Tech Worker Perspectives on Considering the Interpersonal Implications of Communication Technologies

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Communication technologies, from social media to video conferencing, are used by billions of people globally and contribute to shaping relationships between people. As these technologies become increasingly ubiquitous, the tech workers building them are increasingly making product decisions that can have far-reaching interpersonal ramifications. At the same time, few workplace tools and support exist to help tech workers understand and navigate these potential ramifications, and tech worker perspectives on such tools are not fully understood. In this work, we explore the needs, challenges, and opportunities encountered by tech workers in thinking through the interpersonal implications of their products. To do this, we ran a semi-structured interview study with 10 diverse tech workers. To ground the discussion, study participants interacted with a design probe prototype, InterAct, which provides research-grounded information about interpersonal implications of product features. Our findings suggest a desire by tech workers to consider the social implications of the technologies they build, and the potential for structured tooling to help provide the required knowledge and build organizational support. Based on these findings, we provide design considerations for creating future workplace tools to support thinking about the social implications of technologies.

CCS Concepts: • **Human-centered computing → Empirical studies in collaborative and social computing**; **Interactive systems and tools**; **Collaborative and social computing systems and tools**.

Additional Key Words and Phrases: computer-mediated communication, design tool, workplace tool, interpersonal communication, tech workers, software development, social computing

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Communication is a fundamental part of the human experience, and people are increasingly using communication technologies to connect. As of 2022, the seven most popular social media platforms each claim over 1 billion active monthly users [57]. The COVID-19 pandemic accelerated the shift to communication technologies, with the number of daily Zoom calls increasing from 200 to 300 million in just the first month of the pandemic [89, 90]. In addition to social media and video conferencing, people engage with a vast and growing set of other communication technologies – including information-sharing websites, direct messengers, email clients, asynchronous collaboration tools,

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and social apps. As these technologies become increasingly pervasive, they have a growing impact on human communication and relationships.

Given the prevalence of communication technologies, it becomes increasingly important for their creators to understand the potential social implications in order to heighten utility and mediate risks. While communication technologies provide many benefits, they can also incur harms. For example, large-scale communication platforms such as the virtual reality metaverse may be concerning because they combine high-fidelity social cues (e.g. video of a person or representative avatar) with a potentially large audience size. This combination could increase identity-based harassment. For such reasons, scholars have highlighted the need for tech workers[1] to consider products' social implications (e.g. [19, 85]). Many concerns about social consequences of tech exist, and so in this work we narrowed our focus to one area: implications from tech on interpersonal communication.

As scholars in CSCW have long shown, anticipating the social implications of a technology can be challenging because many tradeoffs must be considered. A technology's impacts are not all "good" or "bad"; rather, a given technology enables particular interactions with various pros and cons, and prior work has shown that technology creators want to understand solution tradeoffs [56]. For example, a communication technology that includes many social cues (e.g. video chat or virtual reality) may better support intimacy, but also may compromise privacy by sharing more of a user's identity. Furthermore, a technology's benefits and risks can vary depending on the user and use case. For example, a tool that enables synchronous communication (e.g. a video call) may not fit the needs of a large group with busy schedules, but may be compelling for a small group with similar schedules. Despite the complex tradeoffs that must be considered, industry currently largely lacks structured support to help workers with considering interpersonal implications of communication technology.

In order to provide better support for considering interpersonal implications of communication technology at tech companies, it is essential to better understand tech worker perspectives on how these issues fit into their workplaces and workflows. Scholars have noted that research often fails to incorporate tech worker feedback directly, or to consider the organizational barriers to new tool adoption in the workplace [39, 59]; and current research on tech worker perspectives on tools that support thinking about interpersonal implications is limited. Do tech workers want more support for considering the interpersonal implications of the products they work on? If so, what types of support or tooling might they want? And what barriers or opportunities for integrating this support into the workplace do they envision? Better understanding the answers to such questions may help enable better support for considering interpersonal implications of communication technology at tech companies in the future.

To help provide this background, this work explores tech workers' perspectives on considering interpersonal implications of communication technology. In particular, we focus on tech workers' current needs for considering the interpersonal implications of products they work on, their perspectives on tools supporting such consideration, and how they might envision incorporating such tools into their organizations. To do this, we ran a semi-structured interview study with 10 tech workers from companies that sell communication technologies, using a design probe we call InterAct. InterAct presents a series of questions about a communication technology feature, and provides possible interpersonal consequences and supporting real-life case studies. The prototype allows for iterative thinking by enabling revisiting questions, revising answers, and exploring updated implications. At the end, it provides a printable summary that can be referenced or shared with teammates. Our prototype is neither a comprehensive solution to computer-mediated

[1]In order to be concise, in this paper the term "tech worker" will refer exclusively to designers, engineers, product managers, and others directly involved in the design and development of a technology product.

communication issues, nor a deterministic tool that gives tech workers the "right" answer. Rather, it is a reflective tool, created to serve as a design probe to help study participants think about their workplace processes and needs. During our study, participants used the prototype and engaged in a semi-structured interview about their experience.

Our findings contribute a picture of the needs, challenges, and opportunities for integrating tools that support thinking about interpersonal implications in the contemporary US tech sector. We have five key findings. First, the professionals we interviewed were interested in building products sensitive to interpersonal dynamics, but often lacked adequate knowledge or support. Second, they were generally enthusiastic about engaging with a framework for considering interpersonal implications of communication technology through a supportive tool. Third, while many appreciated non-deterministic support, which facilitated reflection, some struggled with this ambiguity. Fourth, interviewees acknowledged that despite personal investment in considering products' social implications, management often discouraged spending time on this. Finally, many highlighted the potential for research-grounded tools to spur corporate investment in considering interpersonal implications of communication technology, either by directly incorporating tools in trainings or by helping to justify investments in attending to the social implications of technologies. Based on these findings, we discuss future directions for how tools like InterAct might be further developed and deployed.

In summary, our main contributions are:

- An exploratory interview study on the needs, challenges, and opportunities for integrating tools that support considering tech's interpersonal implications in the contemporary US tech sector.
- An exploratory interface that walks the user through a tech feature's potential interpersonal implications, based on computer-mediated communication (CMC) theory.
- Design considerations for future researchers and practitioners working on tools to support tech workers engaged in considering interpersonal implications of communication technology.

1 BACKGROUND AND RELATED WORK

Our work relates to scholarship on computer-mediated communication (CMC), tech workplace tools, and design frameworks. The field of CMC provides information key to considering interpersonal implications of tech, and we incorporate this knowledge in our prototype. We also review tools adopted and studied in the US tech industry, and design frameworks related to social considerations.

1.1 Computer-Mediated Communication

CMC focuses on interpersonal communication that is mediated through computing technologies. The field builds on frameworks from (offline) interpersonal communication and sociological theories of self-presentation and impression management [36]. These theories posit that humans wish to influence how others perceive them, and that work to manage impressions occurs during social interactions. Another concept, the "imagined audience" [2, 55, 60, 61], describes how people adjust their self-presentation based on who they imagine as their audience, which is highly context-dependent and relies heavily on social cues. Scholars have explored the field from various perspectives, providing critical/historical analysis (e.g. [86]), political-economic focus (e.g. [31]), and general overviews (e.g. [6]). Related fields of social science have also considered technology use, for example theories around the complex relationship between technologies, their users, and organizations (e.g. [70]).

The advent of communication technologies have made human communication more complex. Scholars refer to this complication as "context collapse" [12, 21, 61] because users of social technologies struggle to know how to correctly identify their potential audiences and adjust their self-presentation accordingly. A communication technology's design will influence the severity of context collapse. For example, video call tools provide rich contextual information about audience and environment that reduces context collapse, while an anonymous text-only messaging board does not. CMC provides information relevant to many aspects of design including self-disclosure and privacy [10, 88]; identity [11, 38]; relational quality and intimacy [7, 43]; social presence and trust [8]; community formation and governance [15, 45, 77]; social context and emotional expression [22]; social capital [26]; online conduct and misbehavior [51, 62, 80]; lying and deception [24, 42]; and wellbeing [14]. Our work builds on this rich domain knowledge by exploring tech worker perspectives on its presentation in a guided format.

In particular, our work builds directly on Baym's book [6], as our design probe prototype presents information derived from this text. Baym's work provides an overview of how principles of human communication translate to digital contexts, using broad reviews of major theory and research from the field of CMC. The book establishes seven main principles of communication via technology–interactivity, temporal structure, social cues, storage, replicability, reach, and mobility–and explores each with historical and theoretical reflections, research-based insights, and contemporary examples. Our tool helps users analyze communication technologies according to these principles. We chose to build on Baym's work because the framework has been highly influential in the field of Communication, with the book in its second edition with multiple translations and citations in many subfields. The book is frequently assigned to undergraduate students, making it accessible for those with little to no background in CMC. Unlike rule-based framing of social issues identified by other scholars [40, 63], Baym's non-prescriptive approach also facilitated creating an open-ended thinking tool.

CMC theory underpins many aspects of CSCW, as in both fields humans communicate through technology. CMC provides theoretical understanding of computer-mediated interactions, which includes CSCW applications focused on collaborative work. As domain expert Nardi summarized in 2005, "Computer-mediated communication (CMC) is a keystone of computer-supported collaborative work" [66] (p. 91). CSCW research still continues to be informed by CMC theory and analysis. For example, recent works combine CMC and CSCW to study inter-subjectivity during COVID-19 and the heavy use of CMC due to social distancing [20], and examine design solutions to enhance collocated social interaction, with a focus on CMC-informed concepts of interpersonal communication [69]. We contribute to the body of work bridging CMC and CSCW, by informing reflective tools that could help foster collaboration among tech workers and potentially help build more socially-sensitive CSCW applications.

1.2 Tech Workplace Tools

A number of tools have been proposed to assist tech workers with corporate tasks, providing a precedent for creating tools to support interpersonal thinking, which we explore. Existing tools facilitate hiring, trainings, employee management, and HR (see overview in [49]). Many of these tools improve efficiency of information management and facilitate remote interactions. Research has also explored how to educate information workers (e.g. [68]). Training and compliance tools are commonly used to educate employees and ensure conformation to standards. For example, learning management system (LMS) tools present information in text or video, and may contain questions or self-attestations to verify comprehension (e.g. Adobe Captivate Prime [1], Learning Pool Stream LXP [71], and Docebo [23]). Digital HR systems, or "e-HR," may also increase efficiency [53].

In addition to supporting workers with training and compliance, tools have been proposed to assist collaborative tech work. Product development is rarely a solo event, and collaborating on systems can be a challenge. Many tools exist to assist software engineers simultaneously contributing to a codebase (e.g. GitHub [34] and Bitbucket [4]), and taskboards are commonly used to distribute and organize tasks across teams. Tools such as Microsoft OneDrive [64] and Google Drive [37] facilitate collaboration on documents and other types of resources. To combine general resource management with discussion channels, integrative communications tools such as Slack [84] and Teams [65] have become common. In addition to commercial tools, researchers have also studied and proposed collaborative work processes for tech workers (e.g., [44, 48, 52, 72, 81, 87]).

Tools to support designers also exist (e.g., Figma [46], Sketch [13], Balsamiq [82], Adobe XD [83], and InVision [47]). Such tools enable designers to efficiently prototype designs for diverse products. Many support collaborative editing, and exporting wireframes or semi-functional prototypes. Research projects have also explored design tools for various domains and with various types of interactivity (e.g., [3, 16, 18, 27, 50, 54, 74, 75]). While existing tools enable rapid design prototyping, they do not typically provide further assistance in understanding the social ramifications of the designs for users or society. However, research has shown that technology developers desire insights into such tradeoffs [56], and the design probe in our study explicitly highlights such tradeoffs for the user.

1.3 Design Frameworks

Prior work on design frameworks underscore the value of having structured ways to think about the impacts of technology. One key framework that undergirds many others is participatory design (PD). PD focuses on including all stakeholders throughout the design process, including secondary parties who might be impacted [25]. Relatedly, value-sensitive design (VSD) examines the values embedded in technologies and other artifacts, and provides methods to help ensure that stakeholder values are considered [29, 30]. "Feminist HCI" is a framework that draws on feminist theory and includes principles such as pluralism, participation, advocacy, ecology, embodiment, and self-disclosure [5]. "Design justice" is a framework for analyzing "how design distributes benefits and burdens between various groups of people" with the goal of seeking more equitable outcomes [19]. Each of these frameworks provides a structured approach to thinking about the human impacts of technologies.

Scholars from HCI and adjacent disciplines have devised ways to operationalize these frameworks for considering the social implications of technology. Chivukula et al. [17] reviewed 63 ethics design methodologies, which they classified into cards, worksheets, documents/guidebooks, physical manipulatives, templates, and videos. These methodologies vary greatly both in content and where in the design process they can be used. Checklists are another increasingly popular tool that can provide structure to protocols, enable replication, and reduce human error [32, 41, 78]. They have been recommended to help users reflect on the social factors involved in machine learning [33, 58], account for ethics in PD [73], and follow design guidelines [9]. We are not aware of any tool tailored to CMC applications. In addition, existing research does not often consider how these tools–particularly those that consider social implications–might be incorporated into the workplace [39, 59]. In this project, we build on and contribute to this body of prior work by shedding light on tech worker perspectives on tools to support thinking through the interpersonal implications of tech.

2 EXPLORATORY INTERVIEW STUDY WITH TECH WORKERS

To better understand technology professionals' impressions of the usability and impact of tools that support thinking through the interpersonal implications of communication technologies, we conducted a semi-structured interview study, under IRB approval. During the study, participants

used a design probe tool, discussed their experience in a semi-structured interview (see Appendix A), and completed demographic and Likert-style survey questions. All interview data was analyzed by two researchers to identify primary themes of user response.

2.1 Participants

We recruited 10 participants from several tech companies that build large-scale communication technologies, by emailing relevant tech worker mailing lists and through snowball sampling seeded with people working on various communication technologies. Basic participant demographics were:

- Age: 21-42 (mean 28.5, standard deviation 4.7)
- Gender: 6 female (including 1 participant who selected female and non-binary), 4 male.
- Occupation: 4 engineers, 3 product managers (PMs), 1 designer/PM, 1 designer/researcher, and 1 data scientist.

In terms of past relevant coursework, the percent of participants who reported having taken a course in the following topics were: 1) 100% computer science or engineering, 2) 70% design, HCI or UI/UX, and 3) 40% communication, media studies, sociology, or science and technology studies.

2.2 Procedures

The user study was conducted remotely due to the COVID-19 pandemic. Throughout the study, the participant was connected with a researcher via video call to facilitate open conversation and screen-sharing. An online form walked the participant through the procedures, and provided inputs for demographic and quantitative questions. Participants were given a $20 gift card for participating.

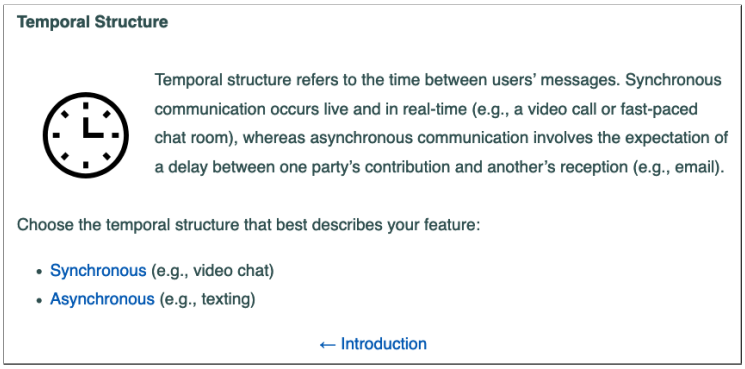
During the user study, participants engaged in the following procedures. Total time ranged 33-62 min (mean 46), and time spent using the prototype ranged 5-44 min (mean 17, std dev 12).

(1) Participant describes a communication feature they are working on or thinking about.
(2) Participant reflects on the communication feature while stepping through a design probe tool.
(3) Participant discusses the experience with the design probe in a semi-structured interview.
(4) Participant completes a brief survey, including Likert scale evaluations and basic demographics.

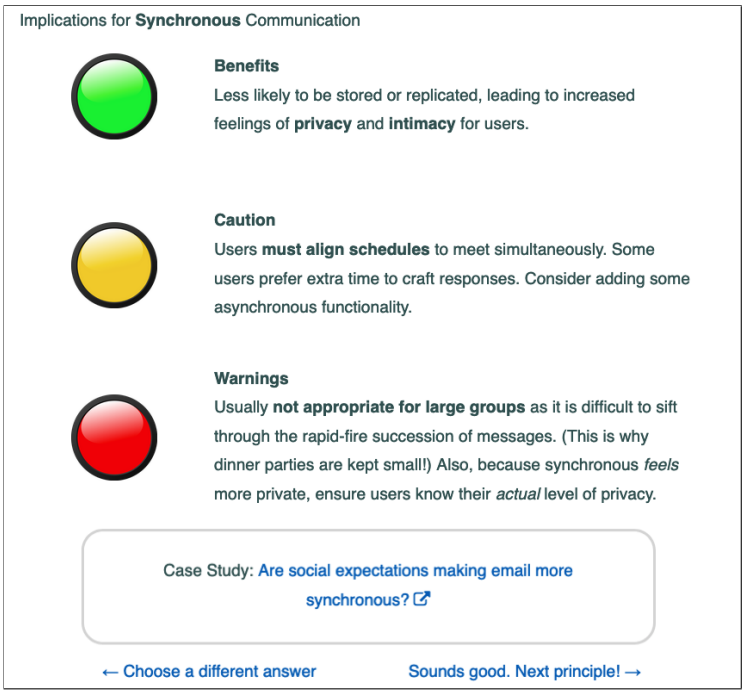
Participants screen-shared while using the design probe so that the researcher could see how they interacted with the tool and better interpret comments and questions. They were encouraged to speak aloud their experience while using the tool. During the rest of the study, screensharing was not used.

The semi-structured interview questions were designed to probe whether participants perceived a need for tools similar to the design probe; whether and how tech workers might use such tools in their daily workflows; what was learned from using the tool, if anything; and how such lessons might be incorporated into corporate technology design and development processes. The conversation deviated from or expanded upon the interview protocol's prescribed questions as appropriate, based on participant responses. Audio recordings of the study were transcribed for subsequent analysis.

The transcripts were analyzed using thematic qualitative coding methods informed by critical discourse analysis [28] and grounded theory [35]. Two researchers independently reviewed and coded the survey results, interview notes, and transcripts to determine the primary themes of response. The two researchers then met and compared lists, revisiting the notes and transcripts until consensus was reached as to the primary result themes.



(a) "Question" page for Temporal Structure. The page provides an introductory explanation of what the dimension means, coupled with a related icon (for Temporal Structure, a clock). The user selects from options for evaluating the feature they have in mind (in this case "Synchronous" or "Asynchronous".



(b) "Implications" page for Temporal Structure, with "Asynchronous" selected. The page lists Benefits, Caution, and Warnings to consider, tailored to the user's selection (written at top), coupled with iconic stoplight colors. The page provides a link to a related case study for additional information.

Fig. 1. Sceenshots of our design probe prototype InterAct, showing (a) "Question" and (b) "Implications" pages for Temporal Structure.

2.3 Design Probe InterAct

InterAct was developed through an iterative design process, with feedback from a variety of tech workers and social scientists. The prototype was designed to support tech workers (the users) in

thinking through the interpersonal implications of communication technologies. Our interactive prototype (screenshots in Figures 1-2) guides users through a structured, personalized exploration of the social implications of a communication affordance of the user's choice. It can be used to analyze any technology affordance that supports human communication (e.g., Facebook's direct messenger, or a code repository's task board). It does not offer solutions to potential problems; rather, it is intended to help reveal implications of design choices, shedding light on possible oversights and providing a conceptual framework for thinking through implications.

To do this, the tool walks the user through seven dimensions of design decisions grounded in CMC, and provides tailored insights based on the user's inputs. These seven dimensions correspond to the seven main principles of human communication via technology established by Baym [6]. We chose to build on Baym's work for the following reasons: (1) it provides an introduction to CMC for people new to the field; (2) it provides a clear organization of synthesized CMC research; (3) it is non-prescriptive and non-deterministic in orientation; and (4) it is used and cited broadly within communication scholarship. The seven design dimensions are summarized below:

- **Temporal Structure**: the time between users' messages. Communication can be synchronous (occuring in real-time), or asynchronous (with delays between creating and receiving content).
- **Social Cues**: the signals that communicate information about social interactions, ranging from low fidelity (e.g. text-only communication) to high fidelity (e.g., video calls).
- **Storage**: the recording and maintenance of messages, text, or other data, over time.
- **Replicability**: the ability to copy messages or other data, which is closely related to storage: persistent storage increases replicability by expanding the time window for replication.
- **Reach**: the audience size available to a user. Features with large reach allow one user to contact many, while features with smaller reach support one-on-one or small group communication.
- **Mobility**: a technology's physical portability. Some technologies are highly mobile, allowing for access on-the-go, while others are only accessible at a particular location.
- **Interactivity**: the intensity of an interaction, which relates closely to the other principles.

For each dimension, the user is first presented with a "Question" page that provides a concept's definition and a set of options for how the concept can be implemented. For example, for the "Question" page on temporal structure, the user sees the definition of temporal structure and can then select whether their feature is "synchronous" or "asynchronous" (Figure 1a). The tool then provides an "Implications" page that lists benefits (alongside a green light), cautions (alongside a yellow light), and warnings (alongside a red light) for that choice, along with links to relevant case studies (Figure 1b). The "Question" and "Implications" pages are repeated for each design choice (except interactivity, which is discussed in the conclusion, as it ties together the other dimensions).

The concluding page (Figure 2) offers a customized report with questions to consider based on the user's inputs. For example, a user who chose asynchronous communication would see the question, "How will you help your users build norms around response times to avoid large communication gaps as well as pressure to respond immediately?" Alternatively, if a user had chosen synchronous communication, they would see, "If your product supports more than a couple people, how will you ensure larger groups can communicate effectively? As synchronous communication feels intimate, how will you remind users of their actual degree of privacy?" Like the dimensions, these questions are grounded in CMC theory and research [6], and are intended to encourage thorough consideration.

The left bar of the tool tracks the user's choice for each principle and includes links to more information. As the user goes through each principle, the left bar populates with their answers.

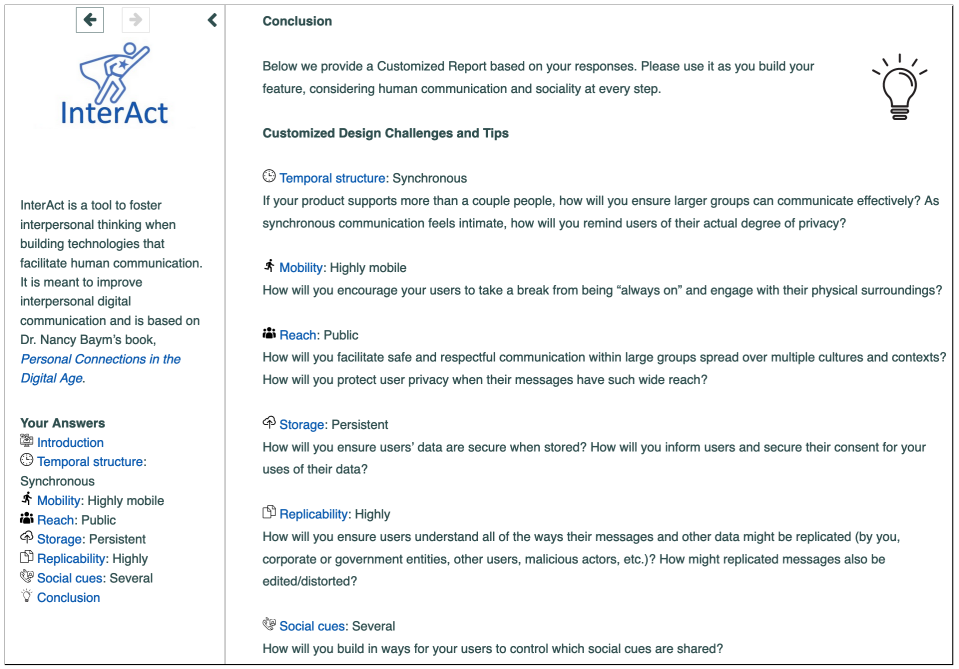


Fig. 2. Screenshot of InterAct prototype's concluding page, showing a customized report based on the user's selection. For each of dimensions, the report shows the user's selection, and provides tailored questions to consider. The navigation bar at left provides links to revisit or update any dimension.

Back and forward buttons at top left enable users to revisit past choices and progress through the tool.

We implemented the InterAct prototype as a website using Twine, an open-source tool for building text-based games, with additional custom CSS and HTML. The tool is hosted on Github.

3 RESULTS: INSIGHTS FROM TECH WORKERS

The primary themes of participant response were (1) the need for increased thinking about interpersonal implications in tech; (2) the value for industry professionals in having frameworks for thinking through interpersonal implications of communication technologies; (3) grappling with the ambiguity of social and interpersonal dynamics and how to make decisions with this ambiguity; (4) the tension between individual desires to spend time thinking about interpersonal implications and corporate pressures to meet business priorities on tight timelines; (5) the potential for using a grounded tool to obtain corporate buy-in to invest in considering interpersonal dynamics in design and development; and (6) locating where tools might fit within the product development pipeline. We detail these findings below and the potential implications of each.

3.1 Thinking about Interpersonal Implications in Tech

All participants reported beliefs that the tech industry needs to consider interpersonal and social consequences when planning and building new products. Participants emphasized a lack of such consideration in the current industry, sometimes pointing to disastrous results. While our sample size was small, and somewhat self-selecting due to their interest in a study on interpersonal thinking, these findings counter some existing narratives in scholarship and popular media that tech workers

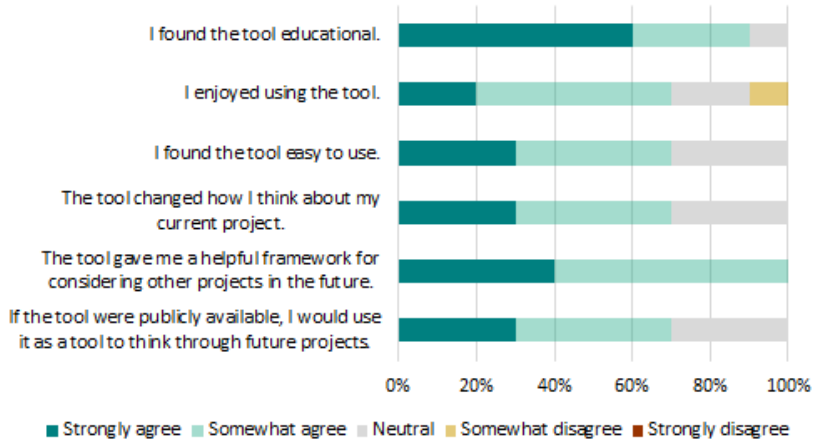


Fig. 3. Participant rankings of each statement about the utility of the design probe.

are ignorant or dismissive of social issues [76, 85]. Participants often noted they wished they had more tools and support for social and interpersonal considerations, and that anything that might help in that respect would make their jobs easier and help them build more responsibly. Across our interviews, participants agreed that tools like InterAct could help meet this need, and that increased usage of such tools could improve societal outcomes of new technologies.

Our participants were overwhelmingly aware that the products they worked on had interpersonal and social implications. For example, one participant described reading Reddit regularly to learn more about industry data scandals. Another participant, a data scientist, brought up Facebook's dilemmas of disinformation and scale, relating it to the concept of audience reach covered in InterAct:

> I feel like the reach of Facebook... they kind of messed up. They didn't really think about it. And when it scaled up they were just like, "Oh, bigger and bigger is better." I think it's something that should be considered so that you are at least building the thing you want to build... And people are like, "Well, we wanted Facebook to be small groups and families," but turns out people just want to post about QAnon (laughs). So yeah, I think this is helpful as a tool for thinking about it and people should think about it when they're building technology.

All participants reported a desire for more or new ways to consider these implications as part of their design and/or development process. One participant enthusiastically endorsed tools like InterAct, saying that at their tech company, "We're just throwing stuff out there and seeing if it sticks... It's the Wild West out here... I'm actually considering the implications before I build something... (and) anything that can help me do that, I appreciate." Final survey results echoed this sentiment, with 90% of participants reporting they found the tool educational and 100% saying the tool gave them a helpful framework for considering future projects (Figure 3). Thus, the survey and interview data demonstrate that our participants believe in the need – and potential – for tools like InterAct to help technology professionals think through the interpersonal implications of the technologies they build. As one participant put it, she valued anything that would "remind me of my responsibility to society; remind me that I'm in a position where I can actually influence these things."

3.2 "Implication Thinking:" The Value of Structure for Considering Implications

Participants tended to report that the greatest value of InterAct and similar tools was in providing a framework for thinking about social implications of technologies. While, as discussed above, all participants reported thinking often about interpersonal and social problems related to tech, most noted they lacked an organized way of considering such issues. Participants said tools like InterAct could provide them with useful structure for thinking about communication technologies and exposing them to new considerations. Further, some respondents reported that such structured ways of thinking would work well for teams as a shared reference.

While all participants were aware of some social limitations of the technologies they built, InterAct helped them, as one software engineer stated, "be conscious of things that I wouldn't necessarily have thought of." InterAct helped our participants reflect specifically on CMC–an area few had considered deeply before. As another software engineer explained:

> It definitely made me think about communication tools more broadly than I have before. If you had said to me at the beginning of this, "You're going to need to design a communication tool, how many issues do you think there would be?" I would be like, "I don't know, two?" I didn't think about all of these, like six things, and the fact that if this was a work tool, [that] letting people understand how to turn it off or walk away from it is really important to the design... More broadly, just... [that] there are six parts to doing personal connection in the digital age? I had no idea.

Another participant, also a software engineer, believed many tech workers were already thinking about the aspects of communication presented in InterAct, but explained that they did not think they could "articulate [links between functionality and social implications] in such a clear form." One PM said the tool's framework would be especially helpful for ensuring that new PMs were familiar with the concepts and where they would typically fit in company processes. She also stated it would be extremely helpful to have the concepts and implications from InterAct on a poster or flowchart for common referral in the office. One participant imagined using such a tool when their team "needed some friction" that could actually change the team's direction. Another likened it to various "design thinking" initiatives and workshops at his company, calling InterAct a tool for "implication thinking."

3.3 Grappling with Ambiguity

In our interviews, participants frequently reflected on InterAct's open-ended nature: some embraced it while others found it uncomfortable.

For participants who appreciated that InterAct did not tell them what to do, instead prompting them to think through how to respond to outlined implications – ambiguity, critical thinking, and brainstorming were welcome parts of their typical iterative creation process. These participants often reflected that InterAct realistically represented the multiple, complex possible outcomes of any decision. A software engineer explained that for him, "a big takeaway was how, for all of these six categories, there's a spectrum of the benefits and detriments." Some of these participants framed the tool as a decision-making aid, and those with this view tended to emphasize the utility and empowering nature of such an approach to their work:

> I like... that it wasn't trying to say there's a specific type of interaction that's desired or good. It's just like, "This is one possible type of interaction and these are the things you should consider when making that choice." I felt like it gave me a framework... as opposed to... pushing me into, like, "Oh, you should have synchronous communication, that's like the only way of doing it." It's kind of more helping you make a decision, instead of trying to make the decision for you.

Other participants displayed and reported discomfort with the tool's ambiguity. Some explained they were not sure how to decide what to actually do based on the tool's feedback. These participants were often less interested in deep discussion about interpersonal implications, instead looking for concrete recommendations. For example, one participant asked if the yellow Caution label meant he could bypass the issue and the red Warning label meant "You should never be doing this." It may be that for those less habituated to ambiguity, tools like InterAct could prove challenging.

Most respondents, regardless of their own comfort with ambiguity, grappled with envisioning where an open-ended tool like InterAct might fit into their organizational workflow, or how it might be implemented by more precision-oriented or less flexible coworkers. Most hesitation about the tool was tied to organizational and industrial norms, which participants framed as potential barriers to successful adoption (explored next).

3.4 Individual Intentions & Organizational Realities

In our interviews, participants often surfaced the tension between personal desires to consider the social implications of technology and the priorities and practical realities of technology development. While many participants found the tool useful for thinking more deeply about interpersonal implications of a feature, they also described organizational contexts that complicate incorporating such insights in product design. For example, many described tension between individual or team intentions to prioritize interpersonal considerations, and workplace pressures to focus on sales, the "executive's mindset," customer demands, or a company's high-level product strategy.

As a result, participants expressed skepticism about their companies providing adequate resources to fulfill their stated commitments to social responsibility. One PM explained that, at her company, "tech comes first" and human-centered questions come later, making interpersonal or social interventions in design difficult. Participants described gaps between tech workers having good intentions, but working in an industry that does not reward following up on those intentions. For example, a participant explained how many tech companies tend to reward engineers:

> What they get prized on is like how much code, what features you added... not a lot of like, "Is the thing you did really the right thing for the product?" Each person just wants to get their thing in so that they can claim credit for it. I think that's almost as big an issue. Not being able to think about these humanistic issues is also an issue, but if they're not incentivized to think about it then all the training in the world won't do anything.

Beyond concerns about organizations not incentivizing socially responsible design and development, some participants were doubtful about larger structural change toward a more ethical, socially responsible industry. Many believed tools like InterAct could help them and other tech workers in particular contexts, but doubted the industry's ability or willingness to shift in more prosocial directions. One participant compared tools like InterAct to corporate anti-racism trainings:

> Like, sure, anti-racist trainings are great. But you (also) have to have the power structures that don't want to keep replicating the same things again, or you're just going to have people trained but you're not going to change any material outcomes. It's still, I think, very helpful to have those sorts of trainings. It's also kind of necessary groundwork before you can do other things. But it's not the final step.

3.5 Obtaining "Buy-In"

Some participants said a tool like InterAct could help them convince supervisors or teams to prioritize and support thinking through a feature's interpersonal implications. Many participants identified the information in InterAct as credible and thus potentially able to satisfy their industry's

value of data-driven or research-supported decision-making. Others suggested tools like InterAct could or should be compulsory in their organizations because they believed the standardization of such an open-ended tool would ensure larger organizational "buy-in" for interpersonal thinking and the resources needed to operationalize it.

In discussing barriers to interpersonal thinking in their organizations and workflows, participants sometimes described the steps needed at their company to gain support and resources for their proposed work. Participants reported needed to justify requests with data, and for this purpose some saw great promise in InterAct's "Case Study" feature, which provides links to demonstrative real-world examples of each principle. In fact, some would have preferred a tool that advertises its grounding and credibility more "aggressively." One product manager explained:

> That's a great feature because so often, whenever we make feature decisions we're asked for evidence, like supporting data, on why we think that's right. So... a case study, things that are really numbers-based, at least on my team, are always super important... Anytime you can cite that the feature you're working on is based on usage data and interpretations, you always get a better shot of getting funding for your project, or resourcing.

In addition to challenges getting support for different design decisions, participants described the problem of organizational buy-in for support tools themselves. A designer/product manager explained that for a tech company to consider using a tool like InterAct, it must be understood as a compliance measure that protected the "bottom line:" "It would have to be positioned... like, 'Oh, look at all these PR disasters companies had. You don't want to be a disaster, do you?' ... To get it instituted at all, you need to frame it that way."

Indeed, compliance was mentioned often. Many felt the tool in some ways resembled compulsory checklists and trainings in their organizations, usually related to legal, accessibility, or ethics. However, they noted the topical focus and open-ended questions was new. One participant explained:

> There's not as much of a desired outcome. For the Datasheets for Datasets or Model Cards, those are saying, "Here's a bunch of things you should do." Where... the main thing [with InterAct] was like, "Here's a bunch of things to consider and make conscious choices about," versus just kind of doing what's expedient or what first comes to mind.

Multiple respondents similarly envisioned tools like InterAct being adopted by industry as a required worker tool. For our interviewees, compulsory tools and trainings represented important topics and priorities for their organizations. Our participants reported a desire for similar institutional investment in the topics covered by InterAct. While most participants admitted they did not typically enjoy compulsory tools, they also emphasized their importance: "People hate them. But... you just hate that kind of thing until one day it saves your ass."

3.6 Who, When, How: Appropriate Uses of Implication Thinking Tools

Findings from our user study suggest tools like InterAct would be most appropriate and useful for product managers at early stages in the ideation process, confirming prior findings of the value of early-stage interventions [19, 79]. Participants overwhelmingly noted that InterAct would be most impactful when used by tech workers with the power to determine product features and/or to manage the people involved. At larger tech companies, it is more likely that PMs would represent such decision-makers. Most participants agreed that members of small teams early in development would also find such tools useful. Participants envisioned the PM's role as spreading the thinking inspired by a tool to other team members. Some laid out scenarios where a tool could encourage teams to develop shared frameworks and foster reflective moments; provide actionable insights to

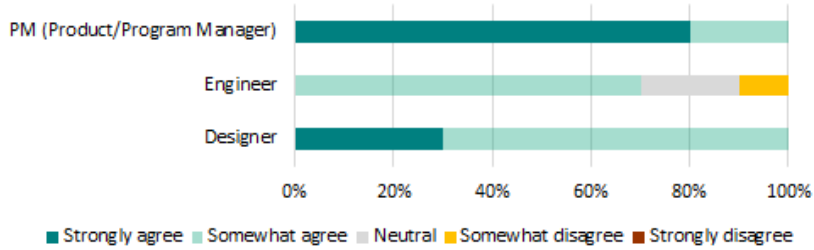


Fig. 4. Participant rankings of how likely they would be to recommend InterAct to each role.

product teams; and function similarly to extant tools for pausing or intervening in the development process.

One participant, a PM, said having a tool like InterAct early in the process "solves the problem of not identifying enough components at the beginning, which is always an issue." She explained: "by servicing these questions earlier, I think you are more likely to have a more long-lasting design and not have to pivot later." This feedback suggests that using tools like InterAct as part of the product ideation process could help streamline a socially informed design process. Our survey responses support this idea: 100% of participants agree that they would recommend InterAct to a PM, with 80% strongly agreeing (Figure 4). Non-PM participants noted that, although engineers and developers might also benefit from using the tool, those roles would most likely be working on implementing an already-designed feature unless they were on a small team or developing a side project.

Participants emphasized that the window of opportunity for using a tool like InterAct was quite narrow in the product development life cycle. One participant said a tool would be "probably less useful... once we're... building [the product] out." Another explained that using the tool did not feel like a "good use of time" at the moment because communication principles like mobility were already decided for his current product. After noting that InterAct seemed targeted at early stage development, one participant said in order for it to apply more broadly, she "would tailor this.. to those different [product life cycle] stages." This feedback suggests that tech workers may be receptive to integrating tools like InterAct into their work routines as long as they fit within their workflows.

4 DISCUSSION

Most participants reported a desire for workplace tools to support thinking through and discussing interpersonal consequences of their products. They also shared insights about what would make such tools most useful, and how they might be most appropriately integrated into the workplace. These results suggest that such tools might facilitate deeper understanding of CMC for technology builders, and empower industry teams to more thoughtfully evaluate and reflect on their design decisions and processes. For future researchers and practitioners working on such tools and their workplace integration, we consolidate design considerations, and discuss future work and limitations.

4.1 Design Considerations

Based on our findings, we consolidate design considerations for creating future tools to support tech workers thinking through products' interpersonal implications, and for overcoming current barriers to workplace integration.

- **Tailor content:** It may be particularly useful to tailor the information provided by future tools to specific applications. In our study, most participants appreciated focusing on a single communication feature (e.g. Facebook messenger), rather than something broader like an entire application (e.g. Facebook) or abstract concept (e.g. ethics). Some desired further customization, for example to provide context-specific CMC scenarios and case studies related to their specific application (e.g. business communication contexts and hospital settings).
- **Provide educational value:** Future designs should strive to present credible research and theory in an educational format, and to incorporate references to sources. Participants were generally interested in the information presented in our design probe, and learning motivated all participants. Participants generally trusted the tool's information, but some desired more evidence of credibility to gain support for tool use or justify design decisions to management.
- **Provide variable levels of structure:** Future tools may benefit from providing users with varying degrees of structure and determinism. Although participants seemed less familiar with open-ended tools that did not prescribe courses of action, many appreciated the idea that for social outcomes, all choices have potential risks and benefits. However, some participants struggled with open-ended reflection, and desired clearer guidance for decision-making. It is possible that varied degrees of structure for different users may help fill these diverse needs.
- **Equip users with language and structure:** Future tools should provide language and structure that users can use to discuss learnings outside of the tool. Participants particularly appreciated learning more organized and systematic ways of thinking through social implications, and having new language to discuss them. As one participant explained, using the design probe provided similar structure and language benefits to a workplace event about race and bias: "I didn't necessarily have a name for it. It wasn't top of mind. And that's kind of how I feel about all of this. These are all familiar...(but) I didn't necessarily think about it in an organized way."
- **Equip users with supporting evidence:** Future tools should provide users with data supporting socially conscious decision-making, that can be used to gain support within their companies. As noted in our findings, participants noted that convincing organizations to invest in designs based on social or ethical outcomes rather than immediate profit is challenging, but also noted that research-backed information provided by tools could help convince management.
- **Integrate early in product pipeline:** Tools focused on social outcomes likely need to be used early in product timelines by PMs or team leaders in order to meaningfully influence decision-making. As discussed in our findings, participants overwhelmingly spoke about how product design decisions are made early and are subsequently difficult to change, and how some team members (e.g. PMs and executives) are better positioned to influence decisions. However, participants in all roles valued the tool, and one noted that there may be other moments in a product life cycle that would benefit from the availability of similar tools.

4.2 Limitations and Future Work

Follow-up studies: While our study engaged deeply with each participant and revealed important considerations for future tools, our study size was limited. Follow-up studies, including more participants and real-world deployments, should be conducted to further expand understanding of

worker perspectives on social thinking tools. For example, our study revealed tension between individual intentions to build with social and interpersonal considerations in mind, and commercial pressures. If human-centered design and reflection are not part of the company's culture, it may be difficult to effectively advocate for these principles. Cultural values also vary globally. Multicultural teams may draw different conclusions about design decisions, and features may impact users in different ways. Future tools may account for cultural differences between team members or users, for example by presenting cultural context alongside implications. Understanding better how socially-focused tools may be deployed and used by entire teams in such environments, or by tech workers in different roles including top decision-makers and executives, makes for interesting future work.

More equitable design practices: It is possible that tools for thinking through social implications could help companies transition to more equitable design practices. Some participants felt that having a "data-driven" tool based on research would help convince supervisors to consider social implications earlier in the product design process. Others noted that such tools could be a valuable part of mandatory employee trainings. In either case, research-backed tools could help tech companies more confidently embrace organizational changes aimed at equity and human-centered design. That tech workers are looking for tools and other means to demonstrate the need for interpersonal thinking to superiors was an unexpected finding of this study. More research should be conducted on the barriers felt by tech workers, and how they might overcome them. It will be important to further study tech company adoption of interpersonal thinking tools and their impact.

Potential use in education: Although our study focused on tech workers, in our interviews several participants suggested that similar tools to our prototype would be useful in educational settings. We see many possible uses for similar tools in computer science classrooms to teach students about interpersonal ramifications of their work. For example, students could use a structured tool to help develop ideas for a final project or as part of a module on computers and society. Similar tools may also be useful in student hackathons, coding bootcamps, or other non-professional sites focused on learning. A tool like InterAct could fit within the growing list of pedagogical interventions designed to help future generations of technology workers contend with interpersonal implications and reduce harmful consequences of technology products. Better understanding possible educational uses and impacts for such thinking tools makes rich future work.

Informing CSCW: This work contributes to CSCW in two main ways: 1) by informing reflection tools for tech workers, which may help foster collaboration among these workers, and 2) by supporting the creation of more socially-aware communication technologies, which include CSCW applications. Our design probe included a final summary page that could be printed out and shared with teammates, and one participant wanted a large printout of the guiding principles in their team workplace to foster reflection and serve as a disrupter to their typical workflow. Such communal summaries and guides could be provided by future workplace tools. Teams could also step through thinking tools together, or even with potential users, and engage in discussion at each step to better understand others' perspectives. Thinking tools can also be used by workers or teams focused on developing CSCW applications, such as crowdsourcing or educational platforms. By thinking through interpersonal implications, hopefully the resulting applications will better support the workers using them. In addition to guiding design thinking, CMC principles such as those deployed in InterAct could also be be incorporated in future design evaluation criteria. For example, a new communication feature could be evaluated along each principle, and given a numeric score based on the severity of warnings triggered. Further exploring the potential impacts of implication thinking tools and CMC theory on teams and groups of workers makes exciting future work.

Similar tools for other domains: While this work focused on tools to support thinking through interpersonal implications of technologies that mediate human communication, similarly reflective

tools may be useful for applications beyond CMC. Technologists must also consider interpersonal implications surrounding applications meant for individual use, machine learning/artificial intelligence applications, and other non-communication technologies. For example, search algorithms may seem decoupled from social impacts, but in actuality have demonstrated interpersonal implications such as reifying racial stereotypes in results [67]. Developing similar tools for thinking about other types of technologies makes promising future work. Overall, we see a lot of potential for tools like InterAct applied to domains other than CMC. All technology is embedded in social worlds, and thus designers and engineers could benefit from understanding these interactions.

5 CONCLUSION

Tech workers build communication technologies that are increasingly integral to everyday life. For example, as the idea of the virtual reality metaverse looms ahead, tech workers must consider how affordances such as number of social cues, audience size, or synchronicity may enable both positive and negative interpersonal interactions. Few workplace tools currently exist to help tech workers reflect on the varied interpersonal implications of these kinds of products, and worker perspectives on the potential introduction of such tools is not well understood. In this work, we explore tech worker perspectives on the process of thinking through the social implications of communications technologies in a corporate environment. To do this, we built a design probe prototype, InterAct, that facilitates interpersonal thinking by operationalizing CMC theory. We used this design probe in a semi-structured interview study with 10 tech workers in order to better understand their perspectives.

Key findings from our interviews include: 1) perceived need for increased interpersonal thinking in technology workplaces, and the potential for tools to help meet this need 2) the value of theoretical frameworks, specifically about CMC, in industry contexts, 3) grappling with the ambiguity of interpersonal issues, 4) tensions between individual desire to focus on interpersonal implications of products and corporate priorities and timelines, and 5) how tools supporting thinking about products' social implications could empower workers with actionable insights. We envision that easy-to-use tools like InterAct could help workplaces consider more interpersonal implications during their design processes. Such tools could work alongside educational efforts, the creation of more interdisciplinary product teams, institutional commitments to equity and ethics, and more traditional compliance tools like checklists. We hope that insights gained from tech workers in our work will spur further research into how tech companies can better support workers considering the social impacts of products.

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A USER STUDY QUESTIONS

A.1 Design prompt for using prototype tool

A.1.1 Consider a Communication Feature. Please describe to the researcher a communication feature in an application (existing or imagined) that you have been thinking about or working on recently. Examples of communication features include git repos, Skype video chat, and Facebook messenger.

A.1.2 Reflect on Your Communication Feature. Please reflect on your communication feature, while using InterAct, a tool that assists with social thinking for technology projects. To use the tool, visit [URL].

A.2 Semi-structured interview questions

- Can you tell me about your favorite thing about the tool? What was the thing you disliked the most about it?
- What do you think this tool is for? Who do you think it is for? Do you think InterAct is an appropriate tool for designers, PMs, or engineers? For each role, why or why not? Who would you recommend use InterAct? How? Why?
- Is this a tool for junior or senior level people in your field, or both? Why?
- In what ways, if any, did InterAct impact your design process? Did it make you reconsider any aspects of your original spec? (If so, which ones and why?) What would it add, if anything, to the existing design or PM process?
- Did you learn anything from the tool? (If so, what?) Have you encountered the information in the tool before? (If so, where?)
- What, if anything, did you learn during the process? What do you remember most from what you learned?
- In your day-to-day design process, how (if at all) would you normally take interpersonal communication and social relationships into consideration?
- Was the tool easy to use? Fun? Boring? Interesting? Tell me how it felt to use. Would you use it again? More than once? Regularly?
- What would you do with your personalized report? Can you see integrating it into your process? Does the tool work as part of an iterative process?
- Do you think the tool might assist in avoiding unwanted social implications?
- Do you think the tech industry needs more consideration of these issues? Why or why not? Would tools like this make tech better, worse, or no different?

A.3 Survey and demographic questions (after using prototype tool)

A.3.1 Please rate how strongly you agree or disagree with the following statements. (5-point scale from strongly disagree to strongly agree).

(1) I found the tool educational.
(2) I enjoyed using the tool.
(3) I found the tool easy to use.
(4) The tool changed how I think about my current project.
(5) The tool gave me a helpful framework for considering other projects in the future.
(6) If the tool were publicly available, I would use it as a tool to think through future projects.

A.3.2 If this tool were publicly available, I would recommend it to a: (5-point scale from strongly disagree to strongly agree).

(1) PM (Product/ Program Manager)
(2) Engineer
(3) Designer

A.3.3 Demographics.

(1) What is your age (years)? (text box for free response)
(2) What is your gender? (Checklist with the following options: Male; Female, Non-binary/gender diverse; A different gender for the options listed above; Prefer not to say; text box for free response)
(3) What is your job title? (Checklist with the following options: PM (Product/Program Manager); Engineer; Designer; Researcher; Manager; text box for free response)
(4) Have you taken a course in computer science, engineering, or a related field? (Yes/No)

(5) Have you taken a course in design, human-computer interaction, UI/UX, or a related field? (Yes/No)
(6) Have you taken a course in communication, media studies, sociology, STS, or a related field? (Yes/No)

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