Overview: Contemporary views about gig workers position them as a socially vulnerable population exploited by economic and technological forces beyond their control[1]. Gig workers, like other workers, employ a variety of strategies to manage the algorithms that manage them. This project will use human-centered methods such as ethnography, digital trace data, and participatory design to develop a grounded understanding of how gig workers use individual and collective practices to supplement complex but brittle algorithmic systems. These findings will inform the design of socio-technical systems to support the future of work by using technology to scale gig worker collaborations and remain resilient in the face of algorithmic breakdowns.

Background: Short-term temporary laborers, or gig workers, are essential to the American economy. Gig workers power on-demand services like Uber, DoorDash, and Instacart as well as "intelligent" services like Amazon Mechanical Turk (AMT)[1]. Proponents argue gig work eliminates the friction of traditional labor arrangements through data-driven and efficient algorithmic matching of supply and demand for goods and services[1,2]. Because algorithmic models cannot anticipate many real-world situations, this causes breakages that disrupt the flow of work: for example, an unexpected road closure can force a driver to improvise alternative routes.

When work breaks down, workers draw upon their knowledge, technologies, and communities to get things done; they engage in infrastructuring. Infrastructuring refers to the intentional, bottom-up construction of foundational elements needed to support a complex system. However, past research has focused on *individual* strategies; research on *collective* strategies for worker-led infrastructuring practices is sparse[3,4]. Collective strategies can take the form of communal information sharing and database building, such as what occurs on Turkopticon, an activist software that promotes collective infrastructuring[2].

Gig workers, by design, operate in environments that are both geographically and informationally isolated. Unlike traditional workers who can call on formal and informal social and technical infrastructures, like an IT help desk or an HR rep, to manage breakdowns in their work, gig workers develop their own infrastructures for managing algorithmic breakdowns with scant support from the algorithmic managers or their coworkers. Despite the benefits of social support, information sharing, and improvising around broken algorithms, the costs of building infrastructure to support collective strategies can be prohibitive. When workers have overcome this collective action problem, they establish robust, reliable systems of support with tools like Turkopticon. To succeed at building infrastructures, workers must share a strong group identity–which is difficult to sustain in the dispersed remote gig work community.

Online communities, such as subreddits, are effective and popular venues for parts of infrastructuring efforts like sharing information or offering support[5]. However, the affordances of online communities like user anonymity and geographic dispersion can contribute to greater isolation and weaker group identity that could undermine collective infrastructuring practices[5]. I will use human-centered methods like interviews, ethnography, and participatory design to identify how workers navigate these affordances when engaging in collective infrastructuring practices within online communities. The development of these grounded insights will enable me to prototype online community designs and interventions to support collective strategies for infrastructuring and quickly scale them to thousands of gig workers.

Research Design and Methods: This project will compare gig workers' online and offline infrastructuring practices to inform the co-development of technical features with gig workers that support their online infrastructuring efforts.

Study 1: How do gig workers develop offline infrastructures? In year 1, I will conduct an ethnography of a local rideshare and delivery driver union. I already have an established collaboration and IRB-approved data collection protocol with the Colorado Independent Drivers United (CIDU), a young organization still in the early stages of building their organizational and technological infrastructures for their workers. This study will identify and refine fundamental elements of the gig worker infrastructuring process including: key actors and roles, processes for gathering and vetting of advice and data, information sharing processes, consensus making processes, and essential organizational structures. The data gathered at this

step will include field notes, interview transcripts, and organizational artifacts like documents that will be iteratively coded for themes about individual and collective strategies for managing algorithmic breakdowns. The findings from this offline and highly organized setting will provide rich empirical findings about gig workers' collective infrastructuring practices under conditions of low isolation and high group identity.

Study 2: How are infrastructuring practices in online communities different? In year 2, I will conduct digital and trace ethnographies of three gig worker online communities on Reddit: r/uberdrivers, r/upwork, and r/turkernation. These subreddits are important venues for newcomer socialization and resource sharing among gig workers[5]. This study will analyze the content of posts, comments threads, and rules on these subreddits as well as the public contribution histories of users to identify infrastructuring efforts for managing algorithmic breakdowns and compare these practices to Study 1. Member-checking, retrospective interviews, and surveys may also be used to validate and triangulate findings. This computer-mediated setting should provide rich insights about gig workers' collective infrastructuring practices under conditions of high isolation and low group identity as well as the role of social platforms' affordances.

Study 3: How can technical features of online communities better support infrastructuring practices? In year 3, I will work with my offline and online community partners to prototype and deploy technical tools such as browser plug-ins and bots to support collective infrastructuring practices. I will conduct participatory design workshops to connect gig workers recruited from the offline and online communities to understand their needs in light of the findings from studies 1 and 2, and surface ideas for collective infrastructuring efforts on top of the affordances of existing social platforms like Reddit. The design of these technical interventions will be done in conjunction with community partners to account for workers' changing needs and values. The tools would build on the precedents set by other worker-led tools like Turkopticon to support building and maintaining collective infrastructuring practices. Specifically, the tools would promote improved data collection, data sharing, consensus formation, advice-sharing, and organizing that they identify as being essential to making gig work viable and sustainable in the face of algorithmic breakdowns.

Intellectual Merit: This project will facilitate convergent research in computer, behavioral, and organizational sciences around the future of work to understand, connect, and scale gig workers' infrastructuring abilities. This project will contribute to a deeper understanding of how to design and maintain socio-technical infrastructures within distributed and algorithmically-mediated workforces (future technology), identify strategies for using existing tools and practices to overcome common problems involving collective action and algorithmic breakdowns (future work), and improve the incentives and reduce the harm present in contemporary gig work (future workers). This research will advance interdisciplinary knowledge across HCI and social computing, organizational studies, labor economics, and industrial relations.

Broader Impacts: Gig work is a rapidly-growing form of labor that lacks the benefits and protections of traditional employment and attracts marginalized communities excluded from the traditional labor market. Understanding gig workers' practices and using technology to connect them together has the potential to reduce the precarity, isolation, and danger of this work. Incorporating and scaling gig workers' collective practices for managing algorithmic breakdowns will promote more responsible and balanced human-technology partnerships as well as more efficient and sustainable work practices. The lessons from designing and maintaining infrastructures for gig workers to manage and be managed by algorithmic systems has implications for improving equity, responsiveness, and resilience of many emerging types of work on the human-technology frontier that will accelerate American economic competitiveness.

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