Achieving greater complexity

Crowdwork's perspective. **Crowdsourcing research has spent the better part of a decade attempting to prove the viability of crowdsourcing in increasingly complex work.** Kittur et al. map the discussion toward this goal in their work on crowdsourcing complex work [8]. The broader body of work has varied significantly in type — providing conversational assistants, interpreting medical data, and telling coherent and compelling stories, to name a few examples [9, 15, 7].

This body of research has involved similar approaches to problems, often involving insights made in Computer Science and applied to human work–flows. The crowdwork literature typically identifies target milestones in CS that have presented significant challenges for researchers, leverages some of the approaches and insights that Computer Science researchers have already made (for example, MapReduce in the case of Kittur et al.'s *CrowdForge*), and arranges humans as computational black boxes within those approaches and processes [8, 18, and others]. This approach has proven a compelling one because it leverages the in–built advantages that technology and digital media afford. *Foundry*'s tools for managing and arranging expert groups into a cohort allow researchers to convincingly argue that expert teams can be rapidly formed, just like non–expert teams [18].

Piecework's perspective. **The research into piecework makes the case that piecework has been limited principally by the challenges of human management and oversight.** Graves describes a case study in Santa Fe Railway, which deployed scientific management and a piecework regime in an attempt to stymie rising repair costs [4]. Returning to Hart's reflections on piecework's limitations, we recall the multidimensional problem — tasks comprising of numerous, sometimes conflicting, goals [5]. It would be reasonable, then, to infer that work like this — reasonably highly skilled work where quality is difficult to assess — would be unsuitable for piecework.

Hart and Graves, without acknowledging one another, seemingly corroborate one another's conclusions at different levels of observation. Graves enumerates some of the roles required to facilitate piecework in the early 20th century: "... piecework clerks, inspectors, and 'experts'..." [5, 4]. Graves and Hart may seem to be making differing claims about the limitations of piecework, but we argue that Graves is simply making a more concrete observation illustrating the insight that Hart later makes. Graves recognizes that it's necessary for a successful piecework shop to employ clerks, inspectors, and other experts to properly design and evaluate complex work. Hart argues an ultimate limit to how far this can go; at some point, evaluating multidimensional work output for quality (rather than for quantity) becomes infeasible.

Piecework researchers also make claims regarding the organizations that benefit from piecework in the first place. Brown discusses the factors necessary for piecework to thrive: "... incentive pay is less likely in jobs with a variety of duties than in jobs with a narrow set of routinized duties" [2]. Graves adds further, that successful cases of piecework owed themselves in part to the fact that "... only [the largest and most wealthy railroads] had the resources to ... pay the overhead involved in installing work reorganization" [4]. Together, Graves and Brown make a persuasive argument that piecework is limited in complexity by managerial overhead and the fixed cost of adopting a piecework payment regime.

There are other characteristics to effective complex piecework institutions, such as appropriately designed management practices. Boal and Pencavel describe the role of the foreman in West Virginia coal mines under the piecework model: "The foreman had the power to hire and fire workers and allocate workplaces, but then left the face–worker largely free to his own efforts so that often he went all day without seeing the foreman" [1]. The general approach adopted by these West Virginia mines was, as in other factories with active foremen, to let the foreman be the intermediary between management and the worker. Specifically, foremen were responsible for allocating resources and understanding when and how to modify work as necessary [24].

What's different about crowdwork. **Digital media have expanded the scope of viable piecework by pushing drastically on the limits cited by piecework researchers.** The research on piecework tells us that we should expect piecework to thrive in industries where the nature of the work is limited in complexity [2]. Given the flourishing of on–demand labor platforms such as Uber, AMT, and others, we ask ourselves what — if anything — has changed. We argue that the Internet has trivialized the costs and challenges of the earlier limiting factors for two reasons: 1) Technology make it much easier to do complex work aided by computers; and 2) The Internet allows us to leverage the benefits of "economies of scale" at very little cost to the system–designer [11, 17].

Technology has made it possible for non–experts to do work that was once considered within the domain of experts. Yuan et al. builds on the work of others (*Voyant* and, more relevantly, *CrowdCrit*) to design workflows that yield "expert–level feedback" [26, 25, 12]. This body of work identifies ways to transform a variety of duties comprising complex tasks and distills them into "a narrow set of routinized duties", informed in part by researchers — acting as inspectors — and experts [quotations from 4] Where Graves would call additionally for the identification of crowdsourcing's version of "piecework clerks", we point out that today algorithms manage workers as pieceworkers once did [10, 4].

Furthermore, technology more directly facilitates the subversion of expertise requirements by giving non–experts access to information that would otherwise be unavailable. Taxi drivers in London endure rigorous training to pass a test known as "The Knowledge" — a demonstration of the driver's comprehensive familiarity. Researchers have identified significant growth of the hippocampal regions of the brains in veteran drivers, generally understood to be responsible for spatial functions such as navigation [14, 13, 20, 21, 23, 22]. Services such as Google Maps & Waze make it possible for people entirely unfamiliar with a city to know more about a city even than experts through the collective data generated by other users ranging topics such as police activity, congestion, construction, etc... [19, 6].

Implications for crowdwork research. **The piecework literature gives us a template for pushing the boundaries of complexity in piecework, but it also signals some of the ultimate limitations of crowdwork and piecework in general.** While the threshold preventing task requesters from utilizing piecework has dropped thanks to affordances of the Internet, the ceiling on task complexity hasn't moved significantly. If we're to make use of Brown's prescriptions, we would benefit from finding ways to decompose varied tasks into homogeneous microtasks.

We should also consider exploring the limitations that algorithmic management bring along more carefully. While research has touched on this subject, we've yet to make out the bigger picture of this theme [10]. If we can resolve the tension between workers and perilously antagonistic managers, as Boal and Pencavel suggest, then we may be able to break a toxic cycle of mistrustful requesters [for example 3] and develop more considerate platforms as McInnis et al. advocate [16].

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