The Language of Data in the Exhibition Discourse. Intertwining Architects, Curators, Artists, Scientists, and Users

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——— Introduction

Architecture and neuroscience seem to embrace two opposed research models. Particularly in the realm of language, architects use metaphors and subjective meanings, while scientists base their hypotheses on measurements and objective definitions. For these two disparate disciplines to successfully collaborate, they must develop shared vocabularies and understandings.

——— Hypothesis

A possible common ground is the *language of data*. As the historian Yuval Noah Harari explains, "according to Dataism, *King Lear* and the flu virus are just two patterns of data flow that can be analysed using the same basic concepts and tools."[1] The Dataism paradigm is cited here for its potential in building "bridges over academic rifts."[2] Data is first and foremost information, never only numbers. "Datasets are often enriched with many dimensions" and each dimension can "be instrumentalized in unexpected and creative ways."[3] When data are available architects and scientists can interface and discuss their theories. Designers contribute conceiving original data collection and visualization techniques to foster interdisciplinary communication that introduce "novel ways of thinking,"[4] in addition to make data more accessible and understandable. Despite the current lack of empirical data, the data-informed design approach is expanding new research domains, the study of visitor experience being one example[5]. Exhibition spaces are gradually becoming a *data ecosystem*, which intertwines designers, curators, artists, programmers, scientists, and users. The role of *Information and Communication Technology* (ICT) in the exhibition and museological context (and in the cultural heritage sector more broadly) has grown considerably over the years, merging "architecture and media."[6]

——— Methodology

Outlining a critical review of some recent, significant case studies is essential for better understanding the present ICT integration in the exhibit design field and promoting experimental researches. To transform the space into a *ubiquitous computing place*, sensors detect environmental qualities, visitors' behavior, and the emotional-cognitive impact of artworks[7]. Through data analyses, designers better comprehend how space is experienced, curators enrich the exhibition's performance, neuroscientists study autonomic activities in realistic conditions, and users observe the data produced, becoming responsive in data quantification. We analyzed three categories of ICT applications: Smart technology (S)[8], Wearable technology (W)[9], and Beacon technology (B)[10]. Examining eleven case studies (CS), we built a prototypical map resulting from the combination of two parameters: the *user interaction* (UI) degree and the *device portability* (DP) level. We described each parameter using three scores: UI–1 (no user interaction), UI–2 (limited user interaction), and UI–3 (free user interaction); DP–1 (static devices), DP–2 (mixed devices), and DP–3 (mobile devices).

——— Results

CS 01. *The Pen*, Cooper Hewitt (New York, NY): 2015–ongoing. S: UI–3; DP–3.
The Pen is an NFC-based device that allows visitors to interact with the exhibition and recreate their experience online. The museum monitors which items are more popular and how much time visitors spend on site.[11]

CS 02. *ASK*, Brooklyn Museum (New York, NY): 2014–ongoing. B: UI–3; DP–2.

ASK is a mobile application that interplaying with beacons installed throughout the galleries locates visitors, connecting them with staff. The use of spatial data enhances the relationship between art experts and users.[12]

CS 03. *Gallery Explorer*, National Gallery Singapore (Singapore): 2015–ongoing. B: UI–3; DP–2.

Mobile app interfaces with beacons to digitally engage users. The Gallery gains insights into visitor behavior to develop data-informed strategies for improving crowd management and the overall visitor experience.[13]

CS 04. *IMApp*, Musei Civici di Palazzo Farnese (Piacenza, Italy): 2014. B: UI–3; DP–2.

IMApp is a mobile app working as an interactive multimedia guide and drawing on beacons. This technology enriches the user experience, customizes notifications, and collects information about visiting preferences.[14]

CS 05. *Body Metrics*, Tech Museum of Innovation (San José, CA): 2014. W: UI–2; DP–3.

Visitors received a sensor kit (to track their physiological activity, brain signals, and movements) and an iPod. The devices compiled data about users' psychophysical reactions, reproduced in final videos and graphics.

CS 06. *A Space for Being*, Spazio Maiocchi (Milano, Italy): 2019 Design Week. W: UI–2; DP–3.

Visitors wore a sensor armband (Google-powered) to collect and process biometric data as affected by three immersive design installations. After the visit, each guest obtained a visual report of their body's responses.

CS 07. *eMotion Project*, Kunstmuseum St. Gallen (St. Gallen, Switzerland): 2009. W: UI–1; DP–3.

Visitors wore an electronic glove able to measure bodily reactions. The aim was to analyze how artworks and curatorial strategies influence the visitors' behavior, observing physiological signals and engagement.[15]

CS 08. *Piedad y Terror en Picasso*, Museo Arte Reina Sofía (Madrid, Spain): 2017. S: UI–1; DP–3.

Visitors' behavioral patterns were mapped through big data produced by their mobiles and other sources (e.g., opinion polls, meteorological and travel data) to evaluate the social and economic impact of the exhibition.

CS 09. *Art Traffic at the Louvre*, Musée du Louvre (Paris, France): 2014. B: UI–1; DP–2.

Bluetooth signals (recorded by proximity sensors and emitted by visitors' mobile devices) provided a detailed analysis of individual transitions. This study surveyed unknown behaviors to improve the visiting quality.[16]

CS 10. *RFID Tracking*, Osaka Science Museum (Osaka, Japan): 2007. S: UI–1; DP–2.

RFID tags (worn by visitors) and readers (attached to robots and installed in the environment) monitored users' trajectories. The experiment examined typical/atypical visiting patterns, spatial interactions, and durations.[17]

CS 11. *Degas: At the Tracks On the Stage*, Art Institute of Chicago (Chicago, IL): 2015–2016. B: UI–1; DP–1.

A 300-beacon network turns on when visitors connect to Wi-Fi. The user data produce maps to visualize interactions with exhibits, travel paths, temporary stops, and the total stay time.

——— Conclusion

The pivotal questions are two: 1. — How can we collect, map, and measure experiential data? 2. — How can we transform it into design input and not just indicators to improve the visitor experience or inform exhibition operations and services? The exhibition spaces, promoting immersive experiences in carefully planned environments, with a high density of information and emotional charge, are ideal contexts for the study of perceptual responses of the public. We think that data analytics[18] needs to take a step forward than the case studies analyzed, becoming a tool that informs the design process. As architects, we are particularly interested in understanding how we can physically manipulate the space (e.g., in terms of proportions, colors, materials, and light effects) to influence perception, emotional engagement and content memorization processes. Nevertheless, as the influence of intrinsic qualities of the exhibited objects are anything but secondary, future experiments should evaluate the effects of different display solutions all other things being equal. Many issues emerge in parallel: 1. — The descriptive powers of combining traditional techniques (e.g., observation, interviews, and questionnaires), extensively tested in Museology and Museography, with new data-collecting technologies that measure non-filtered and non-verbal feedback; 2. — The role of architects in perfecting visual data analysis and promoting interdisciplinary communication; 3. — The hypothesis of extending the data mining, visualization, and mapping practice also during the performance of virtual tours; 4. — The mission of data open access to enhance the interpretation and accessibility of Cultural Heritage.

1-2 Harari Y.N. 2016. *Homo Deus: A Brief History of Tomorrow*, 367–368. New York, NY: Random House.

3 Ratti C. and Claudel M. 2016. *The City of Tomorrow: Sensors, Networks, Hackers, and the Future of Urban Life*, 45. New Haven, CT and London: Yale University Press.

4 Murphy H. and Lupi G. 2017. Seeing through Data: Visiting the Museum with the Eyes of an Information Designer. *The Museum of Modern Art (MoMA) Medium Account*. [www.stories.moma.org | 07.07. 2021].

5 Vargas L. 2019. Smart Media: Museums in the New Data Terroir. In *The Routledge Handbook of Museums, Media and Communication*, ed. by K. Drotner, V. Dziekan, R. Parry, and K.C. Schrøder, 261–273. Abingdon and New York, NY: Routledge.

6 Kenderdine S. 2017. Embodied Museography. In 'The Digital in Cultural Spaces' Conference Publication (2016), ed. by Karthigesu T., 24–43: 25. Singapore: The Culture Academy.

7 See *Sensitive Pictures*, a prototype experience capturing and visualizing emotional reactions from the visitors during an exhibition at the Munch Museum. Oslo, Norway. August 2019. This case study is part of the EU H2020 project GIFT.

8 Devices based on RFID (Radio-Frequency IDentification), NFC (Near Field Communication), Bluetooth, and Wi-Fi standards.

9 Body-worn equipment with sensors enabled to measure and record physiological responses and/or neural activation.

10 Beacons are small wireless transmitters, which send signals to other devices nearby using Bluetooth Low Energy technology.

11 Wright L. 2017. New Frontiers in the Visitor Experience. In *Manual of Digital Museum Planning*, ed. by A. Hossaini and N. Blankenberg, 109–130. Lanham, MD: Rowman and Littlefield.

12 Bernstein S. 2015. The Realities of Installing iBeacon to Scale. *Brooklyn Museum Blog* [www.brooklynmuseum.org | 02.24.2021].

13 Lim K. 2017. Data Analytics: Journey of the National Gallery Singapore. In 'The Digital in Cultural Spaces' Conference Publication (2016), ed. by Karthigesu T., 44–58. Singapore: The Culture Academy.

14 Fabbri F. and Boeri. 2015. La Tecnologia Beacon al Servizio del Patrimonio Culturale: Il caso dei Musei di Palazzo Farnese e della città di Piacenza. *Archeomatica – Tecnologie per i Beni Culturali* 6 (3): 32–35.

15 Kirchberg V. and Tröndle M. 2015. The Museum Experience: Mapping the Experience of Fine Art. *Curator: The Museum Journal*, 58 (2): 169–193. — DOI: 10.1111/cura.12106.

16 Yoshimura Y. et al. (2014). An Analysis of Visitor's Behavior in the Louvre Museum: A Study Using Bluetooth Data. *Environment and Planning B: Planning and Design*, 41 (6): 1113–1131. — DOI: 10.1068/b130047p.

17 Kanda T. et al. 2007. Analysis of People Trajectories with Ubiquitous Sensors in a Science Museum. *Proceedings 2007 IEEE International Conference on Robotics and Automation* (ICRA '07), 4846–4853. — DOI: 10.1109/ROBOT.2007.364226.

18 Freeman A. et al. (2016). *NMC Horizon Report: 2016 Museum Edition*. Austin, TX: The New Media Consortium.