture, the format of storage and display, and any other feature of the archive that is intrinsic to the forms of its expression. While all of these are expressions of arguments, and thus interpretations, they do not show or model interpretation on the fly as a constitutive act of reading, relating,

connecting, and sense making. In sum, these acts of interpretation make use of the format features of graphical presentation as well as responding to and thus producing the "content" of these artifacts. Some combination of user-centered but co-dependent systems analysis and critical reading practices as performative acts would have to underpin such graphical visualizations. But that is also work for another time.

## Conclusion

My argument is a polemical call to humanists to think differently about the graphical expressions in use in digital environments. A fundamental prejudice, I suggest, is introduced by conceiving of data within any humanistic interpretative frame on a conventional, uncritical, statistical basis. Few social scientists would proceed this way, and the abandonment of interpretation in favor of a naïve approach to statistical certainly skews the game from the outset in favor of a belief that *data* is intrinsically quantitative — self-evident, value neutral, and observer-independent. This belief excludes the possibilities of conceiving data as qualitative, co-dependently constituted — in other words, of recognizing *that all data is capta*. 49

Again, to reiterate, I am not suggesting that we simply introduce a quantitative analysis of qualitative experience into our data sets. I am suggesting that we rethink the foundation of the way *data* are conceived as *capta* by shifting its terms from certainty to ambiguity and find graphical means of expressing interpretative complexity. In some circumstances (the example of the bar chart given earlier that was displaying information about gender, nations, and populations) ambiguity merely requires a higher order level of complexity in the model, so that apparent "certainties" are qualified by variables and nuances that can be specified in mathematical terms. But the idea of capta as fundamentally co-dependent, constituted relationally, between observer and observed phenomena, is fundamentally different from the concept of data created as an observer-independent phenomena. That realization has to be at the heart of humanistic approaches to the graphical display of interpretative phenomena, of interpreted artifacts and the acts of interpretation themselves. Because interpretation is performative, bringing objects into view through a reading or other act of intervention, it forecloses the possibility that autonomous objects or phenomena exist within the horizon of human experience. Phenomena of human experience are constituted as interpretative acts. 50

The natural world and its cultural corollary exist, but the humanistic concept of knowledge depends upon the interplay between a situated and circumstantial viewer and the objects or experiences under examination and interpretation. That is the basic definition of humanistic knowledge, and its graphical display must be specific to this definition in its very foundational principles. The challenge is enormous, but essential, if the humanistic worldview, grounded in the recognition of the interpretative nature of knowledge, is to be part of the graphical expressions that come into play in the digital environment. If we don't engage with this challenge, we give the game away in advance, ceding the territory of interpretation to the ruling authority of certainty established on the false claims of observer-independent objectivity in the "visual display of quantitative information." [7] 51

I'll finish with one more concrete example of the shift from observer-independent realism to co-dependent constructivism. Snow's justly famous chart of deaths from cholera allowed city officials to track the source of the epidemic to a single water pump. 52


**Figure 16.** Dr. John Snow's famous chart tracing the source of an epidemic using graphical methods that plotted frequency of outbreaks and geographical location. But each outbreak was an individual, and their degrees of vulnerability, impact of their illness, effect on the family and loved ones, was specific and particular in ways that a single dot cannot express. Seen from the point of view of an individual participant in these tragic events, some of these individuals loom much larger than others when depicted from within the gaze of someone actually seeing them occur. Graphic credit Xárene Eskandar.

The distribution of dots on the street map makes evident the role of the pump by the way they cluster. A useful map, crucial to analysis, its clarity and succinctness served an important purpose. It was sufficient to that purpose, adequate, but we could revisit that map and use it to express other factors. Who are those dots? Each individual had a profile, age, size, health, economic potential, family and social roles. In short, each dot represents a life, and none of these are identical. Many demographic features could be layered into this map to create a more complex statistical view of the epidemic. That is neither subjective data nor a subjective display. But what if we take the rate of deaths, their frequency, and chart that on a temporal axis inflected by increasing panic. Then give a graphical expression to the shape of the terrain, that urban streetscape, as it is redrawn to express the emotional landscape. Then imagine drawing this same streetscape from the point of view of a mother of six young children, a recent widow, a small child, or an elderly man whose son has just died.

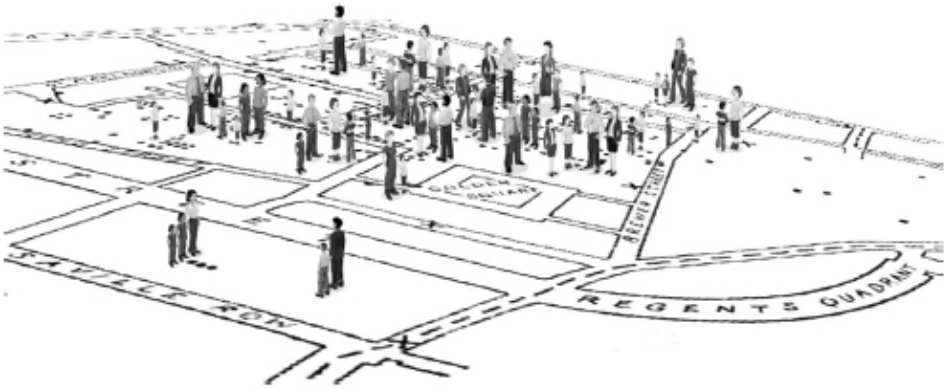


**Figure 17.** Snow's chart altered. Graphic credit Xárene Eskandar.

These latter are all instances of the graphical expression of humanistic interpretation. They are as different from the visual display of quantitative information as a close reading of a poem is from the chart of an eye tracker following movements across a printed page. They are fundamentally different in character and in their basic assumptions about the role of graphical expression as an aspect of knowledge production. We have a very long way to go in creating graphical expressions that serve humanistic interpretation, but I hope I have suggested some of the premises on which this work might begin.

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