Lecture 7:
Humans are “Humans”:
Understanding and Modeling Humans

Questions: https://sli.do #27125

Chien-Ju (CJ) Ho

Logistics: Assignment 2

- Due: October 16 (Friday)

- For majority voting, we mean simple majority voting
- Pseudo code of EM

Algorithm 1 The basic EM framework of Dawid and Skene (1979).

Input: Sets of worker-generated labels for each instance
Initialize each instance's label based on a simple majority vote
repeat
  for all Workers w **do**
    Calculate w's quality parameter(s), treating each instance's current label as ground truth
  end for
  for all Instances i **do**
    Calculate the most likely label for i, treating each worker's approximated quality parameter(s) as ground truth
  end for
until Label assignments have converged
Output: The current label assignments for each instance

Empirical correct ratio as worker skills

Weighted majority voting for MLE

Logistics: Assignment 2

- Due: October 16 (Friday)

- Some tricky details in implementing EM:
  - How to choose the weights during the step of weighted majority voting?
  - The MLE weight log(p/(1-p)) is very sensitive to noise when p approaches 0 or 1
  - You can do either one of the following:
    - Crop the probability using ideas in Section 4 of “Who Moderates the Moderators”
    - Use the (2p-1) weight for workers with correct probability p
      - technically not leading to MLE, but it give the smallest theoretical error bounds (see lecture 3 and 4)

Logistics: Project Proposal

- Due this Friday.
- Topics are relatively flexible: as long as your project focuses on “humans” in the computation process
  - I might suggest/require changes after the proposal

- You may check the list of example/past projects
- If you want to have a chat, you can schedule a meeting:
  - https://calendly.com/chienju/meetings

Logistics: Reviews

- I have updated the review status on Gradescope. Please let me know if you spot any errors.

- I plan to update the status every 2~3 weeks.

Today’s Lecture

About Assignment 1

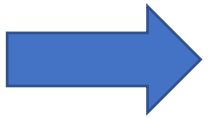
- Motivated by this post:
  - My MTurk (half) Workday. Jeff Bigham

- How much do you earn per hour?

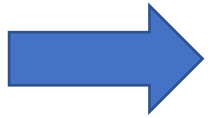
7.67	2.84	1.20
5.00	2.65	1.09
5.00	2.53	0.95
4.00	2.38	0.80
3.97	2.01	0.69
3.60	1.80	0.55
3.00	1.20	0.50

Mean: 2.54
Median: 2.38

Crowdsourcing (Requester's Perspective)



"Crowd"



Flower
Dog
Cute
…

Input

Black Box

Output

The Crowd is Make of People

Flower
Dog
Cute
…

Who are these people?

Why should we care?

- So we know how to better utilize and interact with the crowd
  - CS tools let us reason about machine programs (runtime, scalability, correctness, ...)
  - Need to develop models of human behavior when humans are in the loop
  - Most studies so far make strong assumptions about human behavior

- Remind us crowd workers are humans like us (sounds obvious, but…)
  - Human-centered research has been receiving great attention
  - Ethical-related issues (fairness, transparency, and privacy) are important

- Relatively under-explored. Potential interesting topics for your projects…
  - They might be quite challenging though

Who are these workers?

- Demographic information
- Are workers working independently?
- How many workers are there?
- …?

The information is not trivial to get

- There is no official census data about crowd workers

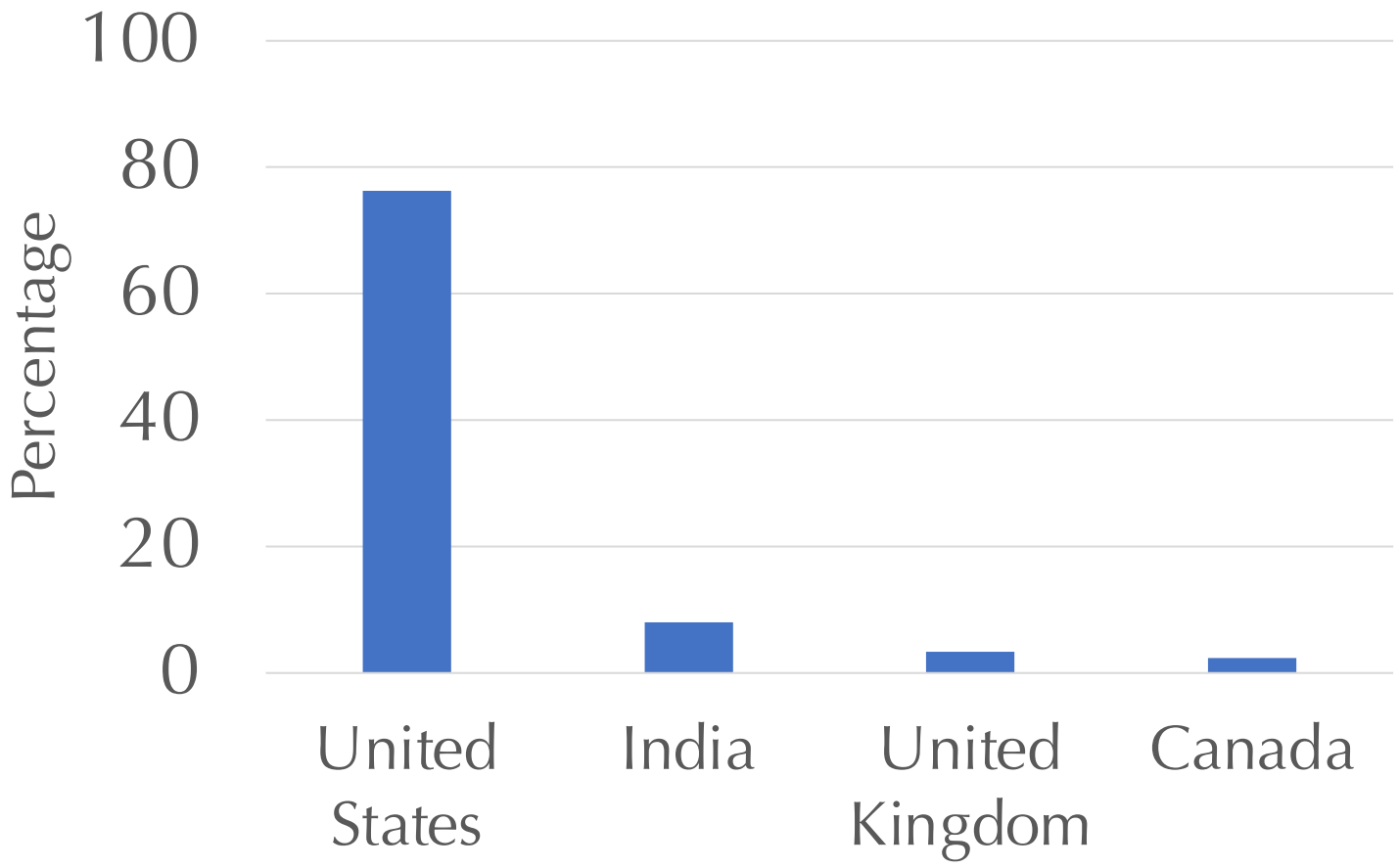
- Potential solutions:
  - Conducting surveys
  - Ethnographic analysis of digital trace
  - What else?

The Demographic of MTurk

- Survey on 1,000 Turkers
  - Conduct the survey twice (Dec. 2008 and Oct. 2008)
  - Consistent statistics
  - Blog Post:
    - A Computer Scientist in a Business School https://www.behind-the-enemy-lines.com/

- One of the early attempts to understand MTurk demographics

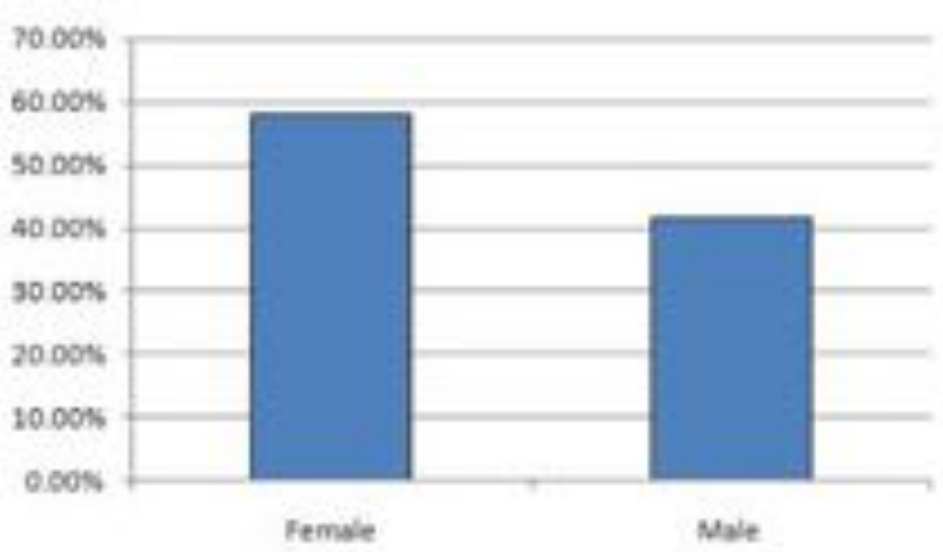
MTurk Worker Demographics (2008): Country



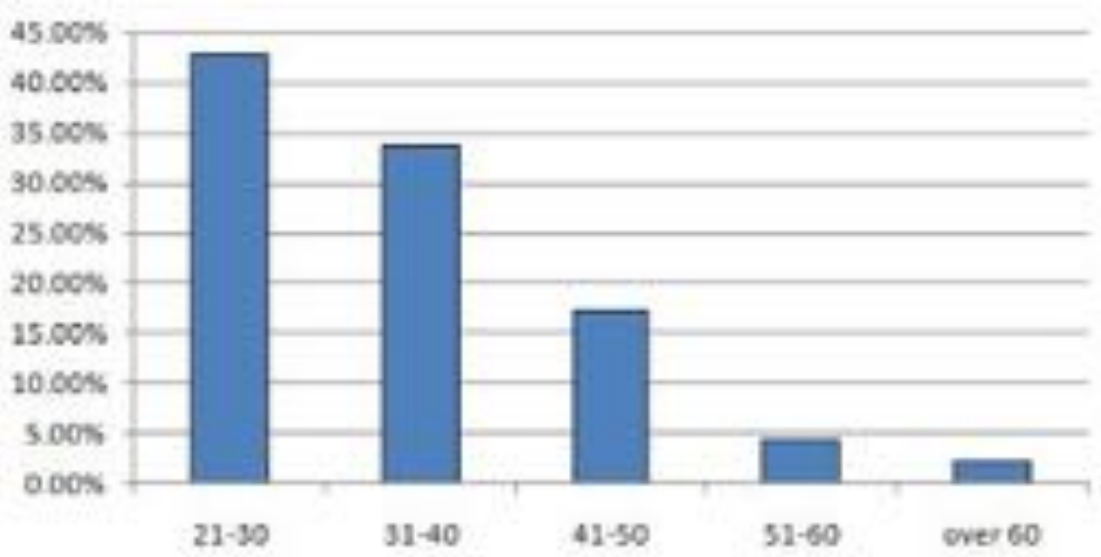
The majority of crowd workers on MTurk come from the US

http://www.behind-the-enemy-lines.com/2008/03/mechanical-turk-demographics.html

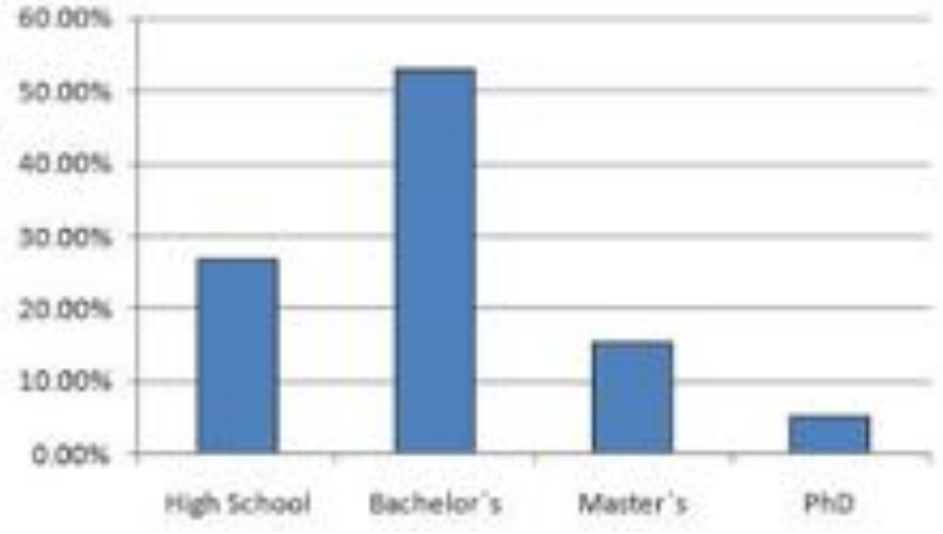
Gender



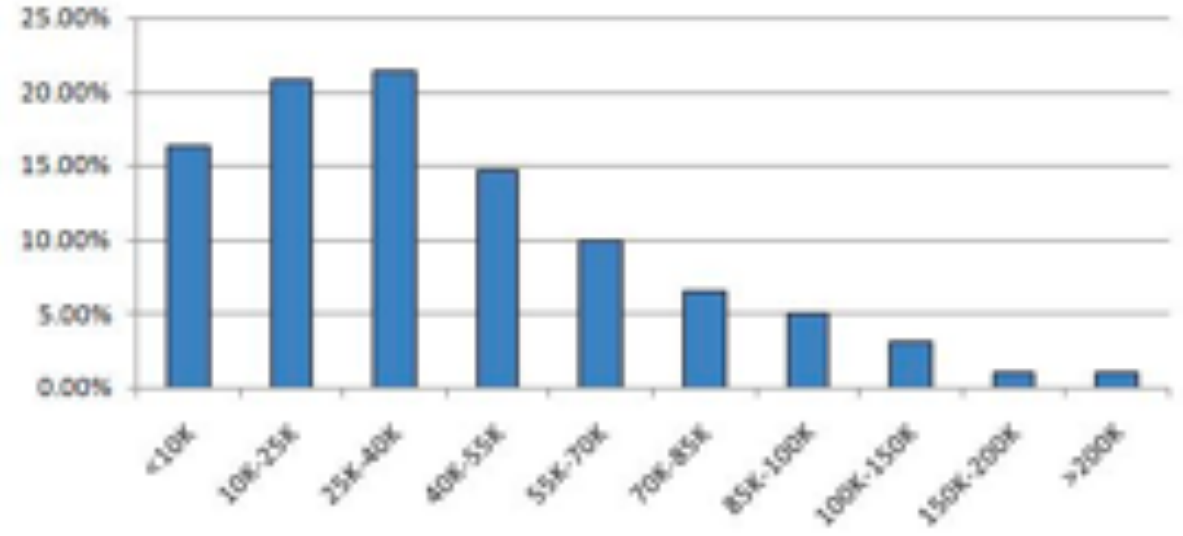
Age



Education



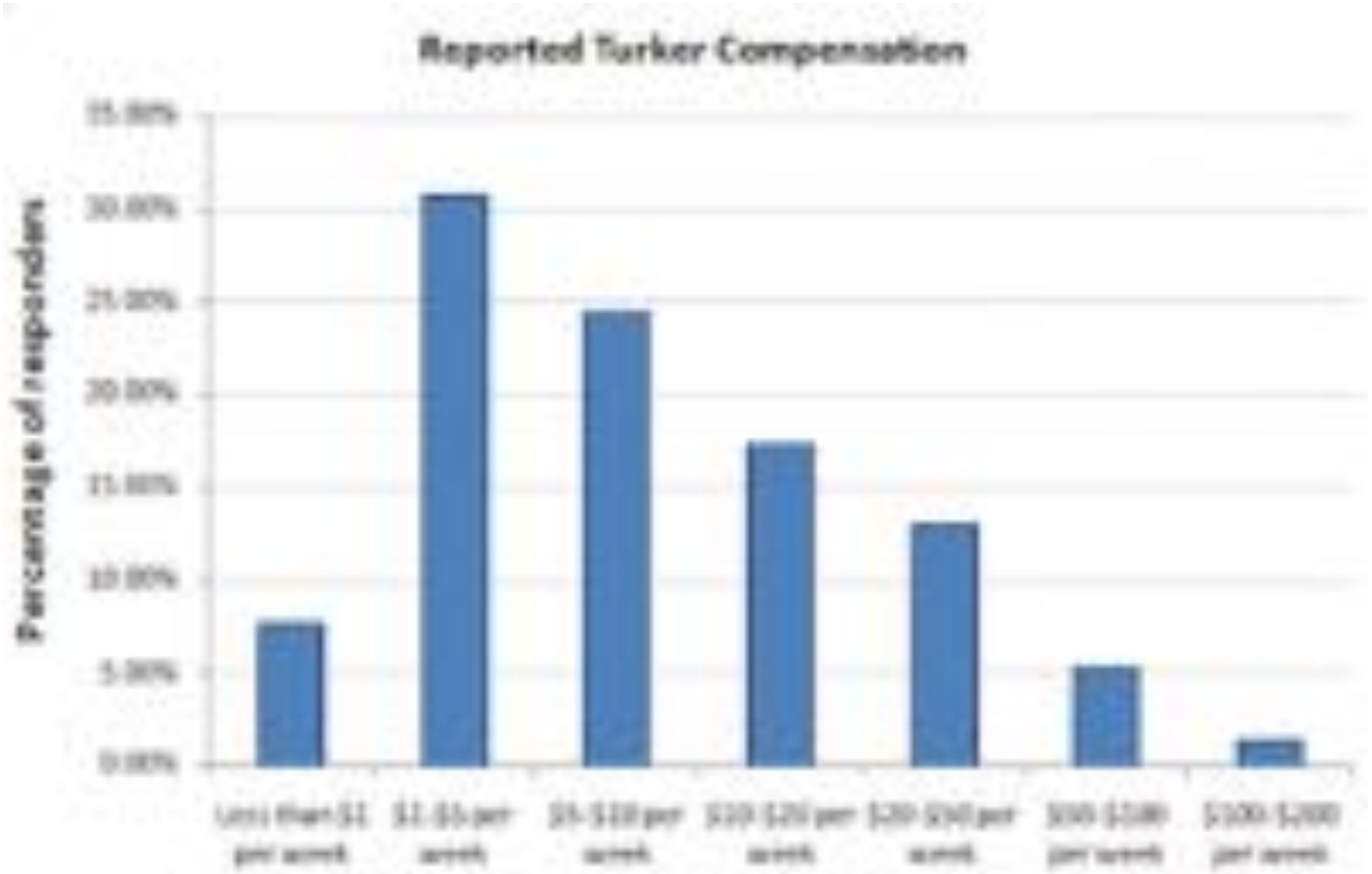
Income



MTurk Worker		Internet Users (2008, US)	
			
Younger	54%	**Age: 21-35**	22%
More Female	70%	**Female**	50%
Lower Income	65%	**Household income < 60K**	45%
Smaller Family	45%	**Household <= 2 people**	28%

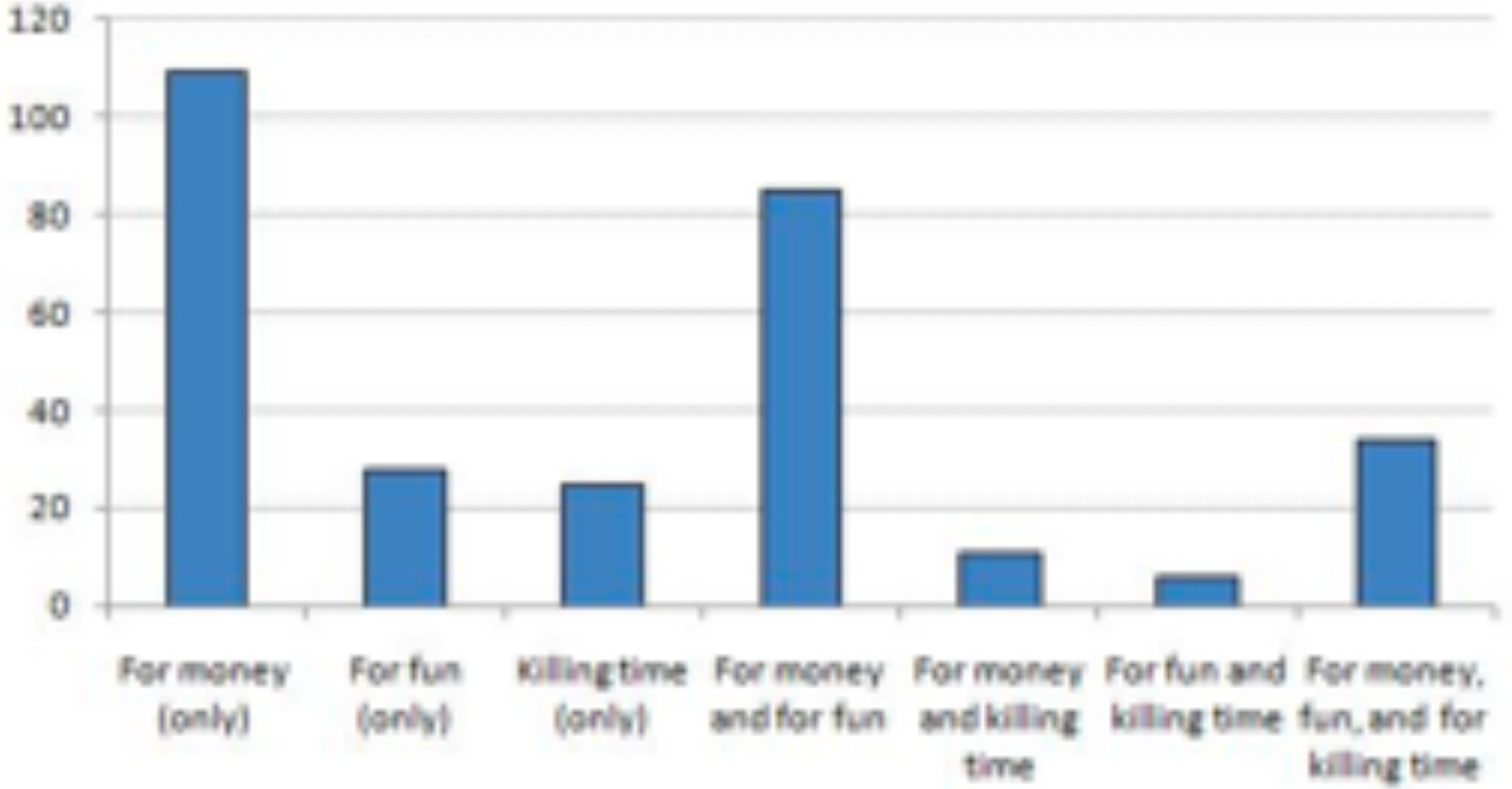
http://www.behind-the-enemy-lines.com/2009/03/turker-demographics-vs-internet.html

MTurk Worker Demographics (2008): Payment received



http://www.behind-the-enemy-lines.com/2008/09/how-much-turking-pays.html

MTurk Worker Demographics (2008): Purpose

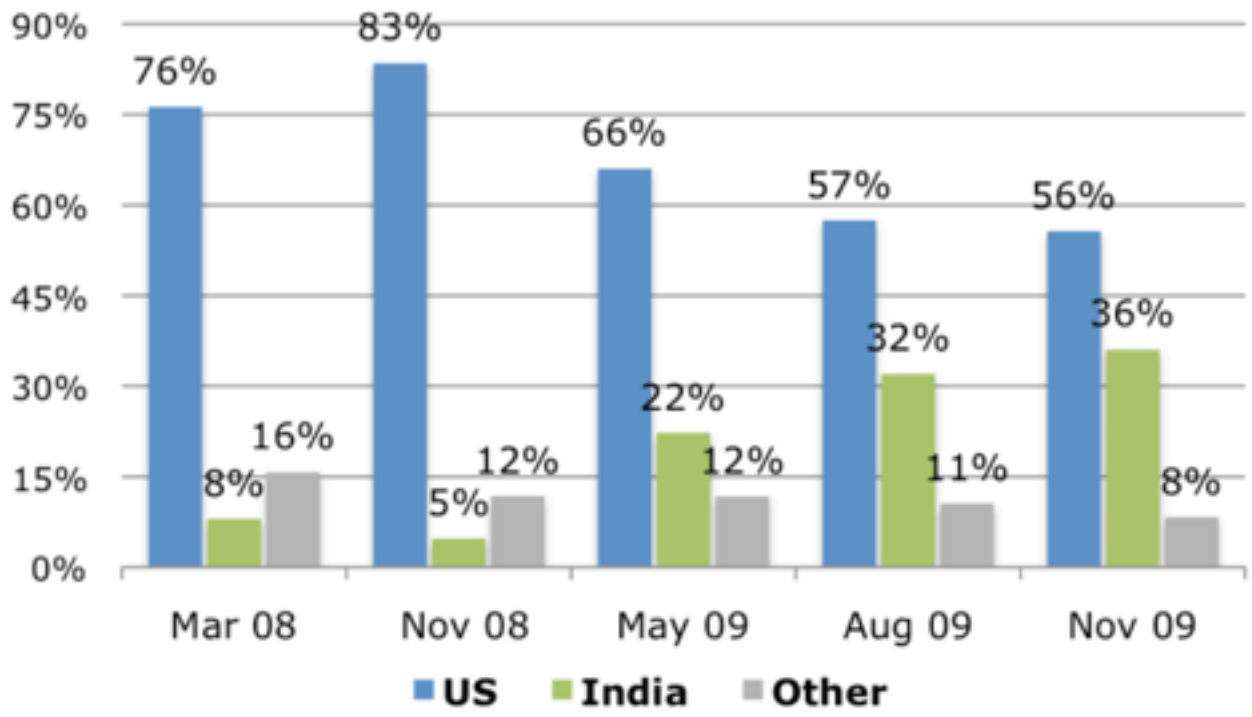


Faces of MTurk workers

https://waxy.org/2008/11/the_faces_of_mechanical_turk/

$0.05 => 2 submissions within 24 hours
$0.25 => 8 submissions within 48 hours
$0.50 => 20 submissions within 48 hours

But Demographics Also Changes Over Time…



From a primary US-based workforce to an increasingly international group of workers.

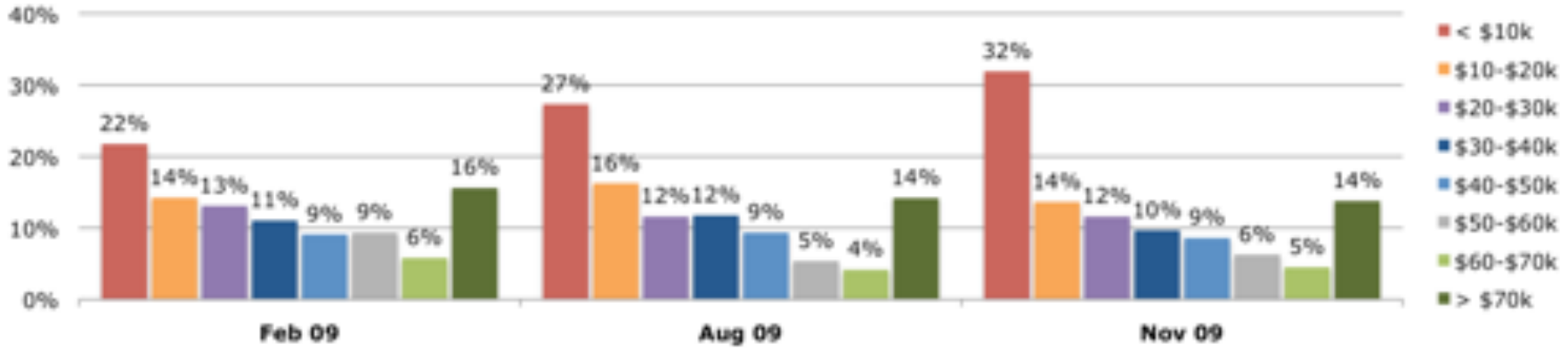
Ross, Joel, et al. "Who are the crowdworkers?: shifting demographics in mechanical turk." *CHI'10 EA*

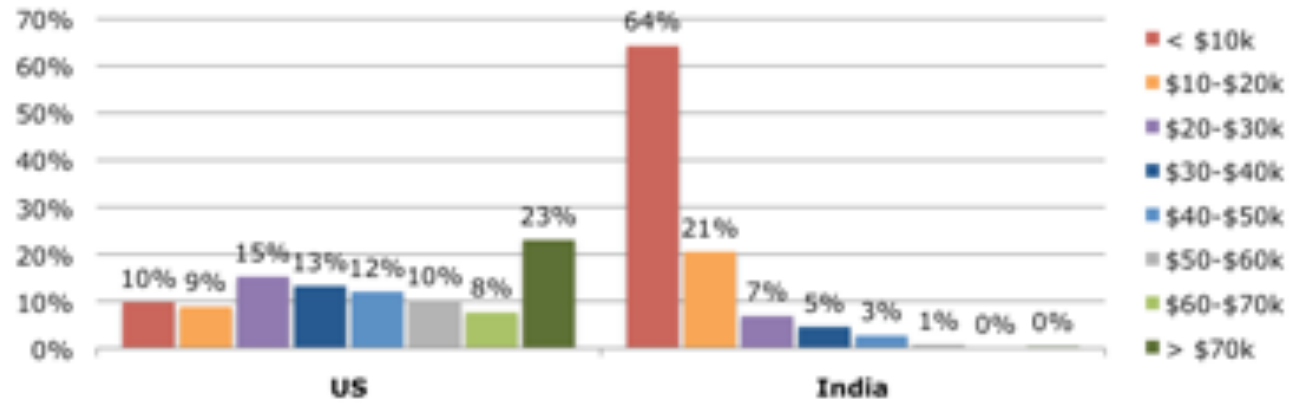
But Demographics Also Changes Over Time…

		Nov 08	May 09	Aug 09	Nov 09
Average Age	*US*	33.6	34.3	33.2	35.4
	India	28.5	28.8	27.6	26.4
Gender	*US*	28% male, 72% female	34% male, 66% female	31% male, 69% female	37% male, 63% female
	India	75% male, 25% female	61% male, 39% female	69% male, 31% female	66% male, 34% female
Education	*US*	32% Bachelors, 11% Graduate	34% Bachelors, 14% Graduate	34% Bachelors, 19% Graduate	38% Bachelors, 17% Graduate
	India	69% Bachelors, 29% Graduate	56% Bachelors, 18% Graduate	56% Bachelors, 13% Graduate	45% Bachelors, 21% Graduate

Ross, Joel, et al. "Who are the crowdworkers?: shifting demographics in mechanical turk." *CHI'10 EA*

But Demographics Also Changes Over Time…





Ross, Joel, et al. "Who are the crowdworkers?: shifting demographics in mechanical turk." *CHI'10 EA*

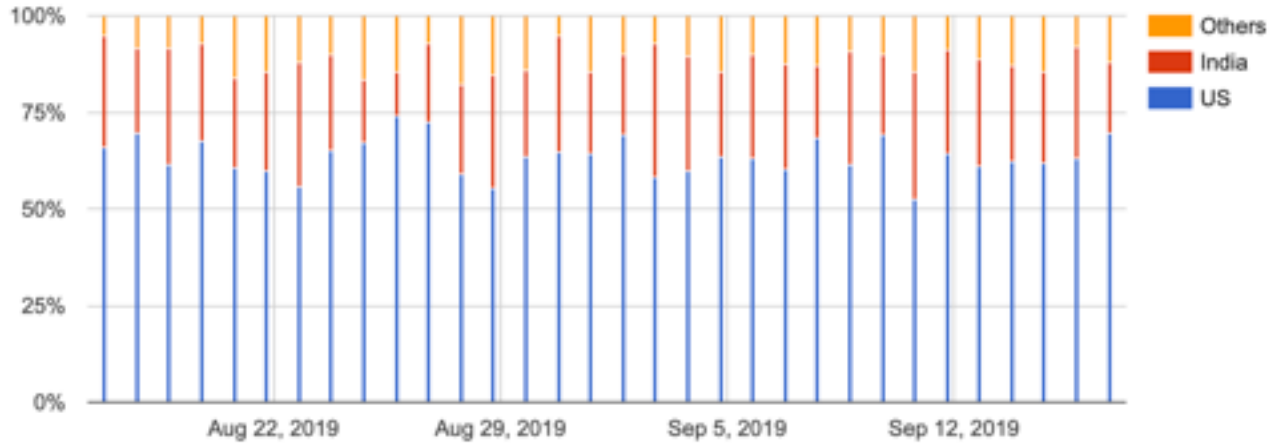
MTurk-Tracker: A Long-Term Demographic Survey

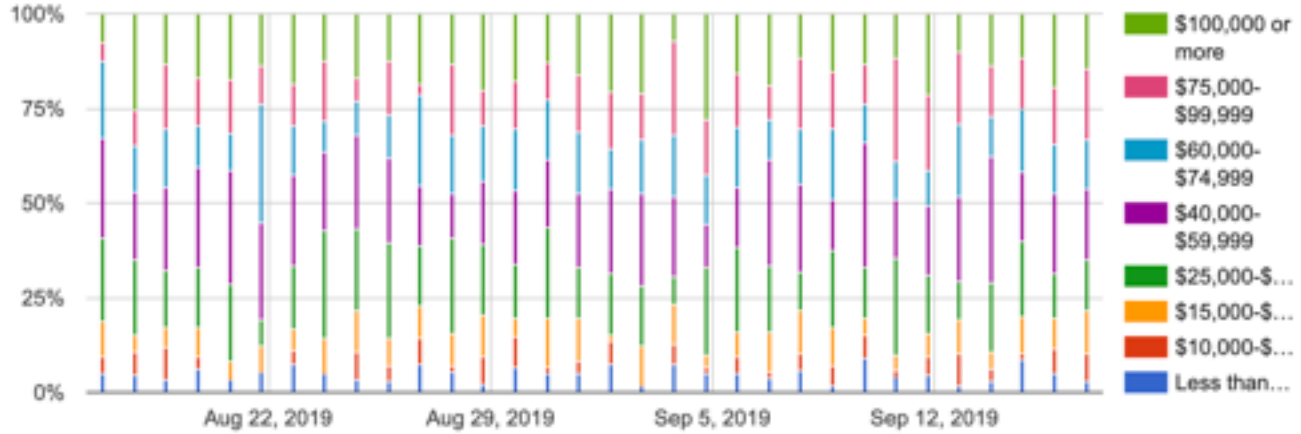
Each worker can take at most one survey in 30 days http://demographics.mturk-tracker.com/#/gender/all

MTurk-Tracker: A Long-Term Demographic Survey

mturk tracker

- Gender
- Gender (US)
- Gender (India)
- Year of Birth
- Year of Birth (US)
- Year of Birth (India)
- Marital Status
- Marital Status (US)
- Marital Status (India)
- Household Size
- Household Size (US)
- Household Size (India)
- Household Income
- Household Income (US)
- Household Income (India)
- Countries
- API





http://demographics.mturk-tracker.com

Warm-up Discussion

Does the demographic information collected from self-reported survey responses suffer from any problems?

Can you some up with potential fixes for the problems?

What about ethnographic analysis of digital trace in the required reading?

Warm-up Discussion

Does the demographic information collected from self-reported survey responses suffer from any problems?

Can you some up with potential fixes for the problems?

What about ethnographic analysis of digital trace in the required reading?

- Potential issue 1: Data bias (sampling bias, human bias)
- Potential issue 2: Untruthful self-reports

Sampling Bias

Ideally, we want to select participants from the population “uniformly at random”.

However, it’s not always that easy…

1948 US Presidential Election

- Truman vs. Dewey
- Chicago Daily Tribune decided to run a phone poll of how people voted

Chicago Daily Tribune

THE WORLD'S GREATEST NEWSPAPER

HOME

DEWEY DEFEATS TRUMAN

G.O.P. Sweep Indicated in State; Boyle Leads in City

REPUBLICAN TICKET AHEAD OF 1944 VOTE

Town Balloting Gives Trend

Tops Coghlan in Hot Race for Attorney

RECORD CITY VOTE SEEN IN LATE TALLIES

Suburban Ballot Near 375,000

BULLETINS ON ELECTIONS

Early Count Gives G.O.P. Senate Edge

PUTS G.O.P. BACK IN THE WHITE HOUSE

Sizable Electoral Margin Seen

Truman


Chicago Daily Tribune
DEWEY DEFEATS TRUMAN
G.O.P. Sweep Indicated in State; Boyle Leads in

What happened?

One explanation: we cannot claim anything for certain.

"The Inescapability of Uncertainty: AI, Uncertainty, and Why You Should Vote No Matter What Predictions Say". Vaughan and Wallach. 2016.

However, there are bigger issues here…

- Phones are expensive in 1948…
- Dewey was more favored in rich populations

- Imagine you are polling from people in DC/Texas/NY to predict who will win the presidential election…

Sampling Bias

- No simple solutions: Be aware of the issue and think about the impact it might bring in your results.

- You might be able to “correct” the bias if you have additional knowledge.
  - Importance sampling
  - Potentially interesting/relevant paper
    - Conducting Truthful Surveys, Cheaply. Roth and Schoenebeck. EC 2012.

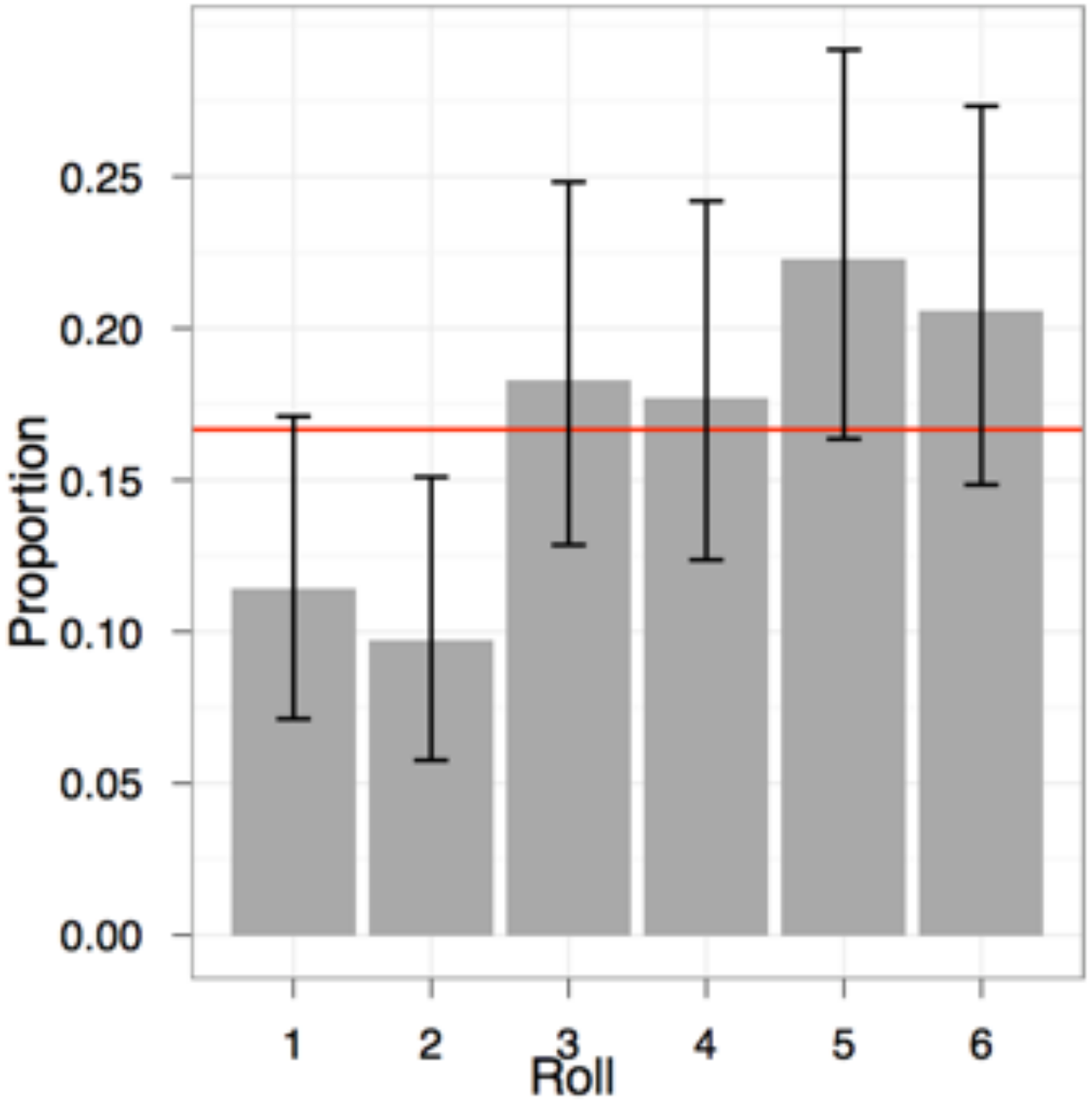
Are workers honest?

- Workers are asked to answer demographics questions [Suri et al. 2011]
  - Sex, Age, Location, Income, Education

- Ask workers to privately roll a die and report the outcome.

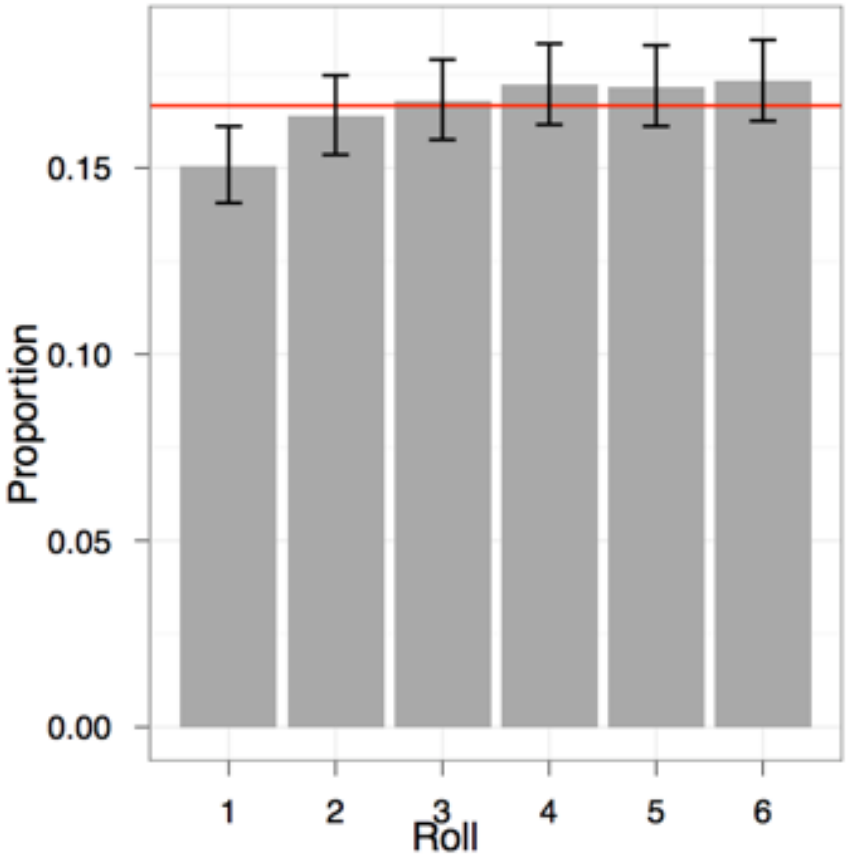
  Payment = $0.25 + $0.25 * roll

- If all workers are honest, mean report: 3.5
- What do you think the mean was?



Mean: 3.91

Ask workers to report 30 rolls



- Not conclusive evidence, but workers are more honest than we think.
- However, some workers are not. We should be careful to avoid attacks.
  - E.g., designing consistency check questions

Methods for Information Collection

- Direct surveys

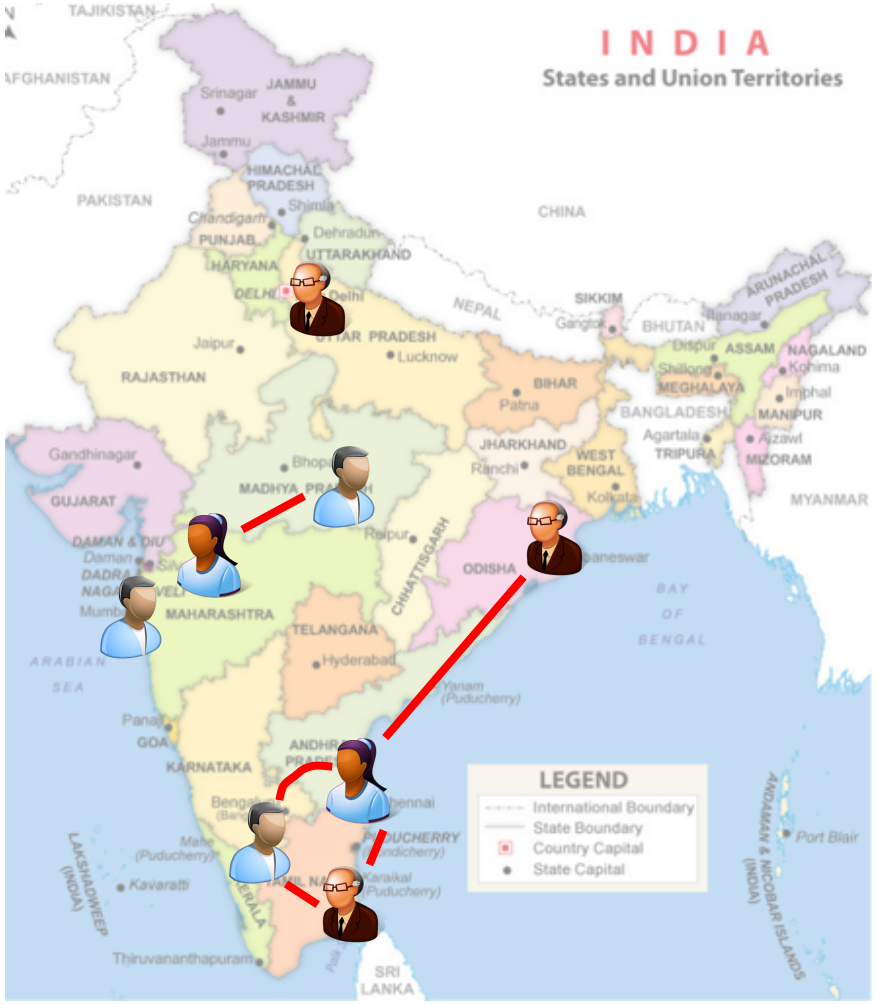
- Ethnographic analysis (as in the required reading)
  - Rely on researchers' judgements. Not quantitative.
  - Slowly increasingly, ML has come to help.

- More intricate methods
  - Example 1: How to measure the communication network of the crowd
  - Example 2: How to measure the size of the crowd

Common Assumption: Workers are Independent

[Yin et al., 2016]

Some Evidence From the Field



[Gray, Suri, Ali, Kulkarni. CSCW 2016]

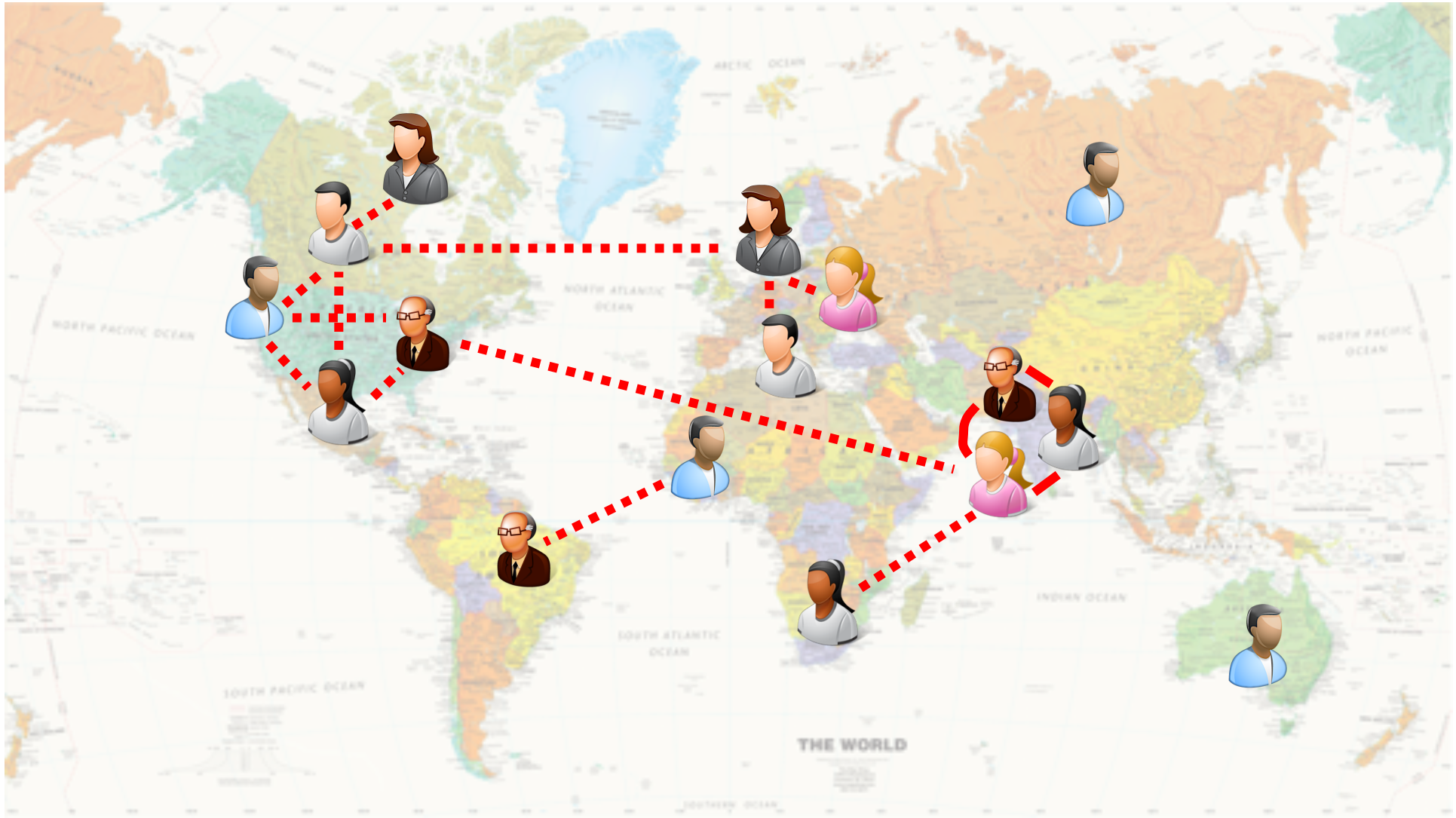
Workers talk to each other to...
(based on **~100** interviews)

Help with administrative overhead

Share useful information

Recreate social connections

Can we Map the Network?



What is the scale? ***What is the structure?*** ***How is it used?*** [Yin et al., 2016]

Why is it Challenging?

Not accessible through API

Not on the MTurk platform

Nowhere to download

Can't just crawl from the web

The goal…

- Elicit "true" connections only

Can't pay by connections!

- Elicit as many true connections as possible
- Preserve workers' privacy

Can't directly ask for names!

A Web App

- Workers self-report their connections

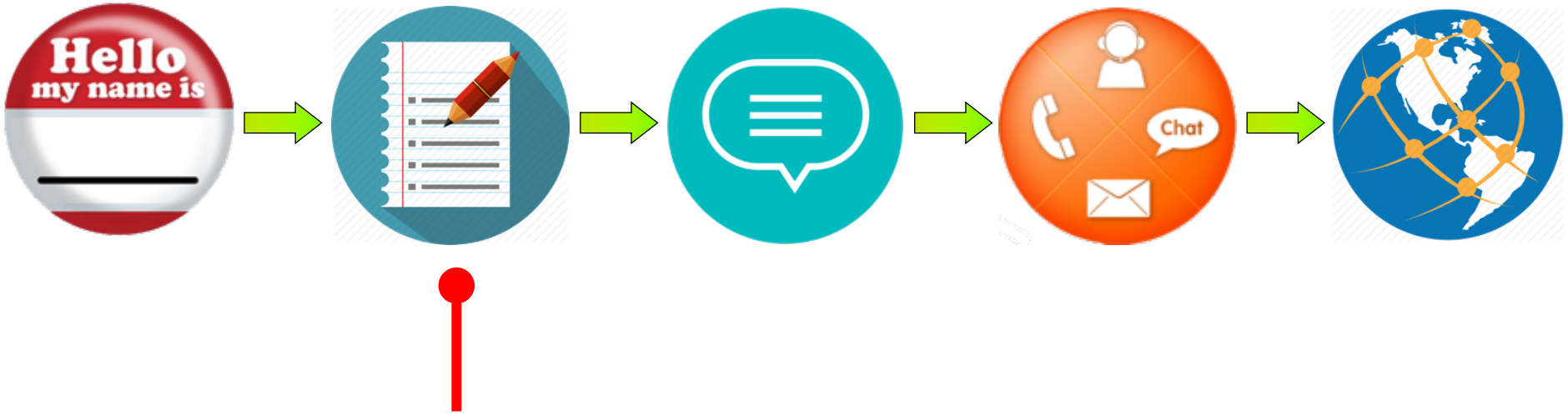
- Provides some value back to the workers so it's their best interest to report as many true connections as possible

[Yin et al. 2016]

The Network Mapping App

Step 1: Create a nickname for yourself

The Network Mapping App



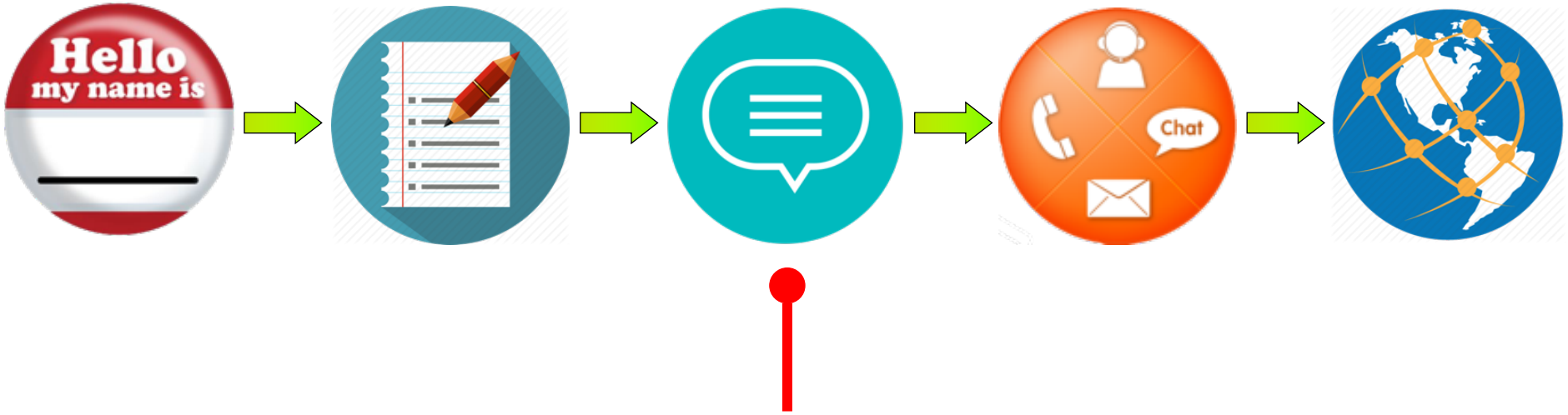
Step 2: Complete a brief demographic survey

Age
Gender
Country
Approval rate
…

- (●) Share with all other workers
- ( ) Share with workers connected to me
- ( ) Not share with anyone

Value back: Who are the other workers?

The Network Mapping App



Step 3: Tell us about your personal experience with MTurk

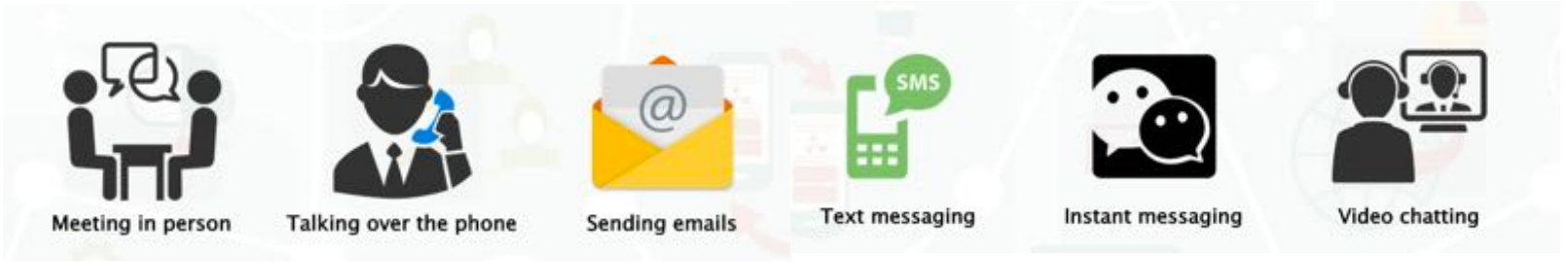
Why did you start Turking?
What motivates you to keep Turking?

(Selected based on a pilot study!)

Value back: What are other workers' Turking stories?

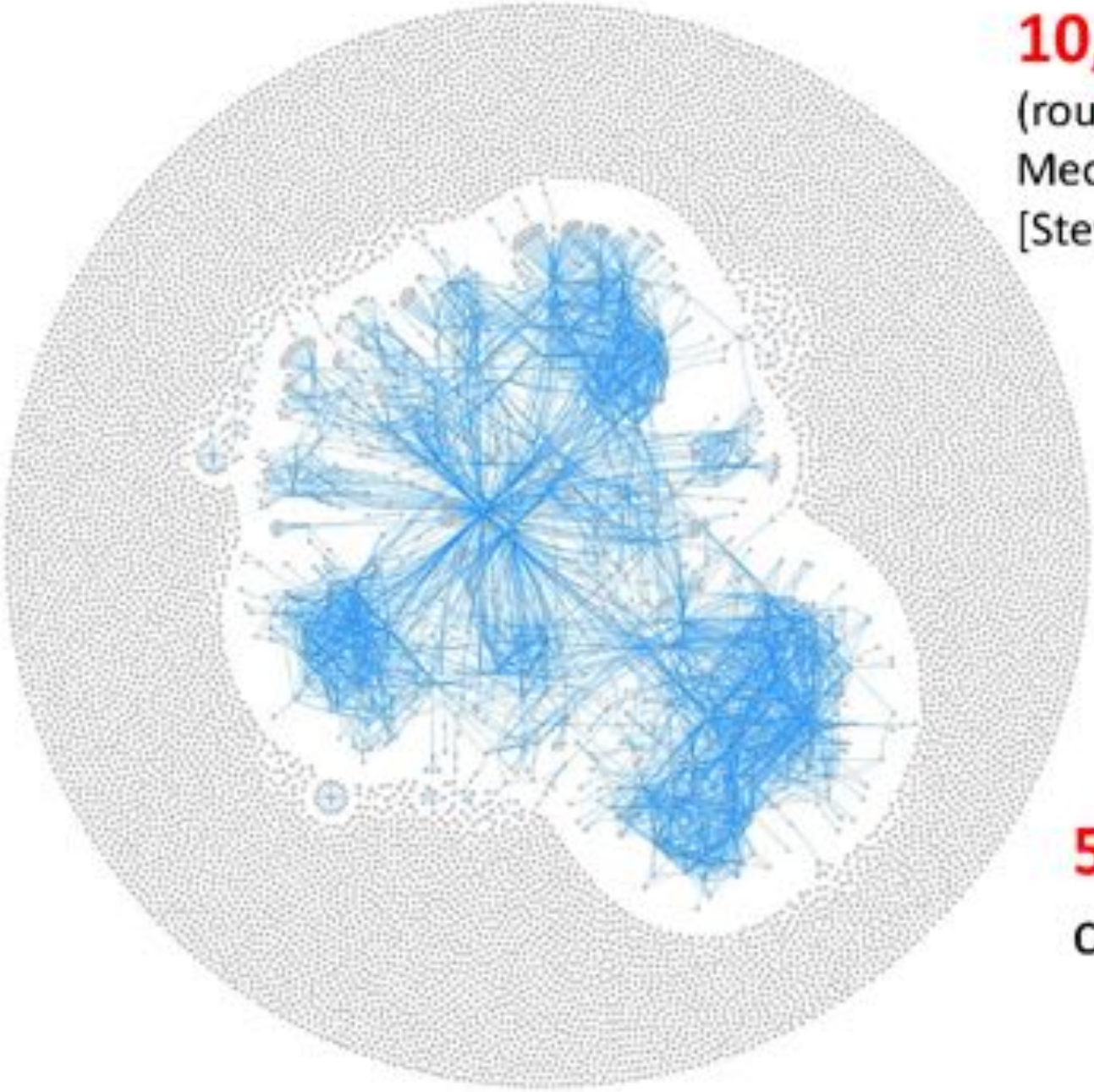
The Network Mapping App

Step 4: Swap nicknames with Turkers you know



The Network Mapping App

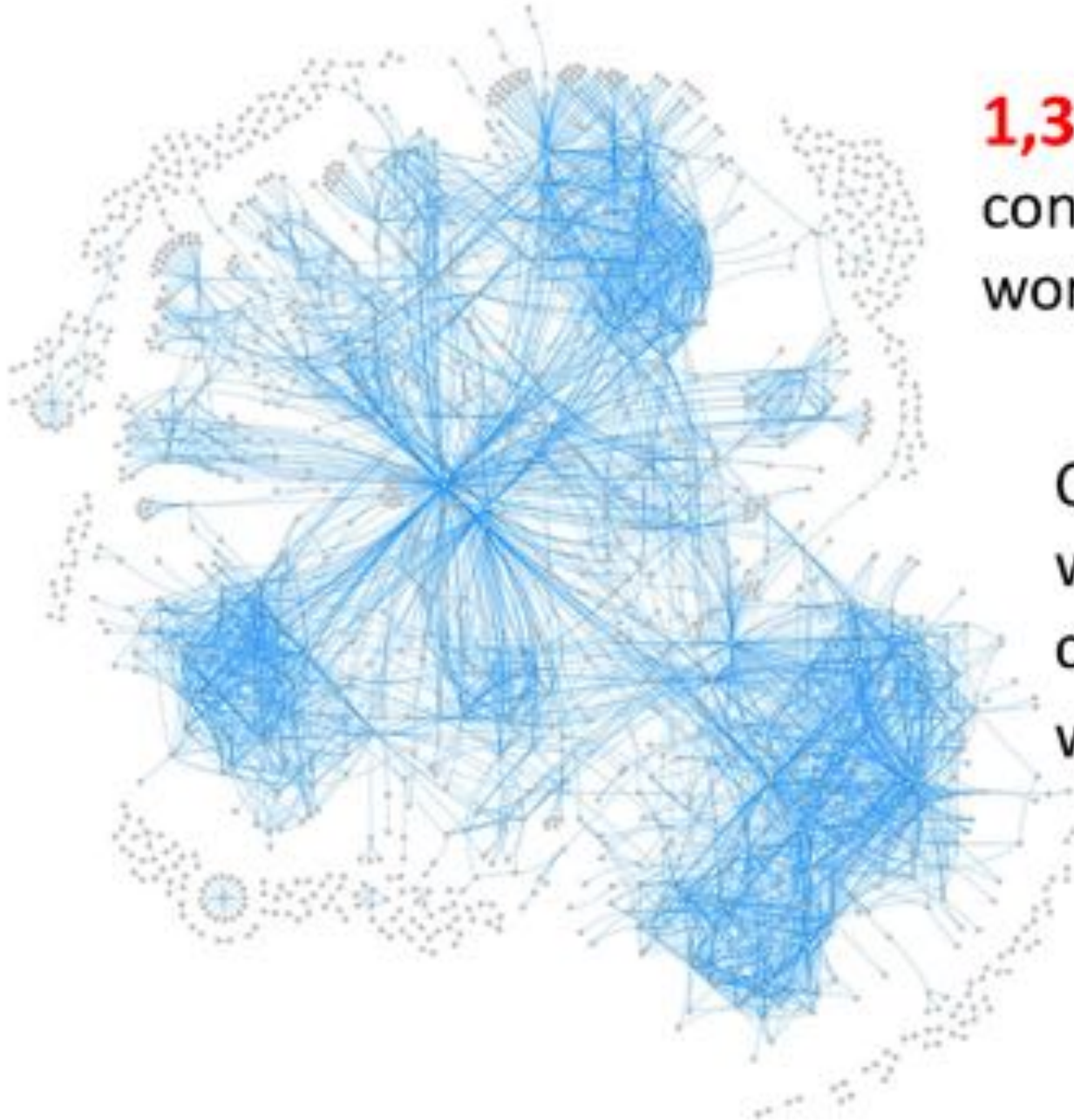
Step 5: Explore the Turker network



10,354 workers
(roughly a census of
Mechanical Turk
[Stewart et al. 2015])

5268
connections

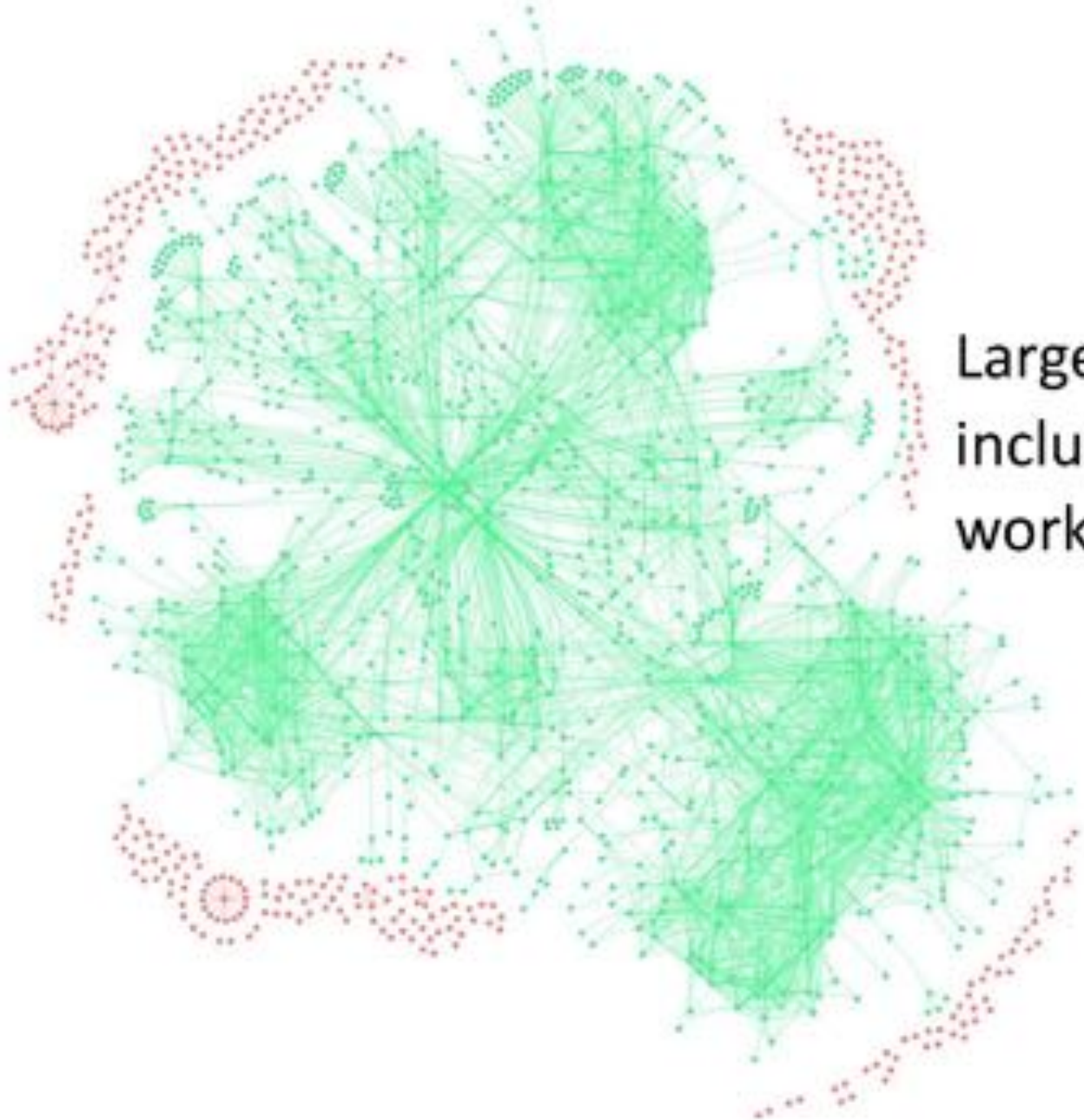
[Yin et al., 2016]



1,389 (13%)
connected
workers

On average,
workers
communicate
with **7.6** others

Max degree
is **321**
[Yin et al., 2016]



Largest component includes **994 (72%)** workers

[Yin et al., 2016]

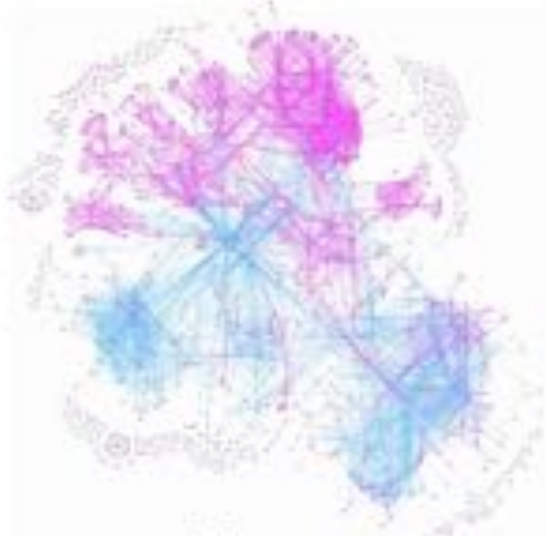
A Network Enabled By Forums

- **59%** of all workers and **83%** of connected workers reported using at least one forum.

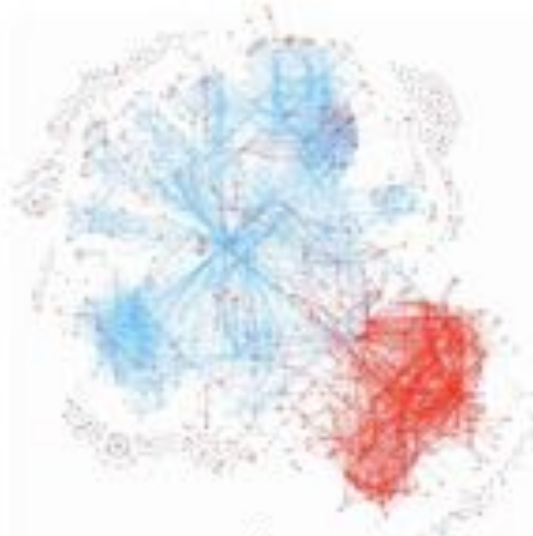
- **90%** of all edges are between pairs of workers who communicate via forums, and **86%** are between pairs who communicate *exclusively* through forums.

[Yin et al., 2016]

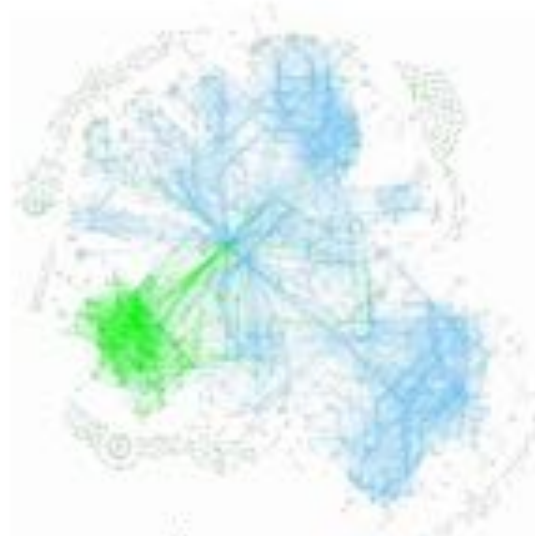
Forums Create Subcommunities



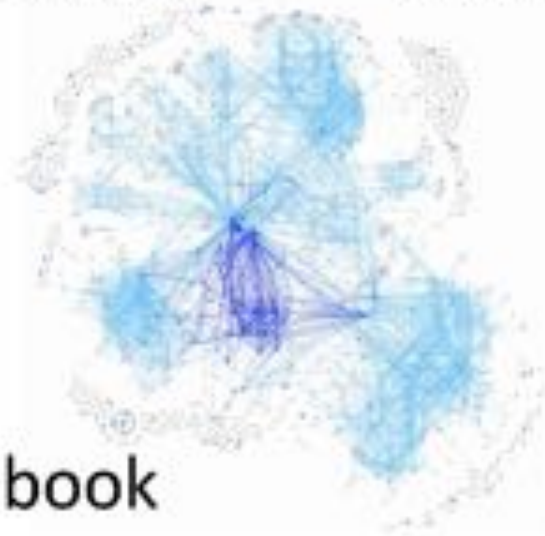
Reddit HWTF



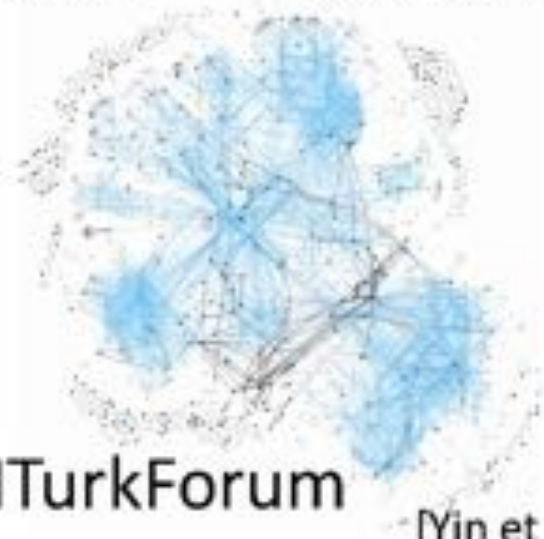
MTurkGrind



TurkerNation



Facebook



MTurkForum

[Yin et al., 2016]

Subcommunities Are Different

Topological Structure: How tightly connected is each subcommunity?

Temporal Dynamics: Do relationships endure over time?

Communication Content: Is communication social or strictly business?

[Yin et al., 2016]

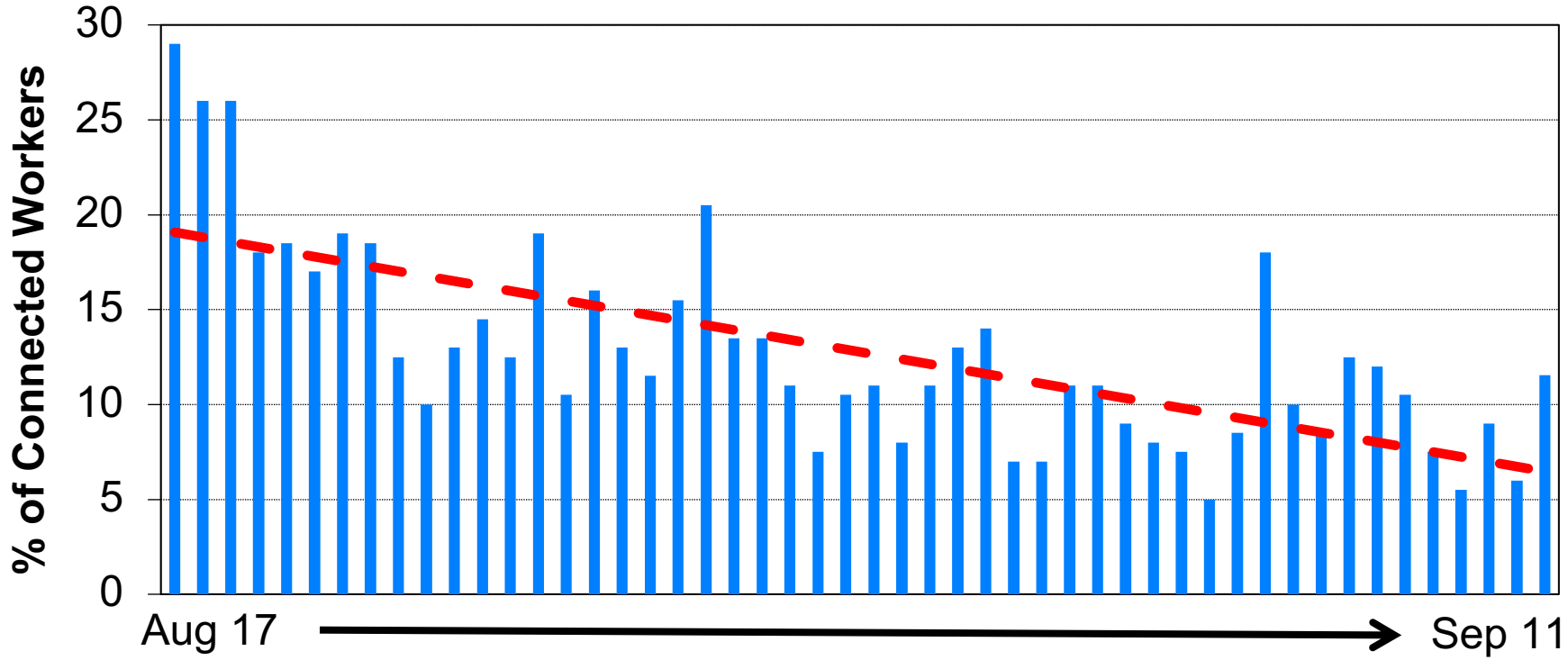
Measures of Success

Property	Connected	Unconnected
Be active > 1 year	55%	46%
Use forums	83%	56%
Master	11%	7%
Approval rate	98.6%	97.4%

Connected workers were also more likely than unconnected workers to find our task early.

[Yin et al., 2016]

Connected Workers Find HITs Earlier



Discussion

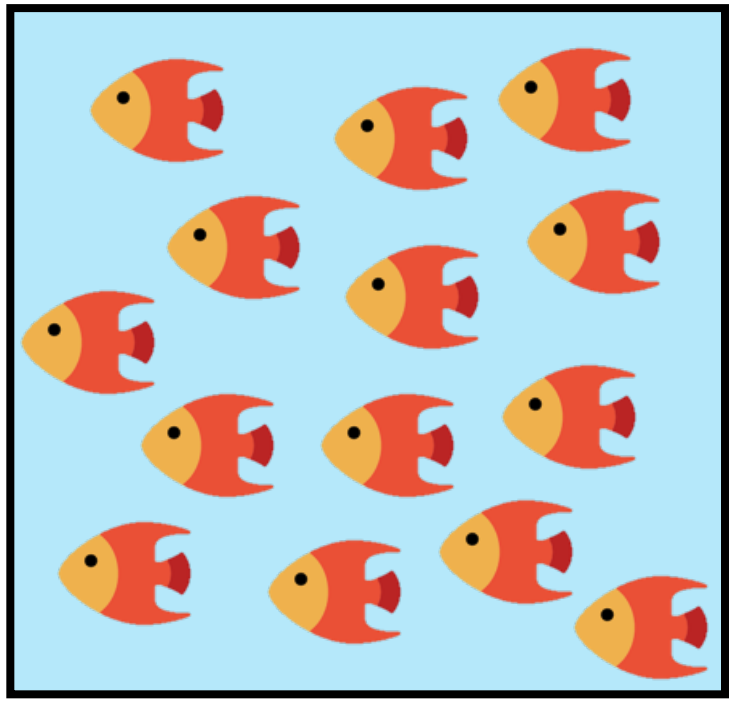
- What are the implications of this study?

- What do you think the fact that there are communication networks would affect the way we think of crowdsourcing?

Oct 29	Practical Issues: Non-Independent Work **[Student Presentation #6]**	**Required** MicroTalk: Using Argumentation to Improve Crowdsourcing Accuracy. Drapeau et al. HCOMP 2016. **Optional** Revolt: Collaborative Crowdsourcing for Labeling Machine Learning Datasets. Chang et al. CHI 2017. Atelier: Repurposing Expert Crowdsourcing Tasks as Micro-Internships. Suzuki et al. CHI 2016. Cicero: Multi-Turn, Contextual Argumentation for Accurate Crowdsourcing. Chen et al. CHI 2019 Leveraging Peer Communication to Enhance Crowdsourcing. Tang, Ho, and Yin. WWW 2019

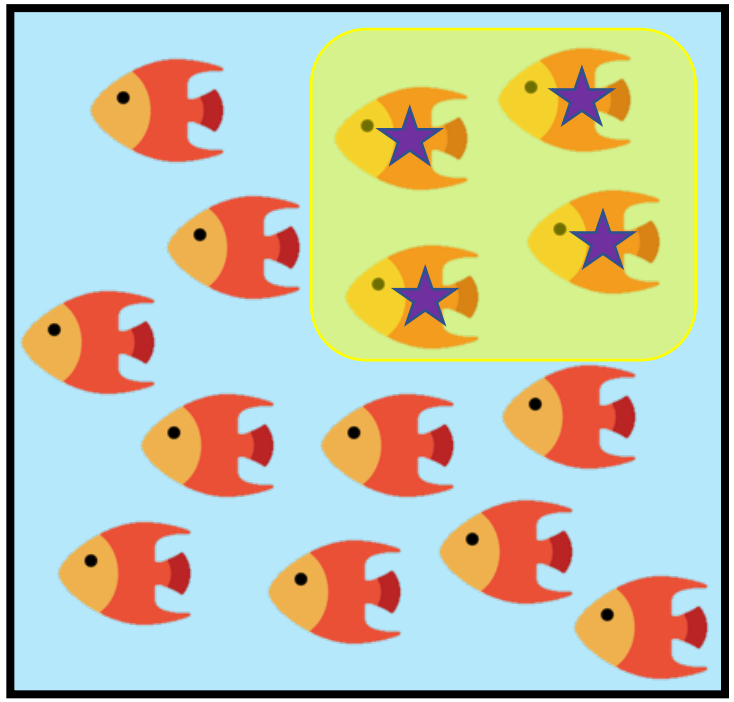
How Many Workers are There?

How Many Fishes are in the Lake?

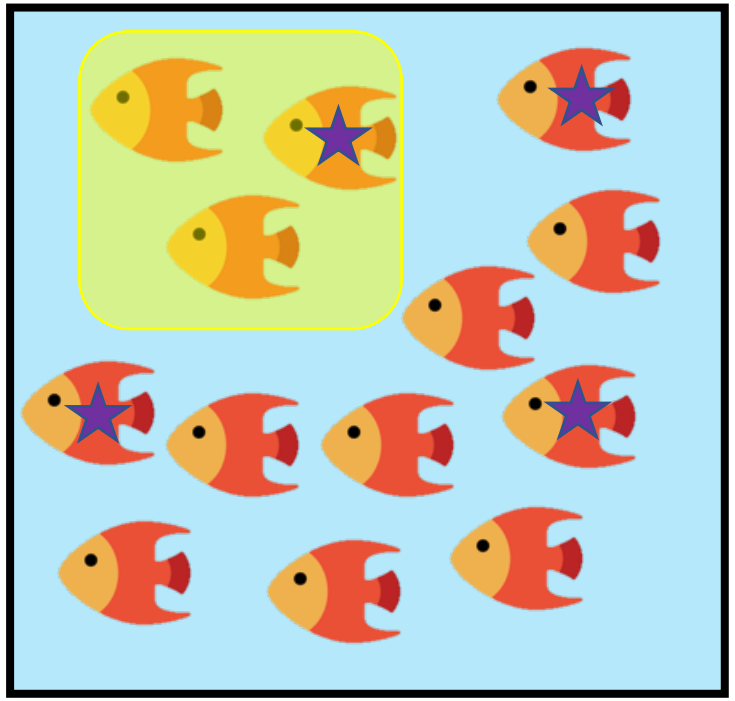


How Many Fishes are in the Lake?

The capture-recapture analysis



M fish, N_1 captured (& marked)



N_2 recaptured, n marked

$$\frac{N_1}{M} = \frac{n}{N_2}$$

$$M = \frac{N_1 N_2}{n}$$

How Large is the Crowd?

- Applying the capture-recapture analysis to workers who respond to demographic surveys, we may estimate that M= 13,410.

- What assumptions are made?

  - A1: Closed population model: No workers will leave the worker pool, and no new workers will join the pool

  - A2: Equal propensity of participation: The probability to participate in demographic survey is equal across all workers.

Difallah et al. "Demographics and Dynamics of Mechanical Turk Workers", *WSDM'18*

How Large is the Crowd?

Relaxing A1: Open population model

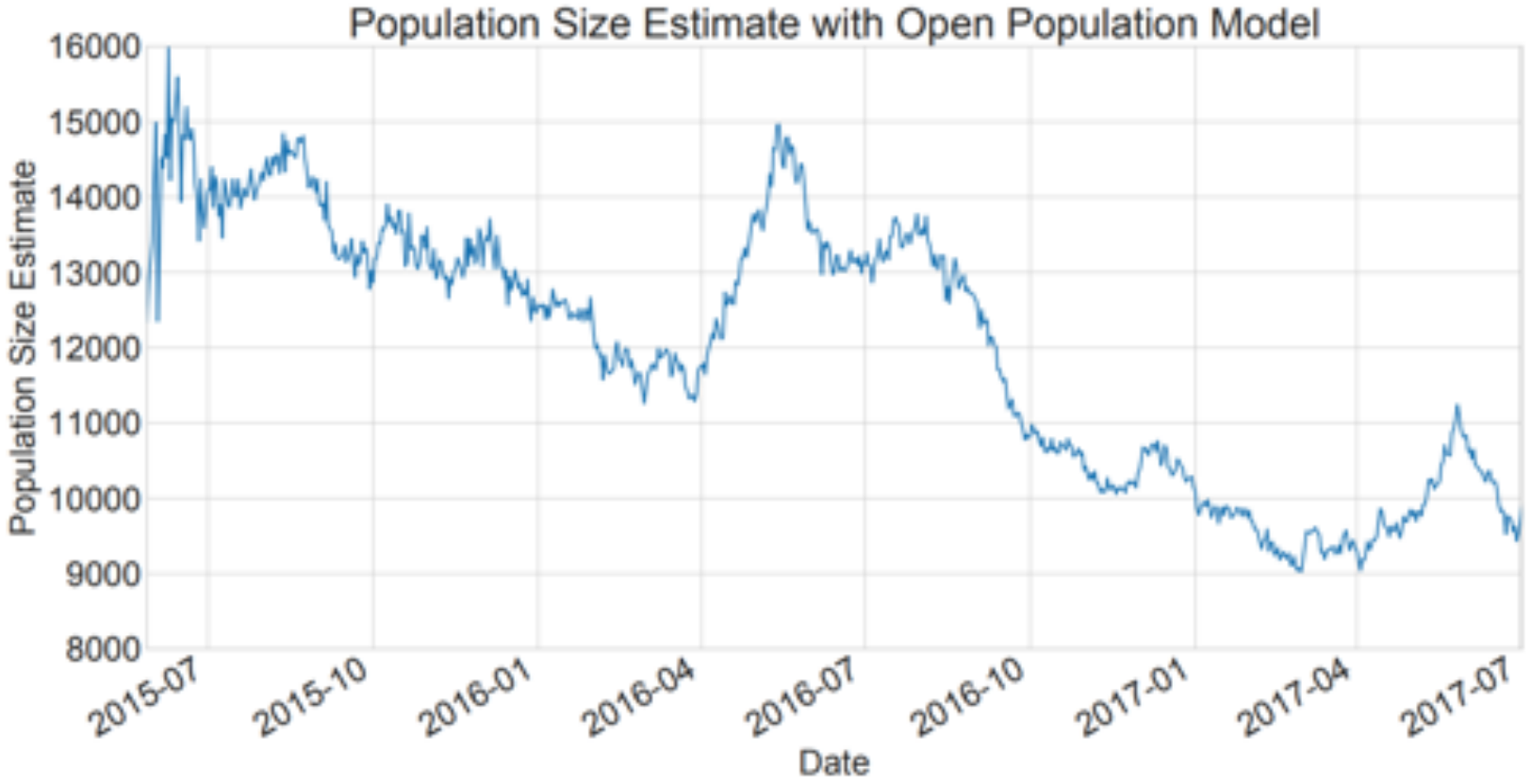
- Survival probability: $S(t) = \exp(-\lambda t)$
- At time $d - t$, N_{d-t} workers participated in the survey
- At time d, assume that there are M_d workers in total. Among N_d workers that participated in the survey, $n_{d,t}$ workers also participated in the survey at time $d - t$.

$$n_{d,t} = \frac{N_{d-t}\exp(-\lambda t)}{M_d} \times N_d$$

$$M_d = \frac{N_{d-t}N_d\exp(-\lambda t)}{n_{d,t}}$$

Difallah et al. "Demographics and Dynamics of Mechanical Turk Workers", *WSDM'18*

How Large is the Crowd?

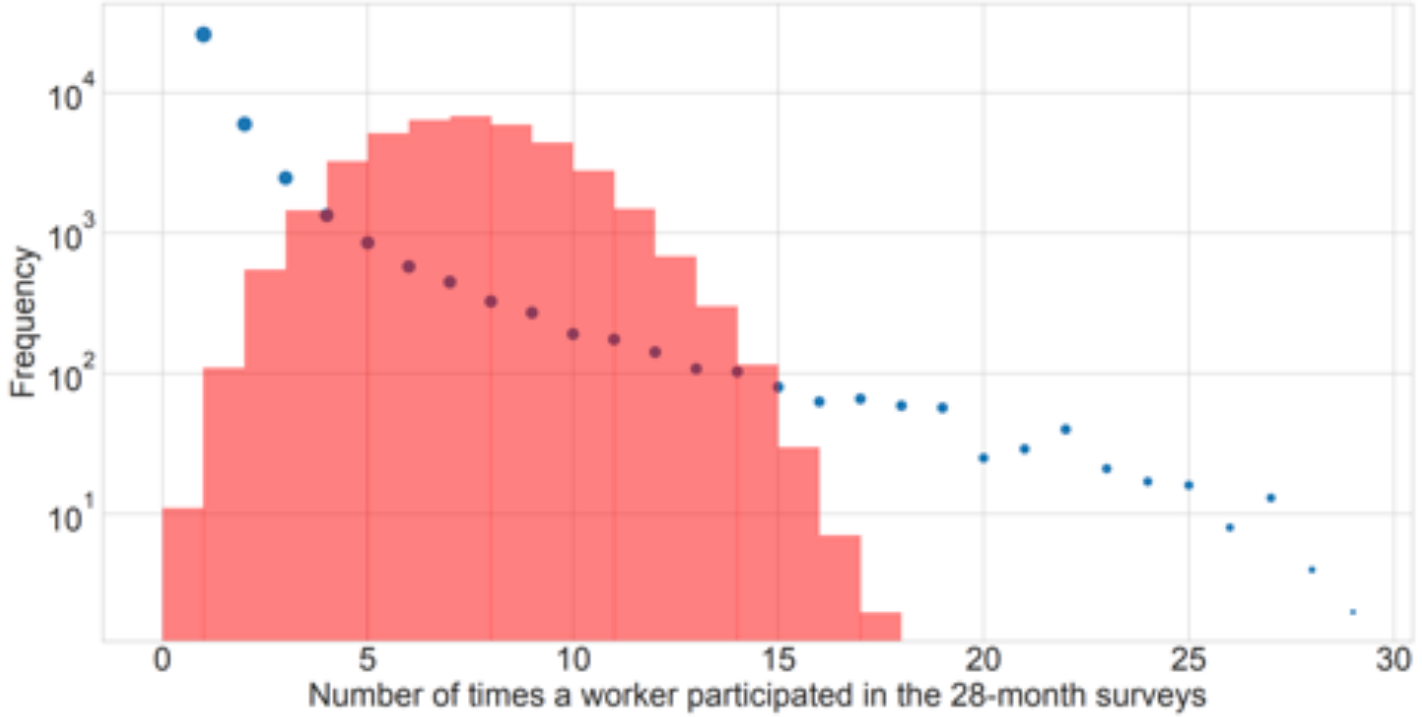


Half-life of the MTurk worker population is 404 days

Difallah et al. "Demographics and Dynamics of Mechanical Turk Workers", *WSDM'18*

How Large is the Crowd?

- Is “A2: Equal propensity of participation” reasonable?
  - If every worker participate the survey with the same probability, we should see a binomial distribution over # participations with many surveys.



How Large is the Crowd?

Relaxing A2: Accounting for propensity of participating surveys

- Assume there are N workers in total, each worker gets a propensity score $a_i \sim p(a)$
- Capture n_1 workers, $P(capture|a_i) = 1 - (1 - \frac{a_i}{\sum_{j=1}^{N} a_j})^{n_1} \approx \frac{n_1 a_i}{NE[a]}$
- Recapture n_2 workers, $P(capture, recapture|a_i) = \frac{n_1 n_2 a_i^2}{N^2 E[a]^2}$
- The expected number of workers participating in both surveys:

$$m = N \int \frac{n_1 n_2 a_i^2}{N^2 E[a]^2} p(a) da = \frac{n_1 n_2}{N} (1 + \frac{Var[a]}{E[a]^2})$$

- Following this method, the estimate for the number of Mturk workers is 178,000!

Difallah et al. "Demographics and Dynamics of Mechanical Turk Workers", *WSDM'18*

Data-Driven Approaches

- Want to collect some information.
- It’s challenging to obtain enough data points to estimate the information.
- Propose models (i.e., making assumptions) of the process. So you only need to estimate a small number of model parameters.
- Using ML approaches to learn those parameters from data.

- Your estimate is only as accurate as the best your model can do.

Discussion

- What additional information do you want to know about Turkers?
- Can you come up with methods to collect that information?
- Does that information help us design better crowdsourcing platforms? How?