Editorial: Data-centric design: data as a human-centred material

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Editorial on the Research Topic
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The digitalisation of our societies has made data ubiquitous, capturing the behaviors of individuals through their interactions with products, services, and systems. As design and HCI researchers increasingly integrate data throughout human-centered and participatory design processes, the highly dynamic nature of behavioral data reveals its deep interconnection with people, their behaviors, and experiences. Data-Centric Design leverages data as material for subjective inquiry–an entry point to better understand human dynamics through deeper reflection in research and design processes. This Research Topic aims to collect emerging, illustrative projects from the community, share the messiness of research and design processes with data, and surface good practices for effective and responsible data use. This need emerged from the guest editors' engagement in a series of Special Interest Group (SIG) meet-ups (Gomez Ortega et al., 2023) and workshops (Lee-Smith et al., 2023) at the ACM conference on Human Factors in Computing Systems (CHI).

The four papers in this Research Topic exemplify diverse approaches to data as human-centered design material, each offering unique perspectives on how data transforms design processes and stakeholder relationships. They are a selection from a broader set of contributions from the community who gathered at the Data-Centric Design Symposium[1] in December 2023 in Delft (NL).

Rout et al. present "*One tree matters: reflections on data as a design material in urban forestry*", exploring how visual and spatial data from drone-mounted sensors can inform urban forest design. Through interviews with urban forestry experts examining prototype data visualizations, they demonstrate how combining point cloud data with anthropological theories (particularly Ingold's concepts of "Life of Lines" and "Imagining for Real") can bridge analytical and cultural perspectives. Their work highlights how data physicalisation can make abstract ecological information tangible, enabling stakeholders to explore energy-consuming habits and identify opportunities for change.

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1   Data-Centric Design symposium website: https://datacentricdesign.org/symposium.html.

Gómez Ortega contributes "*Sensitive data donation in practice: unforeseen challenges and lessons learned*", offering critical reflections on implementing data donation across three case studies involving menstrual tracking logs, speech records, and physical activity data. This auto-ethnographic account reveals practical challenges in data donation processes, from parsing changing data structures to supporting donors in exploring their own data. The work emphasizes the importance of transparency, data minimization, and empowering participants to set boundaries around their sensitive data (Gómez Ortega et al., 2024).

Özge Ağça presents "*Tangible consumption data landscapes of teenagers*", demonstrating how physical data mapping can increase teenagers' awareness of energy consumption. Through workshops in which participants created physical models that represent their home energy use, the study shows how tangible interaction with data enables young people to recount consumption patterns and envision behavioral changes. The integration of questionnaires, layout drawings, and three-dimensional data landscapes illustrates how multiple data representations can support different levels of engagement and understanding.

Raviselvam et al. explore "*Rollercoasters and research: applying data-enabled design to a semi-public context*", documenting the challenges of implementing Data-Enabled Design (DED) (Funk et al., 2024) in an amusement park setting. Through a two-week design workshop with student researchers, they identify how the open nature of semi-public spaces affects data collection practices, stakeholder engagement, and the balance between quantitative and qualitative approaches. Their findings highlight the importance of contextual immersion and the challenges of technical implementation in dynamic environments.

These articles collectively demonstrate that data as design material requires careful consideration of context, participants, and representation methods. A striking connection across all contributions is the emphasis on making data tangible and accessible to non-experts. Whether through physical models (Özge Ağça), interactive visualizations (Rout et al.), donation platforms (Gómez Ortega), or contextual probes (Raviselvam et al.), each approach seeks to bridge the gap between abstract data and lived experience. The papers also highlight an array of approaches to collaboration, moving from data subject to data participant. While Gómez Ortega emphasizes individual agency in controlling personal data, Raviselvam et al. focus on collective experiences in public spaces. Özge Ağça's work with teenagers highlights generational perspectives on data engagement, while Rout et al. demonstrate professional stakeholder involvement in interpreting environmental data. Overall, these are practical examples relating to emerging data mindsets and philosophies from data humanism (Lupi, 2017) to data feminism (D'ignazio and Klein, 2020) and data locality (Loukissas, 2019).

Several practical yet critical challenges emerge from this Research Topic. First, the ethical infrastructure of research institutions clashes with these approaches to research. Gómez Ortega's experiences with institutional review boards and changing data formats highlight the need for more flexible ethical frameworks that can accommodate exploratory data work while protecting participants. How can we develop an ethical infrastructure that supports innovation while ensuring responsible data practices? Second, along with the high effort and contextualization comes the challenge of scale and transferability:

While these studies demonstrate successful applications in specific contexts, questions remain about scaling data-centric approaches. Can methods developed for urban forestry be transferred to other environmental contexts? How do approaches designed for semi-public spaces adapt to private or fully public settings? Third, these papers highlight challenges around technical accessibility. The tension between sophisticated data collection tools and the need for accessible, low-tech alternatives appears throughout these papers. How can the field develop toolkits that balance technical capability with broad accessibility, particularly for communities with limited resources? Finally, the issue of power dynamics around data representation becomes more apparent. The choice of data representation, whether physical, visual, or interactive, fundamentally shapes participation and understanding. Future work must critically examine how different representations include or exclude stakeholders and how power dynamics influence data interpretation and use.

These contributions demonstrate that data-centric design is not just about collecting and visualizing data but about creating meaningful encounters between people and data that can inspire reflection, understanding, and action. As the field evolves, maintaining this human-centered focus while addressing technical, ethical, and contextual challenges will be essential to realize the transformative potential of data as design material.

Author contributions

JB: Writing – original draft, Writing – review & editing. MF: Writing – review & editing. SG: Writing – review & editing. AK: Writing – review & editing.

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