Chapter 2
Giving Shape to Data

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Abstract A key challenge for designers is to be able to present large amounts of data in very clear and simple ways. By this, it involves bypassing, if not eliminating entirely, sophisticated forms and convoluted graphics, as well as countless textual metadata (legends or notes). High-dimensional data space, requiring the use of advanced user tools to navigate inside, is also to avoid. What it boils down to is nothing other than data assimilated into straightforward and captivating forms. The aim is to design primitive or minimal shapes stripped down to their very essence for the purposes of delivering both a sensitive and meaningful experience of datasets—this kind of experience leads us to the fundamental principles of *Gestalt* perception. In this chapter, we shall attempt to prove that visual and graphic representation of "Big Data" needs to shift toward a new formalized approach using pure shapes to enhance the qualities of its aesthetic perception (and improve interaction with data representation and visualization)—note that the possibility to infer phenomena from data depends mainly on the aesthetic experience of the data itself. To do so, we will refer to some cutting-edge data design projects. It will also be an opportunity to introduce a new series of large-scale data representations currently underway, entitled *Data Shapes*, in which the simplicity of forms is addressed.

2.1 Introduction

Over 40 years ago, certain computer science laboratories specializing in human–system interaction set in motion significant research programs targeting new ways to display and describe information and knowledge. With this in mind, the majority of studies and experiments carried out unveiled a series of unique methods, techniques, and procedures designed to present metric- or statistic-oriented scientific data

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(Kruskal 1977, 1972; Kruskal and Hart 1966; Freeny and Gabbe 1966; Freeny et al. 1969; Caroll and Chang 1970).

As time went on, research naturally evolved to a more holistic approach on how new systems built viewed information, not to mention the number of avenues[1] there within. From data-viewing to data-processing, these initial, theoretical findings were combined with more practical ones pertaining to how cognitive systems (human, artificial) work and interact. Approximately 20 years later, this crossroads of thought drew in a multitude of experts from around the globe aiming to create visual and graphic displays of information[2] for the fields of engineering and cognitive science (behavioral psychology). Among those fueling this initiative were Card et al. (1999), Robertson et al. (1989), Stasko (1993, 1996), Hollan et al. (1986), Hutchins et al. (1985), Hutchins (1995) and Furnas and Bederson (1995), as well as various laboratories affiliated with the Xerox PARC (Palo Alto Research Center), the University of California, San Diego (UCSD),[3] the University of Maryland, Georgia Institute of Technology (Georgia Tech),[4] Virginia Polytechnic Institute and State University (Virginia Tech),[5] and the laboratories of IBM, AT&T and Bell.

Aware of the infinite possibilities at its disposal, the field of Design decided to take matters into its own hands in the 1990s and seize the opportunity wherein to give rise to a creative entity that would embody its expertise and know-how better known as data design. With a focus on technically complex issues, the newly created field sought to provide more formal,[6] Enactment of rationale principles. "interface-based"[7] input from the angle of new facets specific to the physical image,[8] alongside consideration attributed to processes of perception and cognitive representation (see Denis 1989). As a result, the interface transitioned to one wherein both expression and representation of the informational complexity reached closure—for should the quality and accuracy of information-display systems depend on the interface, it would only be correct to say that formalizing the process and model paved the way for the meaning that ensued and the significance thereto related. Be they graphic shapes and symbols, colors, movements and sequences or *interactors*[9] of data manipulation, all of the above act also as influential parameters in an ongoing transcription pattern of informational reality or a partial viewing of it.

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[1] In reference to various contexts (situations, tasks).

[2] E.g., treemap, touchgraph, and complex network graphs.

[3] Home of the Distributed Cognition and Human–Computer Interaction Laboratory overseen by James D. Hollan and Edwin Hutchins.

[4] Home of the Graphics, Visualization, and Usability [GVU] Center.

[5] Home of the Laboratory for Information Visualization and Evaluation [InfoVis].

[6] Creative process and artistic expression, as well as the enactment of shapes generated (designs, indications, illustrations, symbols, etc.) in a system-to-structure pattern.

[7] In reference to the intersection of informational (semiotic), visual and graphic (aesthetic) and functional (technical) patterns.

[8] In Ancient Greek, αἰσθητικός, aisthêtikós, meaning "who perceives through the senses, perceptible."

[9] Referring to components or interactive objects.

Due to an exponentially growing amount of data being produced, exchanged and generated electronically nearing the three (3)-zettabyte limit worldwide, new headway across technical, functional, ergonomic, and aesthetic fronts is now necessary to confront this epic phenomenon known as "Big Data." Traces of this "informational avalanche" are inadvertently swept under *virtually* endless piles of confidential data from government agencies of countries and nations, not to mention market-fed (stock exchange) financial data or "moneymaker" corporate data, and free/public data from the Internet (e-mails, social networks, blogs, forums, online groupware,[10] "Open Data," etc.), as well as from several other sources bursting with ever-growing quantities of data. The saying, "Desperate times call for desperate measures" never seemed more appropriate. A plague-like spreading of data on the loose is in urgent need of a new take on long-standing models and systems of information representation that can offer structure and substance. The stakes erupting from this revelation concern, first and foremost, those in Engineering Science, though it is clear that other fields could benefit from the revamp efforts, and namely that of design whose job it will be to invent and devise a new offering adapted to how data is presented and processed.

It is this latest contribution by the field of Design to data representation and visualization that we would like to examine more closely within this chapter. We will first take a look at how Data designers, while drawing attention to alternative ways of processing data, go about revisiting methods and techniques of its presentation. We will meticulously dissect designers' expertise and expert eye on the matter, and more importantly, how they unravel or rather *translate* as broadly as possible the complexity inherent in the relational dynamics of data components through unprecedented formal and graphic arrangements; in other words, what shapes, articulates, and establishes (on the micro/macro level) the guidelines specific to relational data. We will then focus on a number of highly theoretical, *Gestalt*-compliant approaches being unveiled by some Data designers. Pushing the limits of the notion to extremes, these designers are devising and applying a *new minimalist* approach to visual and graphic forms of massive dataset representation whose premise is on envisioning, understanding, and recalling the fundamentals. The emphasis now extends beyond the arbitrary shuffling about of meanings conveyed by datasets and clusters. It encompasses a sustainable movement that seeks to document the tucked away, secret, or hidden meaning there within. Having recourse to an arrangement of pure, uncomplicated, raw, and serene shapes, as if stripped of all graphically superfluous elements, the end result boasts an optimistic promise of new, data-derived aesthetic perceptions and insightful outcomes.

[10] Whose data are stored in public and/or private clouds.

2.2 Designing Data

Data design strives to place emphasis on the design of user-driven systems for data-processing purposes. For this to happen, the field calls upon various research done in cognitive science aimed at laying the foundation for "dynamic cognition" (see Dokic 2001; Abrioux et al. 1999) (in reference to a theory on cognitive dynamics; see Dokic 2010). This research assumes that a wide range of relationships exists not only between cognition and time (temporal perception), but also, and here lies the major point of interest, among cognition, perception and action (time-driven interactive sequence). This means that any change or any cognitive variation or evolution in an individual depends almost essentially on outside factors and phenomena. As Denis Brouillet and François Lang (Brouillet and Lang 2012) write, these changes, variations, and evolutions near "…the expression of a broader dynamic within which perception, cognition, sensation, emotion and action undergo circular and systemic causalities in a given environment and temporality."

In light of such assumptions examined more closely by George Lakoff and Mark Johnson (Lakoff and Mark 1980), Ronald Langacker in Cognitive Semantics (Langacker 1987, 1991), as well as Jean Piaget (Piaget and Chomsky 1979), Lev Vygotski (Vygotski 1986), David Rumelhart (Rumelhart and Norman 1975), Timothy T. Rogers, and James McClelland in Psychology (Rogers and McClelland 2004), Data designers have decided to put them into practice[11] by placing the user at the heart of interface-based data representation. The resulting developments require that a certain number of conditions be met, triggering an expanse in the decision-making or judgment process and offering a spectrum that spans from *relative judgment* or low decision-making ability to *absolute judgment* or high decision-making ability. The assumptions establish new visual and graphic possibilities able to view and process a growing number of items. These models of data display deploy a series of perception-driven tactics (see Latour 1985) that encourage discovery (visual data mining), judgment and analysis (visual synthesis).[12] How these tactics play out depends mainly on the user's perceptive–cognitive (underlying visual processing) and memory-based abilities. With this in mind and given that data representation models discern and decipher almost instantaneously basic characteristics (primitive perceptive processes) such as line orientation, length, thickness, size, curvature, cardinality, terminators, intersection, inclusion, color, flicker, direction of motion, stereoscopic depth, 3D cue, lighting direction, etc., it is easy to see how they reap all of the benefits specific to "preattentive" processing[13] as captured so well by Christopher Healey (Healey 1992).

[11] Referring here to *poiesis* (and not *praxis*), from Ancient Greek, ποίησις (poíêsis), meaning "doing, creating, bringing about, leading something into being"—Aristotelian distinction.

[12] In reference to isolating and differentiating structural, and at times, complex "motives," including trends, groups, "gaps", and isolated areas.

[13] Referring to a user's "low-level" visual capacity taken largely into account today by numerous designers and engineers.

From an interactive standpoint (and no longer here just for representation and visualization purposes; see Spence 2007), they call upon the user's faculty to isolate, distance, and thus differentiate certain elements, nonetheless, present within our visual field. Data display models rely on a handful of seasoned techniques such as "dynamic filtering" whose premise uses qualitative variables to first configure how items will appear, and in turn, stimulate and shape our differential analysis ability.

Consequently, and regardless of from where these representation models stem, be it in the research done by Jer Thorp, Santiago Ortiz, Benjamin Fry, Jeff Heer or Moritz Stefaner or that of Martin Wattenberg and Fernanda Viégas, all move ahead using the same dynamic visual programming or coding (in relation to graphic encoding) approach, which rewrites data in the form of graphic objects by pairing each data-derived variable with a graphic one, such as position, length, area, color, light, density, shape, texture, angle and curvature. How these objects evolve over time (referring, ultimately, to a dynamic modification of data-derived variables) can be compatible with "variometric"[14] data. On the interactive front, there seems to be a new series of related procedures designed for better cognitive understanding of data variability, scalability, extensibility, or even resiliency,[15] among which include a sound and comprehensive grasp on the *view* of the data, including regulation of the physical parameters in visual and spatial representation (see Bihanic 2003); the control of the *viewpoint*, be it "exocentric" or "egocentric"; the "multiple" viewpoints ("overview + details") that enable the user to possess both a macro- and microangle; and the "contextual" viewpoints ("focus + context") (Lamping et al. 1995) that categorize the details into the user's various areas of interest ("focus").

The myriad alternatives in terms of data representation, visualization, aggregation, extraction, and interaction pave the way for a better handle on the information fabric. Expanding outside the realm of data mining, monitoring, and supervision (through the graphic reconstruction of system-extracted information), these creative design approaches are banking on the human ability to perceive and process information. Repetition underlies the foundation and functioning of the data environment. It acts *in favor of* an ever-evolving and user-driven posture on data representation within a given system, as well as *toward* a mutually dependent trio consisting of situated perception, cognition, and action (see Dougherty 1985; Winograd and Flores 1986; Lave 1988; Cicourel et al. 1994; Laville 2000; Myin and O'Regan 2008) subjected to multiple unknowns and substantial changes within the environment (environmental dynamics).

[14] Periodic movement or lack thereof of data properties, increase in overall data volume, etc.

[15] In reference to the numerous changes in data shape and format.

2.2.1 Data Relationship Dynamics

As part of the study on dynamic cognition (Cognitive Variability; see Lautrey 2002), one of the major questions that has arisen from the creative proposals of Data designers pertains to action's supposed superiority within the cognitive process[16] or rather the supposed subordinate relationship of perception to action (beyond their universally known inseparability). In the absence of concrete answers, the experimental research in data design manages, nonetheless, to offer conclusive and convincing examples of a truly dominant action entity within all cognitive input. The superiority embodied by action is also apparent in "Situated Cognition" research (Vera and Simon 1993), which posits learning through a subject's experience or discovery rather than on rote, reception, or taught learning. This movement seeks to illustrate that the body (mostly through tactile or physical participation) is in no way withdrawn from the meaning of the action. On the one hand, its environment[17] weighs into the situations dictating the action (Cognitive Anthropology). From there surface a broadly empirical notion both *in* and *through* the action and acknowledgment of the value inherent in the experience (experiential learning) whose role is paramount in shaping meaning and the myriad facets there within.

2.2.1.1 Action and Perception

From the decisive role that experience plays in knowledge-building comes the idea that any cognitive event *hosts* itself in action. Should an idea such as this be approved, then action (mainly interface-based representation) measures and schemes would, in turn, not only occupy a crucial place, but also make up both the *means* and the *place* to understand meaning and its connotations. Henri Bergson wrote that if perception is to be understood as that which "[…] measures our eventual action on things, and conversely, the eventual action of things on us, then the greater the body's power to act and the more possibilities there are for perception" (Bergson 1934/2007). And as Leibniz (1996) wrote, well beyond our "small perceptions" is our apperceptive faculty, which entrusts us with a complete and comprehensive awareness of phenomena and things around us. This awareness opens up a number of avenues, allowing us to dig further below the surface of perception in search of reason, insight, and understanding.

Going forward, if we are able to acknowledge the suggestions offered by Data designers regarding advances that have already made significant headway, it is, first and foremost, the one in favor of lifting the veil (through application) on an action-oriented, apperceptive quality. We have just pointed out how much this suggestion

[16] Process of building skills and knowledge.

[17] From the space of the body caught in action toward exteroceptive sensitivity (not interoceptive or proprioceptive).

could prove vital when delving into the realm of significance. It would then make sense that the resulting advantage could trigger yet another that is tailored to taking perception to new heights (state of consciousness): from sensory-driven perception of things and phenomena to meaning-driven apperception of things and phenomena in action.

What is interesting to observe in certain data design projects is that from an apperceptive hypersensitivity such as this, the possibility to *visualize* information emerges: information that would, otherwise, not have been visible or apperceptive (see Tufte 1990, 2001) had it not been, up to now, entirely missing. The information in question pertains primarily to the *content* of data relationships (qualifying relationships), the *frequency* of its relationships with other data (quantifying exchanges), and several variables relating to data relationship dynamics that form the core of representation and visualization in large clusters of data.

Catching a glimpse of this dynamic means shifting from an immediate apperception of it to a physical intervention—in favor of an act or a sensitive gesture that handles and models data as a material and tangible entity: *feeling*, *perceiving*, and *apperceiving* (see Chouvel and Hascher 2012). The suddenly perceived data are viewed both as a material and product from the activity. It is the sediment of an environment boasting interface-driven models of representation and visualization and whose "cementing" (that of meaning) arises from its connections and combinations.

2.2.1.2 Enaction and Environment

Through some tweaking of the *Gestalt* principles of perceptual organization (proximity, similarity, good continuation, perception of movement, etc.), Data designers are able to devise unique proposals of visual grammar and organization, and cast a different look on Jacques Bertin's *Semiology of Graphics* (Bertin 2011). A variety of shapes ensues, which then trigger active data environments. Like true information ecosystems, these environments visually transform the associations, relationships, and transactions established between the data into phenomenological–aesthetic objects. As such, relational data dynamics are expressed and viewed through the way in which events unravel on the screen, including data effusion and scrolling, data concentration and grouping, data explosion, and dispersion. The more representation seeks to translate this dynamic, the more it appears as a "biocenosis" or ecosystem, uniting items, and biomorphic-like or cellular data.

With the focus being not only on metadata, but the data itself, these "semi-biotic" representations demonstrate the irrefutable edge that space and all things related occupy in the polymodal representation of information. Backed by several studies oriented around more in-depth topological, dynamic, and morphodynamic models and patterns in cognitive science (cognitive grammar) (Petitot 2003; Petitot and Doursat 2011), these display models illustrate on an experimental basis that any intelligible conditions in the relationships seen here between the data are based on the coherence and adjustment of the system's spatial (naturally phenomenological)

representation. Hence, without designating a material or formal aspect to this space and devoid of a primarily perceptive experience within it, no relational data dynamic is possible. Because a space is formed and structured around the interconnectedness of data (flow), cognitive understanding and data access are within reach. Therefore, the reason why these new data environments (data design) work so well is, without a doubt, related to their ability to shape new spaces of representation (space < > meaning).

The main question now nagging every designer is the following: What does it mean and through what means it is possible to create a visual and spatial representation of data capable of accounting for (given the experience) the information-specific properties and peculiarities via the experience? Let's not forget that merely and perceptively capturing the happenings does not enable one to grasp nor even visualize the dynamic addressed here. The user-subject needs to enter into an experiential relationship that is both sensory-based[18] and sensitive so that, one, this information makes its way to him, and two, its processing sparks new knowledge and skill development. Guided previously by the type of interface-based representation[19] chosen, it is the experience that presents itself to the user-subject, offering him (as the experimental subject) a plethora of opportunities. The experience is, in no way, forced upon him. Only the user-subject is at the helm, and only he can dictate the purpose, the direction, and eventually the results, pushing him to seek out even those less explicit. His motivation and drive in carrying out this exercise (perception-action) to the full extent of its potential will reward him with an apperceptive intuition.[20] Both heuristic (Depraz et al. 2003) and aesthetic (sensitive perception), the purpose fundamentally determines the quality of these interface-driven, spatial representations. Their very essence is multifold. They lay the groundwork for *seeing*, *exploring*, *penetrating,* and *roaming* these spaces (opening up the field to a number of interpretations[21] factoring into the experience).[22] The fundamental difference is here, which explains why we attribute a certain amount of originality to these active representation models. As "Big Data" continues to grow and spread, these representations are naturally inclined to resolve new data-processing challenges with the help of new and enlightening percepts (or affects, as necessary) and concepts that offer the possibility to grasp this new informational reality. One route in particular pursued by Data designers in an effort to shed some much needed light on the demand for new ideas comes from biomimicry (biomorphic origin), which transforms spatial data representations into agile and thriving environments comprised of graphic objects in perpetual

[18] For example, in the case of interactions with touch screen or multitouch technology devices (Lenay 2010), this experience triggers sensations specific to the haptic realm.

[19] In line with a selection of action and interaction modalities.

[20] In contrast with the relative agnosia to which the lazy and absent-minded perceiver will fall victim.

[21] To which inferences and deductions have recourse.

[22] Here targeting a hermeneutic dimension between Phenomenology and Cognitive Science.

movement. This same route adopts a new enactive notion of spatial perception (Froese and Spiers 2007), and at the same time, does away with "computationalistic" approaches that treat (and wrongly in our opinion) information processing as a logical and sequential calculation that allows little to no wiggle room when it comes to considering alternative meanings within the experience (interpretation). Alongside the ideas defended by the late and well-known neurologist, Varela (1989), Varela et al. (1993), Data designers count on giving *shape, substance, and stance* to the myriad *"trajections"* and shifts in data. With all of this in mind, what then does it take for them to make this creative endeavor possible? What design-bred steps or approaches are most appropriate to display and view a genuinely complex, relationship-based "go-between" (interface) for massive datasets? Our aim in the next section will be to provide further insight and answers to these questions.

2.3 Giving Shape and Meaning to "Big Data"

2.3.1 The Appearance and Shape of Massive Datasets

Most of the testing done in data design combines *representation* and *visualization* within a comprehensive and formalized, "interface-driven" data initiative. As such, the interface lays out the framework for converting and transforming several piles of unstructured raw data into a system that allows for meaningful, compatible, and relevant[23] data flows and clusters to be displayed and viewed. It is then up to the Data designer to devise an original graphic script featuring a clearly defined and relatively exhaustive combination of terms with the ability to bring to life and execute a number of informational properties and applications. Among the qualities pertinent in transcribing any language,[24] one stands out with its very own unique purpose: that of formal expressiveness, whose definition here refers to conveying meaning of an entire group or a total volume of datasets. Given the large batches of extremely important information filtering through it, this degree of formal expressiveness takes on even greater dimensions, and namely with regards to the dynamic and frequency of data transactions and exchanges occurring, not to mention the total amount of information dispersed.

2.3.1.1 Perception and Sensation

Fully aware that an aesthetic grasp or take on data and the myriad ways in which it appears play a crucial role in how the meaning there within is extracted, some Data designers are now deploying new visual and graphic formalisms of massive dataset

[23] Formally ridding certain "critical mass" issues.

[24] For example, "distribution", referring to grapheme arrangement and association.

representation that round out or fill in, where necessary, those previously established, such as diagrams, networks, maps, symbols, or mashups. Rather similar to what Roger Brunet coined as "chorems" (Brunet 1986) or schematic representations of a geographic space or territory, these Data designers are shifting their creative talents into higher gear by not only positioning graphic primitives (point, line, and color), but also combining[25] visual primitives (X and Y plane or position, size, value, texture, color, orientation, and shape),[26] in addition to a number of other visual and graphic attributes such as *edge, contour, area* (empty-full relationship), *light, volume,* and *field* (all of which factor into giving rise to a graphic form of data representation and visualization).

All of these new formalisms (or adaptations of existing ones), a handful of which will undergo further speculation, conform to the same demand: that which removes any ornamentation, gimmicks or visual and graphic elements considered superfluous from the shapes depicting the data in an effort to retain but the crux, purity itself.[27] Simple and primitive, these shapes have been stripped and freed from all forms of sophisticated imitation and exaggerated virtuosity without surrendering the slightest bit of refinement or elegance. With nothing but geometry to define them, these shapes reduced to the barest form do not conceal, in any way, the qualities of the data they symbolize. Instead, they model them in accordance with their image and blend them into their aspect and appearance. Should a direction such as this have a legitimate place on an aesthetic level, thanks to the data's expressive added value, then it also has its place on a functional one. Enhanced performance (Data Interaction) relies on this perspective and arrangement (which we will examine later). In favor of absolute simplicity, the conditions of unmasking meaning from data (from simple or pure shapes to meaning exposure) forge stronger bonds. The same applies to an overall meaning (and not in what appears to be a reflection of meanings) for which a *path* may be found only through graphic representation and visualization and not in the work or handling of the data itself. In other words, an overall meaning could emerge from colossal volumes of massive datasets; however, it is likely to do so but through those shapes that have been assigned to them for a specific role or purpose. A more expeditious take on things would lead us to affirm here that the data do not, in any way, diffuse meaning; only the shapes, here of a symbolic nature, are meaningful. Isolated, the data do not contain any information that would allow it to choose a direction or orientation, define ahead of time, or hinder expansion of its meaning (excluding, of course, the semantic deviations that could arise among the various data elements). Architecture inspires the best analogy: These piles of data are like stones waiting to be put toward the erection of a building whose fate depends solely on the project and the work that ensues.

Shapes breed meaning. Here is an adage that Data designers could adopt, chant, and proclaim with the same enthusiasm as did those at the start of the twentieth

[25] According to distributions by *point*, *line* or *area*.

[26] In reference to the classification system defined by Bertin (1982, 2011).

[27] This demand also requires that any formal irregularities seen as accidental be corrected.

century in response to that uttered by famous architect Mies van der Rohe: "Less is more." If they have found it worthwhile to focus as much as they have on graphic formalization, it is precisely because there has been no other way, up to now, of accounting for and processing "Big Data" (whose magnitude remains a mystery to this day). Although computer systems are doing what they can to handle such an outpouring of data, both user and designer are still struggling to view the overall data ensemble (even a mental picture of it has proven challenging). Plus, as we have just mentioned, it will be up to the user and his interpretation of the data that will give rise to its meaning. Despite the performance levels and efficiency exhibited by systems, their ability to extract or describe the meaning from data has its limits. Therefore, it is necessary to reiterate the importance of not opposing what, here, appears as aesthetic data recovery versus truly perceptive data capture. The bimodality seen in the relationship pairing the graphic representation of data and the meaning attributed to it is inevitable, if not indispensable.

Hence, the primacy given to shapes (the plural usage being most appropriate here), each unconventional in its own way, is what gives these Data designers reason to bank on the creation of new formalisms. Paul Valéry[28] wrote, "Shape is everything" (Valéry 1957), with an understanding, here, referring to full and complete autonomy of shapes in the conception and expression of meaning. Keeping intuition intact (Intuitive Vision), some of the foremost qualities in target data will cross over into the apperceptive realm after discerning how shapes are aesthetically perceived and understood. Of the same opinion and enthusiasm as expressed in the *Gestalt* principles, these Data designers are committed to aesthetically illustrating massive datasets through a mix of pure sensation and perceptive capture. By taking advantage not only of the objective properties in data, but also the findings from data mining searches that reveal, more often than not, contrasting content from databases and ensembles, Data designers have at their disposal a rich breeding ground for experimentation and application. Their painstaking efforts have not been in vain, and from this preliminary analysis of the databases and datasets, other pertinent observations for the purposes of future creative syntheses will, no doubt, emerge.

If sensory-driven sensation or understanding marks the start of our awareness of these massive datasets, we are then left with figuring out how to incorporate either or both into our perceptive and cognitive faculties. In close, if the user is able to discern these shapes, then he is also able to discern their structure, both on a visual and perceptive level, in addition to their combinations and degrees of change,[29] while at the same time aesthetically judging the balance or imbalance of their proportions. This bimodal interpretation of shapes then fuels the origin of meaning whose interpretation is both perceptive (perceptive–cognitive stimuli and excitation) and aesthetic (impression, sensation). Banking fastidiously on the respect of various *sensory thresholds* (establishing the scope of the perceptive field based on a

[28] Quoting the poet, Frédéric Mistral.

[29] Specifically, in the case of generative or animated shapes.

given meaning) and limits of *differential thresholds* (detecting the smallest change in stimulation), the Data designer is also responsible for showcasing data through concrete graphic and aesthetic means.

2.3.1.2 The Role of Aesthetic Perception

In order to fully grasp the uncertain nature that perception (aesthetic data recovery and optical data capture) embodies, it is necessary to take a more in-depth look at the singularities of a purely aesthetic understanding of the shapes that stem from a sensitive awareness[30] of the world, its objects and their various states. Each aesthetically based data recovery makes room for a broader grip on things belonging to the worldly realm, while stressing our inability to examine them from all angles, narrow down the number of meanings there within, and penetrate right down to the essence itself (of an exclusive access within a phenomenological world). Contemplating a deeper, more aesthetic interpretation of a work, otherwise considered sterile by more short-sighted individuals, the observer, perplexed, will suddenly see the paths of perception unravel before his eyes (in line with Hegelian notions of "sense certainty" and perception). If perception is meant to instill in us a more thorough awareness of our surroundings, it is, no doubt, due to an intricate and detailed network of its bimodal functionality mentioned earlier, laying the very foundation upon which our perception takes root.

Determined to breathe new aesthetic life into how primarily massive dataset shapes are displayed (with high hopes that a new wave of graphic and more qualitative options surface for a variety of reasons), certain Data designers are committed to pushing through the idea and need to understand data on an aesthetic level, and furthermore, the phenomena that arise from it. One of those designers is Moritz Stefaner, who has recently authored *Wahlland* (Fig. 2.1) and *Stadtbilder*. The first project, *Wahlland*, offers the user a "hands-on" experience using a simplified map presenting the results from the 2013 German Bundestag elections. Extending well beyond its original function, the map becomes an original interface, breaking down and arranging the entire Germany territory (and its image, for that matter) by electoral districts according to voter behavior, attitude, and political party affiliation. The new data-mapping interface becomes the specially designed place and space for massive dataset exploration expressed through plain and simple geometric shapes serving as symbols, tools, and materials in a new version of data display for the purposes of visualizing and interpreting data. *Stadtbilder*, on the other hand, offers the opportunity to display what typically does not show up on a map; in other words, a city's shape and "living" infrastructure. Unpredictable and transient in nature, the shape is not indicative of geographically generated data retrieval, but rather a graphic transcription of a city in constant motion whose guise reflects the lifestyles of its residents, the "hotspots" they frequent and other outlets

[30] Prior to any new knowledge being acquired.

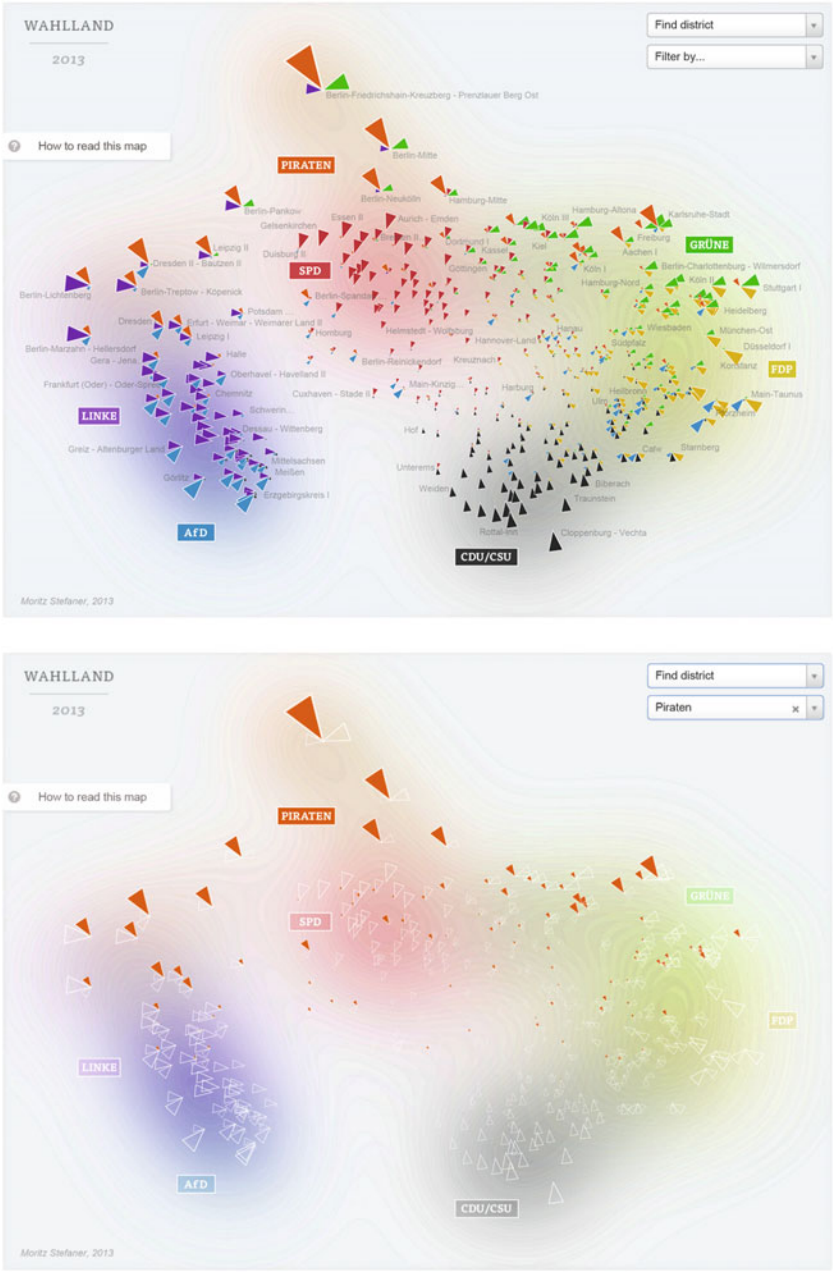

Fig. 2.1 *Wahlland*, Moritz Stefaner, 2013

contributing to the city's makeup. A multicolored, graphic mist hovers over the territory and keeps pace with the urban fabric and its enigmatic components. Spatial perception takes on a new dimension following a rather minimalistic graphic formalization of the multivariate data extracted from a portion of a city in motion.

In a rather different context, it is equally worthwhile to address electronic composer and visual artist Ryoji Ikeda's project, entitled *datamatics* (Fig. 2.2), whose experimentation with sound and image explores an infinite, or better yet, *transfinite* number of ways to render and visualize raw data via sonic and visual dimensions, layers, sequences, and patterns. Through a mix of graphic, often binary code-embedded textures in black and white (or empty and full), he exposes a wave of new environments whose success relies on an experiential dimension of aesthetic perception. Processing piles of data as substance, Ryoji Ikeda strives to simultaneously resolve how they materialize and are expressed.

There are some similarities between Ryoji Ikeda's work and that of designer Yugo Nakamura. The latter opts for a radically minimalist approach in his interface-based, graphic representations, which, in no way, exhibits any kind of graphic idleness, and which illustrates both the dynamic and interactive traits present in the interface's graphic shapes and objects. Through his unconventional and audacious, data-generated interfaces offering those present an epic visual, graphic, and audible experience, he gives life to an entirely new dimension of the experiential space and the relationships that arise within it.

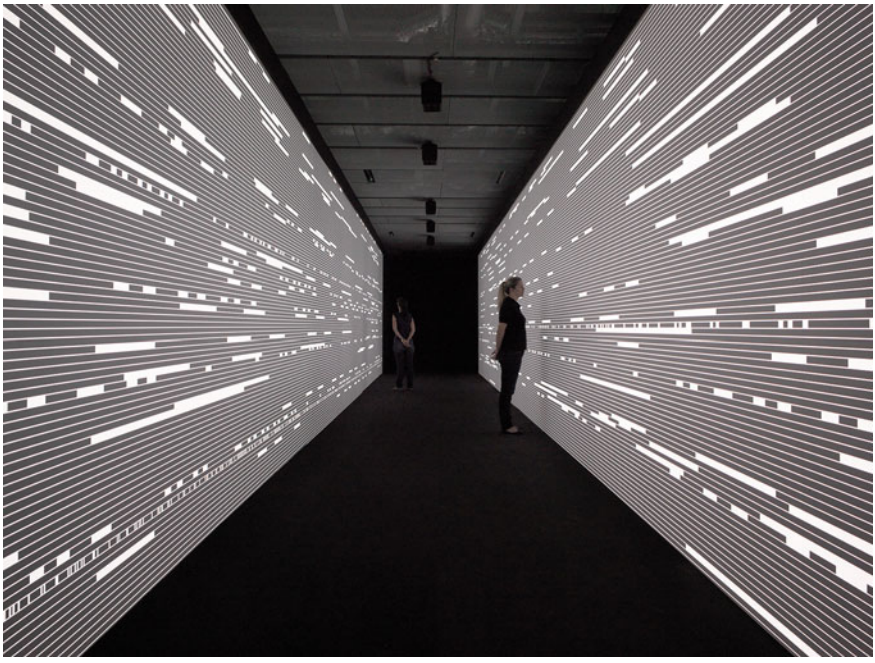

Fig. 2.2 *data.path* audiovisual installation, Ryoji Ikeda, 2013—photo by Fernando Maquieira, courtesy of Espacio Fundación Telefónica

Fig. 2.3 *Connected China*, Fathom Information Design, 2013

Created by the Fathom Information Design studio, the *Connected China* project (Fig. 2.3) is a sound example of the operational (practical), cognitive, and aesthetic implications stemming from the use of symbolic and primitive shapes. Aiming to convey a clearer visual transcription of the overall meaning outside of the political and cultural factors shaping modern China (in reference to the false pretext of minimalist formalism), the interface-based representation also helps to devise the methods responsible for its understanding. In other words, how data appear greatly increases the user's ability to process it. Aesthetically perceived primary shapes and the indispensable presence of action (Data Interaction) spawn myriad possibilities in which to further dissect meaning.

The *Kindred Britain* (Fig. 2.4) project designed by Elijah Meeks and Scott Murray also falls within this school of thought. Here again, action plays a paramount role in the assimilation of the overall meaning. Calling upon a wide variety of both historic and social data from Great Britain that has been cross-checked and crossbred, the user is now in position to become fully immersed[31] within the interaction. Deploying a written form of basic shapes,[32] the interface-based representation underlies the action. The variety, breadth, and abundance of the clearly

[31] Theologically speaking, wholeheartedly and with practically all one's might.

[32] Any attempt or effort to radicalize the formal language of data representation and visualization involves bettering the conditions of user-driven processing (both perception- and action-related): toward its design. There is not enough time to get into the details of what this entails. It should be noted that we are currently working on other articles (to be published soon) that prove it. The projects already referenced offer sufficiently convincing examples.

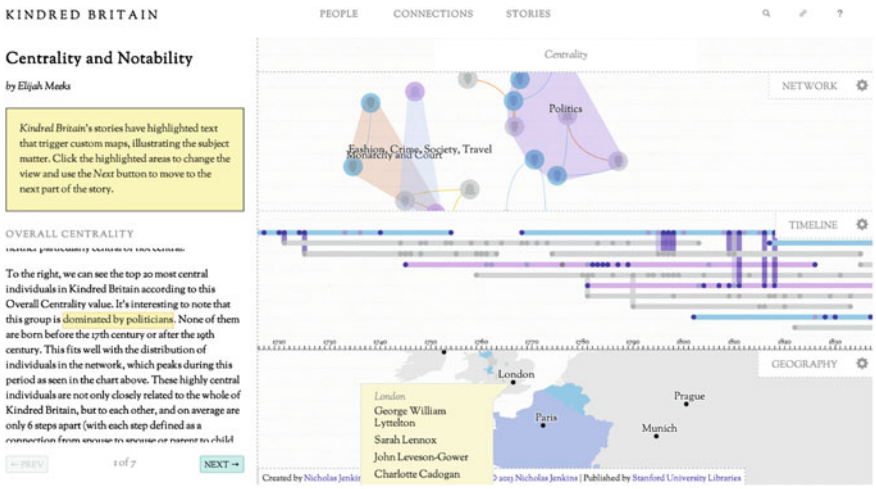

Fig. 2.4 *Kindred Britain*, Nicholas Jenkins, Elijah Meeks and Scott Murray, published by Stanford University Libraries, 2013

displayed data interactions will impel an overall meaning (consequence of data dynamics).

On a broader level, we would like to draw attention to the fact that Data designers' contribution to displaying and viewing large clusters of data is not to be taken lightly. The reason is that they propose a visual and interactive offering that boasts qualities of both an expressive and practical nature, ensuring that users have at their disposal what they need to not only perceive and understand the data-related connections and exchanges (interrelational data dynamics), but also take part in their processing. In an effort to strengthen the perception–action duo, Data designers have come to realize the influence and impact that action has on the kinetic perception and aesthetic grasp of information. In addition, they demonstrate that any graphic translation of large clusters of massive and in-motion datasets expressed as such leads to a rise in the ability to process them.[33] With this in mind and from a reception standpoint, the numerous effects (accentuation, intensity, etc.) and visual and graphic expression characteristics (a kind of formal, visual, and graphic "prosody") resort to impressions, emotions, and sensations that instill and "innervate" (figuratively speaking) the perceptive and cognitive process. With both percepts and affects, the user examines and reflects on the different directions that meaning and its interpretations can pursue as a result of the interrelated and visually expressed data shared. A sensitive and aesthetic experience such as this is viewed as a basis for crafting new perceptive and cognitive methods of information reception. It acts as a pivotal conduit for relaying certain elements of information to which we would have not had access otherwise.

[33] Favoring a wider variety and number of perceptive, interpretative, cognitive, emotional, intentional, and action-driven processing models.

Without completely relying on contemplative judgment for answers when in the presence of a work of art,[34] it would appear that the perceptive and cognitive mechanisms that fall under an aesthetic acumen of graphically processed information share a few things in common: A look or look back at Théodor Adorno's *Aesthetic Theory* (Adorno 1997) or Mikel Dufrenne's *The Phenomenology of Aesthetic Experience* (Dufrenne 1953) (both contemporaries) will be enough to remove all doubt. Other authors, such as Dewey (1934), Schaeffer (1966) and Shusterman (1992), have specifically focused their attention on the relationship between the "aesthetic experience" and "cognitive data capture (reception model)," and have arrived, individually, at the same observations and conclusions as we have. In sum, if certain properties, for example relational dynamics, in the entire data ensemble are within reach (both concretely and conceptually), it is precisely because there is a real push for interface-based representations (namely those devised by Data designers) to express these massive datasets, as well as their aggregation, appearance, and alterations (expressiveness). The expressions conveyed and transmitted through graphic objects and symbols[35] imply an aesthetic approach, which has now become a prerequisite in understanding the meaning within the data, be it, for our purposes, hidden or concealed.

2.3.2 Moving Toward Concrete Data Design

A number of Data designers today share a common vision and direction aimed at visually acknowledging the transformations, changes, and unknowns emanating from the current information hub. Tackling various piles of data, they strive not only to piece together an overview of the data, but also concoct an image of it that is genuine, powerful, and telling and, despite the multitude of interpretative facets generated, seeks, nonetheless, to transmit an overall meaning. Brought deliberately together by formalistic intentions, this twofold project embodies a new, broader "movement" that we have decided to refer to here as *Concrete Data Design*. In line (and on more than one account) with the declarations made by the late Theo van Doesburg regarding "Concrete Art" (van Doesburg et al. 1930), this emerging movement calls for a shape-driven government (of a sovereign and graphic plasticity) with infinite *re*-presentation powers or powers designed to convert reality (formalist realism). Banishing the lyrical, symbolic, and impressionist aspects oozing from a sentiment of excess subjectivity, Data designers behind this relatively

[34] A parallel development could help to specify how perception-targeted objects condition our approach and understanding of them. That said, not every object is a work of art (to put it bluntly). This does not mean that processing it (by the author) more formally is futile—on the contrary, for doing so would bestow upon this object truly aesthetic qualities that it is capable of ingesting thanks to the relatively similar processes of perception and cognition.

[35] Based on aspect—and behavior-based variables.

young movement advocate for the aesthetic clarity[36] of simple and adapted shapes in an attempt to gain objective ground (and, in turn, that of universal truth), and unanimously back the idea that an information hub such as this is not quite a lump of obscure data devoid of meaning.

2.3.2.1 Clarity is Aesthetics

New opportunities are likely to arise from the overwhelming trend in data recovery and capture today; however, their evolution is tremendously hindered should there not be any way to display or view them. As data prospers and accumulates while databases expand, these Data designers have set forth the objective to formulate even clearer, more *transparent* images[37] boasting unparalleled elegance and grandeur. Enlightening and eye-opening, these representations never lack relevance, and avoid falling into the arbitrary realm. Be they for the purposes of large sets of data[38] (informational hub) demanding a bit more distance or for lesser volumes (both are given the same attention), their goal is simplicity (see Maeda 2006). Of course, we perceive and interact better when things are orderly, balanced, and unified than when they are dismantled or disparate. What matters most is not how the shapes are arranged, but rather the quality of the shapes themselves. If composition (organization of shapes) triggers meaning, then pattern triggers not only the accuracy and precision in how it is expressed, but also the insight and judgment resulting from the sensitive perception and aesthetic experience of the data shown here. This neoformalist approach supported (and openly, at times) by certain Data designers involves reducing or simplifying shapes. It stresses their geometry and most fundamental forms (contours, angles, dimensions, curves, etc.). It even goes so far as to commit to greater simplicity and minimalism in shapes, as well as advocate an aesthetic ideal.

Therefore, complexity may find its way into all means and manners of data display, but never will the latter opt to sophisticate its shapes. It will, instead, look to radicalize them with increasingly more candor and meaning. A closer look at the notions of clarity and complexity reveals more similarities than differences and proves these seemingly "polar opposites" are anything but that. In some respects, these two notions complement one another, but they not merge. If clarity (bordering on simplicity) is to be understood as a conquest (of meaning via shapes), then complexity constitutes a victory or success, or better yet, an outcome paving the way to new paths of knowledge and insight. Like the ideas and concepts refuting all reductionist ideologies,[39] this revolutionary twist on complexity portrays it no

[36] Including accessibility and visualization.

[37] Referring here to both info graphic projects and visual and graphic interface environments of "Big Data" representation and visualization resulting from conceptual, formal, and creative investigation.

[38] In addition to the numerous flows and transactions present there within.

[39] These ideas and concepts are examined more closely by authors such as Morin and Le Moigne (1999; Morin 1999), Koestler (2011), Berthoz (2009), and Eco (1989).

longer as a burden or weight bearing forever down upon us, but rather as a chance, a resource, and an opportunity in itself. The time and energy put in by Data designers to reverse this long-standing and uncompromising view on complexity are finally paying off as the term now engenders an image and a meaning that are understandable, within reach, and sensitively perceivable. This newly defined complexity rhymes with curiosity (embedded with heuristic value) and a propensity to picture our ever-evolving and ever-revolving world from a multitude of angles and one in which our presence is non-negotiable. By depicting some of the data-protected phenomena (in response to new realities in the present world), Data designers are out to prove that the world does not only *not* fit into our concepts, but extends well outside of them. As a result, they are heading in pursuit of other means and opportunities wherein to understand this world, play a role within it, or take ownership of it.

2.3.2.2 Data Gestaltung

Differentiating simple, pure, and primitive shapes on an aesthetic level adds to the expressive power of representation. A power such as this tied to meaning and evolution makes reference to the *Gestalt* concept pointed out earlier, originating from the verb, "Gestalten," meaning "to shape or to attribute a meaningful configuration." In other words, if data representation and visualization boasts expressive properties now used to generate and liberate meaning, then it is due to the quality of the shapes themselves that cater to it. The shapes chosen and how they are arranged make for a well-rounded representation. An overall meaning with clarity and direction starts to break away from stark, chiseled, and polished shapes. Profound and panoptic, the meaning is not stuck amid the lonesome and isolated shapes, as if in aimless wander and devoid of affinity, but fully engaged in the exchange and relationship that they nurture and nourish. What takes shape makes sense to us. The same is true when designating a concrete entity or its shape, and a promising and productive whole or its representation, not to mention all of the other criteria that prompt them.

In keeping with this understanding, several contemporary designers, artists, and creative minds have opted to devise a skillful mix of primary shapes. By hypothetically giving *shape* and *content* to entities and wholes, respectively, in reality, these same individuals are able to come up with new, geometric-inspired models. Graphic languages, in turn, emerge, proving more convincing and accessible, and within which image (in its widest sense) does not glorify reality, but rather grants it another meaning. Image does not decorate, illustrate, or describe; it selects, recomposes, and graphically transposes certain objective data elements, which it then codifies and differentiates before presenting them in another light and from other angles. Here, image deploys a system of shapes and establishes a code made up of meaning(*s*). To remove, once and for all, any doubt regarding the abundance of such present in the language of primary shapes, a look at the work by design sisters Nicole and Petra Kapitza is all that is needed. Pooling patterns, fonts, and colors, they endeavor to pick apart nature-embedded geometry, and piece it back

together with originality, tact, precision, and rigor. Armed with a multidisciplinary background in fine arts (see Albers 1963), book design, digital software, and illustration, both graphic designers prove that their creativity and combinations of simple shapes are teeming, more than ever, with promise and prospects. Furthermore, the potential range of meaning and scope is limitless.

Other designers, and not just any, have successfully managed to illustrate that all fundamental shape generation implies an even greater organization of the whole, be it rhythmically, logically, or systemically. The expressiveness in any representation depends upon this organization. Thus, as shapes become more subtle, the space they inhabit becomes more orderly and structured. The more the shapes mature, the more this space expands, and the more the meaning evolves, becomes clear, and intensifies. The approach guiding this shape-the-shape process is not focused on the selection or institution of the shapes alone (as explained), sitting proudly at the heart of a whole, but rather on the whole itself responsible for giving order to them. As a result, this orderly whole doubles as a catalyst, spurring the formulation of meaning, the development of interpretation, and the fulfillment of perceptive data capture and aesthetic data recovery. Let us take, for example, designer Alexander Chen's project, entitled *You Still Believe in Me*, which transcribes the musical expressiveness or musicality from the song originally interpreted by the famous quintet, The Beach Boys. Here, rhythmic pulsations and a vocals-ingrained color palette (chromesthesia) are paired to produce the transcription or "transliteration."[40] Underlying intentionally simple shapes stripped down the bone are a number of minuscule variables, parameters, and fluctuations. Disk-like shapes emit sensory-driven vibrations, and, by virtue of their rudimentary character and unity, keep intact the purity and beauty of the original musical arrangement. Let us look at another example. Developed by Matthew Epler, *The Color of Language* project examines more closely the expressive power of language. He says, "Language is more than words." It is, first and foremost, a system or organized framework made up of signs, glyphs, and shapes enabling an infinite number of combinations, and in turn, an infinite number of synopses and interpretations. Through this project, Matthew Epler invites us to experiment with this multiplicity, and in doing so, gauge the complexity in all language-based meaning construction.

The same conclusions may be applied to data. Formally translated, data also functions within an organized framework used to determine its visual structure. Let us recall that data alone are of little value and meaning, and subsequently, bear little interest just like the shapes entrusted with conveying a relatively small part of that meaning. From the organizing framework referring, here, to an all-encompassing representation or one embodying the shape-driven system of organization, ensues an overall meaning. If what is most important arises from the shapes in their purest form or from their pared anatomy or appearance, then it is their arrangement, assembly and connections that fuel the emergence of meaning. For example, designer Shahee Ilyas's project, entitled *Flags by Colours*, clearly demonstrates that

[40] Transcription of graphemes from one written alphabet to other graphemes in another system: a manner of transposing one system of signs to another without loss of meaning.

by incorporating a simple variable of an ensemble, and for our purposes here on a colorimetric scale,[41] and by ruling out any symbolic, iconic, or indexed trace, other methods of data display and interpretation may be established. *The Periodic Table* project by designer Alison Haigh also agrees with the above notion, which essentially defends the idea that the design of a meaningful display of data, calling for formal relationships to be perceived and interpreted, entails formally reducing data or giving it substance.

In his mind-altering project, entitled *Here is Today* (Fig. 2.5), Luke Twyman, like those mentioned earlier, puts his own spin on an interface-based representation tracing time, history, and geology. Delving into the history of mankind, the representation offers us the chance to visually grasp the degree of granularity separating the current moment from earlier periods, ages, and eras that have existed on earth. Starting from an extremely simple graphic to a simplified and user-friendly application (heightening both perception and action), a time-lapse rendering on a spectrum in motion unfolds. Bewildering and unsettling, the project is also educational as it attempts to chip away at the layers having trickled down and settled over time throughout the course of history.

There are similarities between Twyman's project and that of Carlo Zapponi and Vasundhara Parakh, entitled *Worldshap in* (Fig. 2.6). Here, a combination of basic shapes and models is used to visually compare countries throughout the world on the basis of criteria such as sustainable and human development. Each country is given a shape, whose form changes based on where it stands in relation to various statistical data indicators.[42] The sliding year bar and the option to add or remove countries and their respective results (resulting in an innovative and eye-catching superposition of shapes) determine the spatial coordinates, making it possible to display and view the data accordingly. It is, therefore, the entire interface that constitutes the system of data representation and visualization.

Formal and concrete data representation involves a broader notion of meaning. This is what Data designers are out to prove, including one, in particular, by the name of Genis Carreras. His aim is to graphically isolate various philosophical concepts. In doing so, representation takes on the notion of a strategy or concept image that shapes the meaning. Another example leads us to the initiative taken by creative advertising agency Bartle Bogle Hegarty (BBH-Labs) as part of the ad campaign, entitled *The Three Little Pigs,*[43] which, through a clever and compelling use of minimalist infographic designs disguised as basic shapes, underlines certain gaps in statistical data. Here again, the simplicity seen in the graphic picture helps to better visually compare the quantities represented. DavidMcCandless, MGMT studio designers, Caroline Oh and Young Sang Cho (Fig. 2.7) have devoted

[41] Calibrating and comparing the quantities of colors within each national emblem (gallery of the world's country flags).

[42] The statistical data presented are based on *The Human Development Index* (HDI) and have been extracted from a report published in 2011 by the United Nations, entitled *Sustainability and Equity: A Better Future for All*.

[43] Advertising campaign done for the British national daily newspaper, *The Guardian*.

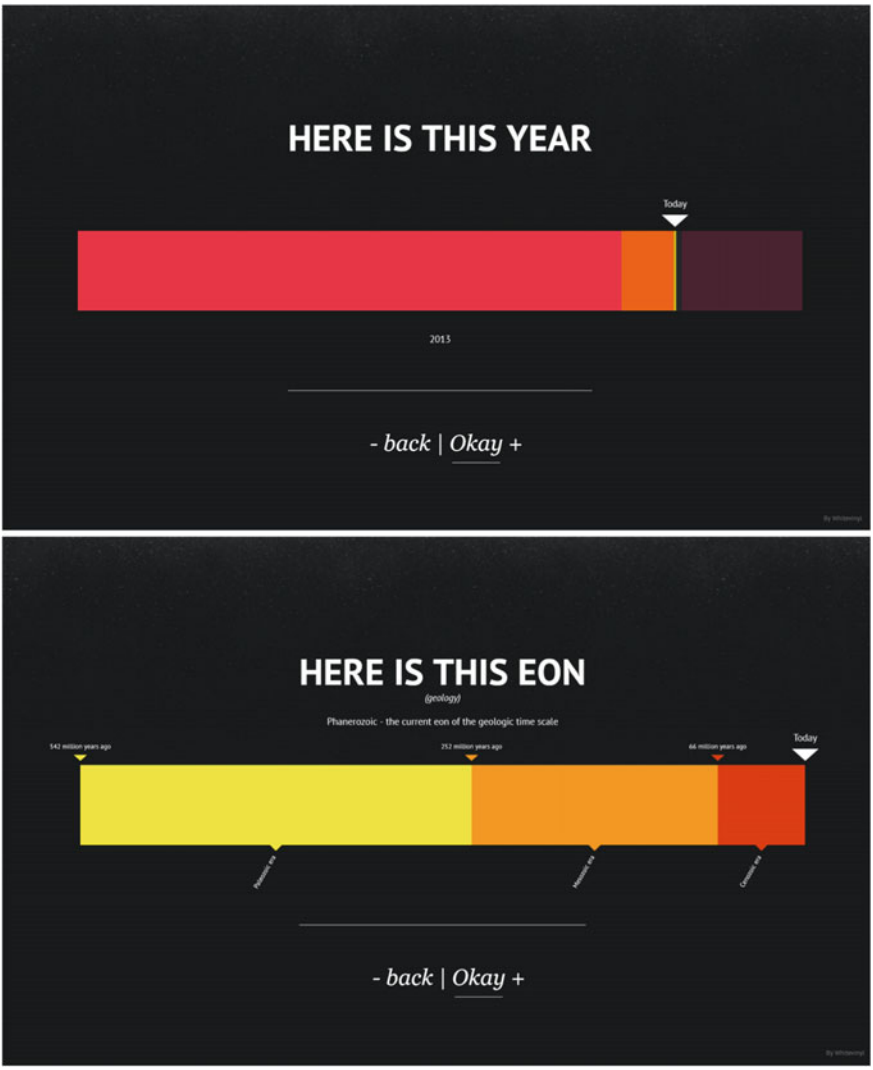

Fig. 2.5 *Here is Today*, Luke Twyman, 2013

timeless energy to this very topic timeless energy. Understanding that all shapes of a whole are perceived not separately or individually, but distinctively, proportionately or comparatively, these creative specialists have their sights set on a concrete formalization of data. The key word here is *concrete*, and for the following three reasons: Firstly, the formalization process depends solely on data representation variables being assigned to a number of formal attributes, 15 of which figure among the most prevalent, including, *shape, form* (or design pattern, symbol), *line, edge, contour, color, value, area* (full-empty relationship), *texture, size, light,*

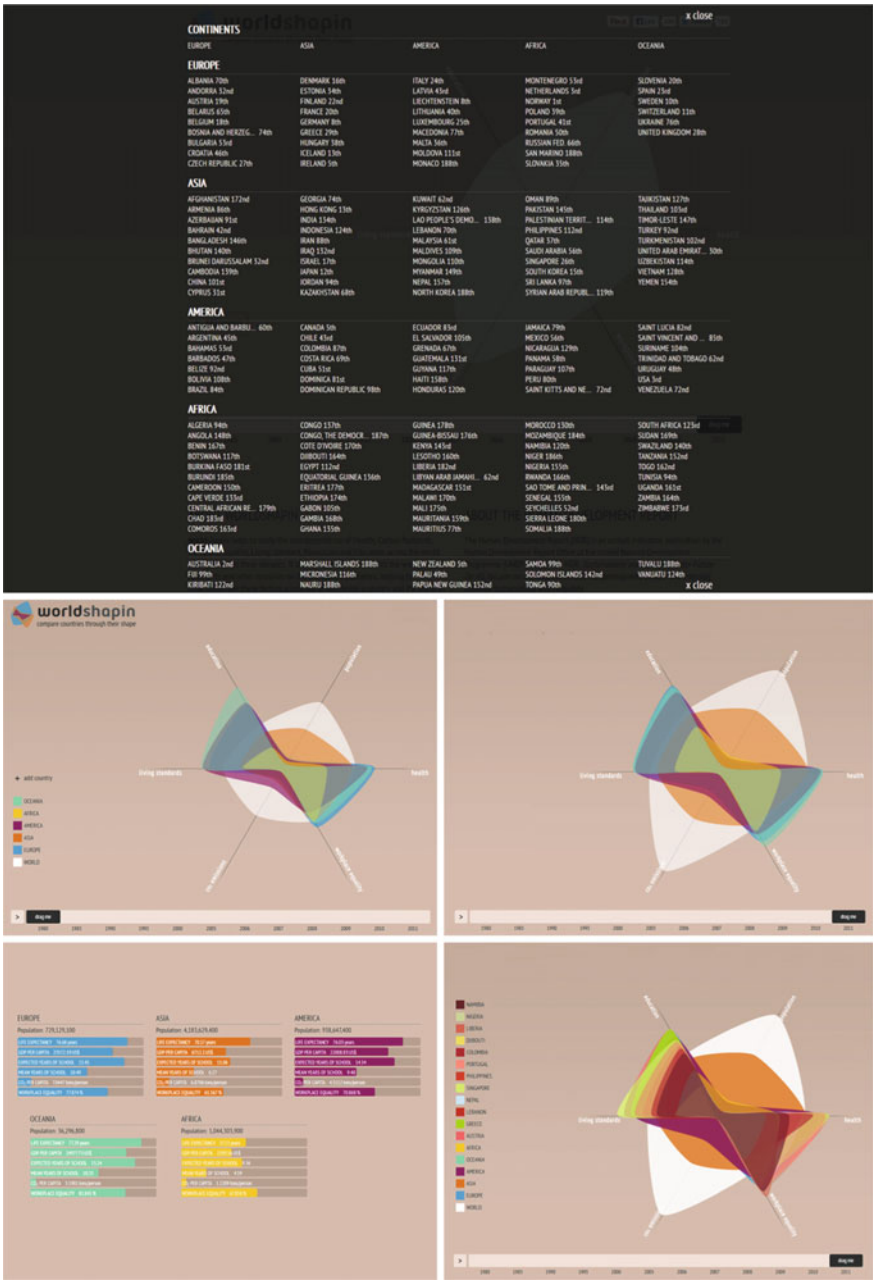

Fig. 2.6 *Worldshap in*, Carlo Zapponi and Vasundhara Parakh, 2013

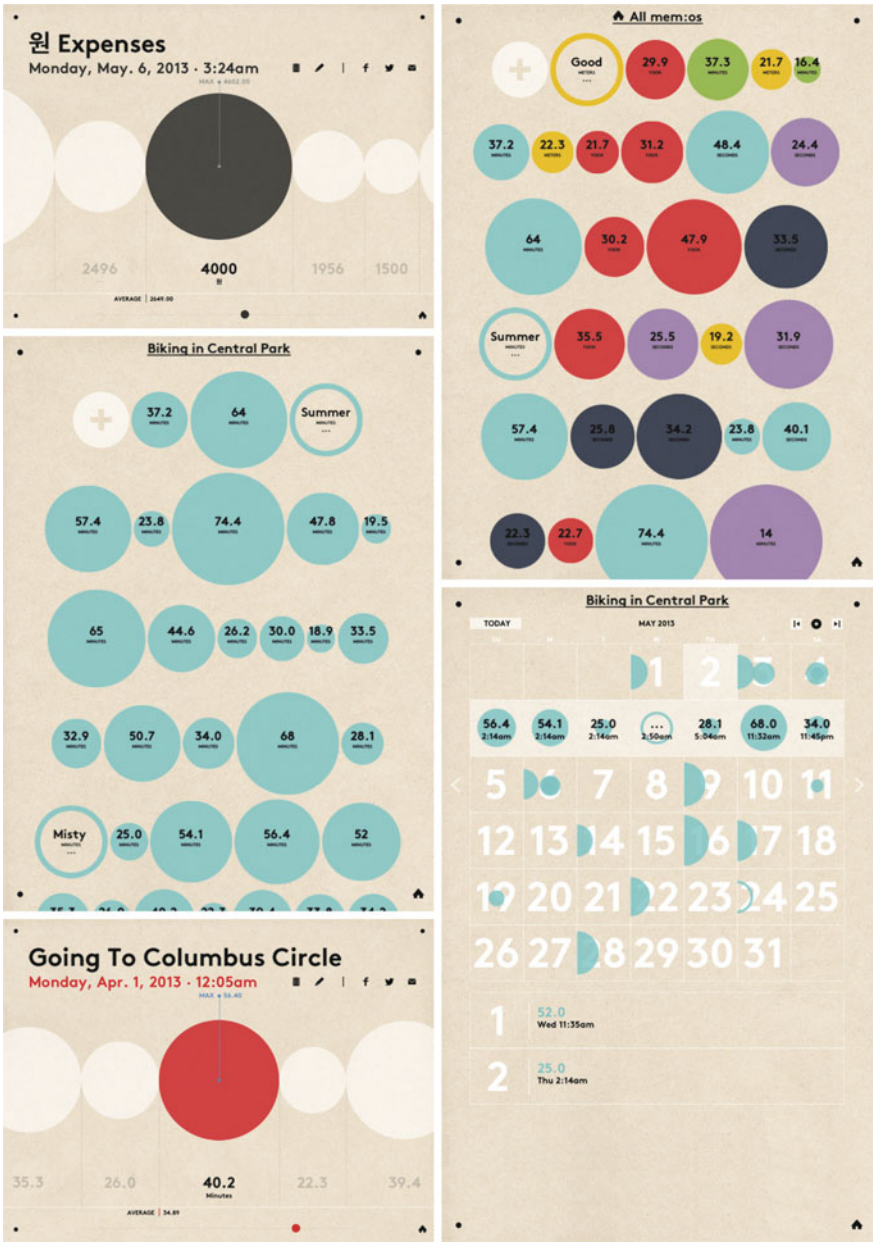

Fig. 2.7 *Mem:o*, Caroline Oh and Young Sang Cho, 2013

volume, plane, field (or space), and *format* (or orientation)—representation is then synonymous with graphic data code. Secondly, the term applies to the generation of pure and perfect shapes free of graphic imperfections or "anomalies" out to impede how the shapes are meant to be interpreted. These same shapes also exude honesty and transparency, exposing, in turn, but the lifeblood. Lastly, in the kingdom of pure shapes, creative expression is an infinite and exuberant realm, yet at the same time, one boasting measure and sophistication. As once proclaimed by concrete artists in their Second Manifesto, this creative expression breathes clarity and harmony into the artificial world in which we live. The deep-seated and indecipherable obscurity found within the information comprising databases, tables, and indices gives way to a clearer and more accurate conception of the images,[44] leaving no doubt, whatsoever, as to their meaning. Observable phenomena materialize from residual data. Although continually evasive and elusive, transforming this data via representation models would make it palpable and comprehensible. What was once beyond our faculties is now at our fingertips. As a result, we have all we need to not only assimilate our world, but also potentially alter it, and all this through the use of visual and graphic representations of data.

One of our latest projects, entitled *Data Shapes* (Figs. 2.8, 2.9), argues the idea of a new formal method that bestows upon massive dataset representation a concrete and explicit character. The project illustrates simple, yet fully formulated shapes of data extracted from the fields of economics, finance, and politics. Each of the shape's attributes is then directly associated with data and value means calculated in real-time and appearing as vector and spatial coordinates broken down by color. If the data and values are to be considered as indexed measurements of the working world, then the corresponding shapes are the proof. Here, the shapes do not represent the data. They do not communicate it nor divulge its numerous meanings. They are but its reflection, depicting a picture of the utmost accuracy, as well as one that could not be further from it. Rebelling against a more passive form of representation, the shifting nature and instability of the shapes avoid all forms of contact and comprehension. They try desperately to come together and form a whole, but to no avail. Our inability to ascertain the diverse meanings, not to mention the meaning of perception itself, result from these shapes and their volatility. They tap into our consciousness and push us to wonder about the things to which we have access and why they have been presented as such. This project is a sequence. Every single shape factors into its representation. Shapes are assigned means, or even a mean of means, calculated according to a number of criteria. Their fluctuations double as the pulse, and the range reading doubles as the heart.

The attempt to display and view data and the push to generate other aesthetically phenomenological data comprise the twofold purpose behind this project, and on a broader level, the creative approach whose definition we are committed to

[44] Visual and graphic representations of data, interface-based or not.

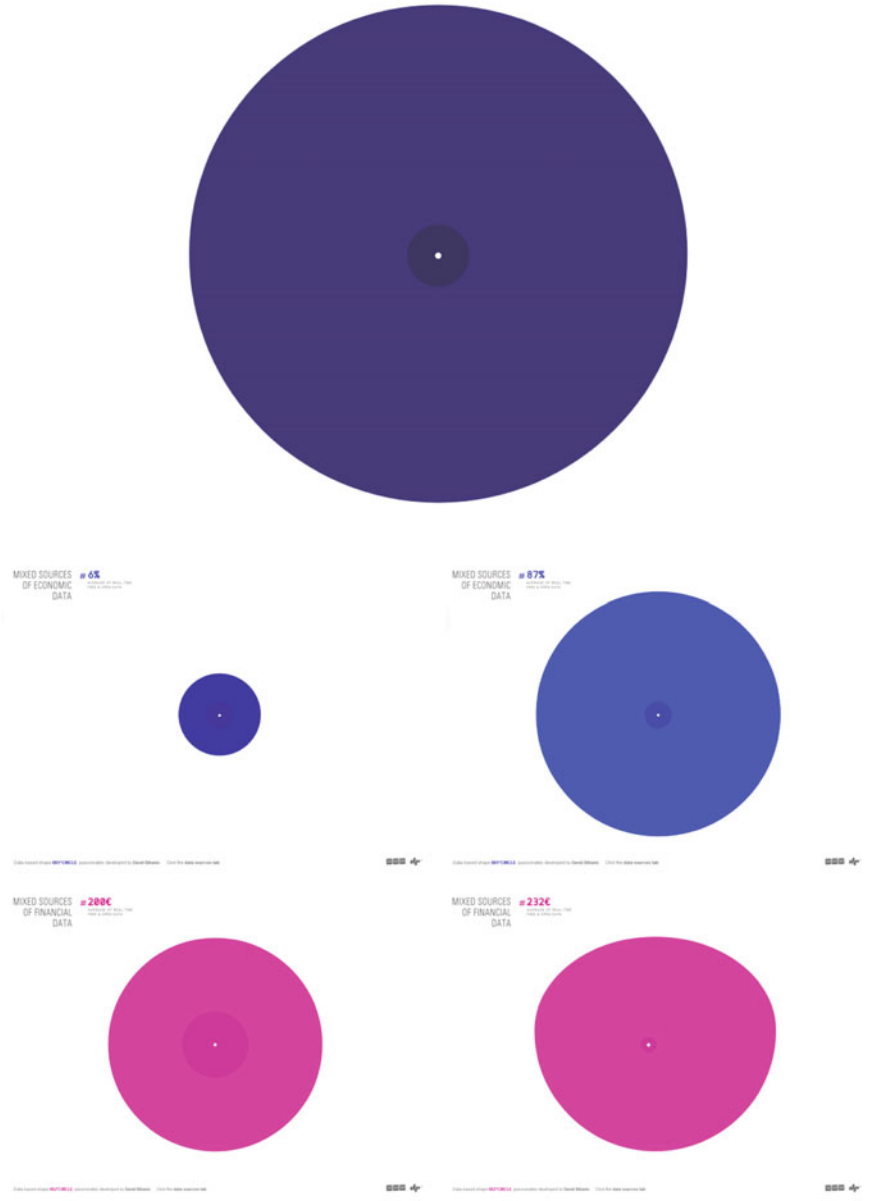

Fig. 2.8 *Data Shapes*, David Bihanic, 2013

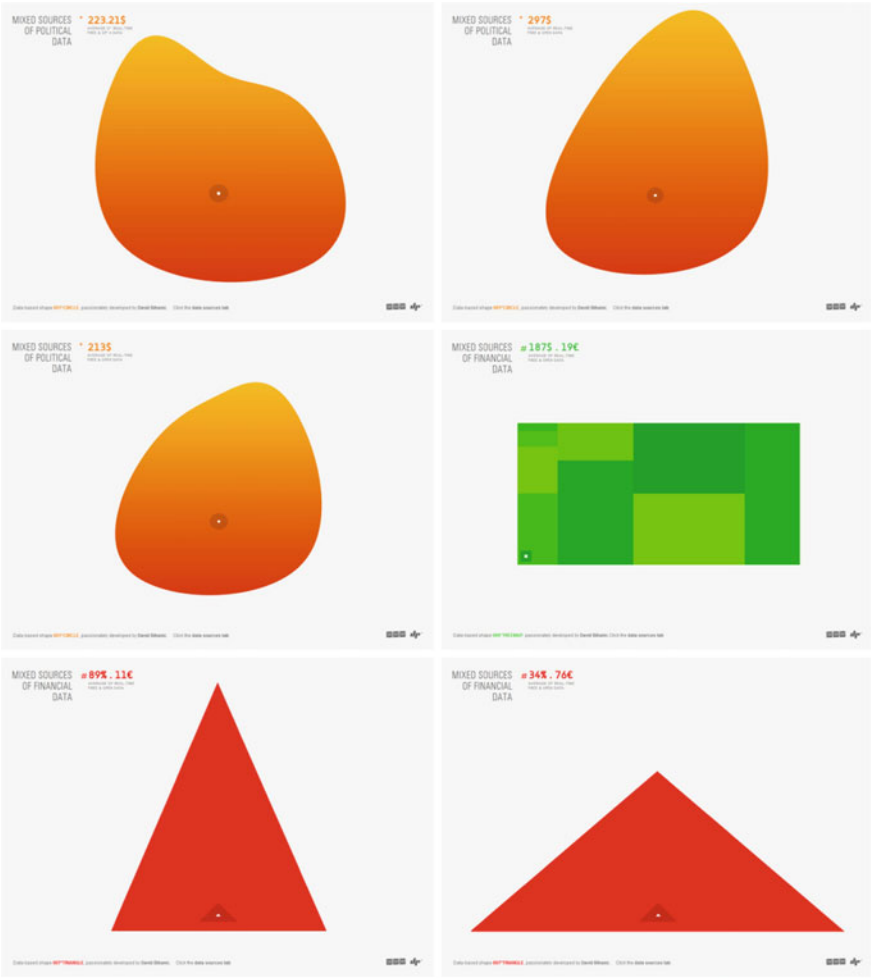

Fig. 2.9 *Data Shapes*, David Bihanic, 2013

elucidating.[45] Here, representation paints a more accurate picture of reality. By configuring shapes objectively, representation exposes itself to a genuine phenomenological data demonstration, ranging from the relationship with aesthetically oriented concrete data to the meaning of a newly formed aesthetic object and a new emergence of shapes.

[45] All things considered, the reasons driving this project are not completely foreign to those of *Listen Wikipedia* created by Stephen LaPorte and Mahmoud Hashemi or *Color Forecast* developed by Pimkie.

2.4 Conclusion

The approach of data design basically aims at creatively exploring and investigating new ways and methods of representing, visualizing, and processing computer data. To do so, Data designers are not refraining from forging other visions and paradigms that radically cut ties with tradition, rules, and designs, which, up to now, have been adamantly defended and accepted as true.[46] Their ultimate goal is to optimize all research, including those of a seemingly trivial nature, for the purposes of rebuilding the foundation of all knowledge. Through *exploration* and *exploitation* of massive datasets in motion, Data designers are committed to leaving no stone unturned, and exposing the *buried or hidden* (ideally *tried and true*) potential within disseminated data ensembles. By first forcing ourselves to clarify this handful of attributes and peculiarities[47] before delving further into the more formally aesthetic properties and expectations surrounding the display and view of "Big Data," only then will we be able to reach the conclusion that more emphasis needs to be placed on both the concrete and formal aspects of expressiveness in data representation and visualization, the benefits of which include more added value information-wise, embodying a greater sense of perspicacity and perceptive sensitivity of the user, in addition to a broader notion of meaning, and in turn, a more enriching experience.

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[46] Wiping out, once and for all, all outdated and obsolete shapes.

[47] Inadvertently stressing how design's contribution to data representation and visualization is proving, now more than ever, indispensable.

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