formats, are inherently non-hierarchical, with proximity and connectivity relations serving a more powerful rhetorical purpose. Like any two-dimensional surface, a screen can support the illusion of depth using a third axis, particularly useful for graphing events or time-based media like film, video, and audio. Each additional dimension adds complexity. Node-link diagrams support pathfinding, connections, through adjacency and associational trails. In diagrams that need to support multiple paths, even overlapping paths, such as those that display transportation systems (where some lines or roads pass over or under each other rather than intersecting), multiple layered matrices are better suited to the schematic organization of the information than flat diagrams.[182]

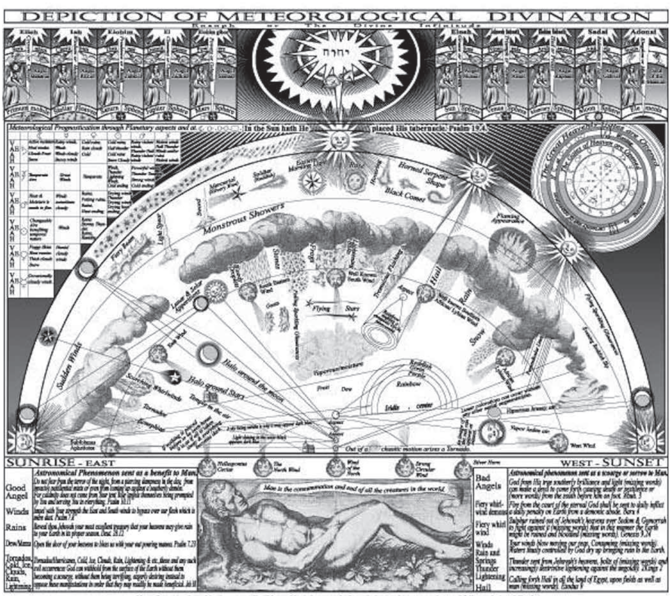
Dynamic systems

The combinatoric generators we have been describing can be used to reorganize relations among elements, but they do not change either the elements or the structure that contains them in that process. Diagrams of dynamic events or processes are also generative, but they often display processes rather than products.[183] They use dynamic elements, such as vectors, or directed graph lines, direction, flow, movement, and rates of change as components whose spatial order creates a graphical field. A diagrammatic event is a means of provoking and sustaining processes that are in flux, unfinished, open-ended, complex, or probabilistic. Diagrams of dynamic processes are different from knowledge generators. They are not meant to produce an outcome that can be repeated, or guaranteed by the careful observation of rules (as in calculating scale changes with a ruler or adding a sum of numbers). Instead these diagrams make use of graphical organizations, operations, and relations to analyze or model events or processes. Diagrams of complex systems model many possibilities and probabilities. Values change as the diagrammatic activity progresses, and multiple variables may be active at different scales and rates of change so that the outcome for such a dynamic system is necessarily probabilistic.

New challenges arise in using graphical means to show dynamic processes and events, including complex adaptive systems. Because an event is a state change, a presentation of dynamic circumstances, conditions in which various force, vectors, flows, pressures, or other changeable phenomena are being charted, it does not necessarily lend itself to graphical format. Nonetheless, visualizations of fluid dynamic systems—such as the weather, tides, and atmosphere—have a much longer history on which we can draw. Once again, we can trace literary references into antiquity. Among the Greeks, Thales and others described weather phenomena but creating graphic techniques for meteorological analysis was slower. Aristotelians charted the four elements—earth, air, fire, water—in a diagram that was meant to be generative, productive, capable of the infinite variety of combinations that produced the natural world.[184] This system was frequently refined to show the zones of frigid, torrid, and temperate air, and to indicate the power of the winds to blow from each direction and formed, as we have seen, the basis of Leibniz's view in the 1660s. The effort to align weather changes with planetary movements also gave rise to an industry of observations and calculations. The astronomer Tycho Brahe was convinced that weather forecasting could be done based on astronomical observation.[185] The efforts of the sixteenth century astronomer were copied in later years by figures like John Goad, who recorded thirty years of observations in his 1686 publication, *Astrometeorologica*, tracing the "Discourses of the Bodies Celestial, their nature and influences, discovered from the variety of the Alterations of the Air […].”[186]

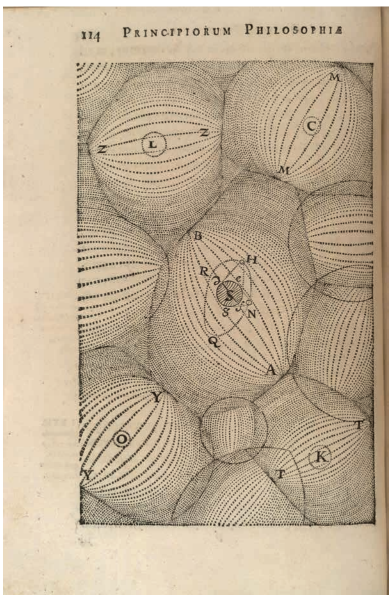
The aforementioned Fludd produced a remarkable image of Meteorology (1626) that combines occult and astronomical imagery. His system allegorizes natural phenomena and allows for the Twelve Winds to be interspersed with images of the Four Archangels.[187] Though mechanistic, his vision of interlocking wheels and spheres hints at dynamic representations of processes and forces.[188] His weather scene is theatrical, and combinatoric, a stage on which diagrammatic play can be enacted by calling the selective elements into play. What it lacks in scientific accuracy it makes up for in imagination.

Diagrams of wind and currents became a feature of navigational maps (Leonardo had done detailed studies of waves and currents, vortices, and other formations in moving water), and seemed to belong to the world of things, observ-



Robert Fludd, *Philosophia sacra et vere christiana seu meteorologica cosmica* (Frankfurt: T. de Bry, 1626).

able, and tractable. But the motions of air, vapor, clouds, and the actions of the atmosphere were more difficult to describe in graphical form. René Descartes's 1637 *Discourse on Method* contains several diagrams that chart processes of atmospheric transformation.[189] These are fascinating, since they are visual attempts to show activities that are almost unseen. Descartes still imagines the world to be composed of the primal elements—earth, air, fire, and water—but his scientific imagination addresses the particulars of molecular structure and operation. Molecules of water, he suggests, are shaped with wiggly tales, small and slippery, so that they can move in between the hard-edged and larger molecules of wood, earth, or stone. These materials are composed of molecules whose edges catch and lock together, but are large enough that water can sometimes still find its way into the crevices left in the interlocking structures. His analyses of rising water vapor, cloud formation, and changes in temperature, early attempts to show complex processes, are unique in their connection of atmospheric activity and landmass. He recognizes that what he is observing and describing is a system, not isolated entities. The lines of pressure and change align directionally, become compressed, and make

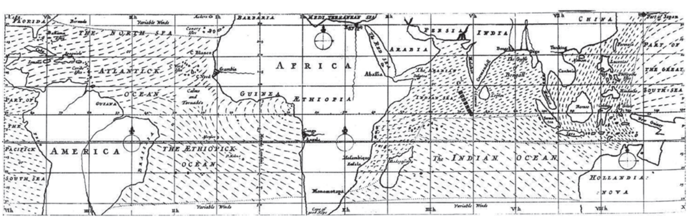


René Descartes, images of meteorological phenomena from *Discourse on Method: Dioptrics, Meterology, and Geometry* (1637).

use of other innovative visual means. Static images, they optimized their graphic capacity to show the thermal and pressure systems in relations of land and air.

Descartes also created a remarkable diagram of energy vortices in the plenum, showing the substance that fills the voids of the universe. The image has a magical dimension to it, presenting the imagined force fields exerted by planets in a pulsing field of activity.[190]

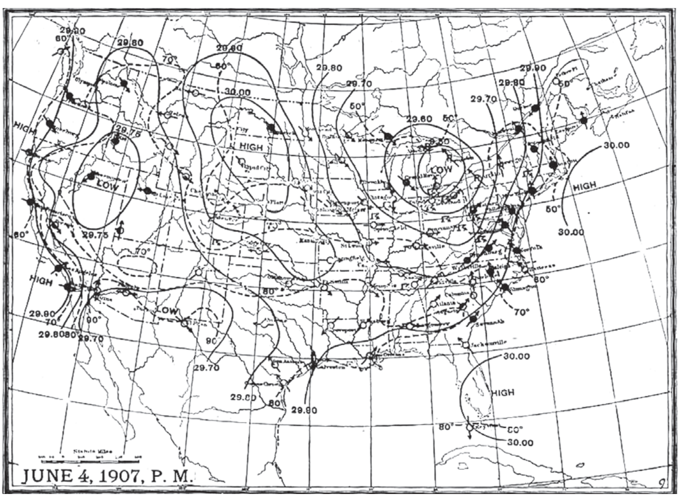
Meteorological observation took a leap with the development of instruments for gauging wind velocity, temperature, and barometric pressure, thus creating a statistical foundation for the science.[191] The thermoscope, invented by Galileo in the last years of the sixteenth century, was soon succeeded by thermometers and barometers capable of regular and reliable readings. Statistical metrics were becoming standardized in this period. Abstracting intangible, sometimes invisible, phenomena into a graphical language and diagrammatic form depended on the intersection of adequate instrumentation and measure, sufficient record keeping to supply data, mapping techniques on which the information could be projected, and then a graphical language for diagramming ephemeral phenomena—or, at least, making a study of the forces and variables of a highly complex system. While meteorological observation forms one excellent case study, the attempt to depict magnetism and other unseen forces was another area in which dynamic processes sought graphical



Edmond Halley, map of the winds (1686).

expression as a foundation for understanding.

Basic instruments for taking temperature and barometric pressure readings, recording wind direction and, to a limited extent, velocity, as well as precipitation gauges, were chiefly seventeenth century inventions. Edmund Halley is credited with creating the first meteorological chart when he mapped the winds on the surface of the globe in 1686.[192] His arrows of wind direction are not systematic, but they do indicate unstable, changeable conditions. The combination of direction and force is intuitive, but systematic creation of what are known as surface analysis maps only emerged after development of coordinated telecommunications systems. Records of meteorological data started to be mapped in the early nineteenth century, though tides and currents had been charted several centuries earlier. The creation of isobars (lines connecting areas of similar barometric pressure) is attributed to the French meteorologist Edme Hippolyte Marie-Davy in the 1860s, though a map with isobars appears in the 1834 treatise on meteorology written by William Prout.[193]



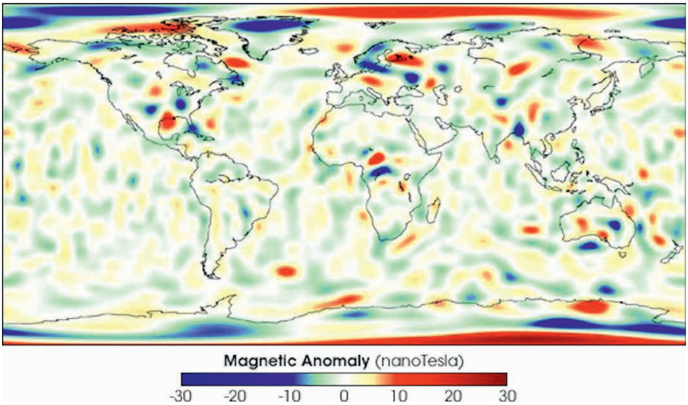
June 4, 1907 thunderstorm mapped using standard conventions with isobars (early twentieth century) from Sverre Peterssen, *Introduction to Meteorology* (1941).

One of a storm in New England in the late nineteenth century shows the graphical system for wind direction and force, isobars, temperatures, and pressure in place. Snapshots of particular moments, they imply process and change rather than actually showing it.

Interest in the microlevel of analysis of meteorological events, long expressed in passages of poetic prose description, found graphical expression in several detailed studies produced in the 1860s. H.W. Dove's *The Law of Storms*, published in 1862, is filled with detailed and technical discussion of measurements of barometric pressure, temperature, wind velocity, and direction as well as storm tracks and wind shifts, even as its title aligns it with the systematic approach to thinking characteristic of other approaches to knowledge and its representation at which we have already glanced.[194] Rear Admiral Fitz Roy's 1863 *The Weather Book* contained carefully mapped meteorological data for several days running that showed the wind directions, velocities, precipitation, temperature, and barometric pressures during a major storm in October 1859.[195] Two years later, Francis Galton's *Meteorographica, or methods of mapping the weather*, created a system of conventions for showing meteorological conditions in Europe for the entire month of December 1861.[196] Methods of showing fronts, precipitation, using isobars, and mapping other data were quickly adopted. The military interest in weather forecasting intensified the pace at which conventions were pressed into use. More sophisticated methods of measuring, including balloons and other devices, combined with simultaneous coordination of information across distances, gave rise to the modern weather map by the late nineteenth century.

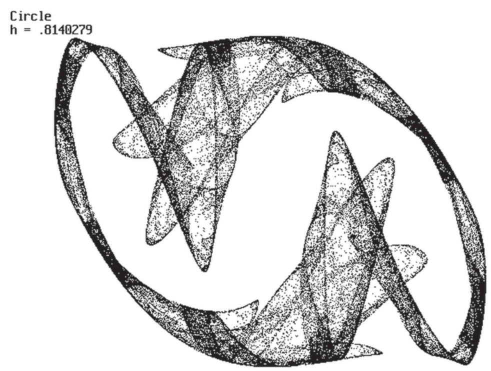
Much more could be detailed in the history of graphical representation of fluid dynamics, as increasing sophistication of instruments combined with improved methods of calculation so that rapidly changing conditions, graphed temperature, pressure, and wind conditions became part of forecasting and analysis.[197] But challenges arose from studying thermodynamic properties of the atmosphere whose complexity was just glimpsed by nineteenth century scientists. Non-linear systems posed mathematical challenges. For purposes of thinking about the visualization of interpretation, approaches to the thermodynamics of the atmosphere offer an example of ways an enormous number and type of variables can be put into a model for analysis to generate outcomes that cannot be predicted mechanistically. These systems are extremely sensitive to start conditions, and exhibit emergent behaviors. By the early twentieth century, meteorologists were not only recording observable phenomena (wind, temperature, etc.) but also modeling dynamic systems.[198] The combination of motion graphics, simulation, and computational capability necessary for visualization of complex mathematical models has only been possible with digital computers.

Graphical means in two-dimensions, or even the third and fourth dimensions created as spatial-temporal illusions,



Magnetic activity visualized, NASA.

are often inadequate to address the mathematical complexities involved. But conceptually, we can imagine diagrams of systems with variable organization, changes of scale, and almost inexhaustible complexity in micro to macro modeling. The foundations of chaos and complexity theory arose from the observations of Edward Lorenz, a meteorologist and mathematician, while watching the dynamics of cloud formation.[199] If we are to model interpretation with all of the many variables, statistical and probabilistic distributions it involves, these are the sources to which we will have to turn, even for a speculative vision.



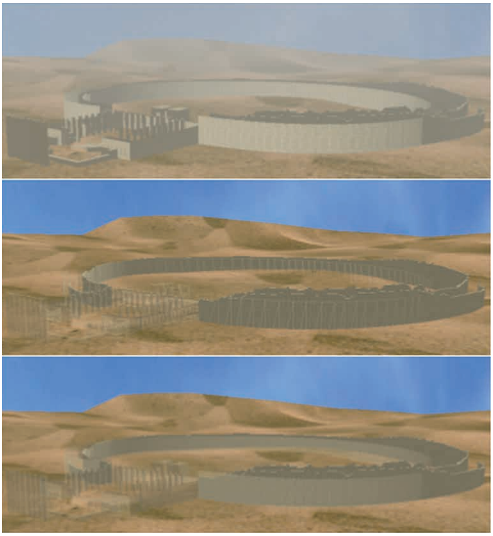
Lorenz's engagement with chaos theory resulted in the production of standard diagrams to show the ways tipping points and other events transform the dynamics of systems. Related to chaos theory in its dynamic unfolding, complexity theory uses non-predictive modelling to study probabilistic outcomes of variables in relation to each other within a system as it changes over time. Chaos models show transformation, they are built on interactive variables in a co-dependent, adaptive, system, rather than mechanistic models. Dynamic systems, in which adaptation and emergence occur, cannot be graphed in advance. A model has to run its course in order for the outcome to become apparent, and in the process, graphical forms and expressions allow the emerging patterns to become legible. Knowledge is generated, and expressed graphically, but the graphical system is not the means of data input in either chaos or complex systems.

Euler circle, chaos diagram.

Visualizing uncertainty and interpretative cartography

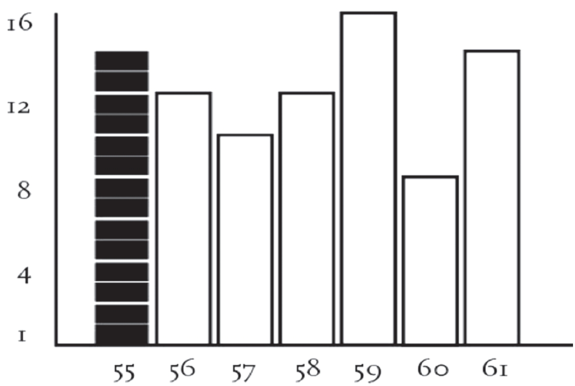
T. Zuk, S. Carpendale, and W.E. Glanzman, "Visualizing Temporal Uncertainty in 3d Virtual Reconstructions," *Proceedings of the 6th International Symposium on Virtual Reality* (2005): 99-106.

Most, if not all, of the visualizations adopted by humanists, such as GIS mapping, graphs, and charts, were developed in other disciplines. These 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 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 constructedness 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 concept 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 critical discussion of realist models of data gathering.[200] At best, we need to take on the challenge of developing graphical expressions rooted in and appropriate to interpretative activity.

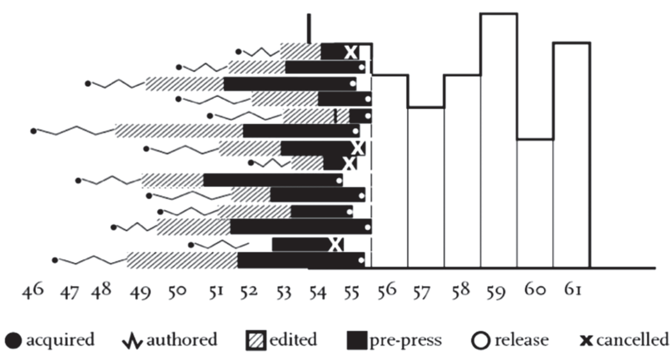
Because realist approaches to visualization assume transparency and equivalence, as if the phenomenal world were self-evident and the apprehension of it a mere mechanical task, they are fundamentally at odds with approaches to humanities scholarship premised on constructivist principles. I would argue 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 models for GIS, decision-making, archaeological research, and other domains.[201] But an important distinction needs to be clear from the outset: the task of representing ambiguity



Standard bar chart based on discrete data entities.

and uncertainty has to be distinguished from a second task —that of using 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 constructedness of space. Both rely on rethinking our approach to visualization and the assumptions that underpin it.

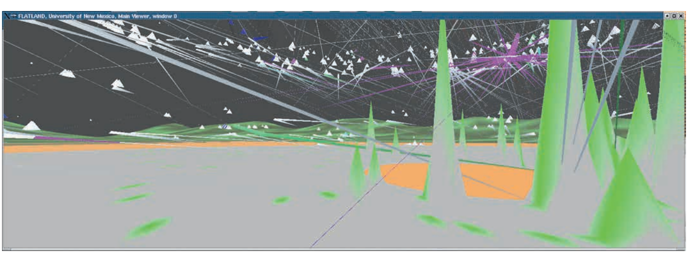
If I set up a bar chart or graph, my first act is to draw a set of one or more axes and divide them into units. The conventional forms of the graphical display of information, 'data,' make use of a formal, unambiguous system of standard metrics. Charts use simple (if often misleading) geometric forms 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



Alternative to standard bar chart showing greater complexity.

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 latitudes, 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. 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.

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. That last formulation should be read 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 ex-*



Steve Smith, immersive data visualization.

pressions, 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.

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 constructedness of the categories according to the uses and expectations for which they are put. 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 (nations, genders, populations). If the challenges 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*.

Humanistic methods

The humanistic aspect of this approach should be obvious: that knowledge created with the acknowledgment of the 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 are by the observation. Theoretical physicist Werner Heisenberg never suggested that the relation of intervening observer and effect on phenomena was symmetrical, merely that it was codependent, when he introduced the concept of uncertainty in the early twentieth century.

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 am going to characterize all information as *constructed*: as 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 constructed, interpretative information* to the *constructed expression of perceived phenomena*, but constructedness 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 observer-dependent 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.[202]

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.

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

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

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.

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.

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 might vary in size and scale or degree of ambiguity of placement. 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 embeddedness 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 do their work, whether the budgets will have any effect on learning outcomes, or any of the other factors that come into play in assessments based on metrics extracted from lived experience. They do not account for the ecological, social, cultural, ideological, expertiential aspects of the larger system of which they are a part. 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; pencils as a factor of resource allocation, and so on. All metrics are metrics about something for some purpose.

The challenge is to design graphical expressions suited to the display of interpreted phenomena: information *about subjective user-dependent metrics, constructed displays of information*, and *inflected methods of graphical expression*. Interpretative construction registers point of view, position, the place from which and agenda according to which parameterization occurs. Constructedness does not align with the first term in a subjective/objective opposition. It is not individual inflection of mere idiosyncracy. Constructedness stresses co-dependent relations of observer and phenomena (in contrast to presumptions of objectivity, of observer-independent phenomena).

The display of information about affect often uses 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.

The next task is more complicated. Constructed information (which is, in essence, all information, though for practical purposes, I insist on these approaches only in domains where the humanistic component of the interpretative act needs to be structured into the visualization), that is information whose constitution exhibits its situated, system-dependent character, deviates from the standard norms by using graphic variables such as intensity of tone, size, color, or other feature to embody its qualities. Constructed 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 constructivist display of information*.

Creating a display that uses *constructivist methods* of graphical expression extends this last example to the design of the basic visual structure. A constructivist grid used to show anxiety might have a widely varying set of spacings to show that the information on display is constituted as a variable of some other aspect of experience (number of family members present at an event, for instance). Recognizing that such methods are anathema to the empirically minded makes even more clear that they are essential for the generation of graphical displays of interpretative and interpreted information. The point is to create visualizations that expose, rather than conceal, these principles of knowledge in the domains where the authority of information makes (still persistent and often pernicious) claims to "truth" through the "transparency" of the visualization.

Visualizing interpretation

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 four basic levels of interpretation or knowledge production:

1) Modeling phenomenological experience in the making of humanities (*data* as *capta*, primary modeling, the representation of temporal and spatial experience);

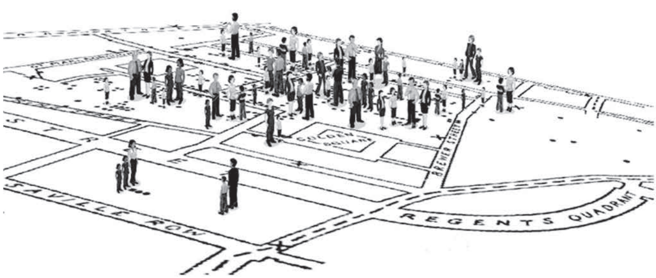
2) Modeling relations among humanities documents, i.e., discourse fields (a different metric might be needed to understand dates on diplomatic documents from the spring of 1944 or 1950);

3) Modeling the representations of temporality and spatiality that are found 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).[203]

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 do not 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."[204]

I will conclude 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. 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 has a profile, age, size, health, economic potential, family and social role. In short, each dot represents a life, and no life is 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. 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 eyetracker 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.



Snow original followed by point of view system built into the representation.