

Naming Things is Hard: Real Title Following Colon

Leave Authors Anonymous
for Submission
City, Country
e-mail address

Leave Authors Anonymous
for Submission
City, Country
e-mail address

Leave Authors Anonymous
for Submission
City, Country
e-mail address

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.

ACM Classification Keywords

H.5.m. Information Interfaces and Presentation (e.g. HCI): Miscellaneous; See <http://acm.org/about/class/1998/> for the full list of ACM classifiers. This section is required.

Author Keywords

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 microtasks, 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 [29, 20, 31]. 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 [19, 30, 24]. But the

connections between historical piecework and contemporary crowd work haven’t been deeply made as yet.

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 [21]. Following the improvements in breaking down tasks, delegating work, and managing workers more broadly, Crowd-powered has continued to parallel historical piecework’s trajectory by outgrowing ad-hoc worker groups and coalescing into more formal working groups; we might call this the beginning of factorization.

Making sense of this 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 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” [31]. For one, information work (e.g. 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 [19]. Sec-

Paste the appropriate copyright statement here. ACM now supports three different copyright statements:

- ACM copyright: ACM holds the copyright on the work. This is the historical approach.
- License: The author(s) retain copyright, but ACM receives an exclusive publication license.
- Open Access: The author(s) wish to pay for the work to be open access. The additional fee must be paid to ACM.

This text field is large enough to hold the appropriate release statement assuming it is single spaced.

Every submission will be assigned their own unique DOI string to be included here.

only, 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 [42]. 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 [30]. *[al2: I really don’t like this paragraph...]*

Piecework as a lens to understand gig work

Kittur et al. investigate the future of crowd work by situating and interrogating it through “piecework”, which historically described 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*) [21]. Given the scope, we can frame piecework and gig work 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..

Context

Importantly, since the reemergence of piecework we’ve seen substantial frustration and resistance among the workers in this area [24, 19, 30]. This paper attempts to make sense of the broader research on this piecework, or “gig work”, by framing this as one of several steps in the marginalization of workers. All of this is to say that these milestones follow sequentially, not coincidentally but necessarily, and that by tracing this path using the corpus of scholarship on labor and workers we can both make sense of past events and perhaps reasonably predict next steps.

We explore each topic — discretization, routinization, & management — by looking at case studies in social computing. Having validated this lens as a way of reasoning about contemporary piecework, or “gig work”, we turn to look ahead, envisioning future areas that researchers in social computing — and particularly digitally mediated work — should explore.

CASE STUDIES

The existing body of research has shed light on on-demand 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**, in “Making Gig(s) Work”;
2. the outcomes of that discretization, both on the work itself as well as the workers, in “The Fallout of Crowd Work”; and finally
3. the results of these forces; namely the turning of work toward **factories**, which we will discuss in “Factories”.

We will follow these topics, using them as prompts for case studies in the emergence and development of contemporary piecework.

Making Gig(s) Work

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 [15].

Decomposition

Scholarship describing and exploring the decomposition of tasks is perhaps the most established of the above areas among HCI researchers; Bernstein et al. made early contributions to this area with *Soylent* (by coining and employing the “find-fix-verify” approach) [2]. 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. [38, 39]. 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” [27].

Work decomposition 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 [21, 34, 25]. 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 [28].

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 [41].

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 [15]. 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 flexibly, fully exploiting the abstracted nature of each piece of work [16, 23, 40]. 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 myriad diverse workers complete these tasks in order to accurately inform the model. 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].

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) [19, 30]. 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 [24].

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*" [13]. This work has largely informed much of the research into and practice of estimating crowd work compensation [32, 26]. More cynically, we would describe this work as identifying optimal levels to activate race conditions among piece workers.

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 [19]. 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 [13].

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" [36]. 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..." [29, 35].

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 work [30, 17, 7, 19].

Variable quality work

Meanwhile, researchers have struggled with what we might call "variable quality work" along two dimensions: First, to

use the characterization of one of these contributions, “understanding malicious behavior” [10]. While some work has cast workers as “malicious” agents, 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) [24]. 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

The effect that poor wages have had on piece work and factory workers is hardly unknown or novel; 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) [11]. *[al2: Do I need to follow up or does this basically speak for itself?]*

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 [9, 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. Indeed,

Factories

The HCI community is perhaps most familiar with examples such as Innocentive, Uber, Lyft, and Amazon Mechanical Turk (AMT), which all allow requesters in various forms to tap into resources such as cars, computers, and above all “cognitive surplus” with relative ease [14, 8, 18, 33]. 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, 22].

While yellow-cab organizations often manage drivers in similar ways to platforms such as Uber and Lyft (inasmuch as drivers are often considered contractors, or otherwise exempt from the formal status of “employee”), these new systems go further by framing ownership and responsibility for costs (e.g. automotive maintenance) on drivers. In our fieldwork, we discovered many longtime “on-demand” drivers (affiliated with platforms such as Uber and Lyft) who readily voiced frustration with the costs of frequent oil changes and the unexpected replacement of expensive parts. Distributing labor had similar effects on pieceworkers at the turn of the 20th century; textile workers were given the source material with which to work, but were generally expected to use their own sewing materials and work in their own homes [12].

Distributing work in method described above may be thought of as vertically slicing work such that each person is responsible for the whole task — making a whole garment or being responsible for driving in a single neighborhood. Broken down in this way, work could grow to unprecedented scales, but the quality of the work would remain relatively variable. Textile work being a salient example, some seamstresses might be better than others at the same task, making this framing of the work initially problematic.

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. 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.

This approach paralleled what would be known as “Taylorism”, and its influences can be seen today in crowd work and micro-tasks. *talk about breaking tasks down both in general (Cheng) and even for the self (Teevan); horizontal cuts instead of vertical* [5, 37]. 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 [23]. Perhaps more important, however, was that the breaking down of work into tasks has made it more practical to evaluate work at each stage *[citation needed]*.

Opening the door to more discrete modules of work known as tasks Contributions such as “find-fix-verify” and “Cascade” make it easier to assign smaller components of work to myriad workers and recompose the constituent parts into something more complex [2, 6]. Some work has taken special interest in the process of breaking tasks down into more manageable parts inasmuch as decomposing what we might call “macro” tasks into microtasks, both for the purposes of crowd-sourcing in the sense of out-sourcing work as well as “selfsourcing” [5, 38].

The parallels between this kind of work and historical piecework of the turn of the 20th century is by no means new.

The **discretization** and decomposition of work certainly facilitates breaking tasks down, parallelizing work, and getting more done across a broader array of people; but the key advantage in turning macro tasks into many micro tasks is that we can make that work *routine*.

By making larger bodies of work less contextually situated, we can define processes that make that work and the instructions thereof useful for virtually anyone with shared cultural or intellectual background.

routinization can be seen in the contemporary in work-flows [27, 2].

Looking forward

If we agree that discretization, routinization, management, and even resistance necessarily follow one another according

to this theoretical lens, then we have to use it to attempt to envision what comes next.

I've been going back and forth regarding how to frame this paper; the approach that tries to look at things that are similar vs things that are different doesn't seem to work, but I've left the thoughts here because it's not all completely bad.

THINGS STAY THE SAME

How is gig work the same as it's been historically?

I think this section would be compelling to draw parallels between the narratives drivers gave about the flexibility, autonomy, etc. . . and that which we might have seen among pieceworkers (predominantly women, who benefited from being able to work from home).

Flexibility

Are there cultural differences between the people that did piecework and the people that do gig work now? I'm not sure there are significant differences that have affected the outcomes so far.

Many of the workers to whom piecework appealed were mothers, wives, etc. . . who mostly stayed at home for various reasons (certainly largely it was cultural — women weren't afforded equal access to labor opportunities, making in-home job opportunities not only compelling, but also one of few available options).

Gig workers are in some senses similarly constrained: workers on Amazon Mechanical Turk — those that use it as a primary source of income, at least — report being homebound for various reasons (e.g. medical, parenting, etc. . .). Society and circumstance have made it difficult or impossible to join the contemporary, conventional workforce; gig work re-opens that door.

But there are differences; during our research over the summer, we spoke to drivers on Uber and Lyft, cleaners, and other gig workers. Many of them told us about their home lives — about children, spouses, and other commitments — to which they wanted to dedicate more time. One driver (let's call him Raúl) told me about how he drove for Lyft after working as an inventory manager at a hospital for more than nine years.

I asked him why he quit that job and forewent the benefits, predictability, and career growth opportunity that his old job offered. He told me that when his daughter was born, he was overcome with a desire to spend more time with her. No longer satisfied with work where he often left before his daughter would wake up and return after she fell asleep, Raúl decided to start driving for Lyft, because he could drive in the evenings when his daughter was asleep.

Other drivers reported similar benefits; gig work affords its workers flexibility that conventional careers don't allow.

routinization of work

This leads into the next section, but I want to bring up the process of making work about mass-manufacturing, at least inasmuch as the instructions are the same for everyone.

The Internet arguably has made it much easier to broadcast those instructions, but it's had this deeper effect of enabling some amount of back-and-forth between the worker and the (algorithmic) manager.

Taylorism

The routinization of work makes it possible to measure that process, optimize it for certain characteristics, and ultimately lead to Taylorism and scientific management. This is not new; researchers have studied and written about the slow creep of algorithmic management and discretization & routinization of work tasks.

We hope to take a step back from the context in which this work is often applied, and look for its place in the larger trends and theories to make sense of the trends of gig work at large.

Industrialization and the automobile assembly line makes this famous, but piecework functioned on the principle that everyone was making similar or identical garments and other products.

Now, we see Turkers being evaluated on the outcome of their work conforming to norms, sometimes bootstrapped, as in Ranjay's talk on "Embracing Error to Enable Rapid Crowdsourcing", but more conventionally in work flows like "Find-Fix-Verify".

This might be an opportunity to reflect on how pieceworkers internalized the work they were doing, responded to the stress of the uncertainty of potentially rejected work, etc. . . but I'm not familiar with research in that space.

The emergence of decentralized workplaces

The practice of in-home piecework was consumed by the centralization of factories (the effect of which we'll talk about later, since we can talk about how this made unions more practical), but for a time many pieceworkers at the turn of the 20th century worked out of their homes. Strikingly, many of the gig workers Kittur et al. discussed in 2013, and indeed many more continue to do what we might call "information work" — that is, work that predominantly demands human computation — but increasingly we're seeing the movement toward transient work that largely requires embodied presence [24] (and others).

What was this about?

I was going to check in quickly and take a photo of your whiteboard (hoping that you'd kept our conversation notes around) but your room was *literally* full of people lol.

THINGS ARE CHANGING

The medium on which this work is being done — and to an extent the medium used to manage workers — has dramatically changed things as well, however; workers are distributed around the world, working out of their cars in the cases of delivery services (notably, never returning to a base of operations) across and between cities as well as nations, or in their homes (paralleling the trend of piecework even more closely).

Trying to understand how gig work has differed from piecework should at least start with looking at the different characteristics of the work involved. After that, we should think about how the demography and culture of the people engaging in this kind of work have changed versus that of the pieceworkers.

Differences in the work itself

Gig work has all of the above similarities with piecework, but there are key differences.

Piecework emerged at the turn of the 20th century, right at the time that telecommunications began to boom in the United States. *Did telecom enable remote management?*

Gig work in its contemporary formation is largely mediated by ubiquitously accessible digital media (the Internet, telephony, etc. . .) and importantly has relied on this technology to facilitate the remote management of workers [24].

Has the work fundamentally changed, or are we just being managed remotely in different ways? I'm not entirely sure.

How does this work differ from the experience of being “on-call” that is so familiar to retail employees? How does this work differ from the work in which truckers, taxi drivers, and other independent contractors have been participating for decades? We argue that the substantive difference in these markets is the speed of the market itself, motivated by the technology which mediates it. Because workers can be sourced and dispatched virtually instantly, businesses that engage in this kind of work (e.g. Uber, Amazon Mechanical Turk, etc. . .) have taken to removing other bottlenecks, like vetting workers upfront

MORE DELIBERATE WORK

References

- [1] George A Akerlof. “The market for” lemons”: Quality uncertainty and the market mechanism”. In: *The quarterly journal of economics* (1970), pp. 488–500.
- [2] Michael S. Bernstein et al. “Soylent: A Word Processor with a Crowd Inside”. In: UIST ’10 (2010), pp. 313–322. DOI: [10.1145/1866029.1866078](https://doi.org/10.1145/1866029.1866078). URL: <http://doi.acm.org/10.1145/1866029.1866078>.
- [3] Robin Brewer, Meredith Ringel Morris, and Anne Marie Piper. ““Why Would Anybody Do This?”: Understanding Older Adults’ Motivations and Challenges in Crowd Work”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. Santa Clara, California, USA: ACM, 2016, pp. 2246–2257. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858198](https://doi.org/10.1145/2858036.2858198). URL: <http://doi.acm.org/10.1145/2858036.2858198>.
- [4] L. Elisa Celis et al. “Assignment Techniques for Crowdsourcing Sensitive Tasks”. In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW ’16. San Francisco, California, USA: ACM, 2016, pp. 836–847. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2835202](https://doi.org/10.1145/2818048.2835202). URL: <http://doi.acm.org/10.1145/2818048.2835202>.
- [5] Justin Cheng et al. “Break it down: A comparison of macro-and microtasks”. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. ACM, 2015, pp. 4061–4064.
- [6] Lydia B Chilton et al. “Cascade: Crowdsourcing taxonomy creation”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. ACM, 2013, pp. 1999–2008.
- [7] Ellen Cushing. *Dawn of the Digital Sweatshop*. Aug. 2012. URL: <http://www.eastbayexpress.com/oakland/dawn-of-the-digital-sweatshop/Content?oid=3301022>.
- [8] Tawanna R. Dillahunt and Amelia R. Malone. “The Promise of the Sharing Economy Among Disadvantaged Communities”. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI ’15. Seoul, Republic of Korea: ACM, 2015, pp. 2285–2294. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702189](https://doi.org/10.1145/2702123.2702189). URL: <http://doi.acm.org/10.1145/2702123.2702189>.
- [9] Karën Fort, Gilles Adda, and K Bretonnel Cohen. “Amazon mechanical turk: Gold mine or coal mine?” In: *Computational Linguistics* 37.2 (2011), pp. 413–420.
- [10] Ujwal Gadiraju et al. “Understanding Malicious Behavior in Crowdsourcing Platforms: The Case of Online Surveys”. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI ’15. Seoul, Republic of Korea: ACM, 2015, pp. 1631–1640. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702443](https://doi.org/10.1145/2702123.2702443). URL: <http://doi.acm.org/10.1145/2702123.2702443>.
- [11] Henry Laurence Gantt. *Work, wages, and profits*. Engineering Magazine Co., 1913.
- [12] Laura Hapke. *Sweatshop: the history of an American idea*. Rutgers University Press, 2004.
- [13] John Joseph Horton and Lydia B. Chilton. “The Labor Economics of Paid Crowdsourcing”. In: *Proceedings of the 11th ACM Conference on Electronic Commerce*. EC ’10. Cambridge, Massachusetts, USA: ACM, 2010, pp. 209–218. ISBN: 978-1-60558-822-3. DOI: [10.1145/1807342.1807376](https://doi.org/10.1145/1807342.1807376). URL: <http://doi.acm.org/10.1145/1807342.1807376>.
- [14] Jeff Howe. “The rise of crowdsourcing”. In: *Wired magazine* 14.6 (2006), pp. 1–4.
- [15] Te C Hu. “Parallel Sequencing and Assembly Line Problems”. In: *Operations Research* 9.6 (1961), pp. 841–848. DOI: [10.1287/opre.9.6.841](https://doi.org/10.1287/opre.9.6.841). eprint: <http://dx.doi.org/10.1287/opre.9.6.841>. URL: <http://dx.doi.org/10.1287/opre.9.6.841>.
- [16] Shamsi T. Iqbal and Brian P. Bailey. “Effects of Intelligent Notification Management on Users and Their Tasks”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI ’08. Florence, Italy: ACM, 2008, pp. 93–102. ISBN: 978-1-60558-011-1. DOI: [10.1145/1357054.1357070](https://doi.org/10.1145/1357054.1357070). URL: <http://doi.acm.org/10.1145/1357054.1357070>.

- [17] Lilly Irani. "The cultural work of microwork". In: *New Media & Society* 17.5 (2015), pp. 720–739.
- [18] Lilly C. Irani and M. Six Silberman. "Stories We Tell About Labor: Turkopticon and the Trouble with "Design"". In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI '16. Santa Clara, California, USA: ACM, 2016, pp. 4573–4586. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858592](https://doi.org/10.1145/2858036.2858592). URL: <http://doi.acm.org/10.1145/2858036.2858592>.
- [19] Lilly C. Irani and M. Six Silberman. "TurkoPtion: Interrupting Worker Invisibility in Amazon Mechanical Turk". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '13. Paris, France: ACM, 2013, pp. 611–620. ISBN: 978-1-4503-1899-0. DOI: [10.1145/2470654.2470742](https://doi.org/10.1145/2470654.2470742). URL: <http://doi.acm.org/10.1145/2470654.2470742>.
- [20] Aniket Kittur, Ed H. Chi, and Bongwon Suh. "Crowdsourcing User Studies with Mechanical Turk". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '08. Florence, Italy: ACM, 2008, pp. 453–456. ISBN: 978-1-60558-011-1. DOI: [10.1145/1357054.1357127](https://doi.org/10.1145/1357054.1357127). URL: <http://doi.acm.org/10.1145/1357054.1357127>.
- [21] Aniket Kittur et al. "The Future of Crowd Work". In: *Proceedings of the 2013 Conference on Computer Supported Cooperative Work*. CSCW '13. San Antonio, Texas, USA: ACM, 2013, pp. 1301–1318. ISBN: 978-1-4503-1331-5. DOI: [10.1145/2441776.2441923](https://doi.org/10.1145/2441776.2441923). URL: <http://doi.acm.org/10.1145/2441776.2441923>.
- [22] Ranjay A. Krishna et al. "Embracing Error to Enable Rapid Crowdsourcing". In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI '16. Santa Clara, California, USA: ACM, 2016, pp. 3167–3179. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858115](https://doi.org/10.1145/2858036.2858115). URL: <http://doi.acm.org/10.1145/2858036.2858115>.
- [23] Walter S. Lasecki et al. "The Effects of Sequence and Delay on Crowd Work". In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI '15. Seoul, Republic of Korea: ACM, 2015, pp. 1375–1378. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702594](https://doi.org/10.1145/2702123.2702594). URL: <http://doi.acm.org/10.1145/2702123.2702594>.
- [24] Min Kyung Lee et al. "Working with Machines: The Impact of Algorithmic and Data-Driven Management on Human Workers". In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI '15. Seoul, Republic of Korea: ACM, 2015, pp. 1603–1612. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702548](https://doi.org/10.1145/2702123.2702548). URL: <http://doi.acm.org/10.1145/2702123.2702548>.
- [25] Jeffrey V Nickerson. "Crowd work and collective learning". In: *Technology-Enhanced Professional Learning*. Routledge, Forthcoming (2013).
- [26] Gabriele Paolacci, Jesse Chandler, and Panagiotis G Ipeirotis. "Running experiments on amazon mechanical turk". In: *Judgment and Decision making* 5.5 (2010), pp. 411–419.
- [27] Daniela Retelny et al. "Expert Crowdsourcing with Flash Teams". In: *Proceedings of the 27th Annual ACM Symposium on User Interface Software and Technology*. UIST '14. Honolulu, Hawaii, USA: ACM, 2014, pp. 75–85. ISBN: 978-1-4503-3069-5. DOI: [10.1145/2642918.2647409](https://doi.org/10.1145/2642918.2647409). URL: <http://doi.acm.org/10.1145/2642918.2647409>.
- [28] Jacob August Riis. *How the other half lives: Studies among the tenements of New York*. Penguin, 1901.
- [29] Joel Ross et al. "Who Are the Crowdworkers?: Shifting Demographics in Mechanical Turk". In: *CHI '10 Extended Abstracts on Human Factors in Computing Systems*. CHI EA '10. Atlanta, Georgia, USA: ACM, 2010, pp. 2863–2872. ISBN: 978-1-60558-930-5. DOI: [10.1145/1753846.1753873](https://doi.org/10.1145/1753846.1753873). URL: <http://doi.acm.org/10.1145/1753846.1753873>.
- [30] Niloufar Salehi et al. "We Are Dynamo: Overcoming Stalling and Friction in Collective Action for Crowd Workers". In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI '15. Seoul, Republic of Korea: ACM, 2015, pp. 1621–1630. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702508](https://doi.org/10.1145/2702123.2702508). URL: <http://doi.acm.org/10.1145/2702123.2702508>.
- [31] Trebor Scholz. *Digital labor: The Internet as playground and factory*. Routledge, 2012.
- [32] Aaron D. Shaw, John J. Horton, and Daniel L. Chen. "Designing Incentives for Inexpert Human Raters". In: *Proceedings of the ACM 2011 Conference on Computer Supported Cooperative Work*. CSCW '11. Hangzhou, China: ACM, 2011, pp. 275–284. ISBN: 978-1-4503-0556-3. DOI: [10.1145/1958824.1958865](https://doi.org/10.1145/1958824.1958865). URL: <http://doi.acm.org/10.1145/1958824.1958865>.
- [33] Clay Shirky. *Cognitive surplus: Creativity and generosity in a connected age*. Penguin UK, 2010.
- [34] M Silberman, Lilly Irani, and Joel Ross. "Ethics and tactics of professional crowdwork". In: *XRDS: Crossroads, The ACM Magazine for Students* 17.2 (2010), pp. 39–43.
- [35] Six Silberman. *Stop citing Ross et al. 2010, "Who are the crowdworkers?"*. 2015. URL: <https://medium.com/@silberman/stop-citing-ross-et-al-2010-who-are-the-crowdworkers-b3b9b1e8d300>.
- [36] Yongqiang Sun, Nan Wang, and Zeyu Peng. "Working for one penny: Understanding why people would like to participate in online tasks with low payment". In: *Computers in Human Behavior* 27.2 (2011). Web 2.0 in Travel and Tourism: Empowering and Changing the Role of Travelers, pp. 1033–1041. ISSN: 0747-5632. DOI: [10.1016/j.chb.2010.12.007](https://doi.org/10.1016/j.chb.2010.12.007). URL: <http://www.sciencedirect.com/science/article/pii/S0747563210003742>.

- [37] Jaime Teevan, Shamsi T. Iqbal, and Curtis von Veh. “Supporting Collaborative Writing with Microtasks”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. Santa Clara, California, USA: ACM, 2016, pp. 2657–2668. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858108](https://doi.org/10.1145/2858036.2858108). URL: <http://doi.acm.org/10.1145/2858036.2858108>.
- [38] Jaime Teevan, Daniel J. Liebling, and Walter S. Lasecki. “Selfsourcing Personal Tasks”. In: *CHI ’14 Extended Abstracts on Human Factors in Computing Systems*. CHI EA ’14. Toronto, Ontario, Canada: ACM, 2014, pp. 2527–2532. ISBN: 978-1-4503-2474-8. DOI: [10.1145/2559206.2581181](https://doi.org/10.1145/2559206.2581181). URL: <http://doi.acm.org/10.1145/2559206.2581181>.
- [39] Jaime Teevan et al. “Productivity Decomposed: Getting Big Things Done with Little Microtasks”. In: *Proceedings of the 2016 CHI Conference Extended Abstracts on Human Factors in Computing Systems*. CHI EA ’16. Santa Clara, California, USA: ACM, 2016, pp. 3500–3507. ISBN: 978-1-4503-4082-3. DOI: [10.1145/2851581.2856480](https://doi.org/10.1145/2851581.2856480). URL: <http://doi.acm.org/10.1145/2851581.2856480>.
- [40] Rajan Vaish et al. “Low Effort Crowdsourcing: Leveraging Peripheral Attention for Crowd Work”. In: *Second AAAI Conference on Human Computation and Crowdsourcing*. 2014.
- [41] Vasilis Verroios and Michael S Bernstein. “Context trees: Crowdsourcing global understanding from local views”. In: *Second AAAI Conference on Human Computation and Crowdsourcing*. 2014.
- [42] Donald E Wray. “Marginal men of industry: The foremen”. In: *American Journal of Sociology* (1949), pp. 298–301.