

INTRODUCTION

The past decade has seen a flourishing of on-demand work where the statuses of workers have become so fleeting that these workers (known colloquially as “Turkers”) have been described as “transient” [14, 24, 19]. The realization that tasks can be accomplished by directing and managing this crowd of workers has spurred the research and industry communities to flock to sites of labor like Amazon’s Mechanical Turk (AMT) to explore the limits of this distributed, seemingly ephemeral labor force. Researchers in particular have taken to the space in earnest, finding opportunities to enable new forms of work as well as using Turkers as representative populations of the public [1, 37, 28].

The many sites of work replicating and extending on the general style of labor popularized by AMT have predominantly involved work done on a computer or involving the human processing of data, leading many to call this “information work” [13, 33, 11, 27]. Howe defined “crowdsourcing” in 2008 as “taking a job traditionally performed by a designated agent (usually an employee) and outsourcing it to an undefined, generally large group of people in the form of an open call” [10].

In the years since, scholars have generated taxonomies for the work done by many distributed workers in an attempt to better categorize and reason about the many forms of work done on information work platforms such as AMT, oDesk, etc. . . [42, 6, 29]. We add that, under Howe’s constraints, even *more* new forms of work fall squarely under the metaphorical umbrella we collectively call “crowdsourcing”.

Indeed, this on-demand workforce has sparked interest across industries ranging livery (driving for hire, for example Uber), house-cleaning (Handy), and generalized services (TaskRabbit) [39, 9, 38]. Today, a rapidly growing transient workforce is forming, itself assembling piece-by-piece as industries and researchers find yet more unexpected ways to benefit from a latent pool of previously vetted workers [35].

Researchers have made efforts to understand the people that have gravitated toward crowdsourcing platforms since its emergence and popularization, but as the form of work has grown and changed, so too have the demographics of workers [31, 34]. Some of this research has been motivated by the realization of the sociality of gig work, and the frustration and disenfranchisement that these systems embody [13, 32]. Other work has focused on the outcomes of work, reflecting on the resistance workers express against digitally mediated labor markets [21].

The extant body of work has ostensibly sought to answer one underlying question: What does the future hold for work and those that do it? Researchers have offered their input on this open question along three major threads of scholarship:

1. What are the limits of crowdsourcing? Perhaps more tightly constrained, what can and cannot be done by crowd workers? [30, 36, 15, 41, 40, 17, 25, 8];
2. What forms of work design, and worker management and arrangement, are viable? [1, 4, 22, 18, 20, 3, 5, 26]; and

3. What will work and the place of work look like for the workers? [13, 12, 32, 7, 2, 23]

Piecework as a lens to understand crowdsourcing

This large and growing body of research has conversed to varying degrees with labor scholarship, but has not offered a persuasive framing for holistically explaining the developments in worker processes that researchers have developed, or the phenomena in social environments we have observed; nor has any research, to our knowledge, gone as far as predict future developments.

We offer a framing for crowd work spanning the aforementioned industries collectively as a contemporary instantiation of “piecework”. Piecework as a metaphor for the type of work at hand is not new. Indeed, Kittur et al. in Kittur et al. referenced crowd work as “piecework” briefly as a loose analogy to the form of work emerging at the time [16].

But more than this, the framing of on-demand labor as piecework (re-instantiated) allows us to attempt to make sense of the broader research on this new form of work by evaluating this work through a much more refined lens. More concretely, by looking at task-based or “gig” 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) bring into focus the ongoing work among workers, system-designers, and researchers in this space; and finally, 3) 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. Finally, we will offer design implications based on this research. . .

[al2: notes/what i want to get across. . .

- on-demand labor has consumed an increasing proportion of the labor market in the past ten years [*Pew research on on-demand labor*]; the work has ranged from Turk work processes
- some of it has been about resisting Uber & other gig labor platforms [1, 21]; some researchers have tackled understanding this new instantiation of work, but come up short (*how*).
- (what binds this together)
- we offer a framing on this topic that situates the research so far on a timeline of the maturation of another form of work that emerged approximately 150 years ago — that is, piecework — which convincingly suggests that on-demand labor in the form of Turking, driving for Uber, etc. . . are in fact little more than piecework re-surfing today.
- this paper will trace the body of research describing microwork — and later gig work — and place it in the context

- of historical piecework and the industrial revolution as a whole.
- informed by this new lens, we'll then turn our attention to the future of this re-emergent form of work, and suggest ways that researchers and users of on-demand labor might influence the outcomes we predict in this paper.

]

References

- [1] 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>.
- [2] 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. New York, NY, 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>.
- [3] Carrie J. Cai, Shamsi T. Iqbal, and Jaime Teevan. "Chain Reactions: The Impact of Order on Microtask Chains". In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI '16. New York, NY, USA: ACM, 2016, pp. 3143–3154. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858237](https://doi.org/10.1145/2858036.2858237). URL: <http://doi.acm.org/10.1145/2858036.2858237>.
- [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. New York, NY, 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] Joseph Chee Chang, Aniket Kittur, and Nathan Hahn. "Alloy: Clustering with Crowds and Computation". In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI '16. New York, NY, USA: ACM, 2016, pp. 3180–3191. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858411](https://doi.org/10.1145/2858036.2858411). URL: <http://doi.acm.org/10.1145/2858036.2858411>.
- [6] David Geiger et al. "Managing the Crowd: Towards a Taxonomy of Crowdsourcing Processes." In: *AMCIS*. 2011.
- [7] Mary L. Gray et al. "The Crowd is a Collaborative Network". In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW '16. New York, NY, USA: ACM, 2016, pp. 134–147. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2819942](https://doi.org/10.1145/2818048.2819942). URL: <http://doi.acm.org/10.1145/2818048.2819942>.
- [8] Nathan Hahn et al. "The Knowledge Accelerator: Big Picture Thinking in Small Pieces". In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI '16. New York, NY, USA: ACM, 2016, pp. 2258–2270. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858364](https://doi.org/10.1145/2858036.2858364). URL: <http://doi.acm.org/10.1145/2858036.2858364>.
- [9] *House Cleaning, Handyman, Lawn Care Services in Austin, Denver, Kansas City, Minneapolis and San Francisco* — Zaarly. Sept. 2015. URL: <https://www.zaarly.com/>.
- [10] Jeff Howe. *Crowdsourcing: How the power of the crowd is driving the future of business*. Random House, 2008.
- [11] Lilly Irani and M. Six Silberman. "From Critical Design to Critical Infrastructure: Lessons from Turkopticon". In: *interactions* 21.4 (July 2014), pp. 32–35. ISSN: 1072-5520. DOI: [10.1145/2627392](https://doi.org/10.1145/2627392). URL: <http://doi.acm.org/10.1145/2627392>.
- [12] 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. New York, NY, 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>.
- [13] Lilly C. Irani and M. Six Silberman. "Turkopticon: Interrupting Worker Invisibility in Amazon Mechanical Turk". In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI '13. New York, NY, USA: 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>.
- [14] David R. Karger, Sewoong Oh, and Devavrat Shah. "Iterative Learning for Reliable Crowdsourcing Systems". In: *Advances in Neural Information Processing Systems* 24. Ed. by J. Shawe-Taylor et al. Curran Associates, Inc., 2011, pp. 1953–1961. URL: <http://papers.nips.cc/paper/4396-iterative-learning-for-reliable-crowdsourcing-systems.pdf>.
- [15] Joy Kim and Andres Monroy-Hernandez. "Storia: Summarizing Social Media Content Based on Narrative Theory Using Crowdsourcing". In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW '16. New York, NY, USA: ACM, 2016, pp. 1018–1027. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2820072](https://doi.org/10.1145/2818048.2820072). URL: <http://doi.acm.org/10.1145/2818048.2820072>.
- [16] Aniket Kittur et al. "The Future of Crowd Work". In: *Proceedings of the 2013 Conference on Computer-Supported Cooperative Work*. CSCW '13. New York, NY, 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>.
- [17] 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. New York, NY, 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>.

- [18] Pavel Kucherbaev et al. “ReLauncher: Crowdsourcing Micro-Tasks Runtime Controller”. In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW ’16. New York, NY, USA: ACM, 2016, pp. 1609–1614. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2820005](https://doi.org/10.1145/2818048.2820005). URL: <http://doi.acm.org/10.1145/2818048.2820005>.
- [19] Thomas D LaToza et al. “Crowd development”. In: *Cooperative and Human Aspects of Software Engineering (CHASE), 2013 6th International Workshop on*. Citeseer. 2013, pp. 85–88.
- [20] Edith Law et al. “Curiosity Killed the Cat, but Makes Crowdwork Better”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. New York, NY, USA: ACM, 2016, pp. 4098–4110. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858144](https://doi.org/10.1145/2858036.2858144). URL: <http://doi.acm.org/10.1145/2858036.2858144>.
- [21] 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. New York, NY, USA: 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>.
- [22] Ioanna Lykourantzou et al. “Personality Matters: Balancing for Personality Types Leads to Better Outcomes for Crowd Teams”. In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW ’16. New York, NY, USA: ACM, 2016, pp. 260–273. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2819979](https://doi.org/10.1145/2818048.2819979). URL: <http://doi.acm.org/10.1145/2818048.2819979>.
- [23] Brian McInnis et al. “Taking a HIT: Designing Around Rejection, Mistrust, Risk, and Workers’ Experiences in Amazon Mechanical Turk”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. New York, NY, USA: ACM, 2016, pp. 2271–2282. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858539](https://doi.org/10.1145/2858036.2858539). URL: <http://doi.acm.org/10.1145/2858036.2858539>.
- [24] Tanushree Mitra, C.J. Hutto, and Eric Gilbert. “Comparing Person- and Process-centric Strategies for Obtaining Quality Data on Amazon Mechanical Turk”. In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI ’15. New York, NY, USA: ACM, 2015, pp. 1345–1354. ISBN: 978-1-4503-3145-6. DOI: [10.1145/2702123.2702553](https://doi.org/10.1145/2702123.2702553). URL: <http://doi.acm.org/10.1145/2702123.2702553>.
- [25] Michael Nebeling et al. “WearWrite: Crowd-Assisted Writing from Smartwatches”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. New York, NY, USA: ACM, 2016, pp. 3834–3846. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858169](https://doi.org/10.1145/2858036.2858169). URL: <http://doi.acm.org/10.1145/2858036.2858169>.
- [26] Edward Newell and Derek Ruths. “How One Microtask Affects Another”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. New York, NY, USA: ACM, 2016, pp. 3155–3166. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858490](https://doi.org/10.1145/2858036.2858490). URL: <http://doi.acm.org/10.1145/2858036.2858490>.
- [27] Judith S. Olson and Gary M. Olson. “How to Make Distance Work Work”. In: *interactions* 21.2 (Mar. 2014), pp. 28–35. ISSN: 1072-5520. DOI: [10.1145/2567788](https://doi.org/10.1145/2567788). URL: <http://doi.acm.org/10.1145/2567788>.
- [28] 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.
- [29] Alexander J. Quinn and Benjamin B. Bederson. “Human Computation: A Survey and Taxonomy of a Growing Field”. In: *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. CHI ’11. New York, NY, USA: ACM, 2011, pp. 1403–1412. ISBN: 978-1-4503-0228-9. DOI: [10.1145/1978942.1979148](https://doi.org/10.1145/1978942.1979148). URL: <http://doi.acm.org/10.1145/1978942.1979148>.
- [30] 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. New York, NY, 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>.
- [31] 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. New York, NY, 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>.
- [32] 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. New York, NY, USA: 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>.
- [33] M. Six Silberman, Lilly Irani, and Joel Ross. “Ethics and Tactics of Professional Crowdwork”. In: *XRDS* 17.2 (Dec. 2010), pp. 39–43. ISSN: 1528-4972. DOI: [10.1145/1869086.1869100](https://doi.org/10.1145/1869086.1869100). URL: <http://doi.acm.org/10.1145/1869086.1869100>.
- [34] Six Silberman. *Stop citing Ross et al. 2010, “Who are the crowdworkers?”*. Mar. 2015. URL: <https://medium.com/@silberman/stop-citing-ross-et-al-2010-who-are-the-crowdworkers-b3b9b1e8d300>.
- [35] Aaron Smith. *Shared, Collaborative, and On Demand: The New Digital Economy*. May 2016.

- [36] Ryo Suzuki et al. “Atelier: Repurposing Expert Crowdsourcing Tasks As Micro-internships”. In: *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*. CHI ’16. New York, NY, USA: ACM, 2016, pp. 2645–2656. ISBN: 978-1-4503-3362-7. DOI: [10.1145/2858036.2858121](https://doi.org/10.1145/2858036.2858121). URL: <http://doi.acm.org/10.1145/2858036.2858121>.
- [37] John C. Tang et al. “Reflecting on the DARPA Red Balloon Challenge”. In: *Commun. ACM* 54.4 (Apr. 2011), pp. 78–85. ISSN: 0001-0782. DOI: [10.1145/1924421.1924441](https://doi.org/10.1145/1924421.1924441). URL: <http://doi.acm.org/10.1145/1924421.1924441>.
- [38] *TaskRabbit connects you to safe and reliable help in your neighborhood*. Sept. 2015. URL: <https://www.taskrabbit.com/>.
- [39] *Uber*. Sept. 2015. URL: <https://www.uber.com/>.
- [40] Lixiu Yu, Aniket Kittur, and Robert E. Kraut. “Encouraging “Outside- The- Box” Thinking in Crowd Innovation Through Identifying Domains of Expertise”. In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW ’16. New York, NY, USA: ACM, 2016, pp. 1214–1222. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2820025](https://doi.org/10.1145/2818048.2820025). URL: <http://doi.acm.org/10.1145/2818048.2820025>.
- [41] Alvin Yuan et al. “Almost an Expert: The Effects of Rubrics and Expertise on Perceived Value of Crowdsourced Design Critiques”. In: *Proceedings of the 19th ACM Conference on Computer-Supported Cooperative Work & Social Computing*. CSCW ’16. New York, NY, USA: ACM, 2016, pp. 1005–1017. ISBN: 978-1-4503-3592-8. DOI: [10.1145/2818048.2819953](https://doi.org/10.1145/2818048.2819953). URL: <http://doi.acm.org/10.1145/2818048.2819953>.
- [42] M. C. Yuen, I. King, and K. S. Leung. “A Survey of Crowdsourcing Systems”. In: *Privacy, Security, Risk and Trust (PASSAT) and 2011 IEEE Third International Conference on Social Computing (SocialCom), 2011 IEEE Third International Conference on*. Oct. 2011, pp. 766–773. DOI: [10.1109/PASSAT/SocialCom.2011.203](https://doi.org/10.1109/PASSAT/SocialCom.2011.203).