

# Examining Crowd Work and Gig Work Through The Historical Lens of Piecework

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May 10, 2017

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# Before We Get Started...



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**On-demand work** Crowd work and gig work, collectively

**On-demand work is a modern instantiation of a  
much older phenomenon — piecework.**

**The historical arc of piecework can shed light on persistent questions in this  
ongoing phenomenon of on-demand work.**

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**Piecework** Payment for output rather than for time

# Payment for *output* rather than for *time*



Textiles



Automobiles



Metalwork



# Payment for *output* rather than for *time*



Textiles



Automobiles



Metalwork



Crowd work



Upwork

UBER

Gig Work



**What will be the future of work?**

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- What are the **limits** of complexity in on-demand work?

The answers to these questions may predict the *reach* of on-demand work

# Thesis



This question — and others like it — has been asked before.

History can help us answer them today.

We'll reach into the history of **piecework** — of human computers, match stick makers, and metalworkers — and show how the **history** of their work can inform answers to questions about the **future** of digital work.

# Comparative Historical Analysis



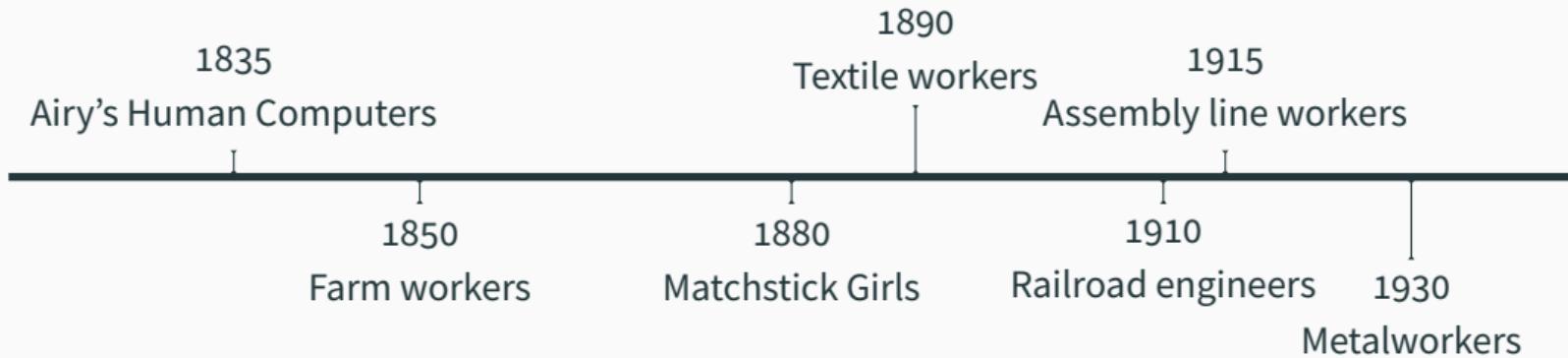
HCI researchers have used **historical analysis** to understand social systems before

Bødker (1993) and Wyche, Sengers, and Grinter (2006)

... But we haven't applied this method to make sense of on-demand work, which is a missed opportunity to...

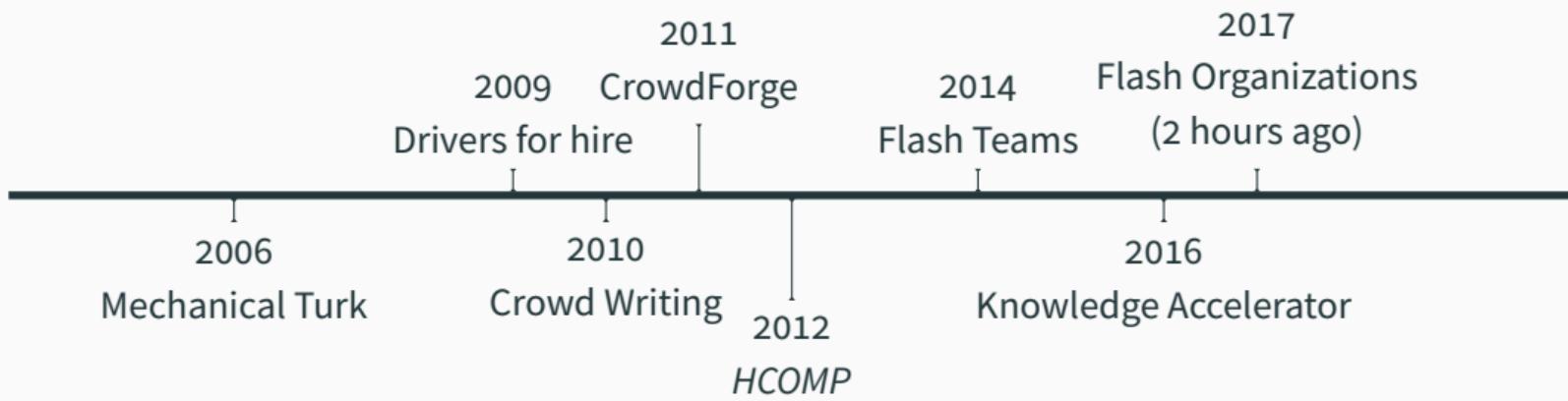
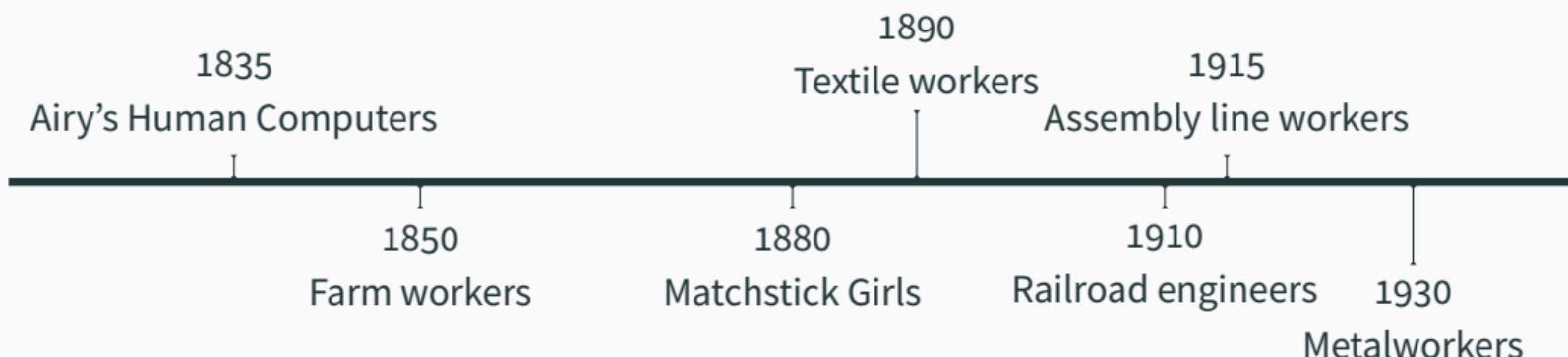
- Provide some basic framing for *ostensibly* new phenomena
- *Explicate* our theoretical grounding
- Flesh out *differences* and their implications

# A Timeline of Piecework



# On-Demand Work

## A Timeline of Piecework



# Ongoing Threads in Crowdsourcing Research



## Complexity

Hahn et al. (2016), Kim and Monroy-Hernández (2016),  
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Within narrow specifications

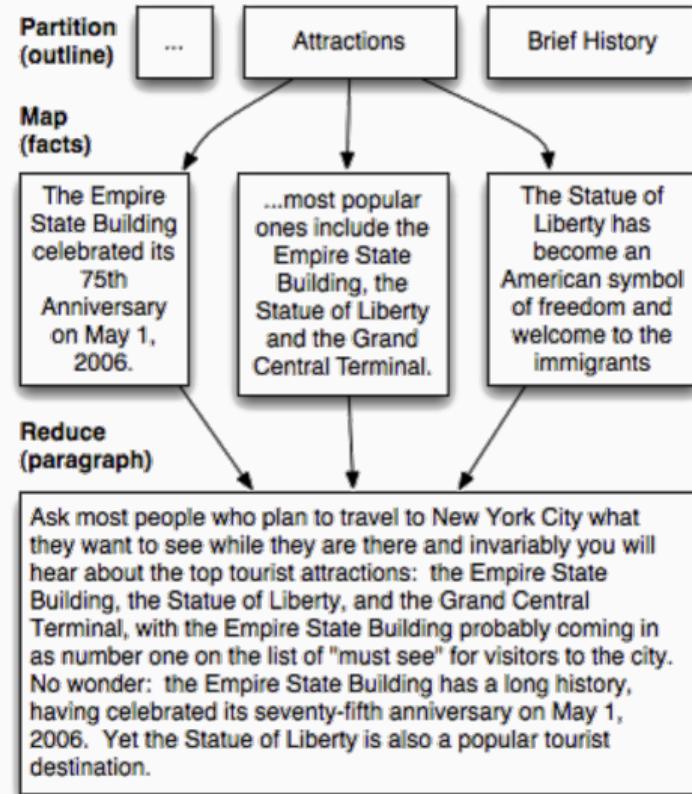
# What Does On-Demand Work Say?



Build complexity into the process

- Apply CS methods to people

Kittur et al. (2011)

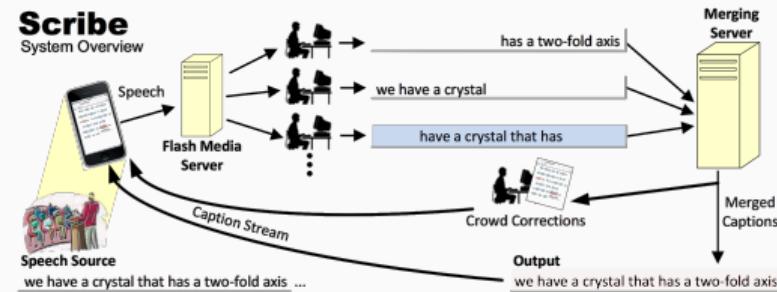


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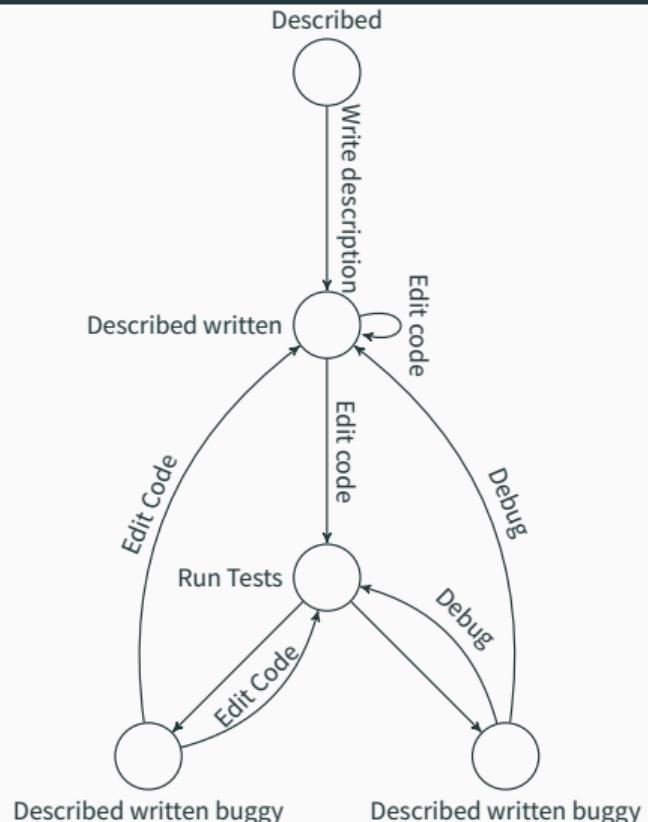


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- Humans as computational units  
Lasecki, Kushalnagar, and Bigham (2014)
- Crowdsourcing workflows as function state machines  
LaToza et al. (2014)



# What Does Piecework Say?



What we'll find

- Building complexity into the processes

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- Incremental advances until managers *tracked* and *standardized* workers and work

# What Does Piecework Say?



What we'll find

- Building complexity into the processes
- Incremental advances until managers *tracked* and *standardized* workers and work
- Insights into task specialization

# What Does Piecework Say?



George Airy (astronomer) used a very similar approach

Grier (2013)



- Employed computers
- 13–20 years old
- no particularly strong background in mathematics
- A basic understanding of logarithms, algebra, etc...

# George Airy



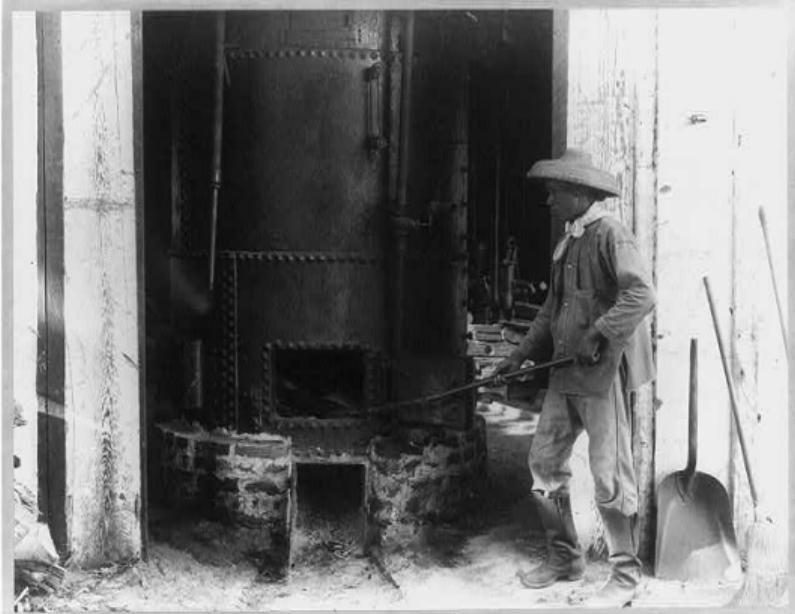
Airy built complexity into the process, assigning *human computers* to calculate astronomical movements.

No. of Swings.	Approximate Time (Astronomical Reckoning).	Number of Signals.	Mean of Times by SHELTON.	Mean of Times by EARNSHAW.	Interval by SHELTON.	Interval by EARNSHAW.	Rate EARNSHAW / SHELTON	Logarithm of EARNSHAW / SHELTON	Corrected Logarithm of EARNSHAW / SHELTON
1....	Oct. 1. 23	22	3 19 36.505	21 23 28.764	h m s ...4 0 23.100	h m s 4 0 38.722	1.0010831	0.00047012	
2....	2. 3	21	7 19 59.605	1 24 7.486	...3 58 21.652	3 58 37.400	1.0011011	0.00047793	
3....	2. 7	21	11 18 21.257	5 22 44.886	...4 45 27.829	4 45 46.421	1.0010855	0.00047117	
4....	2. 11	29	16 3 49.086	10 8 31.307	...4 17 6.532	4 17 23.234	1.0010827	0.00046995	
5....	2. 16	17	20 20 55.618	14 25 54.541	...3 13 21.898	3 13 34.795	1.0011116	0.00048249	
6....	2. 19	25	23 34 17.516	17 39 29.336	...3 49 42.503	3 49 57.654	1.0010994	0.00047720	
7....	2. 23	31	3 24 0.019	21 29 26.990	...3 55 2.071	3 55 17.433	1.0010893	0.00047282	
8....	3. 3	21	7 19 2.090	1 24 44.423	...4 2 41.510	4 2 57.445	1.0010944	0.00047503	
9....	3. 7	25	11 21 43.600	5 27 41.868	...4 31 5.786	4 31 23.591	1.0010947	0.00047516	
10....	3. 11	22	15 52 49.386	9 59 5.459	...3 27 49.747	3 28 3.324	1.0010888	0.00047260	
11....	3. 15	24	19 20 39.133	13 27 8.783	...3 59 47.292	4 0 3.188	1.0011049	0.00047959	
12....	3. 19	24	23 20 26.425	17 27 11.971	...4 3 30.416	4 3 46.029	1.0010686	0.00046384	0.00047194

# Low Complexity



## Farms



- Formalization of piecework:  
*payment for results*  
Chadwick ([1865](#))
- Dynamic piece rates

# Low Complexity



## Textiles



- Distributed workers

- Assuming common skills

# Low Complexity



- Strict management
- Formalizing work methods

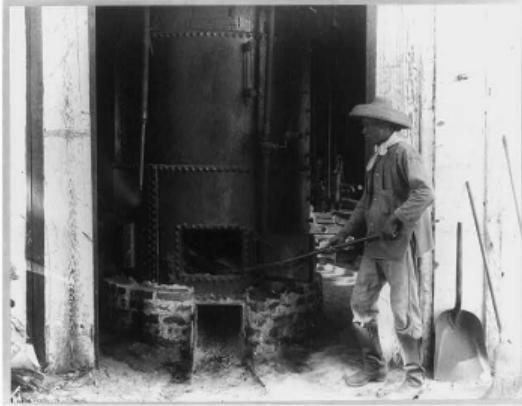
Matchstick Girls



# Low Complexity



Farms



Textiles



Matchstick Girls



# Planes, Trains, and Automobiles



## Trains



- “Efficiency experts” measured how long it would take to do various jobs  
Cunningham ([1911](#))
- These measurements would be used to assign pay rates for each specific task  
Jewell ([1921](#))

# Planes, Trains, and Automobiles

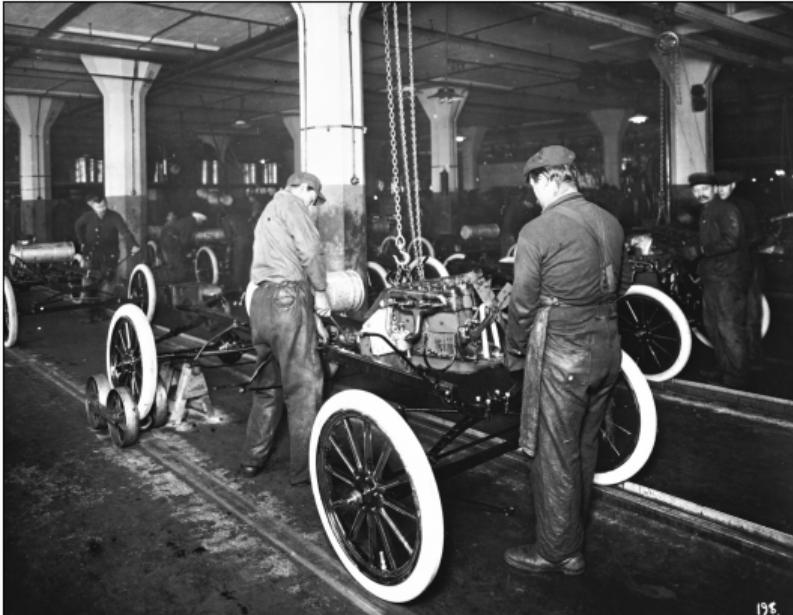


- Consolidating and training workers

(*Fordism*)

Schoenberger ([1988](#))  
and Tolliday and  
Zeitlin ([1986](#))

## Automobiles



- Measuring and evaluating workers by very carefully defined instructions

(*Taylorism*)

Taylor ([1911](#))

# Planes, Trains, and Automobiles



- Men drafted during World War II
- Factories turned to a new workforce who had neither conventional training nor experience
- **Specialized training and assignment**

Planes



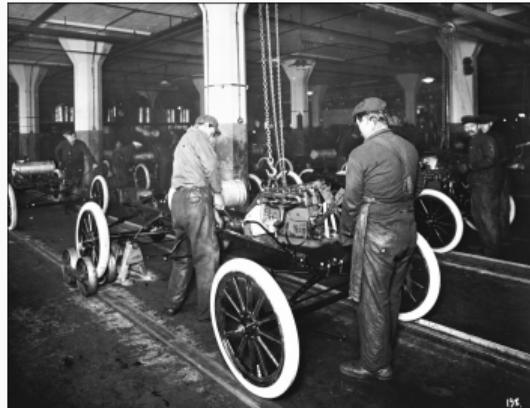
# Planes, Trains, and Automobiles



Trains



Automobiles



Planes



# Comparisons



- Building complexity into the processes
- Challenges dealing with flexibility
  - *Building planes versus fixing trains*

# Implications for On-Demand Work



Has technology shifted on-demand work?

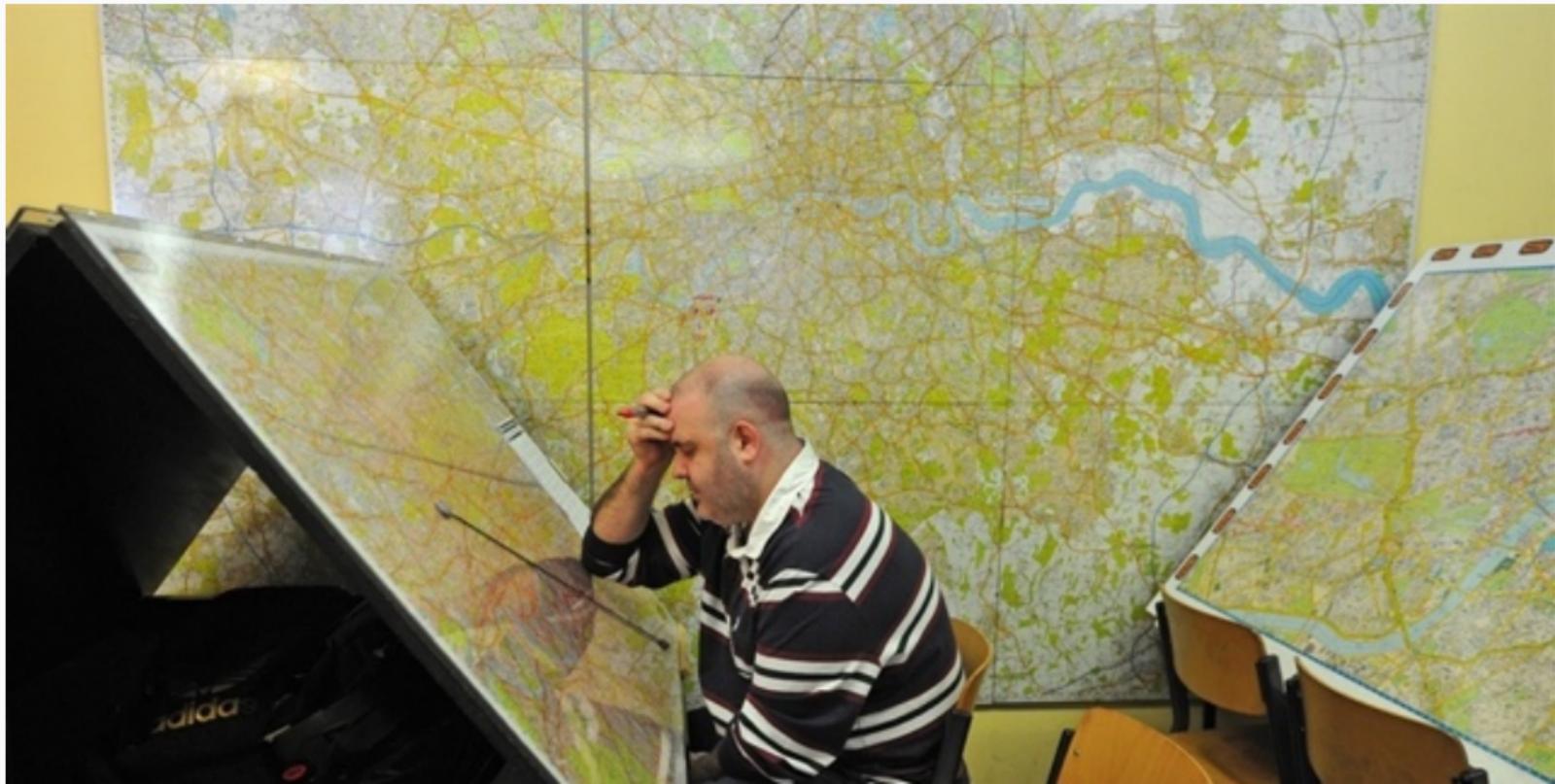
In some ways, yes

- Technology makes *some* complex tasks relatively trivial
- Measuring workers is easier than ever

In other ways, no — we still don't have good end-to-end processes for arbitrarily complex work

*We can make a routine out of building planes, but not out of fixing trains*

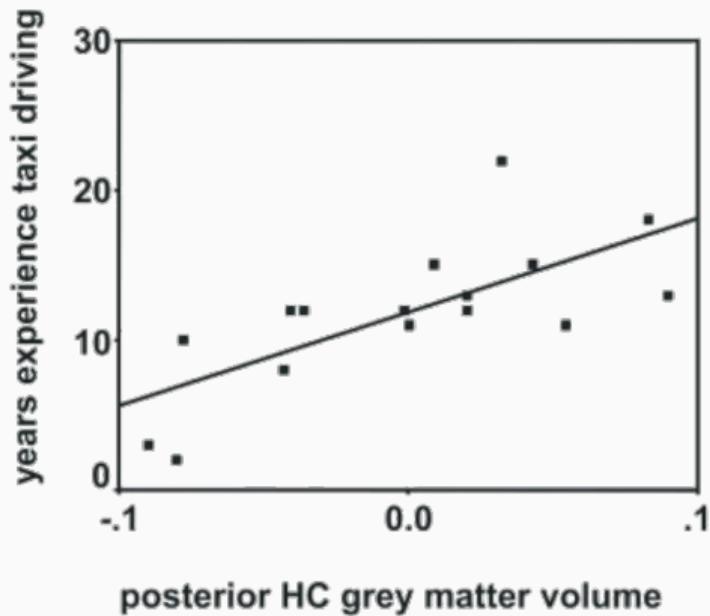
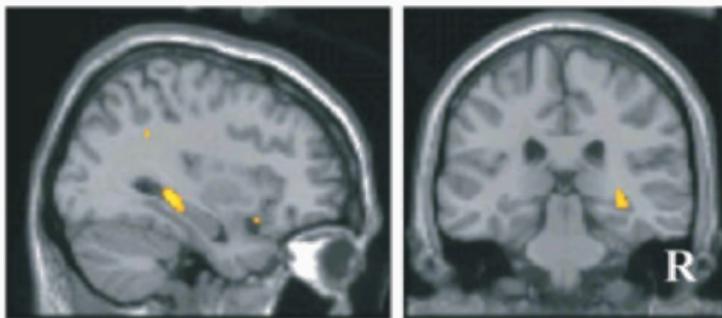
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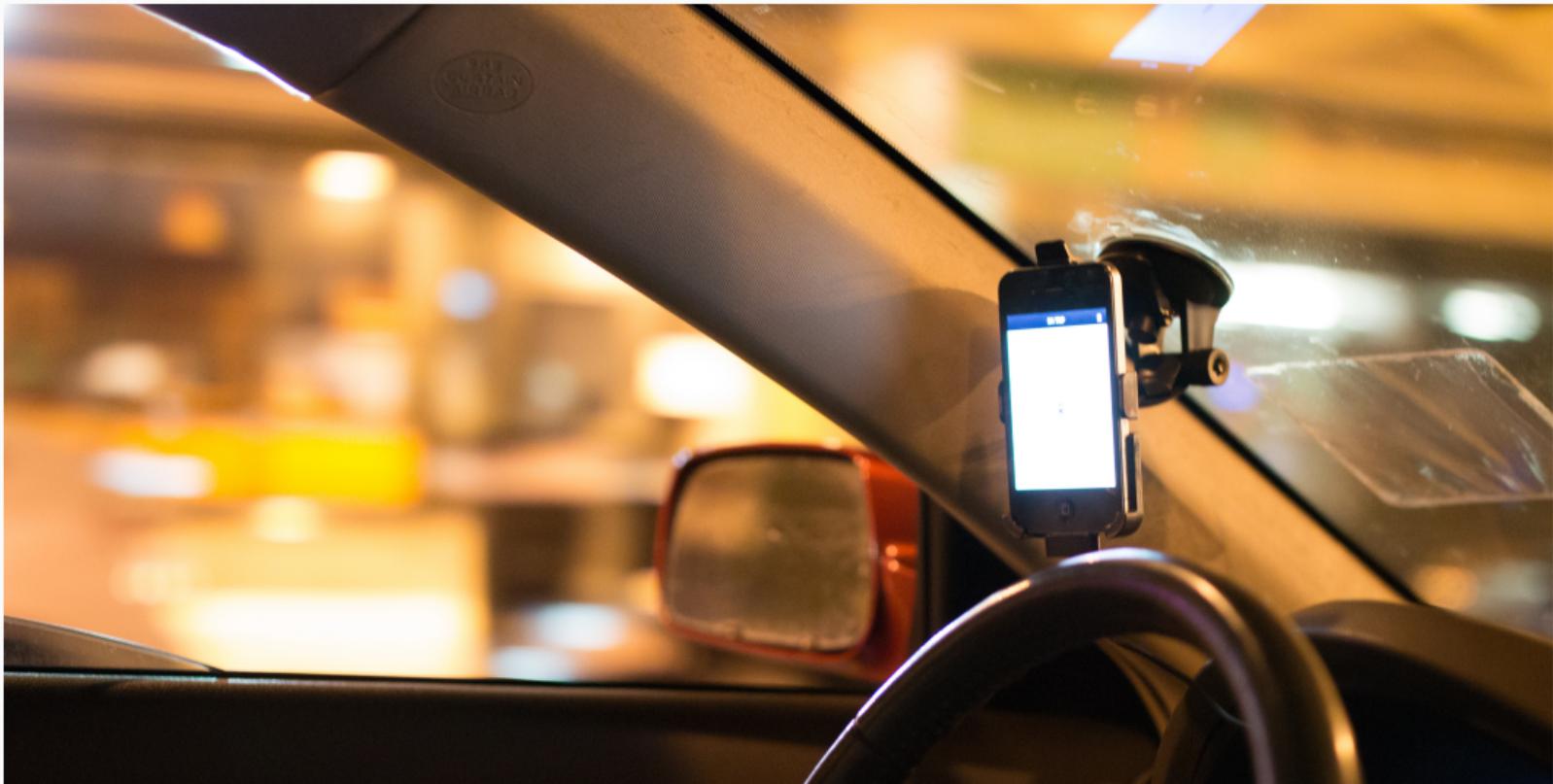
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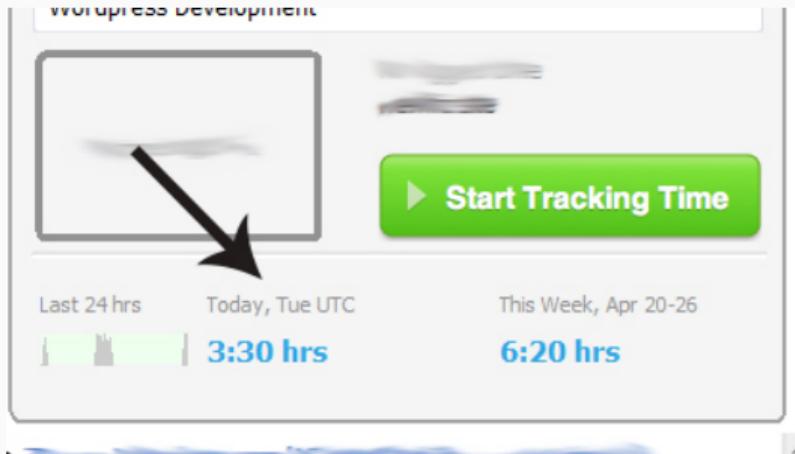
A



# Enhanced Cognition



# Tracking Work and Workers



Upwork has turned to logging workers' keystrokes and taking screenshots automatically every 10 minutes

## Takeaways



- We make stronger assumptions about workers' abilities thanks to technology
- Evaluation remains difficult, but we're trying to find stopgap solutions through decomposition
- We're still not solving the problems of inherently subjectively judged work

# Ongoing Threads in Crowdsourcing Research



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**Workers**

**Decomposition**

# Ongoing Threads in Crowdsourcing Research



## Workers

Firms antagonized and frustrated workers, exploiting that they were independent and often transient for leverage; workers bonded and found solidarity in this image of independence. **With the geographic dispersion to the internet, it's not clear if or how on-demand workers will accomplish the same.**

## Decomposition

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## Decomposition

Scientific Management & Taylorism pushed decomposition by way of measuring & optimizing tasks; as this matured, measurement and evaluation informed more narrow expert task specialization. **On-demand work could follow suit, driving a shift toward dramatically new requirements of workers in decomposed tasks.**

# Discussion



Several goals:

- Give some historical context to **on-demand work**
- Answer some questions that have been difficult to answer
- Recapture attention toward a valuable sense-making methodology

**On-demand work is a modern instantiation of a  
much older phenomenon — piecework.**

**The historical arc of piecework can shed light on persistent questions in this  
ongoing phenomenon of on-demand work.**

## Questions, Answers, etc...



Thanks to the Stanford Cyber Initiative for funding this research

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