INTRODUCTION

The past decade has seen a flourishing of *on–demand work*, largely driven by the reformulation of work as the constituent parts of larger tasks. This framing of work into de–contextualized, modular blocks enables computation to hire workers at scale through open calls on the Internet [12, 2, 17]. Distributed paid participants then engage in the work whenever their schedules allow, with little to no awareness of the broader context of the work, and with (often) fleeting identities and associations [23, 21]. In this paper, we use the term on–demand work to join a pair of related phenomena: 1) *crowd work*, on platforms such as Amazon Mechanical Turk (AMT) and other sites of (predominantly) information work; and 2) *gig work*, typically involving platforms for one–off jobs, like driving, courier services, or administrative support. The realization that complex tasks can be accomplished by directing and managing these crowds of workers spurred industry to flock to sites of labor like AMT and Uber to explore the limits of this distributed, on–demand workforce. Researchers have also taken to the space in earnest, developing systems and designs that enable new forms of production (e.g., [1, 3, 27]).

As on–demand work has grown far beyond the domain of information work from which it first sprang, it has given rise to an increasingly complicated and conflicted culture amongst both the workers who enable it and the researchers who empower it. Originally, Howe described crowdsourcing in general terms as "outsourcing [work] to an undefined, generally large group of people in the form of an open call". However, for years its instantiation was limited to the utilization of human intelligence to process data, participate in scientific studies, and perform information work [16, 36, 39, 8, 28]. More recently, crowdsourcing of physically embodied work — driving and cleaning, for instance — has become a focus for on–demand labor markets [21, 35, 11, 34]. This growth prompted increasing efforts to understand the workers who gravitate toward these platforms [30, 32]. Some of this research has been motivated by the identification of the sociality of gig work, and the frustration and disenfranchisement that these systems embody [14, 23, 24]. Other work has focused on the *outcomes* of this frustration, reflecting on the resistance workers express against digitally mediated labor markets [21, 31].

This body of research has sought to answer one central question: What does the future hold for on–demand work and those that do it? Researchers have offered their input on this open question along three major threads:

1. What are the limits of crowd work? Specifically, (a) How complex are the goals that crowd work can accomplish?, and (b) What kinds of goals and industries may eventually utilize it? [29, 33, 15, 38, 37, 25, 10];
2. How far can work be decomposed into smaller and smaller microtasks? [18, 1, 6, 22, 19, 20, 5, 7, 26]; and
3. What will work and the place of work look like for workers? [14, 13, 31, 9, 4, 24]

This research literature has largely sought to answer these questions by examining the present phenomenon. So far, it has not offered a framing for holistically explaining the developments in worker processes that researchers have developed, or the emergent phenomena in social environments; nor has any research, to our knowledge, gone as far as predict future developments.

Piecework as a lens to understand crowdsourcing

In this paper, we offer a framing for on–demand work as a contemporary instantiation of *piecework*: a work and payment structure which breaks tasks down into standalone contracts, wherein payment is made for *work output*, rather than for *time*. Piecework as a metaphor for crowd work is not new. Indeed, Kittur et al. in 2013 referenced crowd work as "piecework" briefly as a loose analogy to the form of work emerging at the time [17]. But more than this, the framing of on–demand labor as a re–instantiation of piecework gives us years of historical material to make sense of the broader research on this new form of work, and allows us to reflect on–demand work through a mature theoretical lens, informed by decades of rigorous, empirically based research.

More concretely, by looking at on–demand work as an instantiation (or even a continuation) of piecework, and by looking for patterns of behavior that the corresponding literature predicts on this basis, we can 1) make sense of the phenomena so far as part of a much larger series of interrelated events; 2) reflect on similarities in the ongoing work among workers, system–designers, and researchers in this space; and finally, 3) to the extent that history repeats itself, offer predictions of what on–demand work researchers, and workers themselves, should expect to see on the horizon. For example, we will draw on the piecework literature such as case studies of the Santa Fe Railway to understand the historical complexity limits in piecework, and leverage that understanding to suggest which modern complexity limits in crowd work [17] may be fundamental and which may be overcome.

We organize this paper as follows: we first review the literature on piecework to lay groundwork and make clear the analogy to on–demand work. Then, we interrogate the three major research questions above from a piecework frame. We will we will identify similarities and differences between piecework as historically understood and on–demand work as we experience it today. Finally, we will make predictions of future developments based on how those similarities and differences influenced piecework. Finally, we will offer design implications for researchers and practitioners based on our results.

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