

Springer Series in Design and Innovation 37

Francesca Zanella · Giampiero Bosoni ·  
Elisabetta Di Stefano · Gioia Laura Iannilli ·  
Giovanni Matteucci · Rita Messori ·  
Raffaella Trocchianesi *Editors*

# Multidisciplinary Aspects of Design

Objects, Processes, Experiences and  
Narratives

OPEN ACCESS


 Springer

## Editor-in-Chief

Francesca Tosi, *University of Florence, Florence, Italy*


## Series Editors

Claudio Germak, *Politecnico di Torino, Turin, Italy*

Francesco Zurlo , *Politecnico di Milano, Milan, Italy*

Zhi Jinyi, *Southwest Jiaotong University, Chengdu, China*

Marilaine Pozzatti Amadori, *Universidade Federal de Santa Maria, Santa Maria, Rio Grande do Sul, Brazil*

Maurizio Caon , *University of Applied Sciences and Arts, Fribourg, Switzerland*

**Springer Series in Design and Innovation** (SSDI) publishes books on innovation and the latest developments in the fields of Product Design, Interior Design and Communication Design, with particular emphasis on technological and formal innovation, and on the application of digital technologies and new materials. The series explores all aspects of design, e.g. Human-Centered Design/User Experience, Service Design, and Design Thinking, which provide transversal and innovative approaches oriented on the involvement of people throughout the design development process. In addition, it covers emerging areas of research that may represent essential opportunities for economic and social development.

In fields ranging from the humanities to engineering and architecture, design is increasingly being recognized as a key means of bringing ideas to the market by transforming them into user-friendly and appealing products or services. Moreover, it provides a variety of methodologies, tools and techniques that can be used at different stages of the innovation process to enhance the value of new products and services.

The series' scope includes monographs, professional books, advanced textbooks, selected contributions from specialized conferences and workshops, and outstanding Ph.D. theses.

The volumes of the series are single-blind peer-reviewed.

**Keywords:** Product and System Innovation; Product design; Interior design; Communication Design; Human-Centered Design/User Experience; Service Design; Design Thinking; Digital Innovation; Innovation of Materials.

### **How to submit proposals**

Proposals must include: title, keywords, presentation (max 10,000 characters), table of contents, chapter abstracts, editors'/authors' CV.

In case of proceedings, chairmen/editors are requested to submit the link to conference website (incl. relevant information such as committee members, topics, key dates, keynote speakers, information about the reviewing process, etc.), and approx. number of papers.


Proposals must be sent to: series editor Prof. Francesca Tosi ([francesca.tosi@unifi.it](mailto:francesca.tosi@unifi.it)) and/or publishing editor Mr. Pierpaolo Riva ([pierpaolo.riva@springer.com](mailto:pierpaolo.riva@springer.com)).


Francesca Zanella · Giampiero Bosoni ·  
Elisabetta Di Stefano · Gioia Laura Iannilli ·  
Giovanni Matteucci · Rita Messori ·  
Raffaella Trocchianesi  
Editors


# Multidisciplinary Aspects of Design

Objects, Processes, Experiences and Narratives

### Editors

Francesca Zanella   
Department of Engineering “Enzo Ferrari”  
University of Modena and Reggio Emilia  
Modena, Italy

Giampiero Bosoni   
Department of Design  
Politecnico di Milano  
Milan, Italy

Elisabetta Di Stefano   
Department of Humanities  
University of Palermo  
Palermo, Italy

Gioia Laura Iannilli   
Department of Philosophy  
and Communication Studies  
University of Bologna  
Bologna, Italy

Giovanni Matteucci   
Department of Philosophy  
and Communication Studies  
University of Bologna  
Bologna, Italy

Rita Messori  
Department of Humanities, Social Sciences  
and Cultural Industries  
University of Parma  
Parma, Italy

Raffaella Trocchianesi   
Department of Design  
Politecnico di Milano  
Milan, Italy



ISSN 2661-8184

ISSN 2661-8192 (electronic)

Springer Series in Design and Innovation

ISBN 978-3-031-49810-7

ISBN 978-3-031-49811-4 (eBook)

<https://doi.org/10.1007/978-3-031-49811-4>

This work was supported by Centro Studi e Archivio della Comunicazione, Università di Palermo and Politecnico di Milano.

© The Editor(s) (if applicable) and The Author(s) 2024. This book is an open access publication.

**Open Access** This book is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this book are included in the book's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the book's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.


The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Paper in this product is recyclable.



# Beyond Visualisation Data as Raw Material for Uncoded Experiences

Lucilla Calogero<sup>(✉)</sup> 

Università Iuav di Venezia, Venice, Italy  
lcalogero@iuav.it

**Abstract.** In the context of our evolving data-driven society, controlling the current abundance of data and the resulting flow of information does not circumscribe actions from disciplinary boundaries. Many recent theories factually underline this fact contributing significantly to the definition of valuable tools, methodologies, and processes. Numerous cross-disciplinary contributions support an ever-expanding field of knowledge in its many applications, the benefits of which are evident from an economic, social and cultural perspective. Furthermore, they seem to reveal the potential of a material transformation of data: re-materialising data, giving it physical shape and staging it in public spaces to create more emphatic relationships. This plastic experience would make people feel the data, not just watch and observe it. The paper proposes an analytical framework, helpful in exploring the opportunities offered by data design: what technological innovations make the development of new data communication languages possible? What spatial dimension does the experience provide? What value, what meaning do they bring? The framework offered here intends to be a thinking tool and inspire renewed data interaction design practices. A better understanding of what interaction in data design is, and how it can enrich the quality of interaction in data-informed product-service systems which empower those who use them. The goal is to open up the dialogue amongst parties interested in making the human explicit in the data ecosystem.

**Keywords:** data design · narrative · physicalisation · sensification

## 1 Design Contribution in the Context of Data Literacy

Similar to the history of other literacy initiatives, data literacy requires behavioural change [4]. The invention of the printing press created the need for universal text literacy; likewise, the need to manipulate considerable amounts of large numbers created the need for mathematical literacy; the ubiquity and relevance of photography, film and digital drawing tools posed the need for visual literacy [7]. Similarly, with the increasing availability of large data sets, it is possible to draw a parallel with the compelling need for universal data literacy that goes from the understanding of data to the use of visualisations and other enabling systems for the transformation of information into knowledge. Like other literacies, data literacy aims to promote better communication and collaboration, empower users to understand their world, establish individual self-efficacy, and

improve decision-making in many contexts. Data literacy also allows laymen not to be reduced to the mere role of passive data producers. Corral [12] shows how the definition of data literacy constitutes a “wicked problem”: the author combines the multiple definitions of data literacy formulated by scholars to demonstrate the multifaceted and interconnected nature of this definition problem. It may be helpful to note that Buchanan [9] has previously framed the nature of design in a similar manner. In the same vein, Norman [26], echoing the “wicked problem”, refers to a social or cultural problem that is difficult or impossible to solve due to its complex socio-technical nature. In the variety of interdisciplinary contributions that experts can make to help in the development of tools and processes to support this new knowledge, design is understood in its “sense-maker” characteristic [22, 25], its multifaceted naivety and its multiverse applications [3, 15]. As such, design can play a crucial role in facilitating the process of data literacy as a qualitative driver of knowledge communication, where the focus lies not in the final communicative artefact – technical or aesthetic – but in the underlying process of transforming input data into a communication product or experience. On the one hand, design can help solve the formalisation and visual expression of masses and data flows. On the other, it can operate in order to detect new directions and scenarios for the use of data, exploring ways to translate their variable trends, and using a plurality of communication solutions on a macro and micro scale, supporting and facilitating innovations in terms of meaning and value production.

Beyond the traditional models of visual representation of data that come from statistics, which emphasise the “presentation of data”, design can give coherence and structure to the discourse originated by alphanumeric sequences – which are neither accessible nor immediate to understand. Bihanic states that “design provides real spaces of re-presentation” [5], thus facilitating a more sensitive interpretation of the dynamics of relationship between data, and providing valuable devices for detecting meaningful forms of relationship. By experimenting with emerging interactive technologies, materials and innovative processes, design produces a plurality of communication solutions and languages capable of supporting and facilitating innovations in meaning and value production. It is interesting to observe how design intervenes in favour of sense-making from data accumulation.

## **2 Expanding User Experience in Data Design Beyond Visualisation: The Lens of HCI**

Design methodologies incorporate human-centred approaches, encompassing the dynamic and appropriate context involved in data processing, synthesis and communication. If design from the accumulation of data supports sense-making processes, the humanistic focus of the intervention facilitates the transmission of the qualitative value of data [11]. Such an approach promotes data literacy, which Bhargava understands as “the desire and ability to engage constructively in society through and with data” [4]. As already noted, design methodologies and tools contribute to the configuration and arrangement of a space appropriate to host different experience forms and relationships between the user and data.

At the root of understanding data literacy and designing for inclusion is an urgent need to rethink approaches for the design, creation, and support of data-driven systems that are more human-centred and based on inclusion, empathy, and responsiveness. Contextual, human-centred approaches are arguably critical – and often absent – elements in the design and development of data-related activities [4].

The reference to the experiential dimension to which interactive artefacts give rise represents a focus of the most recent philosophical, scientific and mediological discourse. In this case, the concept of experience is to be understood in the Deweyan meaning, that is, as that which allows for factual and reciprocal interaction with the environment, oriented toward a sense of responsibility and participation toward solving society's problems. Such attention resulted in the “experiential turn”, which has led to a progressive shift towards the centrality of the user's experience, in lieu of supports, techniques, and technologies. There has been a shift in the design field from techno-centric approaches to design to developing methodologies and viewpoints centred on the user experience. In the field of user-experience theory, Hassenzahl [18] proposes research methods that lean towards an approach called “experience design”. These methods can identify individuals' and groups' complex and nuanced needs, challenges, and aspirations within a data ecosystem. Discovery and learning, related to experience, are central to human-centred approaches. Empathy is one of the necessary tools for understanding the experiences of others. Furthermore, it is important to take into account the increased attention given to the deepening of the notion of immersiveness. The primary interaction strategy for the use of data is measured by the possibilities offered by the most recently developed platforms, that are not limited to visual representations but also include mobile devices and platforms for the experience of “immersive environments.” This has been fostered in part by the possibilities granted by technological development and the advantages of more excellent distribution and greater accessibility of systems and devices to enjoy immersive environments. In these cases, physical interaction emerges from the two-dimensional *mise-en-scène* of the monitor and pervades, overlapping like a layer of knowledge, the actual space. This brings new challenges to the idea of witnessing, which can be juxtaposed with the ideas of presence and personalisation. Such reassessment could be interpreted in fact as a natural broadening of the field by the data life-cycle concerning the translation stage. With mindful attention to the explicit, implicit, and unconscious needs of different individuals and groups, appropriate activities, tools, supports, and communications for data and data-informed actions can be designed and supported [4].

With technological innovations, new communication languages for HCI have been designed, developed and spread. Throughout history, as a result of this process, different types of interactive experiences have emerged. This led, to a greater or lesser extent, to innovations in meaning and behavioural changes. Since the objects of data design are the user experience and the environmental dimension in which it takes place, and considering the above considerations, it seems appropriate to explore the topic of human-data interaction through the lens of HCI. The evolution of HCI has been traced by considering the technological innovation in terms of hardware and software, the development of the language that made HCI possible and, simultaneously, the innovations – in terms of meaning and behaviour – that have been introduced [2]. The idea is to use the same



criteria to analyse a selection of case studies in which different types of Human-Data Interaction can be identified and, thus, different experiences.

### 3 Framework Analysis

Data visualisation is traditionally regarded as a tool for exploring data and making conjectures. Historically, its roots lie in the domain of scientific disciplines, where they are created by and for the experts. Data visualisation thus represents the result of an analytical process. Taking “data as raw material” [26] implies knowing its specific properties and uses. The specific characteristics underlying data design can be used to support the production of different forms of value.

The following framework of analysis proposes a reading of the state of the art of Human-Data Interaction through four dimensions: what technological innovations enable the development of new data communication languages? What technology innovations in hardware and software allow us to interact with data in a different way? Which spatial scale of experience does this offer? What value, what innovations of meaning does it bring? The suggested framework attempts to “establish alternative cultural decisions as engines of social transformation through design” [15]. It aims to empower the data design process by prefiguring a user experience that appeals to the data illiterate. The data illiterate is an individual who understands, explains and documents the usefulness and limitations of data by becoming a critical consumer of data, controlling their data journey, finding meaning in data and acting upon it. The data-literate individual can identify, collect, evaluate, analyse, interpret, present and protect data. Similar considerations and analyses have already been made from the visual interaction required in the case of data visualisation [14, 33]. However, several projects demonstrate that the possibilities offered can expand the interaction with data beyond mere visualisation.

Data are considered immanent presences, ductile, malleable and endowed with significant plasticity. Such concrete data design practices take on visual or physical form and static or dynamic behaviour to the aggregations, fluctuations and circulation. In this sense, data can be considered a raw material for designing experiences. In the case studies considered below, it is possible to observe how data design intervenes by organising physical or digital spaces capable of embodying immaterial data.

### 4 Data as an Experiential Interface to Innovations in Meaning and Change of Behaviour

Based on the above premises, a selection of case studies proves how designers are expanding the significant scope of data visualisation [34] and developing targeted design interventions.

Stating “Space junk has increased in recent decades and collisions could increase if the problem is not kept under control”, the Space Junk web app, designed by Federica Fragapane for the BCC [16], represents space debris in orbit, classified according to the type of space object and organised by its average distance from Earth. Each type of debris is also quantified by its mass in tonnes. Scholars have stumbled upon the concept

of “data narrative” [23] as, through a humanistic approach, the intent to ‘give human life to data’ combines traditional codes of data visualisation with cognitive studies on perception. The result is a renewed visual syntax. In this case, human-data interaction brings about an epistemic value; the role of design facilitates the interpretative, critical and expository use derived from data in order to foster the production of new knowledge.

Similarly, in *Plastic Air* [24], Giorgia Lupi designs an interactive data experience produced in collaboration with the Google Arts and Culture project. The experience provides a lens through which it is possible to visualise and explore – on the web – the invisible plastic particles always present in the atmosphere surrounding us. It further considers how they impact the environment and our health. In this case, the value proposition is poetic, as data as raw material relies on a more exploratory and heuristic experiential logic.

Another linguistic development fostered by technological innovation has been called “data physicalisation” [20]. Data physicalisation can be experienced through physical and material forms, conveying information through unusual physical paradigms. Digital technologies have undoubtedly enhanced the possibilities of the visual representation of data. In contrast, humans have historically used physical representations of data – consider hourglasses, ancient notational systems, or mercury thermometers. The online archive *Dataphys* [13] collects examples of this type of visualisation and traces its history. There seems to be a resurgence of “data physicalisation” due to the use of technologies, new materials and processes. For instance, digital fabrication techniques such as 3D printing and digital milling may produce physical forms from databases. It is the case of *Emoto* by Moritz Stefaner [31]. *Emoto* is an installation designed during the 2012 London Olympics. It started with a web application that monitored public engagement via Twitter and then returned the results by creating an offline material data sculpture. The value proposed here is also poetic, in that using data as raw material is based on an exploratory and heuristic logic.

Environmental projects reveal data in the context of the natural environments around us, often exploring the use of natural processes. The following case introduces another valuable language: “data sensification” [19]. In this case, data acquire environmental dimensions in which the emphasis shifts to how it interacts with various inputs provided by users or sensors. The public site-specific installation *Orbacles* designed by TenxTen, Minn Lab [32], consist of three spherical environments that connect the citizens of Minneapolis to the phenomena of climate change through the behaviour of birdlife in the surrounding area and the language of the senses. The data design proves helpful as a device for documenting a natural phenomenon and speculating on the future. *Orbacles* facilitates the communication of a species’ decline and migration related to the effects of climate change. Each of the 147 bird species found in Minnesota can be accommodated because the covers are of a size proportional to the length and wingspan typical of the species – a nesting box, feeder or rainwater reservoir.

Another case of “data sensification” [19] is where data acquire environmental dimensions, in which the emphasis shifts to the interaction modes with the inputs provided by the users. *Dustmark/Staubmarke* [29] is an installation for the public space of Stuttgart, a city particularly affected by air pollution. The project displays air pollution by drawing attention to the patina on the surfaces of the city. The dust marks are made in reverse

graffiti – a sensitive material – making the accumulated pollution visible by partially removing it. The process draws attention to dust as a concrete material rather than abstract numerical data. In the following months, the dust marks will vanish, as new dust will accumulate in the areas of the sign that were cleaned.

Applied data automation introduces physical platforms that use automation and robotics to encode data dynamically and interactively. The case of *Surfacing Women* in *Smithsonian History* [17] experimented with the development of tools for machine learning to explore the history and contributions of women in science. Automation applied to data promotes the production of new knowledge and thus epistemic value, but also praxeological value, as it encourages the discovery of new methods for organising museum archives. This represents just one of many cases of methods applied to archive storytelling [8]. We can say it is a participatory language that shows how designers invite users to create new data configurations, allowing them to encode or reveal data through their interactions with a piece, material or other people. In the same way, *Surprise Machines* [29] is a visual investigation of the archives of the Harvard Art Museum that takes the form of an installation. The project aims to organise the collections of the museum, with the goal of opening up previously unexplored sections of the multitude of objects that comprise them. This process makes use of algorithms capable of configuring visualisations from the public's gestural input on the interface. The body of the visitor becomes a kind of "choreographic interface" [29] for interacting with the collection. This system allows visitors to move through the visualisation through total body interaction.

## 5 Humane-Centred Data Design?

Each of these approaches involve precise design solutions that affect the design and production processes, but also the tools and skills needed to create the connection between the designer, the user, and the data. One could argue that humane-centred data design is about more than just the individual, because it extends to group dynamics in the social context. Data designed based on their entire lifecycle could redeem the position of human beings from their position as passive producers of data, giving people the capacity to act within these data systems; the purpose of expanding data literacy is to be understood in this sense.

## References

1. Ackoff, R.: From data to wisdom. *J. Appl. Syst. Anal.* **15**, 3–9 (1989)
2. Au, I.: The future of human-computer interaction. [www.youtube.com/watch?v=t\\_Zzha dA3DY](https://www.youtube.com/watch?v=t_Zzha dA3DY). Accessed 22 Feb 2022
3. Bertola, P., Manzini, E.: *Design multiverso*. *Appunti di Fenomenologia del design*, POLI.design, Milano (2004)
4. Bhargava, R., et al. *Beyond data literacy: reinventing community engagement and empowerment in the age of data*. data-pop alliance white paper series, Harvard Humanitarian Initiative, MIT Media Lab and Overseas Development Institute (2015)
5. Bihanic, D.: *Data Design: Les Données Comme Matériau de Création*. Gallimard, Paris (2018)
6. Bihanic, D.: *New Challenges for Data Design*. Springer, Heidelberg (2016)

7. Börner, K., Bueckle, A., Ginda, M.: Data visualization literacy: definitions, conceptual frameworks, exercises, and assessments. In: Proceedings of the National Academy of Sciences of the United States of America, vol. 116, no. 6, pp. 1857–1864 (2019). <https://doi.org/10.1073/pnas.1807180116>, [www.pnas.org/content/116/6/1857](http://www.pnas.org/content/116/6/1857), Accessed 22 Feb 2022
8. Briones, M., Mauri, M.: Alternative narratives data visualization archive. In: CUMULUS Conference Proceedings series, vol. 2, pp. 3931–3944 (2021)
9. Buchanan, R.: Wicked problems thinking in design. *Des. Issues* **8**, 5–21 (1992). <https://doi.org/10.2307/1511637>
10. Ceppi, G.: Il design dell'esperienza. In Bertola P., Manzini E. (eds.), *Design multiverso: appunti di fenomenologia del design*, pp. 179–186, Poli.Design, Milano (2006)
11. Ciliberto, G.: Data visualization as a qualitative driver in knowledge communication: an interpretative framework. In: *Cumulus Conference Proceedings Roma 2021*, vol. 2, pp. 754–771, Roma (2021)
12. Corral, S.: The Wicked Problem of Data Literacy: A Call for Action. In: LILAC. The Information Literacy Conference, Nottingham (2019)
13. Dataphys, [dataphys.org/list](http://dataphys.org/list), Accessed 12 Mar 2022
14. Dimara, E., Perin, C.: What is interaction for data visualization? *IEEE Trans. Vis. Comput. Graph. Inst. Electr. Electron. Eng.* **26**(1), 119–129 (2020). <https://doi.org/10.1109/TVCG.2019.2934283>
15. Escobar, A.: *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds*. Duke University Press, New York (2018)
16. Fragapane, F.: Space Junk for BBC Science Focus, [www.behance.net/gallery/81688575/Space-Junk-BBC-Science-Focus](http://www.behance.net/gallery/81688575/Space-Junk-BBC-Science-Focus) (2019). Accessed 12 Mar 2022
17. Harmon, E., Cherny, L., Digital curators at smithsonian libraries and archives with google arts & culture lab, surfacing women in smithsonian history (2022), <https://experiments.withgoogle.com/women-in-smithsonian-history>, Accessed 22 Feb 2022
18. Hassenzahl, M.: *Experience Design: Technology For All The Right Reasons*. Morgan&Claypool Publishers, San Rafael (2010)
19. Hogan, T.: Data Sensification: Beyond Representation Modality, Toward Encoding Data in Experience. Presented at the DRS 2018 Design Research Society, University of Limerick, Limerick (2018)
20. Hogan, T., Hornecker, E., et al.: Tangible Data, explorations in data physicalization. In: *Proceedings of the Tenth International Conference on Tangible, Embedded and Embodied Interaction*, pp. 753–756 (2016)
21. Hogan, T., Hornecker, E.: Towards a design space for multisensory data representation. *Interact. Comput.* **29**(2), 147–167 (2017)
22. Krippendorff, K.: On the essential contexts of artifacts or on the proposition that design is making sense (Of Things). *Des. Issues* **5**(2), 9–39 (1989). <https://doi.org/10.2307/1511512>
23. Lupi, G.: The New Aesthetic of Data Narrative. In: Bihanic, D. (ed.) *New Challenges for Data Design*, pp. 57–88. Springer, London (2015). [https://doi.org/10.1007/978-1-4471-6596-5\\_3](https://doi.org/10.1007/978-1-4471-6596-5_3)
24. Lupi, G.: Plastic air for google arts and culture project <https://artsexperiments.withgoogle.com/plasticair/> (2021). Accessed 12 Mar 2022
25. Masud, L., Valsecchi, F., Ciuccarelli, P., Ricci, D., Caviglia, G.: From data to knowledge - visualizations as transformation processes within the data-information-knowledge continuum. In: *14th International Conference Information Visualisation*, pp. 445–449. London (2010). <https://doi.org/10.1109/IV.2010.68>
26. Mauri, M., Colombo, G., Briones, A., Ciuccarelli, P.: Teaching the critical role of designers in the data society: the density design approach. In: Börekçi, N., Koçyıldırım, D., Korkut, F., Jones, D. (eds.), *Proceedings of DRS Learn X Design 2019: Insider Knowledge*, pp. 183–195, Ankara, Turkey: METU Department of Industrial Design (2019). <https://doi.org/10.21606/learnxdesign.2019.12046>

27. Norman, D., Stappers, P.: DesignX: complex sociotechnical systems. *She Ji: J. Des. Econ. Innov.* **1**(2), 83–106 (2015). <https://doi.org/10.1016/j.sheji.2016.01.002>
28. Offenhuber, D., Campbell, B., Samsel, F.: Dietmar Offenhuber: collaboration via the many traces our data sets leave behind. *IEEE Comput. Graph. Appl.* **40**, 120–126 (2020). <https://doi.org/10.1109/MCG.2020.3007058>. <https://offenhuber.net/project/staubmarke-dustmark/>, Accessed 12 Mar 2022
29. Rodieghiero, D.: Harvard Art Museums, Surprise Machines (2022), [darioodighiero.com/Surprise-Machines-for-Harvard-Art-Museums](http://darioodighiero.com/Surprise-Machines-for-Harvard-Art-Museums), Accessed 12 Mar 2022
30. Ruecker, S., Radzikowska, M., Sinclair, S.: *Visual Interface Design for Digital Cultural Heritage: A Guide to Rich-Prospect Browsing*. Routledge, London (2011)
31. Stefaner, M.: Emoto, [archive.stefaner.eu/projects/emoto/](http://archive.stefaner.eu/projects/emoto/) (2012). Accessed 12 Mar 2022
32. Ten x Ten, MINN LAB, Orbacles, [www.tenxtenstudio.com/orbacles](http://www.tenxtenstudio.com/orbacles) (2017). Accessed 12 Mar 2022
33. Tominski, C.: *Interaction for visualization*. Morgan & Claypool Publishers, New York (2015)
34. Viégas, F.B., Wattenberg, M.: Artistic data visualization: beyond visual analytics. In: Schuler, D. (eds.) *Online Communities and Social Computing. OCSC 2007. Lecture Notes in Computer Science*, vol. 4564, pp. 182–191. Springer, Berlin (2007). [https://doi.org/10.1007/978-3-540-73257-0\\_21](https://doi.org/10.1007/978-3-540-73257-0_21)

**Open Access** This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (<http://creativecommons.org/licenses/by/4.0/>), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

