INTERACTIVE DATA VISUALIZATION Session 01
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Body-related Data Visualization. A study for design guidelines.

Body / Data visualization / Guidelines

INTRODUCTION
Human body physiological parameter tracking processes have become essential components of multiple service design projects focused on quantified self issues, becoming a relevant cultural phenomenon for contemporary society from 2010 onwards. Parallel to this transformation in the understanding of one's own body, new forms of data visualization have gradually developed, whose primary objective is to make comprehensible the information that the various sensors collect in people's lives. The human parameters tracked are in various examples represented with respect to a unit of measurement expressed in time, which can be understood by comparison.

Measured data are often characterized by small variations and only comprehensible over a very large time interval. The aim of this contribution is to analyze how, depending on which aspects of the body one wishes to represent, there are different forms of visualization best suited for communicating this information. The representation of the human body and its anatomy culminated in the Renaissance period in which the geometric construction of man by Leonardo da Vinci and Leon Battista Alberti defined the human form in its geometry and proportion.

The evolution in technical iconography reached an analytical level with the anatomical sciences, with the superimposed and interactive tables of Andrea Vesalius' De humani corporis fabrica libri septem (1543) that constitute a cognitive form in which the human eye violates the sacredness of the body and completes the map of the body parts, bringing vision to a scientific level (Maldonado, 1994). A paradigm arrives when the body related to issues of ergonomics in the 20th century with the formal schematizations of Le Corbusier's Modulor (1948) and Henry

Dreyfuss's Modulor (1955). These immobile representations visualize the human being in relation to a space but not its variations over time. With the advent of medical systems, the vision of the body has become three-dimensional (Maldonado, 1994, p. 83), moving and parametric thanks to software processing, finally integrating with the advent of personal tracking systems with the small screens of smartphones becoming usable content in real time to understand oneself.

THE RESEARCH

A series of studies show that in the relationships between wearables, data and people there are significant problems related to storytelling, engagement, literacy, the time factor - which determines the type of attention paid to the tools - and finally the space factor - the pixel space available to display the data and its limitations at the interface level. (Rooksby et al., 2014; Parnow, 2015; Rapp & Cena, 2016; Liçaj, 2018; Zannoni, 2018; Dall'Osso, 2021; Pronzati, 2021)

The research therefore aims to explore these relationships and communication limits in order to understand the most correct ways of visualizing body-related data. The first part of the research focused on defining the state of the art through the analysis of thirty applications between medical, sports and general monitoring (habits), the analysis of the type of monitoring - direct, documentary, diagnostic, reward collection and monodata - [fig 01] and finally the analysis of the types of representation. Of each application, all trends on the types of parameters monitored, the types of graphs used and finally the types of color ranges used were extracted and put in system.

As a result of the first state-of-the-art phase, 30 specific cards for each App [fig 02] and 8 specific cards for each parameter type [fig 03] were produced.

The second part of the research aimed to qualitatively test the different types of representation of the different parameters. The usability testś were conducted in two ways: online survey with 46 people and focus group with 10 participants.

The analysis of the state of the art revealed the usefulness of using an online tool for designers as an aid in the design of data visualization applied to the Quantified Self theme. To this end, the relational database HBI Observatory (Zannoni et al., 2022) was chosen as a tool for construction of the online platform.

DISCUSSION

The research attempts to provide user-centered solutions for the design of Data Visualisation that take into account the perceptual and cognitive contextual limitations of users and explore the dichotomies possible in the field of Data Visualisation both in its approaches - e.g. purity/aesthetisation - and in its structural characteristics - e.g. static/dynamic fruition - trying to understand how these can be related to the theme of the Quantified Self. (Bertin, 1968; Cairo, 2012; Bihanic, 2015; Tufte, 1990; Holmes, 1991) The outputs of the research will be as follows and will then be made available to the design community:

1. Design guidelines, which are a decision-making tool in the construction of body-related Data Visualization, on the themes of: (i) user literacy; (ii) most suitable Ux and Ui depending on the type of media, data and graphics; (iii) how to include potential non-visual feedback in addition to visual ones; (iii) how to take bias into account when designing DataViz.
2. Prototyping tools that then allow users to create free correlations between data.
3. Coding new narrative forms for users depending on the medium, target audience, body data and literacy level.

CONCLUSION

The future goals of the research are to make the online tool an increasingly useful aid in terms of designing Data Visualization for the Quantified Self by improving the consultation experience in the first place.

Two other issues are important in the considerations of future steps, which are multisensory feedback, as a tool for manifesting data in relation to variable spatial and contextual scenarios, and then also rethinking the concept of "extension" in two ways: from smartphones (the application support most used today for managing apps on the Quantified Self) to wearables with minimal or even non-existent screens, and also extension of the interface from smart devices to space/body, associating haptic and visual stimuli to visualizations.

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From Data to Concerns: Gender Equity in Higher Education

data visualization / transmedia design / interactive storytelling

In 2021, the Italian Department for Equal Opportunities (DPO) published the "National Strategy for Gender Equality", which prompts to broadly consider gender in different contexts, including higher education. Strategies range from the allocation of funding to faculty representation, and women students in science, technology, engineering and mathematics (STEM). In spite of this and other strategic plans at the local, national, and European levels, gender differences persist and are even becoming exacerbated by the global pandemic (Carli, 2020).

In Italy, a total of 56% of the university graduates are women; still, only seven out of the 84 university deans in Italy are women. In addition, there is a large difference between disciplines such as computer science and engineering with an average of 22% of women graduates. Furthermore, a recent study shows that graduated women earn up to 20% less than their men colleagues five years after graduation. In spite of these appalling numbers, the systematic and structural barriers in higher education make it difficult to identify and implement effective strategies toward equity (Ahmed & Swan, 2006). To make these barriers visible, we argue that there is a need for bottom-up approaches that identify and make visible the concerns in concrete contexts while implementing situated actions that allow for open discussions not only among "the usual suspects" (e.g., those already interested in gender equity).

In this paper, we describe GENZ, our research project funded by the [institution name removed for anonymisation]. The project aims to generate debate on gender in higher education among students and the entire academic body starting from existing gender-segregated data. The project focuses on gender due to data availability; however, it also keeps an intersectional perspective on, e.g., nationality, race, and class. Methodologically, the project follows a Participatory Action Research (PAR) approach (Baum et al., 2006). This methodology consists of three main phases of collectively identifying, diagnosing, and reflecting on an issue while investigating the potential of digital technologies in each phase [ibid]. Due to the limited scope of the project, the focus is on identifying concerns and experiences relevant to equity at our institution.

We started the project in January 2022 with an explorative intervention that built on our analysis of quantitative gender-segregated data at [institution]. The quantitative data represented the "facts" often used in diversity and equality reports (Ahmed & Swan, 2006). Quantitative data provide an illusion of objectivity and neutrality and are often used in policy-making, but they leave aside people's experiences and non-predominant narratives (D'ignazio & Klein, 2020), which can

be key to driving structural changes. Therefore, in this project, we wanted to use quantitative data as prompts to invite students and researchers to share their situated concerns.

The first explorative intervention took place on Women's Day in 2022. We "hacked" a total of 13 in-between spaces (e.g., bathroom, stairs, elevator) at our university's main building with pamphlets stating: "7 out 10 students at [institution] are women and what I really want to know is..." (Figure 1). Next to the sentence, we placed a QR code for people to scan and express their concerns by completing the sentence. We received 26 anonymous concerns, which were liked up to seven times each. Thematic analysis showed that the concerns related to four main topics: lived experiences (N= 12, e.g., "if they perceive they are a majority"), career (N=6, "how many of them will end up in higher or better-paid positions than their male-read colleagues"), representation (N=5, "why then the quota among tenured associate professors is ~4 out of 10, among tenured full professors is ~2 out of 10"), and intersectionality (N=4, "which languages they are speaking"). Since most of the concerns were related to lived experiences, which were also the most popular in terms of likes, we decided to further investigate students' everyday experiences related to gender and intersectionality in dedicated focus groups.

In addition, we decided to create another playful and provocative intervention that had the ability to reach a broader audience within the university. With that purpose, we designed and implemented an interactive artefact that represents the gender-segregated data through a mobile-first digital artefact. The interactive artefact consists of two components focusing on data visualisation and storytelling. The interactive data visualisation component visualises the university data not only by gender but also by faculty and nationality, thereby introducing an intersectional perspective. The storytelling component provides a reader-centred storytelling experience. The narration builds upon the students' and researchers' self-reported gender, faculty, and age, providing an immersive experience and inviting them to share their concerns on gender in their faculty.

This paper draws on these two interventions and addresses how data visualisation can be used as an inquiry tool, to shed light on issues and concerns about gender in an institution, supporting the opening of debates and personal reflection (D'ignazio & Klein,2020). From a research perspective, this paper contributes to how interactive technologies make concerns visible and outline solutions to complex societal problems (DiSalvo et al., 2014; Latour & Weibel, 2005). Data visualisation and storytelling techniques are crucial to making issues such as pollution, mobility, and diversity visible (DiSalvo et al., 2014; Menendez-Blanco et al., 2007); however,

their ability to foster debate on their own is often limited. In this project, we propose interactive interventions across the physical and the digital to foster debate on gender diversity by creating opportunities to elaborate data on concerns.

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Clustering to synthesize, and scattering to reveal: interactions and animations in the visualization of complex hierarchical data in Atlante Calvino

data visualization / information design / hierarchical data / digital humanities / Atlante Calvino

In this contribution, we describe examples of visualizations that deal with complex hierarchical data in the area of digital humanities. When working with data of a predominantly quantitative nature, aggregation and disaggregation are two common operations we can perform to discover patterns. However, the approaches above are not exploitable when working with data that embeds exceptions and individualities. Indeed, this kind of data, which often appears in diverse fields such as contemporary urbanism cartography (Briones, 2019), forensic investigations (Bois, 2016), or digital humanities (Drucker, 2020), usually presents qualitative attributes. Comparing the micro with the macro (Kurgan, 2013), and bridging close with distant reading (Franzini, 2015), appear as open challenges for visualization research. Hence, in this paper, we discuss visualization case studies that, while drawing from sedimented strategies in visualization research (Brüggemann, 2020), address these issues by employing clustering and scattering to handle visual complexity dynamically. The described examples are designed for an audience of researchers in the areas of Digital Humanities and enable them to reveal complex information through interaction with and animation of the elements that compose the visualization.

The presentation lingers on three case studies belonging to the project platform Atlante Calvino (Elli, 2022), which features interactive visualizations and in-depth literary inquiries about the well-known Italian author.

First, we present Combining [Fig. 1], an interactive visualization built on a Marimekko visual model (Few, 2011) for representing narrative sequences in Calvino's literary works (https://atlantecalvino.unige.ch/form/phase2?lang=en). The affordances of the original visual model allowed for revealing the combinatory nature of Calvino's production, which is visualized using modules. Modules, displayed by columns of different thicknesses according to the number of typographic characters, represent segments of content hierarchically nested in each text. Here, interactivity and animation accompany users in the exploration, enabling them to progressively reveal three layers of information that gradually detail the internal structure of each narrative sequence.

Second, we present Transforming [Fig. 2], a visualization that showcases places in Italo Calvino's literary works (https://atlantecalvino.unige.ch/space/phase2?lang=en). Places are represented as circles of different colors that correspond to different categories, which are located on different axes: terrestrial generic,

terrestrial localizable, invented, cosmic localizable, and cosmic generic. When a hierarchical relationship exists among places, e.g., a region containing one or more towns, circles are sized according to the number of their descendant nodes. Researchers can expand circles recursively and reveal contained places. The solution privileges hierarchical relationships against a positioning based on an ordinal scale. Therefore, it accepts, for example, that generic terrestrial places may result as being located on the axis of localizable ones after the animation has revealed them.

Third, we present Erasure [Fig. 3], a visualization that shows the amount of dubitative text in the narrative corpus of Calvino (https://atlantecalvino.unige.ch/doubt/phase3?lang=en). The stylistic phenomenon is described, categorized, and systematically harvested according to an interpretive grid that combines inner categories (content, form, meaning) with styles (negation, hesitation, reformulation) (Parigini, 2022). The produced data does not present hierarchical qualities since data records are all independent of one another. However, they conceptually belong to the same stylistic phenomena. Hence, designers represented the occurrences of dubitative text as metaballs: agglomerations composed of circles corresponding to different styles and categories of dubitative text. The overview simplifies the presentation of data, reducing cluttering and the number of individual elements. Metaballs can be opened, revealing details about the heterogeneous composition of the dubitative text.

In making these visualizations, designers introduced new visual, interactive, and animated languages that work through the clustering and the on-demand scattering of elements representing data records with a hierarchical relationship. Designers experimented with different forms of clustering, depending on the specific requirements that visualizations had to support. Additionally, designers functionally employed animation. Instead of being only limited to an esthetical value, animation comes in support of audience understanding: it demonstrates and explains how individual graphical elements are combined to create the clusters, but also how clusters unbuild to reveal children nodes.

In conclusion, by bringing three examples from the Atlante Calvino project, we discussed how visualization designers could deal with complex hierarchical data. Interaction and animation appear as suitable strategies to support actions of dynamic clustering and scattering of elements, and, ultimately, to progressively staging data in a way that is more digestible to audiences.

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