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Participatory Design for Cognitive Science: Examples From the Learning Sciences and Human−Computer Interaction

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Abstract

Given the recent call to strengthen collaboration between researchers and relevant practitioners, we consider participatory design as a way to advance Cognitive Science. Building on examples from the Learning Sciences and Human−Computer Interaction, we (a) explore *what*, *why*, *who*, *when*, and *where* researchers can collaborate with community members in Cognitive Science research; (b) examine the ways in which participatory-design research can benefit the field; and (c) share ideas to incorporate participatory design into existing basic and applied research programs. Through this article, we hope to spark deeper discussions on how cognitive scientists can collaborate with community members to benefit both research and practice.

Keywords: Participatory design; Community-engaged research; Meta-science; Research methodology; Learning Sciences; Human−Computer Interaction

The research process in Cognitive Science is often unidirectional—researchers first conduct studies, usually with convenient samples in the lab (Henrich, Heine, & Norenzayan, 2010), then translate the results to inform policy and practice (Gersten & Brengelman, 1996; Lechowicz et al., 2019). However, the already-conducted research may not accurately represent variations in human cognition or directly address pertinent issues in society (Asase,

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Mzumara-Gawa, Owino, Peterson, & Saupe, 2022; Thomas, Ansari, & Knowland, 2019). Collaborations with transdisciplinary researchers and community members throughout the research process can improve the quality of both basic and applied sciences, increasing their impact on policy and practice.

Prather et al. (2022) asked "what can Cognitive Science do for people?". The authors called for the field to accurately represent human cognition, and apply Cognitive Science to benefit people. Echoing this call, we share examples of *participatory design* from the Learning Sciences and Human−Computer Interaction as one approach to achieve these goals. We briefly describe the *five W*s—*what*, *why*, *who*, *when*, *where*—of participatory design and discuss their connections to Cognitive Science to spark deeper conversations that benefit research and practice.

1. What is participatory design?

Participatory design is a research methodology that involves partnerships between researchers and community members (Hall, 1992). It bridges researchers' abstract knowledge and analytical skills with community members' tacit knowledge of real-world practices, allowing both parties to examine the often-invisible aspects of knowledge in authentic contexts (Hansen et al., 2019). In the Learning Sciences, this approach allows researchers, educators, learners, and policymakers to understand one another's perspectives, thus empowering democracy and agency among community members (Booker & Goldman, 2016). In Human−Computer Interaction, collaborating with users in the conceptualization and design process is crucial for developing tools that meet users' needs (Holstein, McLaren, & Aleven, 2019). Similarly, cognitive scientists can collaborate with community members throughout the research process to aptly address issues in human cognition.

2. Why should we consider participatory design?

There are several reasons to collaborate with community members in the design of studies, practice, and tools. First, such collaborations *improve research ethics*. Community members should have a voice in how the research is designed and conducted to maximize potential benefits while mitigating risks (Kelly, 2019). Second, given that cognition is situated in "a dynamic system of people, practices, artifacts, communities, and institutional structures (Mirel, 1998)," collaboration with community members helps researchers to *capture variability in cognition* (Gutchess & Rajaram, 2023) and *uncover implicit assumptions* about participants (Henrich et al., 2010), instruments (e.g., invariance across countries; Gao & Lee, 2021), contexts (e.g., variance within a culture; Saxe, 1988), and interpretations (Barrett, 2020). Third, it *generates practical knowledge and tools* that are directly useful for target communities (Spinuzzi, 2005). Finally, it *broadens the participation in, and impacts of*, research, empowering community members with the skills to reflect on their

experiences, improve practice, and develop collaborative competencies (Benton & Johnson, 2015; Könings, Seidel, & van Merriënboer, 2014).

Alongside these benefits, there are constraints in time, resources, and expertise needed to build relationships with communities. Cognitive scientists can start small, such as asking for feedback on research materials, and then gradually build up community members' involvement (Purpura, Bustamante, Mayes, Acevedo-Farag, & Smith, 2023). Collaborating with researchers who have complementary research skills (e.g., interviews, ethnography, or design) can also help cognitive scientists learn about and conduct participatory design research that directly addresses questions in human cognition.

3. Who are the community members?

Cognitive Science is a multidisciplinary field that studies knowledge representation and cognitive processes from perspectives such as anthropology, linguistics, neuroscience, philosophy, and psychology. Community members in Cognitive Science vary across disciplines and by the project aims. For instance, in artificial intelligence (AI), a field of study that involves using computers to simulate human intelligence, community members may include users of AI technology. As an example, when developing algorithms to make predictions and suggestions on potential treatments based on patient data (Challen et al., 2019), patients and clinicians can contribute to the technological design by (a) suggesting relevant data to include, (b) contextualizing datasets, (c) developing the user interface, and (d) iteratively evaluating the technology, in order to produce the technology and findings that are relevant to a real-world context (Bratteteig & Verne, 2018; Denecke et al., 2019; Zytko, Wisniewski, Guha, Baumer, & Lee, 2022). Cognitive Science can be more directly impactful through such processes where the research and its end goals are designed *with* community members.

4. When to collaborate with community members?

We provide some reflective questions on ways to engage with community members throughout the research process (Fig. 1). We also review examples on how to integrate participatory design in research.

As an example of *collaborative conceptualization*, Merkel and colleagues (2004) conducted interviews, observations, and questionnaires with members of a learning enrichment center (i.e., students, staff, and administrators); together, they identified the need to offer an online health course to high-schoolers. However, after students designed the demonstrative course, the health teachers questioned how the online format would teach hands-on skills like CPR (cardiopulmonary resuscitation). Simultaneously, English teachers saw the promise of online courses, so the students created a demonstration that helped teachers envision an English course in the online format. This evolving design process with the community members resulted in exciting learning among students (designing various courses), teachers (identifying affordances and limitations of online courses), and researchers (the dynamics of introducing new technologies into an existing organization). Although the goal of designing a

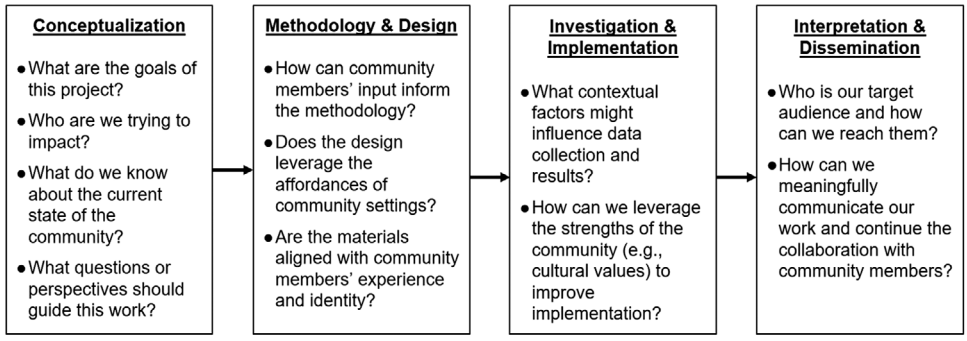

Fig. 1. Sample reflective questions for researchers when collaborating with community members.

practical tool (e.g., system, software, and curriculum) may not apply to all Cognitive Science disciplines, it is still valuable to ask community members what questions they have and what opportunities they see so that our research is *timely* and *relevant* to our broader audience.

In the *design* process, community members and researchers can discover and clarify their goals through activities such as games (Vaajakallio & Mattelmäki, 2014), role play (Iacucci, Kuutti, & Ranta, 2000), drama (Brandt & Grunnet, 2000), and workshops (Halse, Brandt, Clark, & Binder, 2010). For example, at the beginning of workshop sessions to design a computing curriculum with students, parents, teachers, and school administrators, Coenraad and colleagues (2022) asked community members questions such as "what communities or groups do you see yourself as a part of?" These questions raised community members' awareness of their identity and experience, activating their tacit knowledge to inform design decisions. In that study, community members also received art supplies to create "something interesting to them" and storyboards of games. Through these activities, community members created artifacts (e.g., purse and video-game characters) and stories (e.g., a cat with nine lives) that revealed their interests, which were then integrated into the curriculum. The community members also sharpened their reflection and collaboration skills through the participatory design workshops. In Cognitive Science, asking questions and conducting activities that reveal variations in human experiences can provide community members with symbiotic benefits and ground basic research in culturally relevant contexts.

To *investigate* and *implement* the design of tools, studies, or tasks, community members and researchers may jointly create, test, and iteratively improve prototypes through hands-on experiences (Bødker & Grønbæk, 1991; Ehn & Kyng, 1991; Pires et al., 2022). Finally, research partners can *evaluate* the designed product and *disseminate* the findings by reflecting on the design process and the product's influences (Bossen, Dindler, & Iversen, 2010; Kensing, Simonsen, & Bødker, 1998). More examples can be found across fields of Human−Computer Interaction (Ahn, Campos, Hays, & DiGiacomo, 2019; Ehn, Nilsson, & Topgaard, 2014; Miaskiewicz & Kozar, 2011), Educational Psychology (Pesch et al., 2022), and Developmental Science (Belgrave et al., 2022; Bermudez et al., 2023).

5. Where to conduct participatory design research?

Where we conduct studies influences the design activities and community members' perceived agency in research. For example, Litts and colleagues (2022) partnered with indigenous community members to design science learning experiences grounded in their culture of storytelling and oral sharing. In the 4-day workshop, researchers and community members walked through a canyon to explore native plants and (re)interpret the plants' stories. Community members narrated their cultural and experiential science knowledge through stories in a setting that is a backdrop to their community. Although the *where* of research will vary by project, cognitive scientists can consider conducting research in authentic settings or community spaces (e.g., library) instead of labs, to build upon the affordances of the community and foster equal power relationships between its members and researchers (Brown & Baer, 2011; Lee et al., 2021).

6. Conclusion

Coming back to the question, "what can Cognitive Science do for people?" (Prather et al., 2022), we argue that participatory design is an approach to learn what people need from Cognitive Science. We provided guiding questions and examples of participatory design relevant to areas of Cognitive Science to encourage collaboration between transdisciplinary researchers and community members. Participatory design can advance Cognitive Science through improving research ethics, designing timely studies that reveal variations in human cognition across authentic contexts, and implementing practices that directly benefit and empower community members.

Author contributions

Jenny Yun-Chen Chan: Conceptualization, investigation, writing—original draft, visualization. **Tomohiro Nagashima**: Conceptualization, writing—review and editing, visualization. **Avery H. Closser**: Conceptualization, writing—review and editing.

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