



**AALBORG UNIVERSITY**  
DENMARK

**Aalborg Universitet**

## **Environmental Data in SHCI**

*Concepts and Interaction Techniques*

Lindrup, Martin

*Creative Commons License*  
Unspecified

*Publication date:*  
2022

*Document Version*  
Accepted author manuscript, peer reviewed version

[Link to publication from Aalborg University](#)

*Citation for published version (APA):*

Lindrup, M. (2022). *Environmental Data in SHCI: Concepts and Interaction Techniques*. Abstract from NordiCHI 2022, Aarhus, Denmark.

### **General rights**

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal -

### **Take down policy**

If you believe that this document breaches copyright please contact us at [vbn@aub.aau.dk](mailto:vbn@aub.aau.dk) providing details, and we will remove access to the work immediately and investigate your claim.

# Environmental Data in SHCI: Concepts and Interaction Techniques

MARTIN V. A. LINDRUP, Department of Computer Science, Aalborg University, Denmark

Departing from the understanding that environmental data in turn shape the kinds of questions that we can ask about the state of the world and that we shape data in various ways, there is an increasing need for research that focus on how environmental data are mediating our relationship with the state of the world. Using food as a case, we set out to gain insights into what characterizes environmental data, how people engage with and make sense of the world through data. In this paper, we present drivers for our research, preliminary results, and plans for future work toward a greater understanding of the concepts and interaction techniques for environmental data in sustainable human-computer interaction.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**.

Additional Key Words and Phrases: Environmental data; SHCI; concepts; interaction techniques

## ACM Reference Format:

Martin V. A. Lindrup. 2022. Environmental Data in SHCI: Concepts and Interaction Techniques. In *Proceedings of NordiCHI'22*. ACM, New York, NY, USA, 4 pages. <https://doi.org/10.1145/1122445.1122456>

## 1 BIOGRAPHY

My name is Martin Lindrup and I am a PhD-student in the Human Centred Computing (HCC<sup>1</sup>) group at the department of Computer Science at Aalborg University. My PhD journey started September 2020 which means that I am 1.5 years into the project (i.e., half ways). My motivation for attending the Doctoral Consortium at NordiCHI'22 is to gain new perspectives on the framing of my project and how my work can be synthesized and qualified. Also, I hope to gain a better understanding about how to manage my process based on insights about how others PhD students in similar fields are managing their studies and transferring their obtained knowledge into an overall contribution.

## 2 INTRODUCTION

Throughout the last two decades, a sustainability agenda within Human-Computer Interaction (i.e., Sustainable Human-Computer Interaction; SHCI) has rapidly expanded due to global environmental sustainability (while acknowledging the multi-faceted nature of sustainability, including economic and social aspects [21], this work is limited to environmental sustainability) issues of air pollution, climate change, and deforestation to name a few. An area of SHCI that has received increased attention recently is that of food production and consumption. This can very well be because food consumption, and all the many processes contributing hereto, is viewed as a key sustainability challenge in HCI (e.g., due to unequal power relations and disconnects between environmental data and people's everyday lives) [19] and because it is becoming increasingly possible to collect and use environmental data in order to address sustainability problems.

---

<sup>1</sup><https://www.hcc.aau.dk/>

---

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from [permissions@acm.org](mailto:permissions@acm.org).

© 2022 Association for Computing Machinery.

Manuscript submitted to ACM

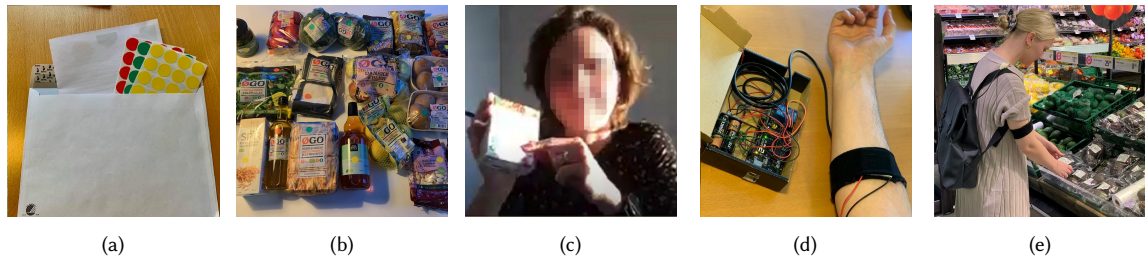


Fig. 1. A collection of images from the studies that we have conducted: a) probe kit that we sent to participants, b) coded food products that we received, c) workshop activity where participants examined food items, d) one of two prototypes that we created for enactments, and e) participant enacting with prototype in a local supermarket.

Multiple researchers have provided people with data (e.g., on food miles, share of organic food, climate footprint), mainly using eco-feedback, persuasion, and nudging approaches, to promote rational and informed decisions toward more sustainable food practices [7]. The understanding of people as rational agents that are merely uninformed, and thus disempowered, has been criticized from multiple angles [4]. Instead, a turn in the SHCI community has been toward triggering open-ended reflection (e.g., [1, 4]) and emphasizing a combination of objective and subjective aspects of environmental data [2, 5, 6, 16, 17, 20]. This break with data as objective facts raise a number of questions. What characterizes environmental data? How do they part-take in reflexive processes? How do we make meaning out of them and connect them to the very real experiences of e.g. the climate crisis? In order to gain an in-depth understanding of the role that environmental data play in our day-to-day lives – how we conceptualize and interact with them – our work is guided by the following research questions.

- (1) What characterizes environmental data in relation to sustainable food consumption?
- (2) How do people make sense of the environment (data) through engaging with data (the environment)?
- (3) How can we make experiences with data that emphasize relational and material aspects of the environment?

### 3 RELATED WORK

As environmental data continue to move into our lives (e.g., through outdoor thermostats, electricity meters, and infographics about the environmental impact of various food groups), an increasing amount of research has started to investigate on data as part of social and cultural contexts (e.g., [8, 9, 13]). Dourish [8] stresses that data shape the kinds of questions we can ask about the world and Gitelman (eds.) [13] argues that we are shaping data when collecting, processing and displaying them. This relational aspect between data and our social worlds has also recently made its way into SHCI research (e.g., [2, 5, 6, 17]). Liu et al. [17, p. 1320] argue that “[...] *reductive measures fail to capture the contours of personal experiences [...]*” and as a result “*environmental data needs to be situated and narrated to have meaning*”. In addition, a fruitful path for research is to use environmental data to extend our ability to reflect on sustainability issues through enabling local, relational, and embodied experiences of data and their connections to larger realities [2]. Lastly, Soden et al. [20] advocate for drawing on both science and art to address the affective and relational elements of data (e.g., climate data) that are rarely explicated in statistics, maps, and charts. Instead of reducing reflection to a cognitive and/or affective process based on presumably objective data, we outline an opportunity for exploring the multitude of connections for environmental data in SHCI to provide critical reflection about sustainability in the context

of food consumption. This research is influenced by phenomenology and postphenomenology readings – we experience the world through our embodied, relational, material being.

#### 4 RESEARCH APPROACH AND RESULTS

I base my work on Research through Design [22], a variety of probing techniques, and a combination of qualitative (e.g., interviews, workshops, observations) and quantitative (e.g., data logging, surveys) data collection methods.

In order to approach answering *RQ1*, I, together with my colleagues, investigated how people experience and evaluate their food based on environmental data. The study involved two rounds of semi-structured interviews with 16 sustainability conscious people (participants were screened using Sustainability Consciousness Questionnaire [12]) and the deployment of a cultural probe [11] that participants used in connection to one of their food shopping trips. The ‘shopping probe’ prompted participants to put stickers in traffic-life colors onto the products they bought based on whether they evaluated it to be unsustainable (i.e., red sticker), sustainable (i.e., green), or they were unable to access the item based on their own criterion of sustainability (i.e., yellow), fig. 1a and fig. 1b. The study, detailed in [16], allowed us to gain an understanding into perceived meaningful data for accessing food sustainability together with challenges and opportunities hereto. Key findings include: (1) people use diverse and sometimes conflicting data and information for evaluating sustainability of products; (2) decisions about products are negotiations of values that take into account accumulated local knowledge and data cultures; and (3) the opportunity for research to bridge environmental data with subjective experiences of sustainability and provide an ‘operational context’ [18] for the data to equip people with the resources to access, interpret, and take action.

To gain additional insights for *RQ1* and to address *RQ2* and *RQ3*, we conducted a combined co-design workshop and speculative enactment study with multiple stakeholders. The workshops comprised of both Tell and Make activities (cf. Tell-Make-Enact framework [3]) where participants, in Tell activities, discussed how sustainability information on products and through technology could be improved (fig. 1c); thus, providing more in-depth empirical knowledge for answering *RQ1*. The rest of the study contributed mainly to *RQ2* and *RQ3* through Make activities during the workshops that revolved around envisioning (the role(s) of) future technologies in sustainable food shopping and how they would enable engaging in conversations about environmental data, the food system, and sustainability issues. Through the Enact activity (i.e., post-workshop speculative enactments [10]), we studied these technology visions in practice in order to bring forth more perspectives about the relationship between environmental data and everyday food shopping. First, we found that embodied and tangible representations of data offer ways of engaging that bring forth our ethical and material relations - to food, to data, to our environment. Second, data representations can be designed to bring future ‘trouble’ [14] of global temperature changes into an everyday context as a way of triggering open-ended reflections. Additional insights for answering *RQ2* and *RQ3* were obtained through a two-month mixed methods study of the use and perception of a technology probe that provides energy use data about products to people during their food shopping. The study consisted of pre-interviews, two month deployment of a technology probe [15] with continuous surveys, and post-interviews. We show that by presenting data in multiple layers (i.e., abstracted and graphical; specific and textual; and relational and contextual), it is possible to foster in-depth reflections about: environmental impact of consumption patterns, norms and values, and data narratives.

#### 5 REMAINING WORK

Currently, I am working on two projects with researchers from KTH Royal Institute of Technology to unfold more perspectives of environmental data in SHCI. One study investigates how data can be part of sense- and change-making

processes for waste management in apartment complexes. The other focuses on how physicalization, materialization, and embodied experiences of environmental data can result in reflections about the environment. Besides these two projects, we plan to synthesize our results from all the studies and organize a framework for the identified concepts and interaction techniques for environmental data in SHCI. The challenges that I am encountering at this point in my project relates mainly to whether the focus on open-ended reflection is too vague and how I can tie the work that I have already done and that I am planning into a coherent thesis.

## REFERENCES

- [1] Roy Bendor. 2017. Interaction design for sustainable futures. In *Digital Technology and Sustainability* (1st ed.), Mike Hazas and Lisa Nathan (Eds.). Routledge, New York, NY, Chapter 12, 205–216.
- [2] Heidi R. Biggs and Audrey Desjardins. 2020. High Water Pants: Designing Embodied Environmental Speculation. In *Conference on Human Factors in Computing Systems - Proceedings*. ACM, Honolulu, HI, US, 1–13.
- [3] Eva Brandt, Thomas Binder, and Elizabeth B.-N. Sanders. 2013. Ways to engage telling, making and enacting. In *Routledge International Handbook of Participatory Design*, Jesper Simonsen and Toni Robertson (Eds.). Routledge, New York and London, 145–181.
- [4] Hrönn Brynjarsdóttir, Maria Håkansson, James Pierce, Eric P.S. Baumer, Carl DiSalvo, and Phoebe Sengers. 2012. Sustainably unpersuaded: How persuasion narrows our vision of sustainability. In *Conference on Human Factors in Computing Systems - Proceedings*. ACM Press, New York, New York, USA, 947–956.
- [5] Adrian K Clear, Sam Mitchell Finnigan, Patrick Olivier, and Rob Comber. 2017. "I'd Want to Burn the Data or at Least Nobble the Numbers": Towards Data-mediated Building Management for Comfort and Energy Use. In *Proceedings of the 2017 ACM Conference on Computer Supported Cooperative Work and Social Computing*. ACM, Portland, OR, USA, 2448–2461.
- [6] Adrian K Clear, Samantha Mitchell Finnigan, Patrick Olivier, and Rob Comber. 2018. ThermoKiosk: Investigating Roles for Digital Surveys of Thermal Experience in Workplace Comfort Management. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 1–12.
- [7] Carl DiSalvo, Phoebe Sengers, and Hrönn Brynjarsdóttir. 2010. Mapping the landscape of sustainable HCI. In *Conference on Human Factors in Computing Systems - Proceedings*, Vol. 3. ACM, Atlanta, GA, USA, 1975–1984.
- [8] Paul Dourish. 2017. *The Stuff of Bits: An Essay on the Materialities of Information*. The MIT Press, Cambridge, Massachusetts.
- [9] Paul Dourish and Edgar Gómez Cruz. 2018. Datafication and data fiction: Narrating data and narrating with data. *Big Data & Society* 5, 2 (jul 2018), 1–10.
- [10] Chris Elsdén, David Chatting, Abigail C Durrant, Andrew Garbett, Bettina Nissen, John Vines, and David S Kirk. 2017. On Speculative Enactments. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*. ACM, New York, NY, USA, 5386–5399.
- [11] Bill Gaver, Tony Dunne, and Elena Pacenti. 1999. Design: Cultural Probes. *Interactions* 6, 1 (1999), 21–29.
- [12] Niklas Gericke, Jelle Boeve-De Pauw, Teresa Berglund, and Daniel Olsson. 2018. The Sustainability Consciousness Questionnaire: The theoretical development and empirical validation of an evaluation instrument for stakeholders working with sustainable development. *Sustainable Development* 27 (2018), 35–49.
- [13] Lisa Gitelman (eds.). 2013. *"Raw Data" Is an Oxymoron*. MIT Press, Cambridge, Massachusetts.
- [14] Donna J Haraway. 2016. *Staying with the Trouble*. Duke University Press, Durham, North Carolina, United States.
- [15] Hilary Hutchinson, Wendy Mackay, Bosse Westerlund, Benjamin B Bederson, Allison Druin, Catherine Plaisant, Michel Beaudouin-Lafon, Stéphane Conversy, Helen Evans, Heiko Hansen, Nicolas Roussel, Björn Eiderbäck, Sinna Lindquist, and Yngve Sundblad. 2003. Technology probes. In *CHI '03: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM (ACM), Ft. Lauderdale, Florida, USA, 17.
- [16] Martin V A Lindrup, EunJeong Cheon, Mikael B Skov, and Dimitrios Raptis. 2021. One Byte at a Time: Insights about Meaningful Data for Sustainable Food Consumption Practices. In *DIS 2021 - Proceedings of the 2021 ACM Designing Interactive Systems Conference*. ACM, Virtual Event, USA, 683–696.
- [17] Szu Yu Liu, Justin Cranshaw, and Asta Roseway. 2020. Making air quality data meaningful: Coupling objective measurement with subjective experience through narration. In *DIS 2020 - Proceedings of the 2020 ACM Designing Interactive Systems Conference*. ACM, Eindhoven, Netherlands, 1313–1326.
- [18] Yanni A. Loukissas. 2019. *All data are local: Thinking critically in a data-driven society*. MIT Press, Cambridge, Massachusetts.
- [19] Juliet Norton, Ankita Raturi, Bonnie Nardi, Sebastian Prost, Samantha McDonald, Daniel Pargman, Oliver Bates, Maria Normark, Bill Tomlinson, Nico Herbig, and Lynn Dombrowski. 2017. A grand challenge for HCI: Food + sustainability. *Interactions* 24, 6 (nov 2017), 50–55.
- [20] Robert Soden, Perrine Hamel, David Lallemand, and James Pierce. 2020. The disaster and climate change artathon: Staging art/science collaborations in crisis informatics. In *DIS 2020 - Proceedings of the 2020 ACM Designing Interactive Systems Conference*. ACM, Eindhoven, Netherlands, 1273–1286.
- [21] United Nations. 2022. Sustainable Development. <https://www.un.org/ecosoc/en/sustainable-development>
- [22] John Zimmerman and Jodi Forlizzi. 2014. Research through design in HCI. In *Ways of Knowing in HCI* (1 ed.), Judith B. Olsen and Wendy A. Kellogg (Eds.). Springer, New York, Chapter 8, 167–189.