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Abstract

This paper focuses on Amazon Mechanical Turk as an emblematic case of microwork crowdsourcing. New media studies research on crowdsourcing has focused on questions of fair treatment of workers, creativity of microlabor, and the ethics of microwork. This paper argues that the divisions of labors and mediations of software interfaces made possible by sociotechnical systems of microwork also do cultural work in new media production. This paper draws from infrastructure studies and feminist science and technology studies to examine Amazon Mechanical Turk and the kinds of workers and employers produced through the practices associated with the system. Crowdsourcing systems, we will show, are mechanisms not only for getting tasks done, but for producing difference between “innovative” laborers and menial laborers and ameliorating resulting tensions in cultures of new media production.

Keywords

cloud computing, crowdsourcing, entrepreneurialism, gender, infrastructure, invisible work, labor, peer production, subjectivities

Introduction

You’ve heard of software-as-a-service. Well this is human-as-a-service.

– Jeff Bezos announcing Amazon Mechanical Turk in 2006

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In 2006, CEO of Amazon Jeff Bezos addressed an auditorium of technologists, reporters, and professors had assembled at MIT to hear “what’s next,” informing investments of capital and research agendas. Bezos, known to many as an online retail wizard, spoke on stage to introduce a series of technology infrastructures that would come to be known as “cloud computing.” Alongside the centralized data storage and data processing services offered from Amazon’s data centers, Bezos introduced a twist on digital data services. Amazon Mechanical Turk (AMT) would enable technology builders to farm out massive volumes of small data processing tasks, including transcriptions, image labeling, pornography categorization, and informational research tasks. The body of computers doing this work would not be the artificial intelligence (AI) algorithms technologists had hoped, but rather legion human workers scattered across the world. Amazon’s services, in turn, would put these tasks in an online marketplace with the price set by the client; there, thousands of people at their computers all over the world would connect to Amazon to pick out and perform these tasks. Like “cloud computing” services more generally, AMT offered immediate, on-demand provisioning of computational power accessible through computer code. In this case, however, the computational power was human.

In the years since, the crowdsourcing sector has grown, with a large number of companies offering such distributed, paid human computation services. These services, along with AMT, assemble cognitive pieceworkers in service of employers and their computer systems. The pieceworkers work on tasks in batches; the employers can put these batches out automatically through computer code they write.

This paper focuses on AMT as an emblematic case of microwork crowdsourcing. In new media studies, research on crowdsourcing and related phenomenon have interrogated how value accumulates through web and crowdsourcing practices and to whom that value accrues (Fish and Srinivasan, 2011; Gehl, 2011). A second strain of work asks of the desirability and fairness of microwork performed in crowdsourcing systems (Fish and Srinivasan, 2011; Horton, 2011; Zittrain, 2009). Both strains inquire into the qualities and ethics of crowdsourced microwork. These questions are crucial, but this paper takes a different tack.

Drawing from infrastructure studies (Bowker and Star, 1999; Star and Strauss, 1999) and feminist science and technology studies (STS; Nakamura and Haraway, 2003; Suchman, 2006), this paper asks of the kinds of relationships AMT promises between users (here, the employers) and the infrastructural technology (here, humans-as-a-service). As an answer, I argue that AMT reorganizes digital workers to fit them both materially and symbolically within existing cultures of new media work. Where AI has fallen short, AMT compensates by constructing a new frontier on which the software industry can invest in high-growth startups, intelligent software, and low-risk labor. AMT also helps ameliorate the contradictions of intensified labor hierarchies by obscuring workers behind code and spreadsheets. Rather than managers of global data factories, microwork employers can imagine themselves as technologists and innovators engaged in non-hierarchical peer production (see Benkler, 2006; Shirky, 2006). **[AQ: 2]** The sociotechnical configuration of AMT does cultural work; this cultural work happens not only through talk or co-present social interaction, but also through the relational politics of interface and systems design (Chun, 2011; Fuller, 2003; Galloway, 2013; Mackenzie, 2006). **[AQ: 3]**

This paper draws on four years of involvement in crowdsourcing both as participant and observer. With M Six Silberman, I have operated a tool and website for Turkers (as many Turk workers call themselves). Both as a co-builder of this tool and as a social scientist, I have attended three crowdsourcing conferences and engaged in informal conversations with a range of participants in the sector, including workers and executives of crowdsourcing companies. This piece draws on several formal interviews with crowdsourcing executives, online discourse around crowdsourcing, and detailed analysis of the sociotechnical design of AMT.

Amazon Mechanical Turk as a platform in the big data business

To understand the cultural work of AMT, first we must understand something of how it works. AMT is an internet marketplace where employers, called Requesters in Amazon's parlance, can post HITs or Human Intelligence Tasks with a price for each task. To post a task, requesters, including startups, non-profits, major corporations, and internet spammers, need only to have a valid credit card. Amazon profits by taking a percentage of the task price paid to workers as a fee for using its platform.

Workers and requesters in the system have vastly different views of the infrastructure. Workers sign in to see a list of tasks that have been posted to the market. They may, perhaps, search for names of requesters they prefer to work for to see if they might take up new tasks. For each task, they see a short description, the name the requester chooses to display, the price for doing a single task, and a sample of the task. A task might be marking the color of the product pictured in an image provided by the requester, or it might be rewriting a sentence. There may be 10 instances of a given task or there may be 10,000.

Requesters interact with the system primarily by posting tasks and receiving results produced by the pool of workers in the marketplace. The requester may post a task through the web interface, or they may post automatically through lines of code (Figure 1) – in either case, they never see representations of particular workers in the system. They may specify the *kind* of worker to whom their task should be available, chosen according to a few parameters: the percentage of tasks the worker has done that have been approved and paid for by other requesters, the geographical location of the worker, and AMT qualification exams the worker has passed. Upon receiving work outputs, requesters can see the worker's random-seeming alphanumeric ID, the amount of time elapsed between their acceptance of the task and submission, and the work output itself. Amazon offers requesters full discretion in deciding whether or not to remunerate workers for their outputs.

Although employers can specify the kinds of workers who should be able to do their tasks, workers have no way within Amazon's website to filter employers. During a hallway chat, a crowdsourcing product manager euphemistically called this Amazon's "prioritization problem." A crowdsourcing startup employee close to Amazon's engineering team suggested a more pervasive structural inequality as the explanation; the employee explained that Amazon has little reason to even this information asymmetry as Amazon's global reach and the American recession makes workers plentiful. Employers, by contrast, must be recruited to invest effort in learning to work with this new kind of workforce.

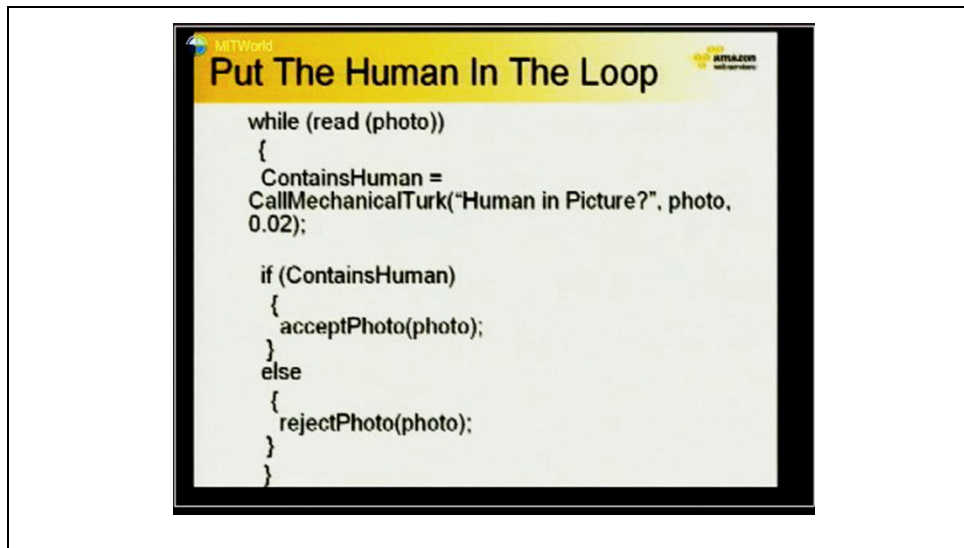


Figure 1. Bezos explains the invocation of human computational work directly within computer source code (Bezos, 2006).

The design of AMT developed within the crucible of Amazon's own computational demands for its retail website. During efforts to streamline their site, Amazon placed large numbers of its product information pages on the service and asked people to locate duplicates among them. Amazon had already tried to develop AI approaches to this large and infrequent data processing problem but their engineers described the problem as "insurmountable" (Harinarayan, 2007). [AQ: 4] To save the time and expense of hiring and managing large numbers of temporary workers, Amazon engineers instead developed a website through which people all over the world could check each product for duplicates, work simultaneously, and receive payment per product checked (Pontin, 2007). [AQ: 5] By developing AMT, Amazon retained its existing divisions of labor and organizational practices – the same structures into which they hoped to integrate AI approaches – while integrating on-demand human workers.

The dream of artificial intelligence, on life support

By offering "artificial artificial intelligence," Amazon promised to fulfill the long-standing, ever deferred dream of computers that could simulate human cognition. Traditional AI refers to the field of computer science that attempts to develop algorithms that can represent, model, and demonstrate human intelligence. The subfield captivates the imagination of researchers, so much so that one senior figure declared that "AI, or computational intelligence, is the manifest destiny of computer science" (Feigenbaum, 2007). Manifest destiny has not yet been achieved, but AMT offers a stopgap in the meantime.

AMT has allowed canonical AI projects by simulating AI's promise of computational intelligence with actual people. One robotics company, Willow Garage, employed AMT workers to help its "autonomous" robots in house-cleaning work (Handwerk, 2013; Willow Garage, 2009). Researchers explained that until AI can fully recognize and plan around everyday objects, AMT toolkits "can help us bridge the gap" (Willow Garage, 2009). Other researchers have ventured farther from staple aspirations of AI by incorporating human labor into novel user interfaces and tools, powering novel interfaces through AMT information work (e.g. Bernstein et al., 2011; Feng et al., 2011). A team of MIT researchers, for example, built word processor extensions that can rewrite and shorten sentences.

The dreams of AI have become more urgent as Web 2.0 businesses attempt to amass and extract value from increasing volumes of people's data. Internet databases – think Amazon, Facebook, Google, and NSA server farms – are filled with proper names, angry rants, family photos, and kitten humor – data of cultural life that have proven difficult or impossible for silicon-based computers to order in culturally competent ways. Even where machine learning algorithms can work, they require training based on human-classified datasets sometimes generated by AMT workers. Computer algorithms, then, must play catch-up to humans. Companies hosting this bulky cultural data have server bills to pay and storage requirements are projected to grow tenfold in the next five years (Gantz, 2008). AMT promises ways to weed out porn, attach relevant advertisements, and quickly integrate breaking news into algorithmic indexes – making sense and economic value out of such data.

While these projects demarcate the shortcomings of AI, researchers do ideological work to reconcile human computation to the long-standing AI dream. Luis von Ahn, a MacArthur "Genius Grant" winner, explained in his dissertation that human computation is not a threat to AI. Instead, it channels people's spare time and energy into "useful work," brings humans into mass cooperation with computers, advancing computer science and even sustaining AI (Spice, 2006; Von Ahn, 2005). AMT, then, allows researchers to do ideological work that brings the lived realities of AI's shortcomings in line with abstract ideals of the computational sciences (Berger, 2004).¹

The sociotechnical organization of "Humans-as-a-Service"

How are the outputs of unruly and diverse masses of AMT workers smoothed over into computer-consumable data? Simply asserting that humans, in aggregate, will act as a computational service does not make it so. This section offers an infrastructural inversion (Bowker, 1994), showing the social and technological practices by which Amazon and employers accomplish human computation. I focus on three key values around which Amazon and complementary crowdsourcing companies have focused their design efforts: accuracy, speed, and scalability. I have two objectives. The first is to demonstrate the extent to which problems of worker management are handled as computational problems. The second is to explain the sociotechnical work by which AMT is achieved and, thereby, underscore the role of the sociotechnical in doing the cultural work of microwork.

Accomplishing accuracy

Technology builders seeking to integrate humans into their information systems privilege accuracy. Accuracy in the world of AMT primarily comes in two varieties to which requesters try to hold workers accountable.

The first is a sort of statistical objectivity; given the same question, accuracy means exhibiting “the most plural judgment,” in the words of then Director of Amazon Web Services Peter Cohen (Sadun, 2006). This can mean simply assigning several workers the same task and using majority vote to decide on the “true” answer, called “the gold standard,” or “ground truth” in Computer Science research. More complex mechanisms might try to take into account attributes of the workers, such as work experience or location as biasing parameters but, in the end, these factors act as tie-breakers. In most cases, requesters count the most plural as the most accurate, stick that in their database, and reward workers accordingly. AMT’s statistical objectivity is a shift in AI and natural language processing research that has traditionally used experts to authoritatively establish “gold standard” datasets (Snow et al., 2008).

The second form of accuracy inheres in tasks that involve what technologists consider to be subjective or personal, such as surveys or making aesthetic judgments. For such tasks, requesters need to figure out which workers are making good faith judgments and which ones are “malicious,” clicking randomly for money or trying to corrupt the dataset. AMT maintains an “acceptance rate” for each worker so that requesters can recruit from workers with high rates of task acceptance from prior requesters. This acceptance rate is the first level in “good faith” worker filtering. However, large-scale requesters use a number of other methods to discriminate “good faith” workers from the “malicious.” Most methods boil down to giving unknown workers questions requesters already know the answers to, such as tasks for which the gold standard is already known. Large-scale requesters can maintain databases of how workers, known by their alphanumeric ID, have performed on past tasks, where their network IP maps to, and other parameters to create filters, blacklists, or whitelists of workers. One requester I interviewed, for example, put up a digital version of the game Mastermind as a task and found that it was a slightly better predictor of his workers’ accuracy than Amazon’s reported acceptance rate. This requester maintained his own database of workers based on past tests and work performance. Logical acuity is not the only relevant performance. Requesters often restrict workers’ country locations as a proxy for filtering workers without the presumed-to-be-stable cultural literacies their subjective tasks require. At one meetup, for example, a group of young engineers requiring workers for marketing experiments joked that they would block any workers who correctly answered a question about the sport cricket; although workers might misreport their location to access jobs, those familiar with India’s most popular sport would be caught. Accuracy in AMT amounts to credible answers, whether based on matching others’ answers or performing sometimes ethnocentric forms of commonsense.

Accomplishing speed

Requesters who need highly informational tasks completed bring in the humans when there is not sufficient time to develop appropriate algorithms to do the job. Because

numbers of workers can be recruited in accordance with task size, the amount of time to finish the micro-tasks does not grow or shrink with the number of tasks. This contrasts with traditional outsourcing in which a fixed size team is recruited offsite; more tasks take a fixed number of people more time. The realities of how long tasks take to complete is more complex, but key is that to a computer scientist, AMT should in principle be faster than a system that offers fixed (human) processing capacities; in practice, this holds true for work that is already reduced to many small information tasks.

A large, simultaneously available workforce requires reach across a global labor market. The internet reaches each of the world's time zones; the sun never sets on Amazon's technology platform. Like the global software teams spread between the US and India (Aneesh, 2006: 84), Amazon's loosely coordinated marketplace of workers "follow the sun." Recruiting and paying an around-the-world workforce requires global currency technologies. [AQ: 6] Amazon has a unique advantage in this respect; outside of the US and India where it pays local currencies, Amazon pays with its own website gift certificates. The global reach of Amazon's currency, retail website, and delivery capabilities facilitates its ability to assemble a sufficiently massive workforce to fuel its platform 24 hours a day, seven days a week.

Another key to the speed of crowdsourcing is efficiently discriminating among workers. AMT only allows requesters limited filters on workers based on location, their percentage of tasks accepted, and standardized or custom qualifications attained through tasks performed in the system. The requester hires workers as a single filter operation when initiating the task. When a requester receives worker output in a spreadsheet or through a program call from AMT, the workers appear to him or her only as a long string of letters and numbers that constitute a worker ID, along with the time elapsed between when the worker took the task and submitted it.

Sharon Chiarella, VP of AMT, explained the minimal expressiveness of worker representations as a means of engineering efficient human resources management by reducing the decisions employers have to make while ensuring that workers are not discriminated against on the basis of race or gender (S Chiarella, personal communication, June 10, 2009), although we will see later that the system sustains gendered divisions of labor in high-technology work.

Among computer systems researchers, task completion speed contributes to "latency," or a measure of the time delay introduced by a particular element in a computer system. "Reducing task completion time has become one of crowdsourcing's holy grails," according to MIT researcher Michael Bernstein (Bernstein et al., 2011). Latency is something of a symbolic performance in Computer Science; even after 10 years in business and many revisions to their search results page, each Google search still proudly announces that its, say, 35 million results were found in just 0.23 seconds. The concern with completion time is also practical. Human-computer interaction researchers strive for minimal latency so interface interactions seem continuous and animations seem smooth (e.g. Miller, 1968; Nielsen, 1993). Some technology designers have come to understand "good" design as immediate, "ready-to-hand" technologies that are worked through, not on. These assumptions drive efforts to maximize "task

velocity” so human computation can fulfill expectations of interactive computer technologies.

Accomplishing scalability

AMT offers developers scalability – developers can command as much or as little human computation as they want, incurring little to no maintenance costs. For large corporations doing machine learning categorization, scalability means a large, temporary workforce that can quickly categorize major inflows of images during phases when engineers are focusing on improving system performance. For startups, scalability promises low initial operating costs, but also promises investors that the fledgling company can handle hoped-for success by reliably handling larger volumes of computation. The computational quality of scalability, then, is both technical and rhetorical.

AMT’s legal terms enable its scalability, enabling requesters to pay for data and nothing more. Requesters have full discretion to deny payment without justification to workers or to Amazon. Although workers need to understand American English and have computer and internet access, requesters do not pay to train and maintain employees and infrastructure. Even tax reporting is optional as long as requesters hire each individual worker for less than US\$600 [AQ: 7] a year. Amazon’s legal architecture leaves requesters free to focus on the elicitation and extraction of data.

Speed, scale, and the problem of management

For a small startup, managing a workforce of 60,000 people may seem an insurmountable challenge. Yet this is precisely the challenge for some large-scale requesters, themselves independent entrepreneurs or staff at small companies. Requesters building on AMT are constantly refining techniques to automate the management of this workforce. For AMT to be scalable, after all, the effort that goes into using AMT – setting up tasks, communicating with workers, and deciding who gets paid and who does not – all need to be manageable for someone who might commission 10,000 workers. Dahn Tamir, a large-scale requester, explains:

You cannot spend time exchanging email. The time you spent looking at the email costs more than what you paid them. This has to function on autopilot as an algorithmic system...and integrated with your business processes.

One practice of automated management is “setting up incentives” so that workers self-select into tasks they are good at and learn to avoid tasks they are bad at. “You have to set up incentives right so everyone is aligned and they do what we want them to do. You do it like that, not by yelling at them,” the founder of one crowdsourcing firm, Rick (pseudonym), explained to me. In practice, “setting up incentives” means denying or reducing payment to those who provide work outputs that do not meet requesters’ needs. The choice of whether or not to pay is based on assessments of accuracy

determined algorithmically, as discussed earlier, and is registered through system calls or a spreadsheet upload to the AMT system.

Large-scale requesters also rely on automated filtering criteria, whether based on Amazon's limited worker information (e.g. task approval percentage) or their own more detailed data gathered as they interact with workers. Workers who do not meet the criteria are simply never shown the task. Requesters sort workers solely through worker performance in the system. At the scale of workforce and the speed of micro-tasks that characterize AMT, there is little time for discipline and little opportunity to mold workers. Instead, requesters are left sorting them by desirability through the faint signals of mouse clicks, text typed, and other digital traces read closely as potential indicators.

Within this large-scale, fast moving, and highly mediated workforce, dispute resolution between workers and employers becomes intractable. Dealing with workers as individuals with specific circumstances costs the employer more than the cost of dismissal and recruitment (which, in AMT's design, is practically nothing for all but employers of the most ill-repute or employers who pay little even by AMT standards).

Within the private sector, automatic management also serves a symbolic purpose with financial consequence. Microwork companies attract more generous investment terms when investors perceive them as *technology companies* rather than labor companies. At one industry panel, a crowdsourcing startup CEO discussed the question, "Am I a labor business or a SaaS [software-as-a-service] business?" In response, a venture capital (VC) investor responded, "SaaS has a higher multiplier in the market. I was hoping it was a technology company and not a labor company when I invested!" Multipliers are rule-of-thumb quantities that appraisers of various sorts – VC investors, banks, buyers – use to estimate the value of companies. Multipliers represent an attempt to guess at the relation between capital investment and market value, whether that value derives from profits, revenue, or future resale. To act as technology companies, microlabor companies must convince investors, firstly, that their labor force is of little risk and of little cost, and secondly, that their technology confers an advantage over other companies. Microlabor companies do this in part by foregrounding their automatic management techniques and the reliable flow of replaceable workers. As companies promise the ability to scale their operations quickly, so do they fuel scaling valuations.

This section has described the social, technical, geographical, and even financial reorderings of the world that is sustained by AMT – sustained by people as computational infrastructure. Computer programmers need no longer limit their imaginaries to the domain of the non-human. Rather, we see the migration and transformation of a style of computing into a style of management, offering computer programmers expanded agency to act upon the world. In this world, as we will see, some become creators while others become computers.

Hierarchies of value in new media work

By managing AMT to achieve accuracy, speed, and scalability, new media producers collectively develop an infrastructure to advance their own craft. AMT serves not only

as a material mechanism to enable software developers, but also an ideological one. Drawing from feminist STS and histories of computing, this section offers an analysis of the kinds of subjectivities and hierarchies of value emerging in a world where some humans are hackers, builders, and programmers and other humans are computational power (Castells, 2000: 233–236).

Jeff Howe, author of the otherwise celebratory book *Crowdsourcing*, characterizes AMT clickwork as “any number of dull, brainless, low-paid tasks that keep the internet economy, for better or for worse, firing on all pistons...Mechanical Turk allows clients to farm out the kinds of menial clickwork that we all wish computers could do, but can’t” (Howe, 2008). He illustrates his explanation of clickwork with an image of a computing primate (Figure 2), marking AMT workers as somehow stripped of fully self-actualized humanity.

These workers absorb the tedious work necessary but unbecoming of idealized “creative” workers. Through the redistribution of tedium, AMT requesters can reshape their roles to more closely align with images of creative work. AMT, then, is not only a means of collaborating, sharing burdens, and pooling cognitive surplus (see Benkler, 2006: 138; Shirky, 2010). Rather, AMT offers a means for new media producers to do boundary work (see Gieryn, 1983), distinguishing innovators from non-innovators in high tech. The boundary work is both rhetorical and organizational, manifested in the actual division of labor AMT enables and the symbolic consequences of those organizational acts of purification. One such symbolic consequence is a hierarchy of value recurrent throughout AMT discourse, distinguishing “dull,” “brainless” work from the work of creating systems and building. I take these distinctions as diagnostic – as creative as “menial” workers are in situ (Star and Strauss, 1999; Suchman, 1995: 59; Suchman and Bishop, 2000: 331), these are categories that shape practice in ecologies of AMT. In this hierarchy of value, technological authors – the appropriators of AMT labor – occupy a high position. This section traces these figures of innovation/creation against routine/service, in historical high-technology discourses through the present moment of high-technology entrepreneurialism and high unemployment.

Enabling “innovators”

Stories told about AMT emphasize how employers can get more done faster and at larger scales by taking up the tool. On his blog, *Crowdsourcing* author Howe explains how he used AMT to get rid of his tedious work quickly and cheaply, obtaining transcriptions of book research interviews at 10% of what professional transcriptionists would cost.

Tamir, the large-scale requester we met earlier in discussions of management techniques, explained that AMT allows him to do more than delegate existing tasks; it allows him to work in new ways. He has taken advantage of low-cost, quick microlabor to tinker with human labor in the way he might have otherwise tinkered in code:



Figure 2. This primate typing illustrates Jeff Howe's blog on Amazon Mechanical Turk clickwork (Howe, 2008). **[AQ: 8]**

You can work in a different way, you can work much faster, you can try things. To me, the try things thing is a wonderful thing about crowdsourcing on Mechanical Turk. You don't have to get your questions perfect...When I was wrong, it really didn't matter. I spent a few bucks. The loss was minimal. It inspires the willingness to try a lot of things.

Even critics of AMT's treatment of workers argue microwork's value lies primarily in expanding computational innovation and, implicitly, the social goods they imagine such innovation brings. Crowdsourcing startup MobileWorks' (2011) founder Prayag Narula is a Berkeley graduate taking on AMT by offering crowd labor at a more ethical wage than AMT. **[AQ: 9]** Narula stressed the importance of programmatic access to the crowd workforce: "We want to give people a stack as reliable as their software stack so they can do innovative things." The analogy to a software stack – to the libraries of code that make higher level programming possible – is more than metaphor; it is realized through these systems' software interfaces and integration with programming languages. The work of managing 60,000 temps transforms into formally specifiable, compact requests to be outsourced and returned directly to one's computer code. Sociotechnical assemblages black box the complex politics of management into familiar acts of writing code and manipulating spreadsheets. By rendering the requisition of labor technical and infrastructural, the design of AMT limits the visibility of workers, rendering them as a tool to be employed by the intentional and expressive hand of the programmer.

“Humans-as-a-service”

The multitudes of workers coordinated through AMT comprise what Bezos, Amazon’s CEO, called “humans-as-a-service.” In this section, I describe the terms by which engineers, journalists, bloggers, and marketers account for AMT workers; I argue that these discourses figure workers as innovators’ Other, kept at a distance and organized for innovators’ pleasures.

We can begin with the obvious – the name of the system itself. AMT is named for the Mechanical Turk, an 18th-century chess-playing automaton (Figure 3). The 18th-century Turk toured around Europe, defeating prominent members of European society at chess. Built by an inventor otherwise known for his simulations of life, the Mechanical Turk instead simulated automation, driven by a small chessmaster hidden inside its case. In the early days of AMT’s launch, news articles frequently cited the hoax in explanation of the system; both worked by clever sleight-of-hand and simulated the promise of machinic intelligence. Not all marketing stories travel, but this story of the computer with people inside it has proven to be quite mobile in nicknames, jokes, and illustrations by which technologists explain AMT.

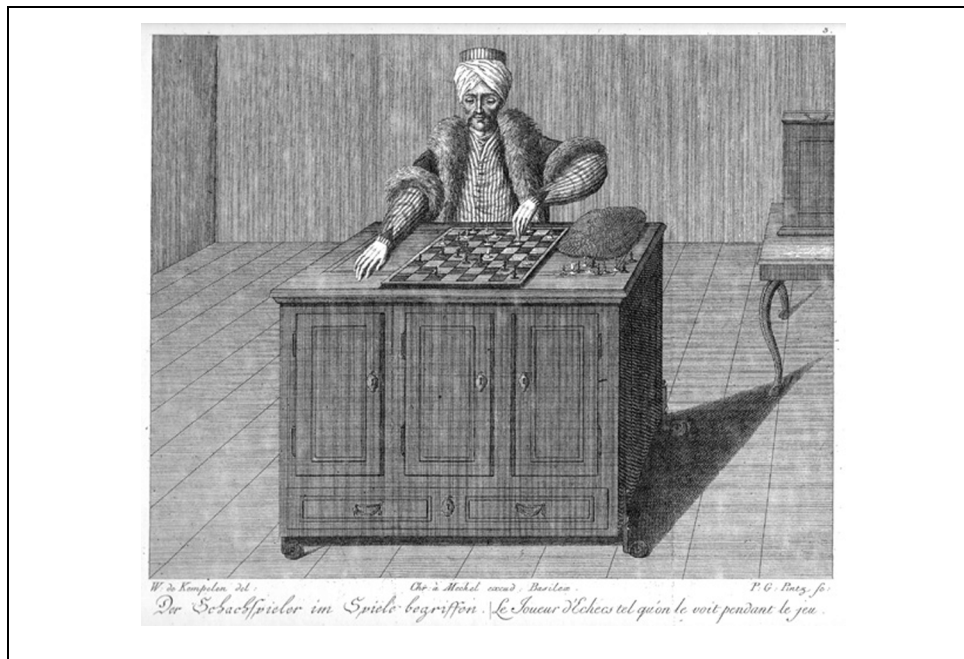


Figure 3. Von Kempelen’s traveling “automaton,” The Mechanical Turk – the namesake for Amazon’s infrastructure.

Source: Von Windisch (1783), Briefe ueber den Schachspieler des Hrn. Von Kempelen in Wikimedia Commons. [IAQ: 101](#)

MIT's website displayed a reinterpretation of the metaphor for the silicon age (Figure 4), illustrating a story on MIT computer scientists developing techniques and applications for human computation. This image depicts AMT as a computer's logic board and Central Processing Unit, populated with melanin-varied populations of abstracted workers placed in the bounds of the chip. A caption citing AMT's "people worldwide" explains and amplifies the iconically racialized bodies. More than just an index of cosmopolitanism, the colors suggest the spatial reach of AMT's global labor recruitment.

Technologists have also developed puns and jokes that figure AMT as humans made into modular, protocol-defined computational services. Some call AMT "the Human API" (Hammond, 2005; Spigelman, 2007). APIs, in software engineering, are "application program interfaces" – standardized definitions of how a programmer should invoke a function in code. Technology bloggers and programmers I met at a meetup joked that AMT offered a "Remote Person Call" in reference to the more common meaning of RPC as "Remote Procedure Call;" one of the bloggers published this joke in the widely read *O'Reilly Radar* (Lorica, 2009). The RPC combines the standardization of computer function invocation with a way of invoking functions agnostic as to the location of the code, whether on your own computer or on someone's server across the world. Both RPC and API are part of a broader discipline by which computer scientists working on large-scale systems bracket off complexity by studiously ignoring how the functions they depend on are implemented (Blanchette, 2011). Programmers are taught to construct and respect "walls of abstraction" – functional modules that can be invoked in standard and consistent ways, hiding complexities within.

These jokes about programmatic calls to humans under the hood build on the idea of "human-as-a-service," a term that refers to a business and technology model common in the corporate technology industry. Recall Bezos' pitch when launching AMT at MIT: "You've heard of software-as-a-service. Well this is human-as-a-service." To make something available "as-a-service" is to hold it in a Heideggerian "standing reserve" (Heidegger, 1977: 17–27) – to make forms of computing power and behavior available 24/7, on-demand, and pay-as-you-go. The relationality Star and Ruhleder have analyzed as infrastructural (2001) – infrastructure is shared, it is incorporated into existing shared practices, and ideally it is ready-to-hand and worked *through* not *on* – describe the design and positioning of AMT, worked *through* by programmers by way of APIs that render workers largely invisible and interchangeable with one another.

This combination of abstraction and service orientation in both the metaphors and infrastructural forms suggest a hierarchy of value and division of labor. "As-a-service" draws meaning from commonplace resonances of service. To serve is to make labor and attention available for they who are served; to promise service is to be bound, by duty or by wage, to the will of the served. Among computer scientists, "as-a-service" builds off of this common sense meaning and more specifically indexes a division of



Figure 4. Human-powered computer chips.

Source: MIT homepage, October 27, 2010. [AQ: 11](#)

technical labor by which programmers can access computational processing functions housed and maintained on the internet and by someone else. As long as the service keeps running, programmers need not concern themselves with where the code is running, what kind of machine it runs on, or who keeps the code running, but only the proper protocol for issuing the call through a computer and receiving the response. As-a-service suggests an arrangement of computers, networks, system administrators, and real estate that allows programmers to access a wide range of computer services remotely and instantly – an arrangement that mediates social relations in large-scale high-technology work.

Lucy Suchman (2006) has argued that Euro-American technologists recurrently imagine computing as feminized servants, assistants, and supports to users (Suchman, 2006: 216). Hierarchies of value have long overlapped with hierarchies of gender in the technological imagination. In early 20th-century America, the word “computer” referred to a highly skilled worker in scientific and engineering research, tasked with calculating complex ballistics tables and making vacuum tube computers do what scientists had specified mathematically (Grier, 2005). These computers were almost always women taking orders from male scientists and engineers and largely omitted from written histories of the modern computer (Light, 1999). As computing machinery evolved, later generations of these skilled women became programmers mediating between male scientists and the machines that would calculate their mathematical

formulas. The males in command developed mathematical formulas and calculations for which they wanted the answer; the women translated those formal mathematical statements into manipulations of the room-sized computing machines. New media theorist Wendy Chun has argued that contemporary personal computers reify the gender relations of these 1940s' computer labs (Chun, 2004). [AQ: 12]

These male–female encounters were common sites of anxiety in public discourse – anxieties reduced through the automation of female technical labors. Vannevar Bush's famous piece “As We May Think” describes the “disquieting gaze” of a “girl” stenographer and imagines her displacement by AI and an audio recorder (cited in Chun, 2004: 49n32; see also Bush, 1945). Anthropologist SL Jain argues that a similar structure of intergender anxiety drove the desire for immediated, male document production as white-collar men replaced their female typists with computer word processors they could use themselves (Jain, 2006: 115). [AQ: 13] The women who stood between men and computing machines were similarly displaced by compilers – programs that automated the translation of mathematical statements into computer code. The removal of women in the man–machine loop created the possibility of what Chun (2004: 36), following Edwards (1990: 109), calls the microworld of the computer – a place where hackers can tinker and master the mesmerizing, rule-based world. [AQ: 14]

These histories underscore the ways gender and mediation inflect the production of technological agency. Firstly, these histories illuminate how computer systems' designers have produced the computer user's experience of immediate control over the machine by automating, black boxing, and removing some people from the loop so others may feel close to the machine. These are the material and semiotic processes by which technologists experience their agencies, not as the universal human agency claimed by liberal philosophers, but agencies affected through social relations and attributions (Suchman, 2006). Secondly, we see that as women worked as computational translators, technology historians largely wrote them out of histories of technological invention, innovation, and progress. This male-biased historiography, in turn, reinforces narratives that locate innovation and invention in the circuits rather than the social relations.

Reintroducing humans, however, creates its own anxieties for Turk users not unlike the stenographer's “disquieting gaze.” AMT's APIs and interfaces go a long way in lessening these anxieties.

Anxieties of new media idealism

Although rarely on formal industry agendas, industry and research players occasionally remark on the intractability of a global crowd ethics before the topic moves on to exciting crowdsourcing projects or new applications. Hand-wringing usually takes the form of one of the following reservations about AMT and microwork more generally.

The first set of reservations focuses on fairness. Is it fair to pay workers what often amounts to less than American minimum wage? To this, advocates for crowdsourcing typically give one of several replies. “Nobody forces workers to participate,” is a common refrain. “It's really hard to coerce people to do something through a computer

screen,” one crowdsourcing CEO explained, “people are choosing to do this” (Cushing, 2012). (Of course, because of the invisibility of Turker workplaces, this assertion is an optimistic guess based on a simplistic model of coercion.) Although most Turkers are in the US, others assume that workers must be in countries where such wages go far and must be desperately needed. The wages are irrelevant, another response goes, as most workers do it for fun and pocket change (e.g. Catone, 2008), using their “cognitive surplus” (see Heimerl et al., 2012). Crowdsourcing advocates, in short, deflect these questions by appealing to workers’ freedom to choose to Turk or exit the system at any time – as far as anyone party to the exchange can tell so far. These stories also selectively overlook the significant minority of workers who rely on AMT as a primary source of income (Ipeirotis, 2010; Ross et al., 2010).

Another set of reservations center on the construction of AMT work as menial or uncreative.

Recall Howe (2008), the author of *Crowdsourcing*, in his account of AMT clickwork: “dull...tasks that keep the internet economy, for better or for worse, firing...” The ambivalence marked by “for better or for worse” deepens into a regret as Howe ends, explaining that AMT is for “the kinds of menial clickwork that we all wish computers could do, but can’t.” The tasks on AMT, for Howe, are those that are beneath any person – from which we hoped to be liberated through automation – but that must be done.

IT blogger Stig Hammond echoes Howe’s ambivalence (2005). Hammond, announcing the launch of AMT in 2005, explains its value by recounting a story that conveys the value of AMT. Hammond tells the tale of an email autoresponder API ceasing to work and the guilt he felt assigning a fast-rising support staff member to perform the work of that algorithm:

It wasn’t worth it to recode the system, as we were about to migrate to a new email platform. So we assigned Wamique to manually review the incoming mail, look at the request, and place the file in the appropriate directory. Mindless work, really, and I felt bad about giving it to him, but he did a great job with it. We started calling him the “Human API.” (Hammond, 2005)

Like Howe, Hammond notes the contradictions of the high-technology workplace. Hammond, the manager, was both responsible for organizing a workplace of creative, interesting work, and also for keeping the office going when mindless work had to be assigned. Wamique had been a fast-rising, respected member of the organization though in a support role. The organization typically delegates the essential but routine tedium of email processing to a machine. As the machine breaks down, so does the putatively non-hierarchical workplace; some person must be delegated the machinic role.

Both Howe’s and Hammond’s stories point to anxiety-producing contradictions in high-technology work. High-technology work is often framed as non-hierarchical, mindful, challenging, and creative (Turner, 2006, 2009). Turner (2009) has argued that Burning Man, for example, exemplifies the idealized values and skills of new media industries. In that utopian space of networked creativity, organizers decry service

workers as a feature of a world devoid of true community (“Culture of Black Rock City”). Howe and Hammond express the dissonance of a reality that violates the creative ideal. The author and the software developer outsource the work that falls short of their creative ideals to AMT, but then worry that such work should not exist at all (see also Fish and Srinivasan, 2011). To Howe, AMT highlights the contradiction by reminding him that the internet economy is powered by media transcription, spam farms, and data entry. For Hammond, this contradiction manifests as the desire to treat Wamique as a valued colleague while being forced to make hierarchy explicit by assigning him the “mindless” work. Clickwork labor relationships, then, are precisely those that violate the ideal image of the communal, creative new media shop.

Hammond recognizes AMT as a resolution to this contradiction; AMT creates an accepted social role for workers performing these tedious tasks and sends the work outside the walls of his office, a non-hierarchical space of peer production. Hidden behind APIs and web interfaces – “the screen,” as Biewald put it – protects workers from employer coercion. The screen also protects employers’ ideals and peer sociality.

Because AMT’s interfaces render workers invisible, crowdsourcing entrepreneurs can imagine workers are in a better place. Recall the proliferation of contradictory justifications for low wages on AMT – Turkers want fun, or live in “developing” countries. These stories proliferate not only in verbal exchanges, but also in vivid cardboard cutouts of ostensibly happy, non-white, global workers on display at crowdsourcing conferences and on the websites of companies such as SamaSource. These vivid stories and images selectively narrate lives of invisible crowdworkers scattered for the benefit of requesters and high-technology professionals. With these stories, and by keeping low-status work at a distance, these professionals maintain the ideology of the non-hierarchical organization within their walls, keeping other kinds of new media work hidden behind the API or the interface. Beyond allowing for rapid outsourcing, then, AMT offers new media “creatives” the benefit of the doubt. In this way, AMT allows technologists to do a second kind of ideological work (Berger, 2004). By literally interfacing with workers through computer code, technologists can maintain creative spaces of peer production close to themselves while imagining their workers freely collaborative from places they choose to be.

Conclusion

At the last crowdsourcing industry conference I attended in San Francisco, a number of microwork startups organized a CrowdHack – an event where organizers convene programmers around a project theme and fuel them food, air conditioning, wi-fi, and electricity. Several teams spent the day intensely coding, absorbing the energy of their fellow hackers, and developing prototypes of computer applications incorporating human computation. A panel of crowdsourcing company employees chose winning applications that demonstrated the potential of human computation. Projects included a crowd-generated weather map, a program to identify signs of melanoma on skin, and even an application that paid workers in India to go outside and remove trash from the street. Coleman (2010: 52–53) argues that hacker conferences are a “ritual condensation and celebration of a lifeworld” in which hacker life is lifted out of its

routines, reorganized, and intensified to achieve personal transformation and group solidarity. Through this lens, CrowdHack stages the subjectivities I have argued are key to understanding the value of AMT. Assembled at the hackathon are the “innovators” – the engineers, the designers; at hand but at a distance, the crowdworkers are present only when summoned as task requests and data inputs into the code. Their bodies are not in the room. Within the co-present space of the hackathon, programmers act out optimistic “making” in a space where they see only their peers.

The hackathon seems an ideal space of networked peer production as described by legal scholar Yochai Benkler (2006). In his book *The Wealth of Networks*, Benkler foretold a world where cheap, widely accessible, and networked computers made possible new polities of active “users” and makers. CrowdHack programmers work in pursuit of pleasure, recognition, and expression among similarly free peers. According to Benkler, cheap computation and commons-based regimes endow new media users with agency once lost in industrial bureaucracies and welfare states (Benkler, 2006: 138). At the CrowdHack event, the cheap computation was not only in silicon, circuits, and software. The cheap computation was also “humans-as-a-service.” Some computer users can experiment, make, and do-it-themselves, while others must reliably keep the infrastructures humming and accessible.

The invisibility of such infrastructural work sustains the joyful optimism and celebrations of creativity so pervasive in new media cultures and shows how mediated labor relations make such optimism possible. Hackathons, TED conferences, and news pieces on high-technology workplaces celebrate egalitarianism, creativity, and the generation of wealth through “flow” experiences (see Czikszenmihalyi, 1997). Recognizing how humans are made into computational service brings into view less celebrated figures of new media production, often hidden by design. If these invisibilities are themselves productive, as I have argued, then we can better understand why they persist. Across the world in Mountain View, one ex-Google employee lost his job attempting to interview and document Google’s well-guarded and segregated book scanning workers, called the Scan Ops (Barrett, 2011). We might understand the firing as retribution for a security breach. This article, however, proposes that much more than discipline is at stake in contemporary politics of visibility in high-technology production. The revelation of Google’s Scan Ops ruptures Google’s image as a high-trust, congenial place to work – a place where Google engineers enlist not only their labor but their souls in the work of high-technology industries. The analysis I have offered of AMT suggests that these stories of uneven rights, compensation, and safety are not aberrations, but rather constitutive of the roles and ideologies of high-technology work – differences that matter in cultures of new media.

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Note

1. Thank you to an anonymous reviewer for pointing this out.

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