Achieving greater complexity

[al2: maybe a subssubsubsusbsubsection on the result/implication? more people can make crowd tasks, but the algiorithmic manag]

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 [5]. 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 [6, 12, 4].

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 [5, 14, 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 [14].

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, who describes piecework as "... based on examination of various shop jobs, which included calculation of the standard time and compensation for each task", argues that piecework must be rigorously evaluated at a time that demands *other people* perform the evaluation. Graves later enumerates some of the roles required to facilitate piecework in the early 20th century: "... piecework clerks, inspectors, and "experts"..." [2]. This criterion strictly limits the extent to which piecework can grow in complexity; it must, for instance, be quickly evaluable by another person.

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" [1]. 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" [2]. 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.

What's changed. **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 [1]. 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 [8, 13].

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" [21, 20, 9]. 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 2] 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 [7, 2].

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 [11, 10, 16, 17, 19, 18]. 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... [15, 3].

Crowdsourcing falters when the routinization of complex work proves difficult. [al2: Something about complexity being difficult to make routine when there are lots of little, varied, unpredictable tasks (nod to Brown)]

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