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ABSTRACT

With growing attention on gig work — ranging from the "sharing economy" to microtasks — scholars have made connections to frameworks like Taylorism, and mechanisms such as worker advocacy and empowerment, to make sense of our observations of on–demand work and the workers that power this movement. We argue that our the underlying trend towards "piecework" — driven in part by the discretization, routinization, and external management of said work — not only suggests, but in fact generates what we have observed: members of this transient workforce increasingly feeling disempowered, marginalized, and frustrated by the systems and platforms on which they work.

After evaluating this framing through a series of case studies in various industries falling broadly under the "gig work" category, we turn our theoretical lens to look to the future, to identify worthwhile questions and points of inquiry that researchers in social computing should consider as we attempt to anticipate and perhaps shape the future of work.

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Please don't make me pick keywords. This is like asking a teacher to give the bullet points of what a student missed in lecture.

INTRODUCTION

The past decade has seen paid microtasking, the "sharing economy", and other instantiations of on–demand contract work grow to occupy the fascination of both academic circles and our culture as a whole [37, 22, 41]. The research community has made connections between this emergent form of work and the historically situated "piecework", as well as a number of observations relating to the frustration workers feel stemming from the management of this work, but situating the causes of these frustrations either in the larger body of scholarship on crowd work, or crowd work itself, has proven difficult; the connection between crowd work and a historical parallel contextualizing its ongoing developments hasn't been deeply made yet [21, 39, 27].

While much of this work appears to gesture toward the parallels between contemporary on–demand work and piecework, it's proven difficult to bring the totality of these observations into focus using one theoretical lens. This paper will attempt to do so by arguing that the topics social computing researchers have investigated are not just parallel to historical piecework and the process of factorization that took place in the early 20th century; indeed, these phenomena *precipitate and reinforce each other*.

In the reflection on the literature published in the last 5 years since Kittur et al.'s "The Future of Crowd Work", we notice a broader trend describing the change in work that's being done [24]. Following the improvements in breaking down tasks, delegating work, and managing workers more broadly, crowd–powered work has continued to parallel historical piecework's trajectory by outgrowing ad–hoc worker groups and coalescing into more formal working groups, for example through the use of a "white list" of familiar workers. We might call this the regularization of factory work.

Making sense of the broader field of crowd work by looking at the movements toward distributing work, routinizing and breaking down tasks, and externally managing workers as linked to one another, we give ourselves a framing of contemporary piecework that explains, and arguably predicts, what we have seen thus far — and perhaps what we should expect to see going forward.

This paper will attempt to demonstrate that the familiarity that we incidentally observe between what we generally call crowd work & gig work and the historical practice of piecework and subsequent factory work is more than passing; that the phenomena researchers have observed in on–demand digitally mediated labor markets were inevitable milestones in the birth and life of piecework. We will set out to show that this perspective of crowd work as an embodiment of piecework predicts the myriad outcomes of contemporary crowd work, including our developments of work–flows further abstracting work, the troubling effects of those developments on factors such as pay and work quality, and many if not all of the frustrations researchers have discovered among workers in the study of crowd and gig work.

"But", as Scholz points out, "it would be wrong to conclude that in the realm of digital labor there is nothing new under the

sun" [41]. For one, information work (e.g. Amazon Mechanical Turk (AMT) & Upwork) and digitally managed work in general make it substantially easier to keep workers geographically dispersed compared to the factory workers that followed home–based piecework. This aspect of work renders workers virtually invisible to the task solicitors — or "requesters" — despite being significantly more connected than historical pieceworkers were [21]. Secondly, while factory foremen and other middle–men traditionally mediated the relationships between workers and managers, today the visible agents are *systems*; rather than employing individuals who "personified the functions of management" and can thus negotiate workers' needs, socio–technical systems mediate these interactions [55]. Finally, this characteristic of modern piecework makes worker coordination for collective advocacy and action significantly more difficult, necessitating special consideration to maintain the inertia of collective will while focusing that energy productively [39].

Piecework as a lens to understand gig work

Kittur et al. write of the future of crowd work in an effort to investigate whether crowd work will be a worthwhile form of work or another instantiation of "piecework" [24]. "Piecework" here makes use of a term historically used to describe work done in the home, in manageable tasks, often involving clear instructions and payment only for work completed, not work done (the differentiation, here, being that one would be paid for the *output* of the work, not the *duration*). Given the scope, we can frame piecework and on–demand labor as sharing these important similarities: 1) this form of work began in the home 2) the worker is paid for each discrete piece of work done, regardless of time or effort; and 3) the worker's status (not only socially, but also economically) is ambiguous, or at least the subject of some controversy..

In the past decade, researchers have observed frustration grow among on–demand workers, with expression of this frustration spanning a wide range of tactics [27, 21, 39]. Attempting to make sense of these case studies has been challenging in part because a wholly encompassing framework for understanding this form of work has thus proven difficult to capture.

This paper attempts to make sense of the broader research on this new form of work, *on–demand labor*, by evaluating this work through a more familiar lens: piecework. More concretely, by looking at task–based or "gig" work as an instantiation and continuation of piecework, and by looking for patterns of behavior that the corresponding literature predicts on this basis, we can do the following: 1) we can make sense of the phenomena so far as part of a much larger series of interrelated events; 2) we can bring into focus the ongoing work among workers, system–designers, and researchers in this space; and finally, 3) we can offer predictions of what social computing researchers, and workers themselves, should expect to see on the horizon of on–demand work.

We'll look at a broad range of cases under a number of major themes we propose as broadly describing the types of research being done in crowd work and more generally in what we argue is contemporary piecework. After validating this lens as a way of reasoning about on–demand labor, we'll attempt to use this perspective to suggest areas of research worth anticipating, and developments we should expect to see in the maturation of digitally mediated work.

CASE STUDIES

The existing body of research has shed light on on–demand labor from various perspectives, and revealed a number of topics that, through our framing, are clearly situated together. Those topics are, at a high level, as follows:

1. the **processes** involved in making work into tasks, or discretization;
2. the outcomes (and indeed the **fallout**) of that discretization, both on the work itself as well as the workers; and finally
3. the **relationships** between workers and requesters of the work — both *cooperative* and *adversarial* cases.

The Processes of Making Gig(s) Work

The HCI community is perhaps most familiar with examples of task–based work such as 99designs, Amazon Mechanical Turk (AMT), and increasingly Uber & Lyft, which all allow requesters in various forms to tap into resources such as cars, computers, and above all "cognitive surplus" with relative ease [15, 8, 20, 43]. This insight, that workers can be geographically distributed and tasks decomposed, has proven remarkably compelling and an effective fulcrum for leveraging the Internet for highly scalable work [4, 25].

This section will largely discuss the processes at work that make distributed, digitally managed work both possible and indeed preferable for "requesters" (in other words, the employers who solicit workers). This body of research spans a broad field within the CSCW and broader HCI community. In this context, we'll look at the body of research through the lens of highlighting contributions which expand what we (as "requesters" of work) can do by managing workers in novel ways. This work broadly consists of three areas: 1) Decomposition, 2) Work Abstraction, and 3) Flexibility. As we explore this work, we'll attempt to relate the advances in the design of crowd work to the research contributions made in the research of assembly line manufacturing, Taylorism, and scientific management during the 20th century [16].

Decomposition

Piecework may be thought of as vertically slicing work such that each person is responsible for the whole task — making a whole garment, in this case. Broken down in this way, work could grow to unprecedented scales, but the quality of the work would remain relatively variable [31]. Textile work being a salient example, it took time for workers to acquire sufficient skill to do every aspect of the work so that the garment would be accepted by the company soliciting that work [54].

A compelling solution emerged in the early 20th century to break tasks down into discrete, manageable routines that could be taught relatively easily, and whose work output could be evaluated in abstraction from the rest of the work [2]. In Ford's assembly line, this meant that workers were not responsible for building a whole car, but a single very narrowly defined action that needed to be done on every car [30]. By the mid–20th

century, Schoenberger writes, "... the intensification of the labor process is argued to have hit mental, physical, and social limits." [40].

This approach, "Fordism" (and its better–known contemporary "Taylorism" of similar ethos), can be seen today in crowd work and on–demand labor through the application of micro–tasks. Teevan, Iqbal, and Veh highlight some of the advantages of breaking work into pieces, facilitating evaluation and parallelization [47]. By decomposing and recomposing tasks, and in particular by assigning similarly natured work to the same workers, workers could become "experts" in a small aspect of the work that they did, speeding their work dramatically [26]. Perhaps more important, however, was that the breaking down of work into tasks has made it more practical to evaluate work at each stage [36].

Scholarship describing and exploring the decomposition of tasks is perhaps the most established of the above areas among HCI researchers; Kittur et al. specifically drive at this goal by addressing the possibility of "crowdsourcing complex work" [23]. Cheng et al. found that microtasks — though not necessarily *faster* than "macrotasks" — yield higher quality work, particularly when that work might be readily interrupted [5]. Teevan, Liebling, and Lasecki further push the boundaries of decomposed work by exploring "selfsourcing", and further this work with Teevan et al. [48, 49]. While this work doesn't strictly fall under "crowdsourcing", the major contributions here seem uncontroversially to be inspired by the design of crowd work.

Much of the research in the space of designing crowd work has sought to illustrate the potential to take highly creative or skilled work and generate high–quality results. Perhaps the most notable case study here can be found in Retelny et al.'s *Foundry*, which employed "flash teams" to achieve expert–level outcomes via thoughtful decomposition of work as "modular tasks" [34].

Work decomposition, then, is far from new; "decomposition" generally illustrates the same concepts of work that "Taylorism" and scientific management sought to embody — Silberman, Irani, and Ross in particular foresaw this danger and warned of it in 2010 [24, 44, 32]. In both the historical and contemporary cases of decomposed work, work was, at least initially, distributed in the form of tasks to the homes of workers; Riis captured this in his documentary work *How the other half lives: Studies among the tenements of New York* in 1901 [35].

Work Abstraction

Decomposition allows requesters to assign tasks without concern for the broader context. While we'll discuss this aspect of crowd work more critically later, it's worth pointing out that discrete blocks of work containing all the relevant context for a worker allows workers to engage with virtually any component of work without worrying that their lack of higher–level awareness of the goals of the requester might negatively affect their work.

Chilton et al. perhaps best illustrated this with *Cascade* by demonstrating that it's possible to break certain classes of tasks apart in such a way that they yield taxonomies of various subjects, a task previously thought to be safely within the domain of expert workers with top–down awareness of the context of the work as a whole [6]. Verroios and Bernstein further illustrate this potential by forming a task one might consider highly contextually dependent — summarizing the contents of a movie — in such a way that crowd workers could contribute small pieces of work without needing to know the content of the rest of the project [53].

Here, Hu's work, saying of assembly line work that "it is assumed that men are of equal ability and every man can do any of the *n* jobs", parallels the approach that dominated early research into crowd work — namely, using non–expert crowds for complex work [16]. This mindset in Hu's analysis, and indeed the study of factory and mass manufacturing labor through the 20th century, substantively owes its existence to scientific management and the rigorous decomposition of work into tasks, discussed earlier, and persists to this day as it colors researchers' goals and objectives in the study and design of crowd work.

Piecework's influence on the abstraction of work into tasks, described above, is more than just caused by the decomposition of work; work abstraction itself makes it possible for workers to come and go flexibly, prompting work requesters to consider ways to design these now discrete tasks in ways that maximize flexibility, both by allowing (and even anticipating) some inconsistency in worker availability *and* allowing and anticipating some inconsistency in the quality of the work output itself. It's to this area that we now turn our attention.

Flexibility

Earlier we discussed Cheng et al.'s work measuring the impact that interruption has on worker performance. This work both points to and embodies a broader sentiment in both the study and practice of crowd work that microtasks should be designed resiliently against the variability of workers, fully exploiting the abstracted nature of each piece of work [18, 26, 52]. That is to say, micro–tasks should be designed such that a single worker's poor performance, or a good worker's sudden departure, would not significantly impact the agenda of the work as a whole. While Cheng et al. identified costs with breaking tasks into smaller components in the form of higher cumulative time to complete (albeit much shorter real time to complete, owing to parallelization), Lasecki et al. found that at least *some* performance can be recouped by stringing similar tasks together.

Given the importance of consistent work results, one might intuit that requesters would prefer high–quality workers who can be relied upon to be available (even for contextually independent tasks), which would appear to contradict the benefits of flexibility already discussed; requesters have thus made significant headway toward "embracing error" to allow requesters to maximize the benefits of a flexible, even transient, workforce.

Krishna et al. offer orders–of–magnitude improvements in various binary classification tasks on the principle that diverse workers complete these tasks in order to accurately inform the model on the variety of delays in response times. And

rather than building tasks to *tolerate* worker drop–off and attrition, some researchers have designed work predicated on the expectation of this phenomenon: Celis et al. describe ways of assigning tasks in such a way that crowd workers would never be given enough information to piece together sensitive information about any single topic [4].

Flexibility has been explored through the lens of Fordism, perhaps best illustrated by Tolliday and Zeitlin's treatment describing turnover rates rising above 300% in the decade leading to the introduction of the assembly line in 1913. Specifically, the utilization of "... 'semi–special' machine tools which could be adapted [and] ... added flexibility through seasonal layoffs for production workers and the use of piece rates ... rather than a day wage system" [50].

The Fallout of Crowd Work

Irani and Silberman point out the disillusion that companies such as Amazon foster on platforms for work like AMT (see also Salehi et al.'s work continuing in the spirit of this observation to generate collective action to improve worker conditions) [21, 39]. Lee et al. find similarly that workers on gig work platforms are frustrated by the systems on which they work, to say little of the policies which these systems enforce [27].

We discussed the benefits of flexibility (both in the sense of having arbitrary workers perform tasks and in the sense that we can design tasks to be more resilient to poor work) in the previous section. It's from that point in the literature that we turn our attention to the perhaps unintended effects of crowd work and the affordances for transience that we build into this mode of work. We'll address two major areas of work under this subject: 1) Low Pay; and 2) Variable quality work.

Low Pay

Horton and Chilton identified problems with crowd work wages relatively early on, attempting to address this imbalance from a behavioral economic perspective — that is, identifying and presenting a model that describes a worker's "*reservation wage*" [14]. This work has largely informed much of the research into and practice of estimating crowd work compensation [42, 33].

But we turn to Irani and Silberman's discussion of "*Turkopticon*", a system they designed to interrogate worker invisibility and to promote better wages across several dimensions [21]. Of particular relevance here, Irani and Silberman call to attention that "Turkers" are ultimately vulnerable to wage theft and pay rates that translate to well under minimum wage. Returning to Horton and Chilton, we find that the median "reservation wage" in 2010 was $1.38, while the mean was $3.63 [14].

Understanding workers' motivations given these conditions has thus become a goal for some researchers [3]. Sun, Wang, and Peng conclude that "... solvers participate in online tasks not only for money but also for enjoyment or the sense of self–worth" [46]. This might have rung true in 2011, and certainly corroborates Ross et al.'s findings after investigating "who are the crowdworkers", but as Silberman points out "we [have since] learned that most tasks on AMT are done by a small group of professional Turkers..." [37, 45].

Now, Irani and Silberman and later Salehi et al. cite insufficient pay as a central point of frustration among workers, via Irani and Cushing's contributions in this space [39, 19, 7, 21].

On–demand workers were not the first to be exploited along the dimension of low pay rates. Frustration over low (and declining) pay was one of the chief grievances among then nascent British labor unions in the early 20th century [51]. This, Ebbinghaus and Visser argued, fueled the rocketing union membership rates through the mid–20th century until 1980 (to which we'll return when we discuss Levi et al.'s reexamination of labor unions) [10, 29]. This realization has similarly fueled a body of research into the various incentive structures available to piecework employers [38].

The parallels between the complaints of low pay among crowd workers and other on–demand workers and the pieceworkers and later factory workers in the 20th century are inescapable. We argue further that the *causes* here — work decomposition, work abstraction, and flexibility — lead inexorably to low and declining pay for workers. Moreover, we point out that low pay leads to other negative outcomes both in on–demand work as well as in piecework and on assembly lines.

Variable quality work

Researchers have struggled with what we might generously call work of "variable quality" along two dimensions. The first, to use the characterization of one of these contributions, we can call "understanding malicious behavior" [12]. While some work has cast workers as "malicious" or at least adversarial parties, the evidence thus far suggests that workers behave in unexpected ways as they attempt to assert some control over their interaction with the system (a topic of discussion to which we'll return later) [27]. The second dimension of research in this space generally attempts to eke out the highest quality work possible from workers given the apparent difficulty in predicting work outcomes [25].

The effect low wages have had on piece work and factory workers is well–known; Gantt discuss this exact mechanism in his book on *Work, wages, and profits*, pointing out that "... where there is no union, the class wage is practically gauged by the wages the poor workman will accept, and the good workman soon becomes discouraged and *sets his pace by that of his less efficient neighbor*, with the result that the general tone of the shop is lowered" (emphasis added) [13].

This research is similar to, but subtly different from, the notion of the "market for 'lemons"' which Fort, Adda, and Cohen discuss; specifically, Akerlof's writing of a "market for 'lemons"' describes a marketplace where the quality of the product or service is unknown to the buyer [11, 1]. The effect of this *perceived* uncertainty is that the *actual* trustworthiness drops precipitously as all of the consistent, reliable, high–quality workers capable of leaving these markets do so, leaving only the ones who cannot or will not establish their trustworthiness.

Suffice it to say, then, that poor pay and poor work are linked, and that we should not be surprised to find this relationship play out online as strongly as it does offline.

Relationships Between Workers and Managers

External Management

Scientific management in other words; should I just call it that and get right into it? I kind of want the focus to be on the adversarial nature of the management, and "external" seems to connote that more strongly than "scientific", which has a tone of being more... Measured? Objective? Better?

There's a fair amount to say here, and lots to cite, so I'm not super concerned. I do want to bring up Irani and Silberman's "Stories We Tell About Labor: Turkopticon and the Trouble with "Design"" [20] as a way of pointing out that even in our effort to study piecework ethnographically, and despite our attempts to be reflexive and conscientious of the power dynamics that we bring into any discussion (as engineers, as people with megaphones, etc...) we still manage to influence and perhaps steer.

Alienated Workers

Marx's big entrance. Lily has lots of work pointing to this, and lots of that work points to yet more work gesturing in this direction. I want to bring a lot of that work that hasn't made it into the discussion yet into the conversation here.

Note to self: examples of citations would help make it clearer for MSB which ones I'm overlooking, if nothing else

Resistance

Lee et al.'s paper on Uber drivers [27].

Salehi et al. on *Dynamo*; Irani and Silberman on *Turkopticon* [21, 39].

BLEAK FUTURES

We've traced a path from piecework itself through the processes that describe the design and implementation of piece work and crowd work as part of the same thread; from there, we followed the trail from decomposition to work abstraction, and the potential to break work away from workers themselves, which in turn facilitates flexibility for requesters as well as workers

Factories

So work output is variable, and that's bad. What are we doing about it? Historically, this is what led to factories; you would pay some experts who understood what they needed to do and they would form a cohort into which you invest more.

Some research already looks at stuff like investing in workers [9]. What else is there that kind of goes in this direction? Informally, we know that this happens a lot [17]. AMT, meanwhile, offers requesters the ability to create tasks which are not just hidden from unqualified workers by default, but completely. Requesters have taken to using lists of worker IDs which reference workers who have proven their reliability, representing a sort of proto–organization of loosely connected workers.

IMPLICATIONS FOR DESIGN

If it's agreed that the major topics we've discussed thus far are related and — at least to *some* extent — precipitated in the fashion we argue, then we have a rare opportunity as researchers, and as agents of change in the communities we study, to affect change on the dynamics of crowd and on–demand work as they continue to develop.

Without claiming to have easy, cut–and–dry solutions to these problems, we can nevertheless bring to attention a number of critical opportunities to learn from historical parallels in piecework and factory labor, and make informed decisions regarding whether (or indeed how) we may want to influence outcomes. The challenges we bring to attention here are as follows: 1) codifying investment toward collective goods into the designs of systems; 2) (re–)decentralizing the internet (hey, it's lowercase now!); and 3) enabling reputation transferral.

Codify the common good

As Lessig points out in his book, digital media give designers the opportunity to design and build into the systems policies and practices to contribute to the collective benefit of the people therein [28]. Historically, the confluence of forces Lessig describes would ultimately result in outcomes such as benefits for workers, funds for sick leave and vacation, and other conveniences. The transient nature of on–demand work would seem to problematize this arrangement, but we can discuss and explore the viability of building into systems the mechanisms necessary to save a portion of payment from every gig, record taxable income, or myriad other generally administrative tasks automatically.

Decentralize the internet (again)

Digitally mediated on–demand labor markets have historically been insular and incompatible with one another, forcing workers either to choose one or juggle participation in these markets with great difficulty. Drivers

Deal with reputation

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