

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

Chien-Ju (CJ) Ho

# Logistics: Assignment 2

- Due: September 30 (Friday)
- For majority voting, we mean simple majority voting
- EM (only assuming unknown worker skills):
  - 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: Review and Project Proposal

- Review:
  - Need to elaborate your answers.
  - I have marked some submissions (with 0.5 gradings or additional comments) that are below the bar.
- 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

# Logistics: Project Timeline

- Sep 23: Project proposal
  - Brief description of the proposed project (1~2 paragraph)
  - Citing at least one paper that's relevant to your proposal
- Oct 14: Milestone 1
  - A brief literature review and the description of your plan (one page)
  - Last chance to change the topic of the project
- Nov 4: Milestone 2
  - Summary of your current progress (up to 2 pages)
  - Last chance to convert the research project to (a more extensive) literature review
- Dec 6/8: In-class project presentations
- Dec 9: Project report due

# Today's Lecture

# About Assignment 1

- Motivated by this post:
  - [My MTurk \(half\) Workday](#). Jeff Bigham
- How much do you earn per hour?

0.04	1.20	2.00	4.40
0.40	1.30	2.00	4.96
0.60	1.32	2.40	5.00
1.00	1.50	2.64	6.00
1.00	1.56	3.00	8.40
1.20	1.80	3.60	12.00

Mean: 2.88

Median: 1.90

Side note:

Make sure you read the homework instructions before submitting.

# Assistive Tool/Information for Workers

- Forums
  - TurkerNation, MTurkGrind,...
- Browser plugins (e.g., Turkopticon)



The screenshot shows a forum thread with three posts:

- Post 1:** Posted by u/richdelmo 15 days ago. A HIT titled "Dead - Answer a short survey about your stock market activity - Tim Lisk - \$0.10/25 - 30 sec. (Total approved HITs GreaterThan 1000, HIT approval rate (%) GreaterThan 98, Location EqualTo US) Only a dime but only one question". It includes a preview link and a 'Req' link.
- Post 2:** Posted by u/richdelmo 20 days ago. A HIT titled "Dead 5 minute survey about search engines - Desktop only - STQ-Surveys - \$1.70/6:30- (Total approved HITs GreaterThanOrEqualTo 1, HIT approval rate (%) GreaterThanOrEqualTo 90, Location EqualTo US) A little writing". It includes a preview link and a 'Req' link.
- Post 3:** Posted by u/enderkg 22 days ago. A HIT titled "Dead US ~4min study about buying groceries. \*\*REQTS: 18-54yo, Android/iOS user, main household grocery buyer, take study on computer - KY3 - \$0.60/2:30 - (Total approved HITs is not less than 1, HIT approval rate (%) is not less than 90, Location is US)". It includes a preview link and a 'Req' link.

# Crowdsourcing (Requester's Perspective)



Input



Black Box

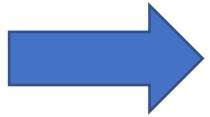


Flower  
Dog  
Cute

...

Output

# The Crowd is Made 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?
- ...?

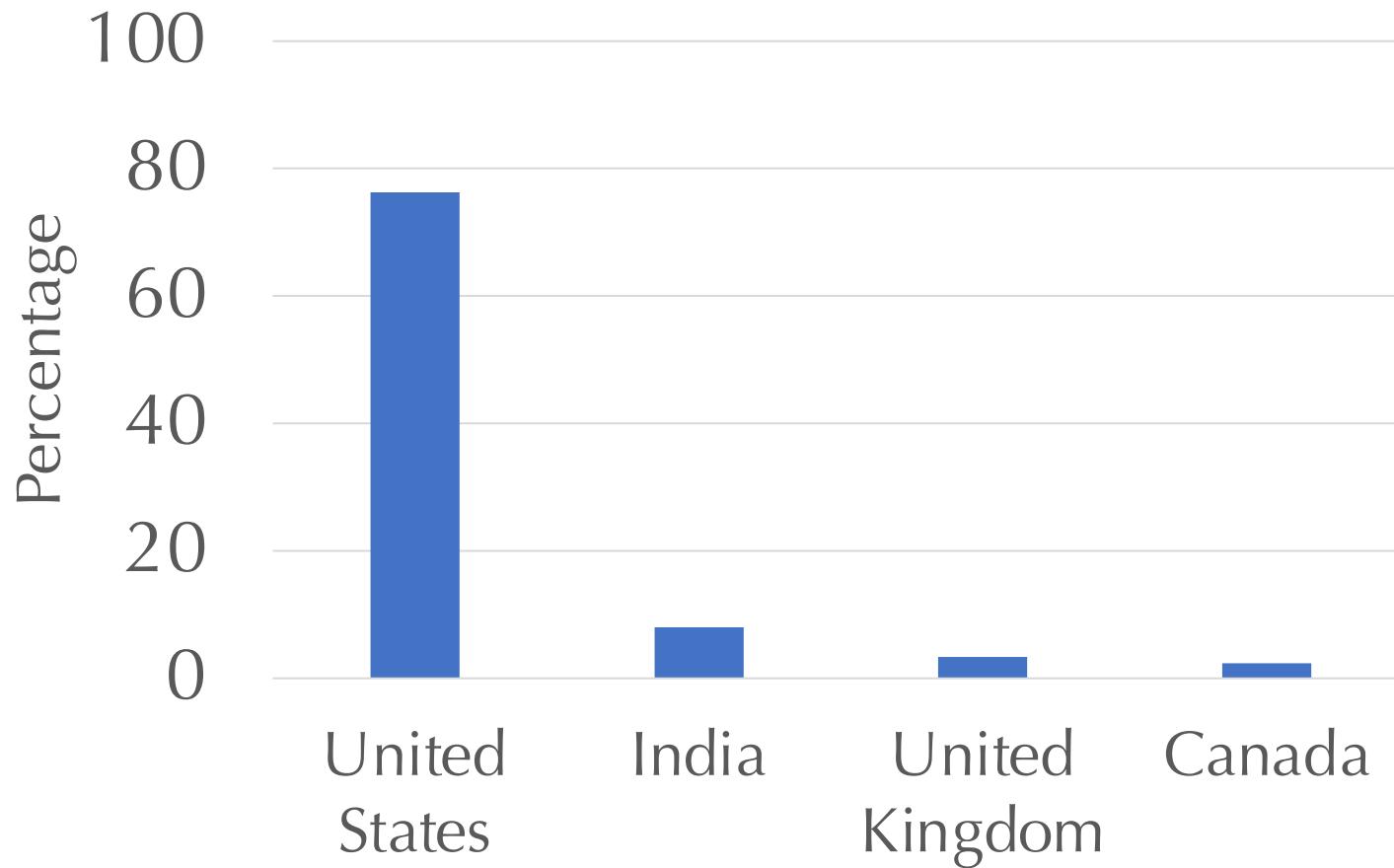
# The information is not trivial to get

- There is no official census data about crowd workers
- Potential solutions:
  - Conducting surveys
  - Ethnographic analysis of digital trace
  - What else?

# The (Old) Demographic of MTurk

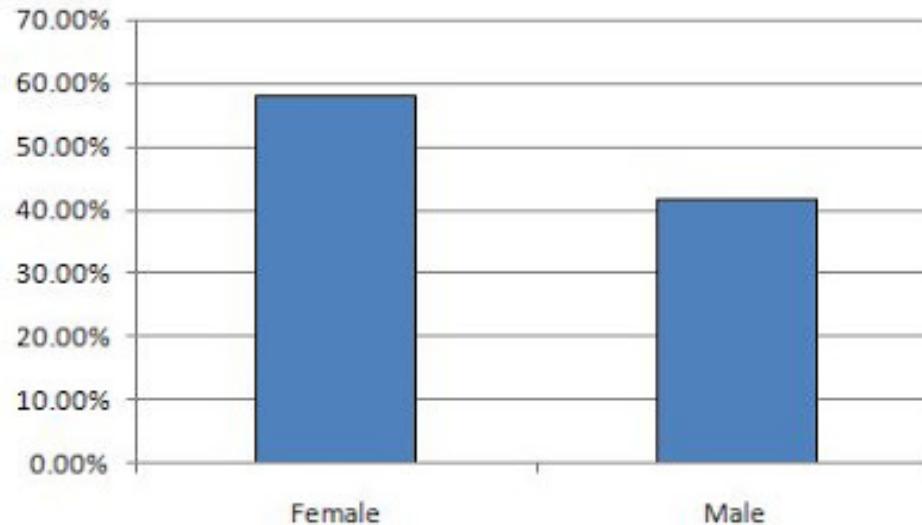
- Survey on 1,000 Turkers
  - Conduct the survey twice (Dec. 2008 and Oct. 2008)
  - Consistent statistics
  - Blog Post:
    - A Computer Scientist in a Business School
- One of the early attempts to understand MTurk demographics

# MTurk Worker Demographics (2008): Country

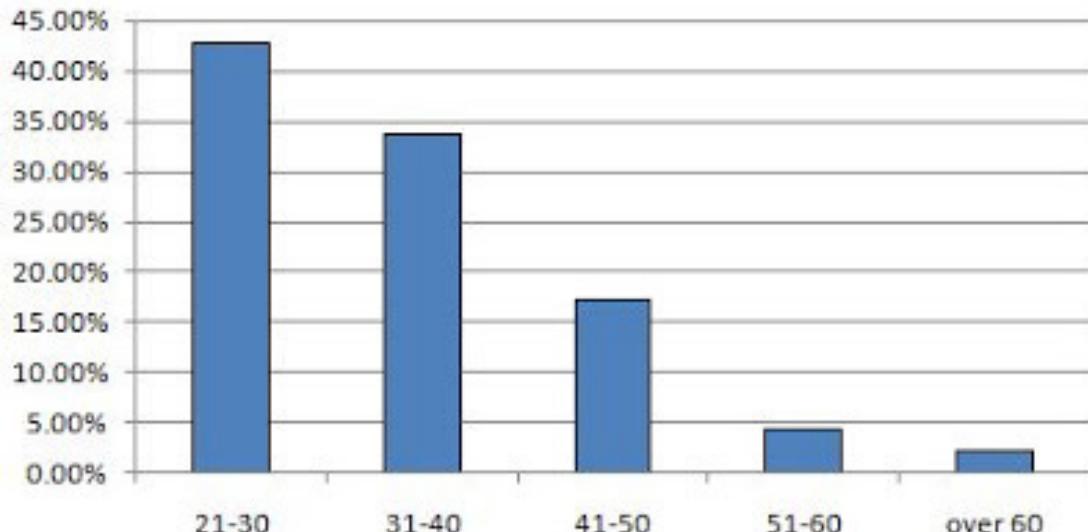


The majority of crowd workers on MTurk come from the US

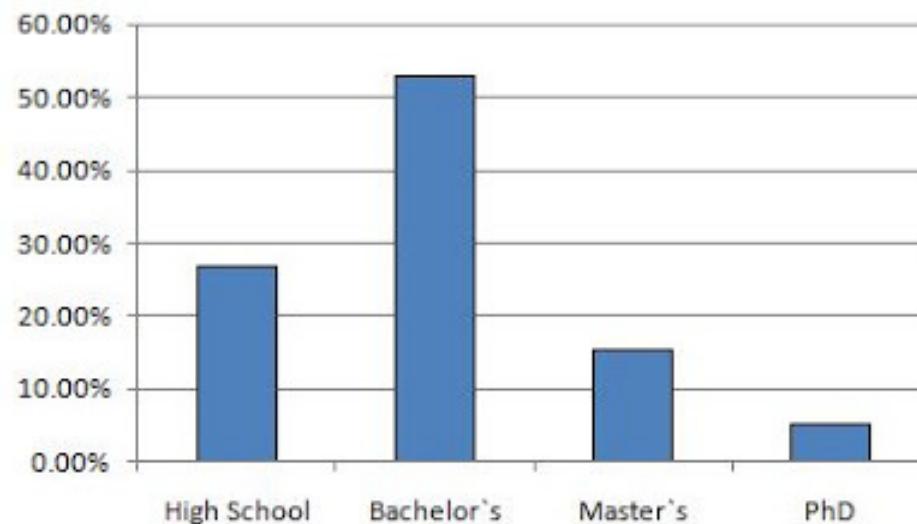
## Gender



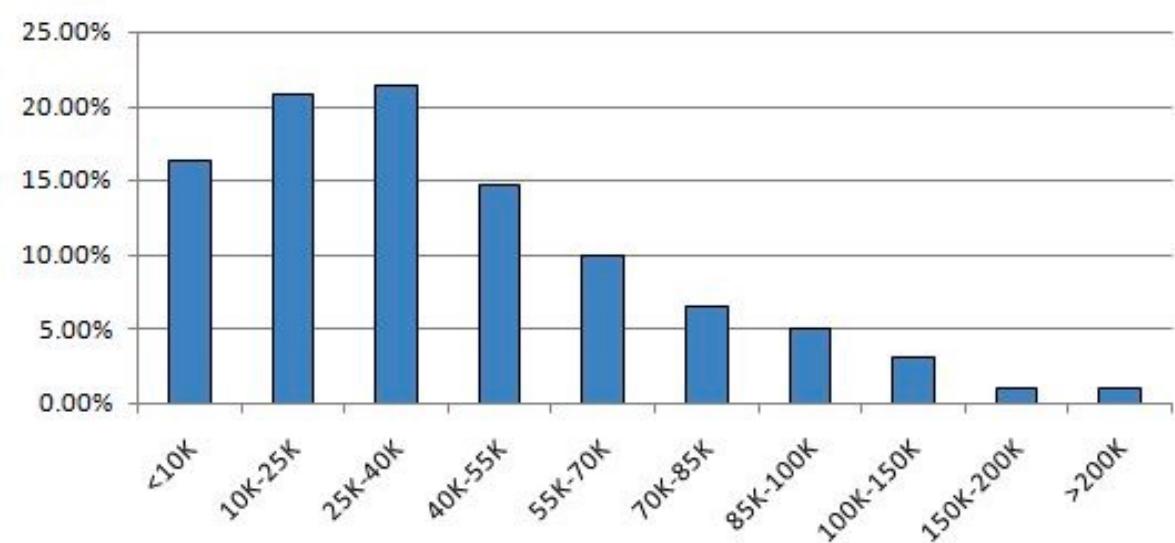
## Age



## Education



## Income



# MTurk Worker



**Younger** 54%

**More Female** 70%

**Lower Income** 65%

**Smaller Family** 45%

# Internet Users (2008, US)



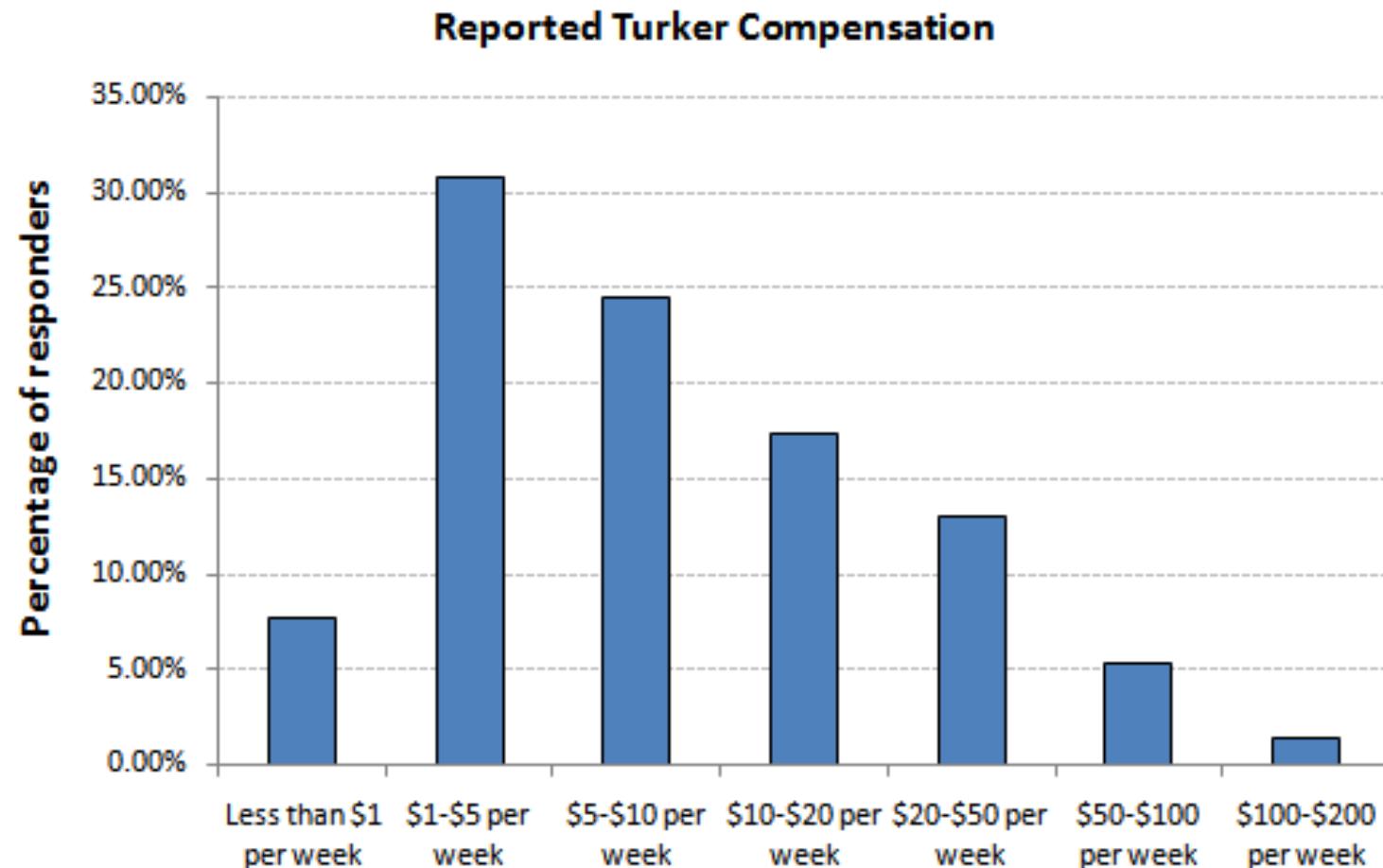
**Age: 21-35** 22%

**Female** 50%

**Household income < 60K** 45%

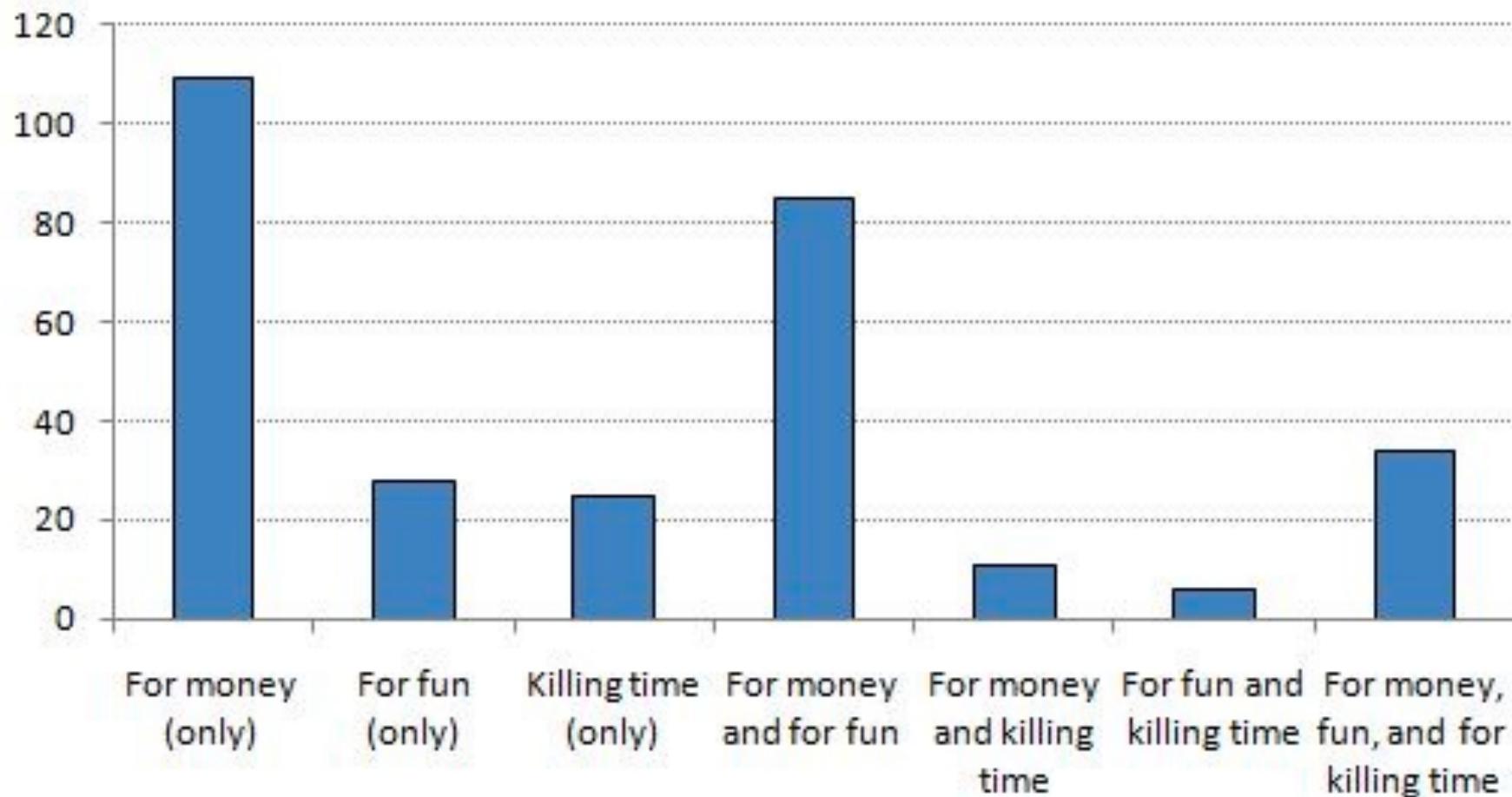
**Household <= 2 people** 28%

# 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

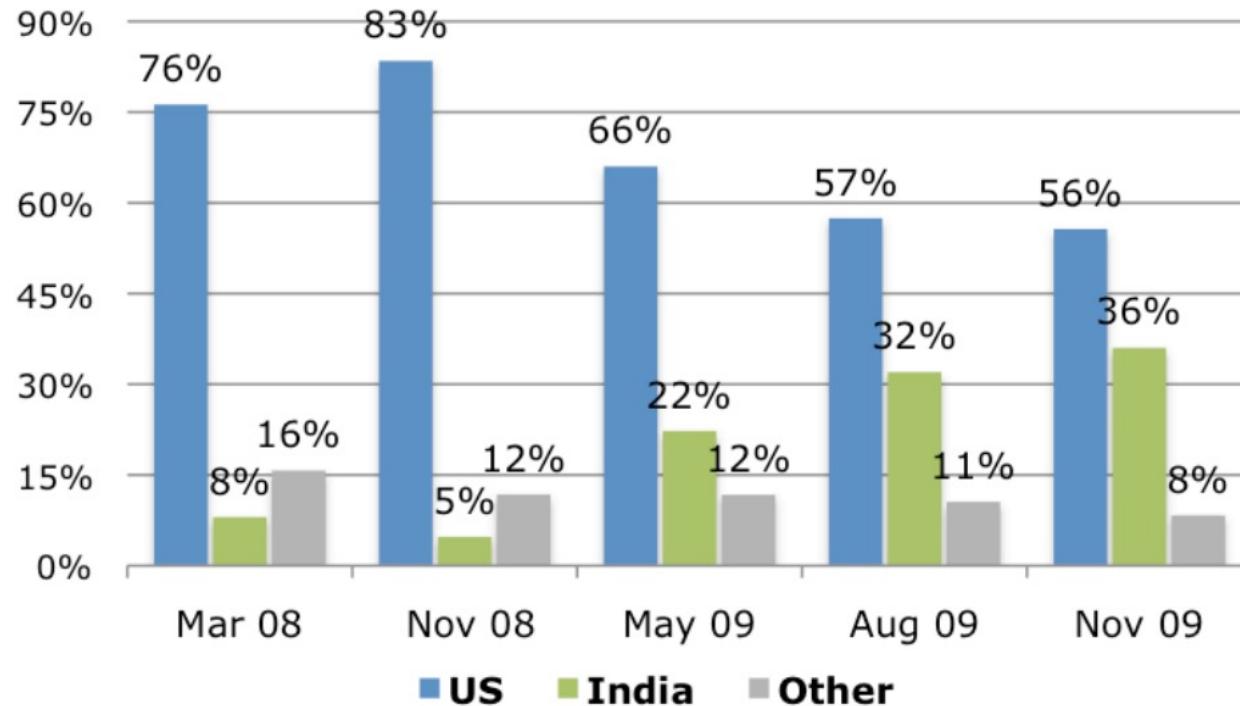


\$0.05 => 2 submissions within 24 hours

\$0.25 => 8 submissions within 48 hours

\$0.50 => 20 submissions within 48 hours

# But Demographics Also Changes Over Time...



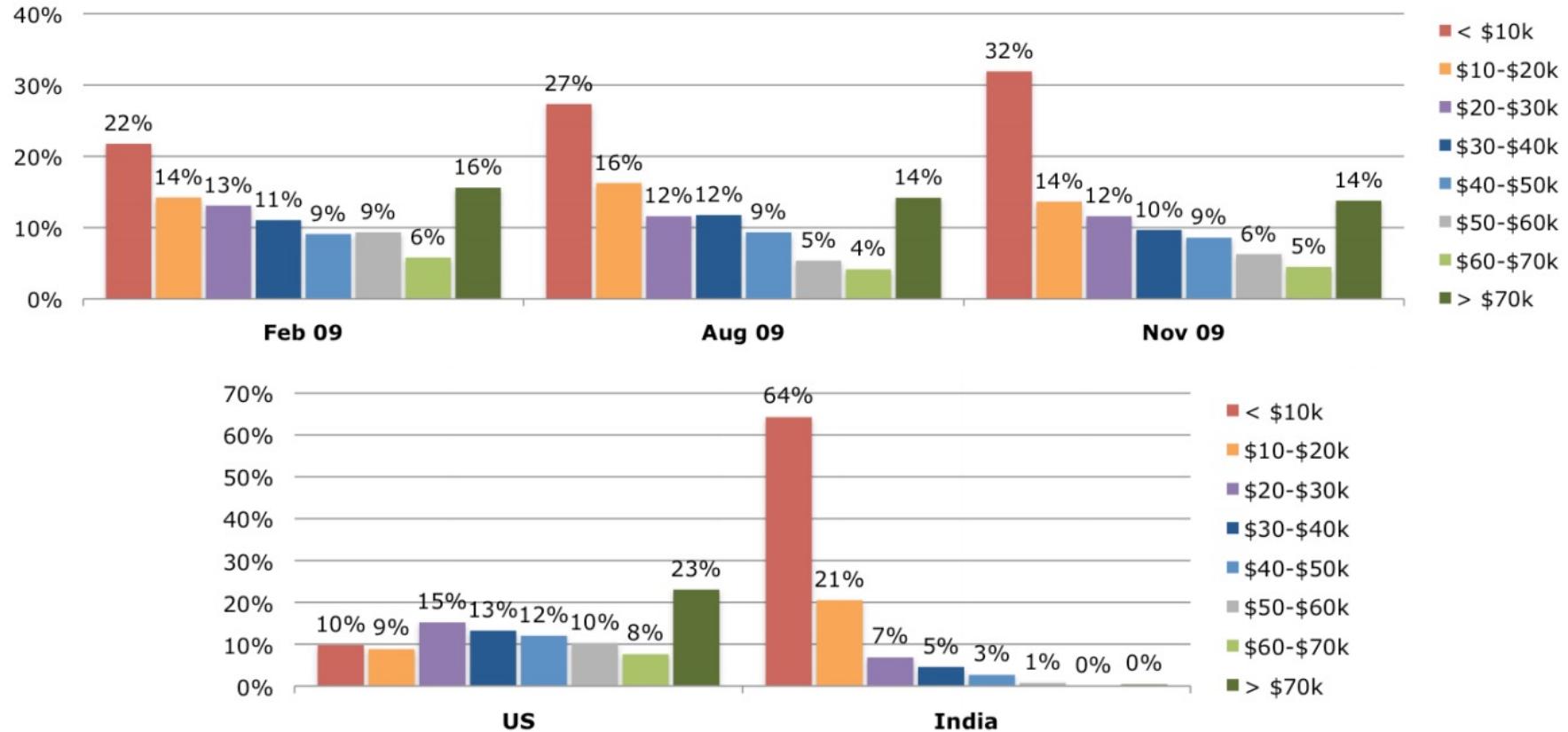
From a primary US-based workforce to an increasingly international group of workers.

# But Demographics Also Changes Over Time...

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

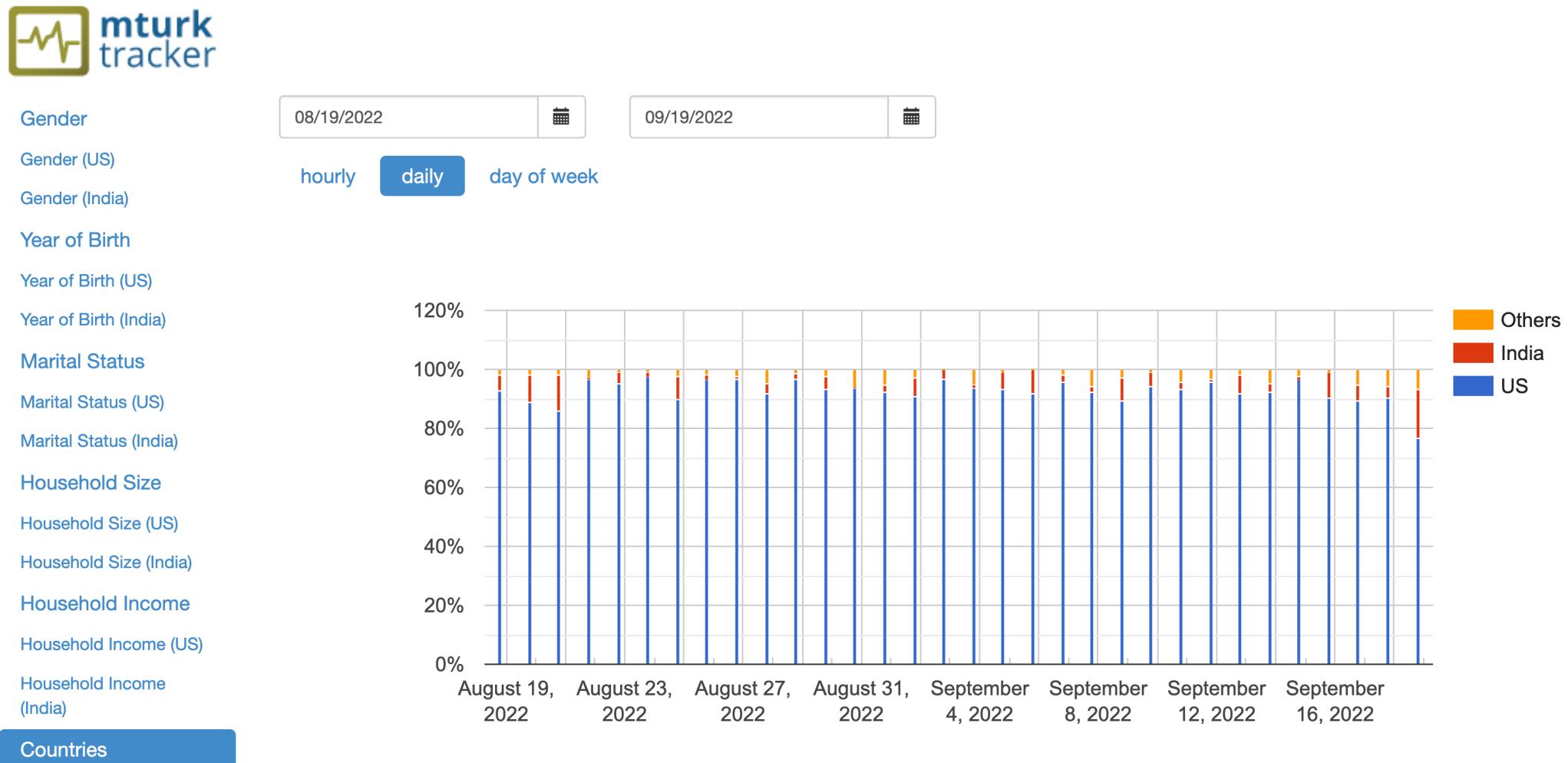
Ross, Joel, et al. "Who are the crowdworkers?: shifting demographics in mechanical turk." *CHI'10 EA*

# 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

<https://demographics.mturk-tracker.com/>

# Warm-up Discussion

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

Can you come up with potential fixes for the problems?

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

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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



Truman



# 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

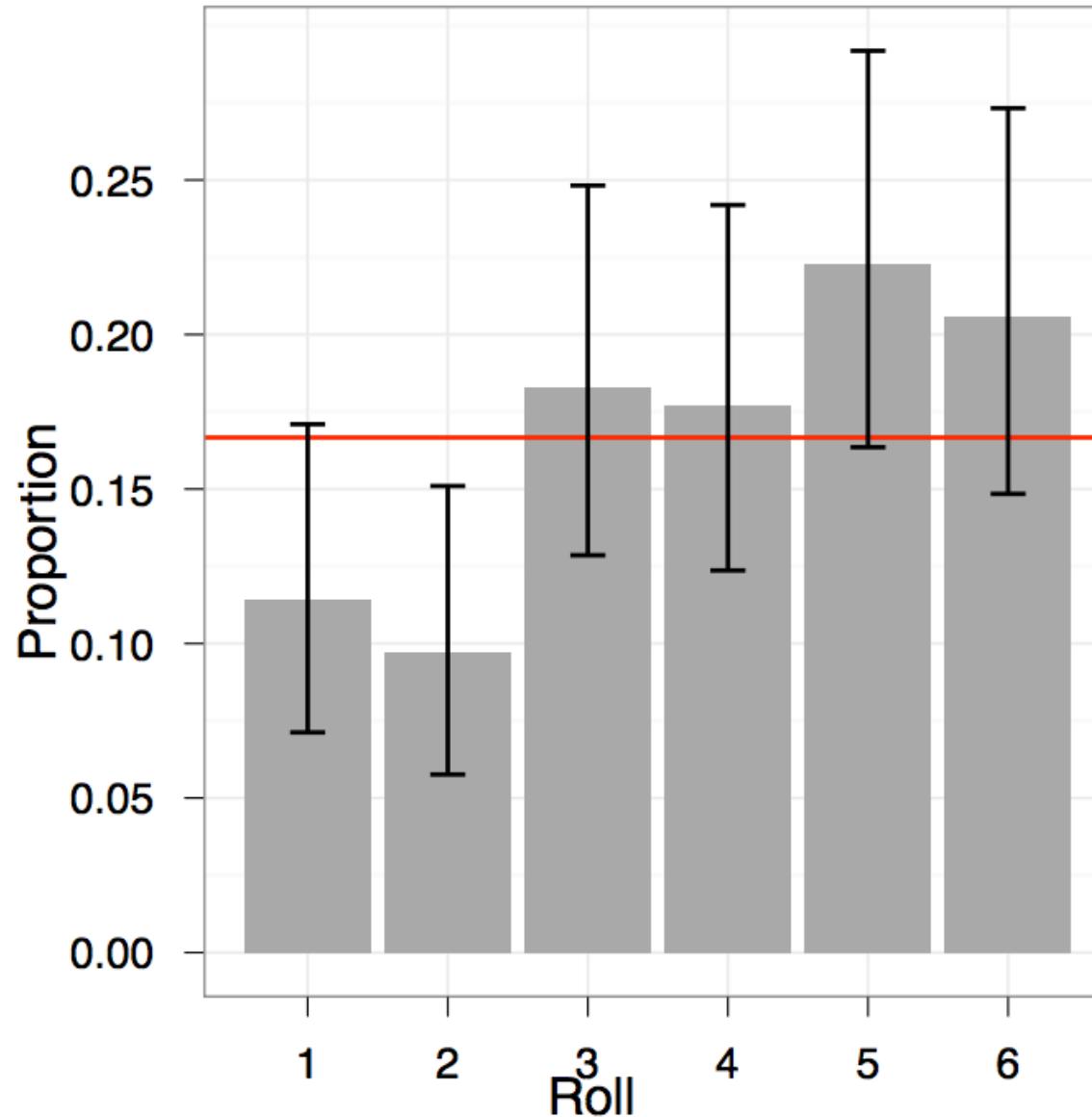
- No simple solutions: Be aware of the issue and think about the impact it might bring in your results.
- You might be able to “correct” the bias if you have additional knowledge.
  - Importance sampling
  - Potentially interesting/relevant paper
    - [Conducting Truthful Surveys, Cheaply](#). Roth 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.

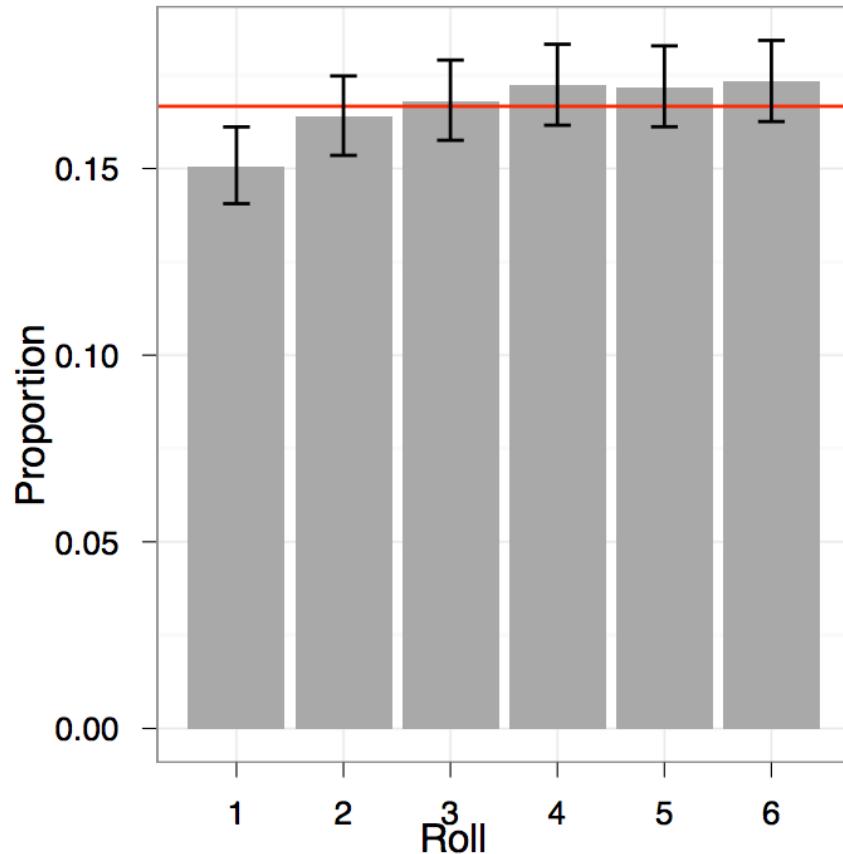
$$\text{Payment} = \$0.25 + \$0.25 * \text{roll}$$

- 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

# The Communication Network Within the Crowd

Ming Yin , Mary L. Gray , Siddharth Suri , Jennifer Wortman Vaughan. WWW 2016

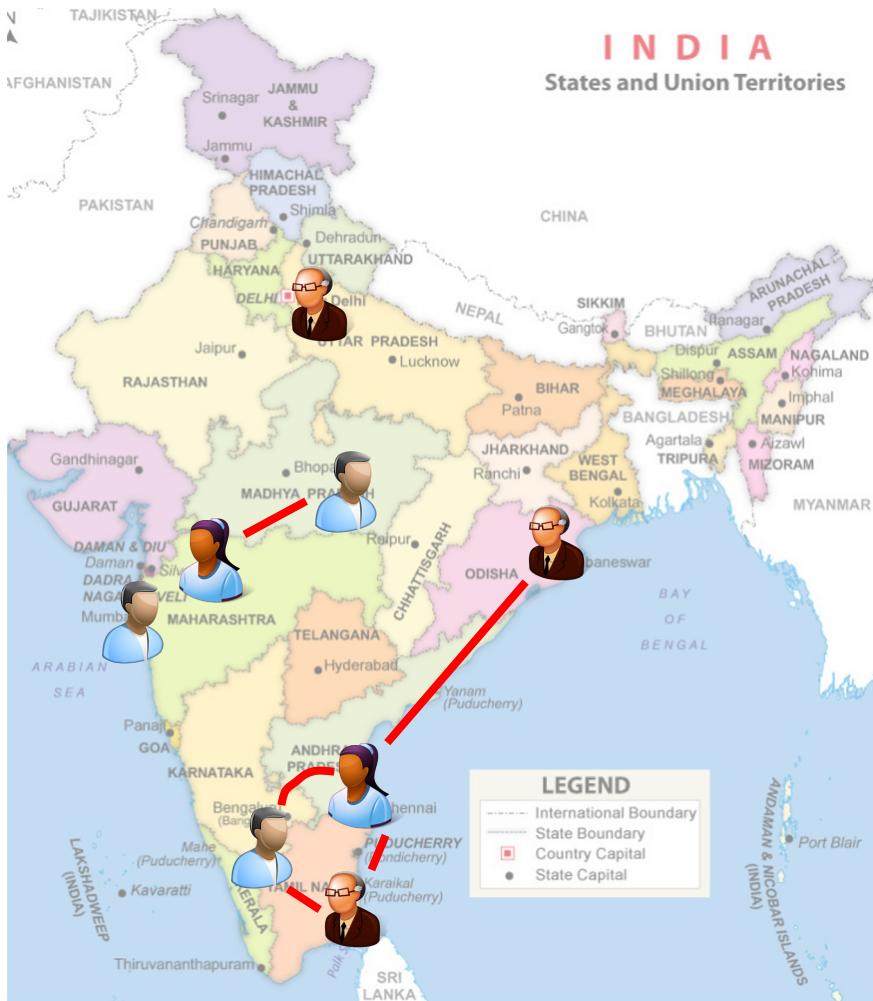
Acknowledgement: The next few slides are from Ming Yin.

# Common Assumption: Workers are Independent



[Yin et al., 2016]

# Some Evidence From the Field



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



Help with  
administrative  
overhead

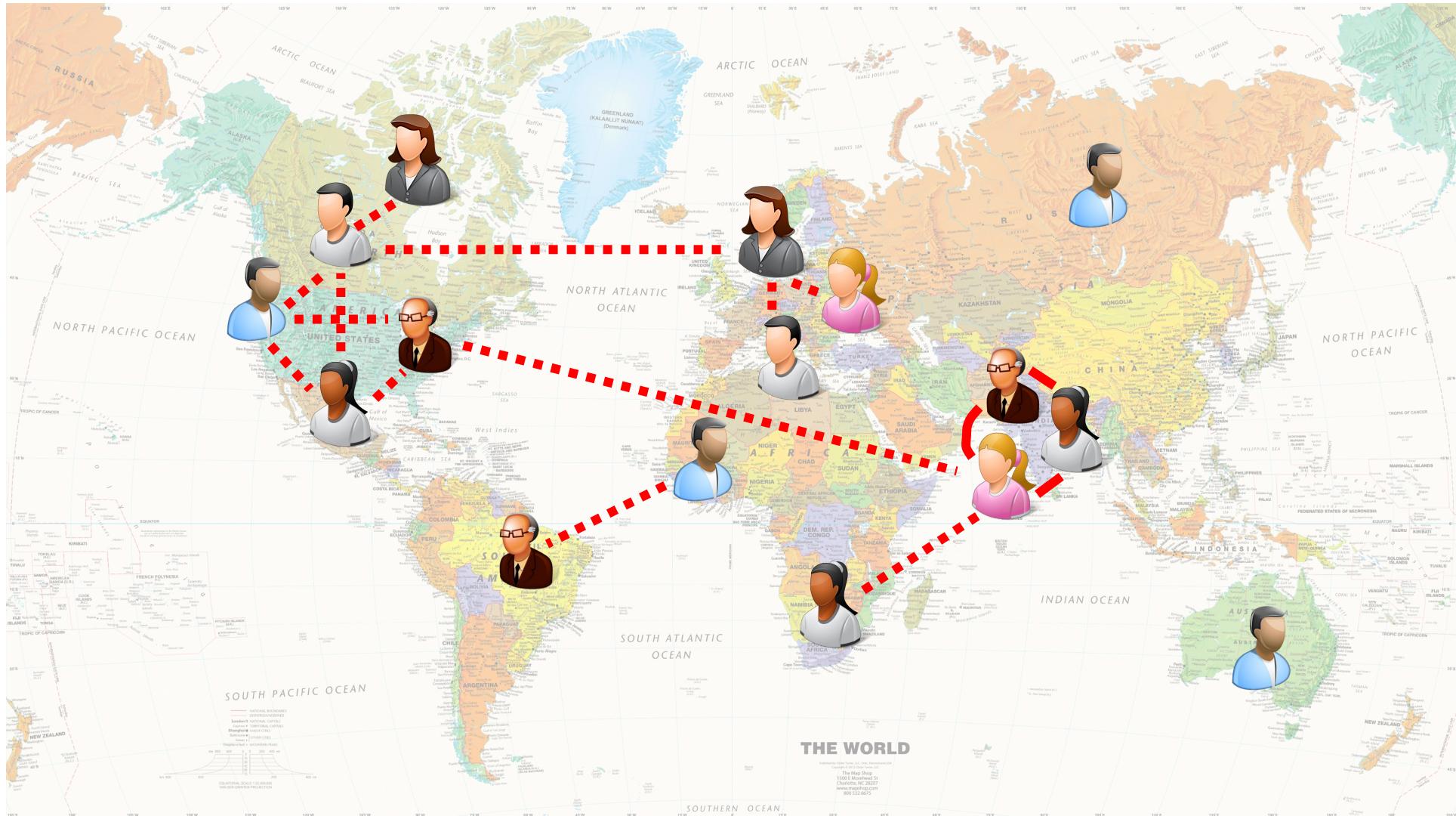


Share useful  
information



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
- ◆ Elicit as many true connections as possible
- ◆ Preserve workers’ privacy

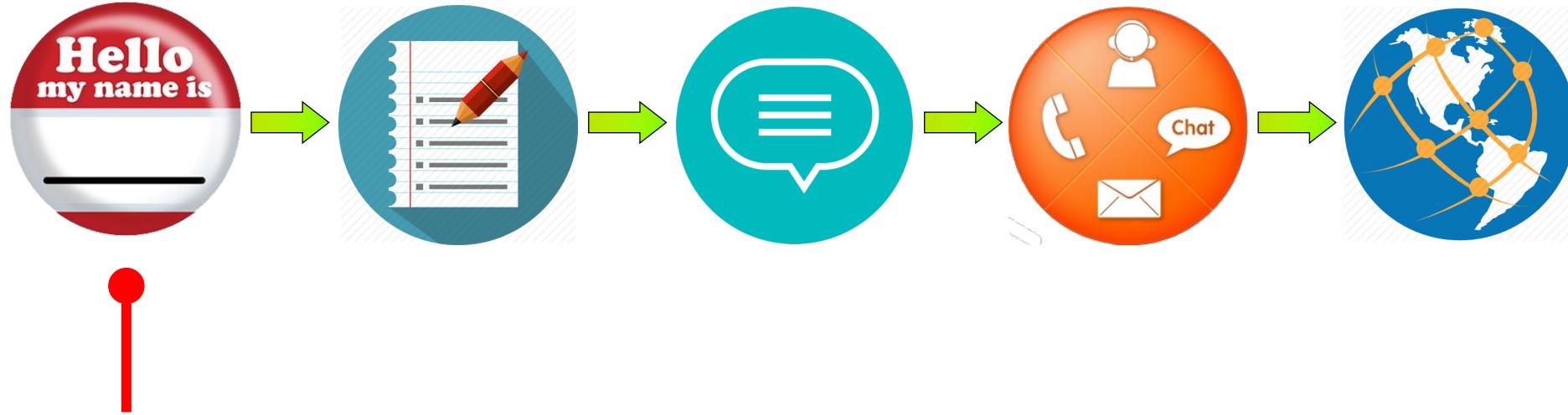
**Can't pay by connections!**

**Can't directly ask for names!**

# A Web App

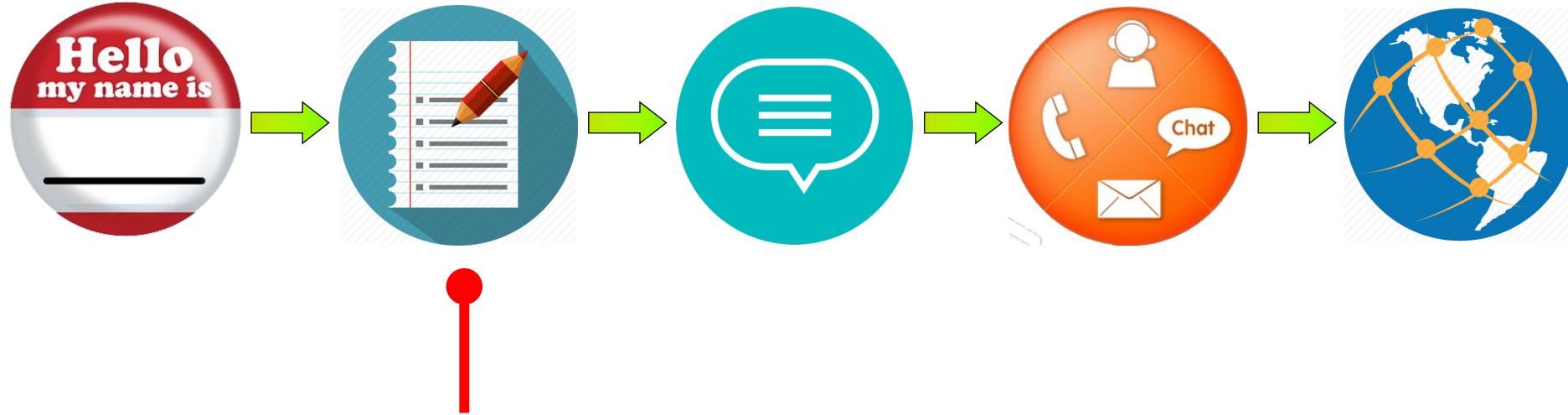
- Workers **self-report** their connections
- Provides some **value back** to the workers so it's their best interest to report as many true connections as possible

# The Network Mapping App



**Step 1:** Create a nickname for yourself

# The Network Mapping App



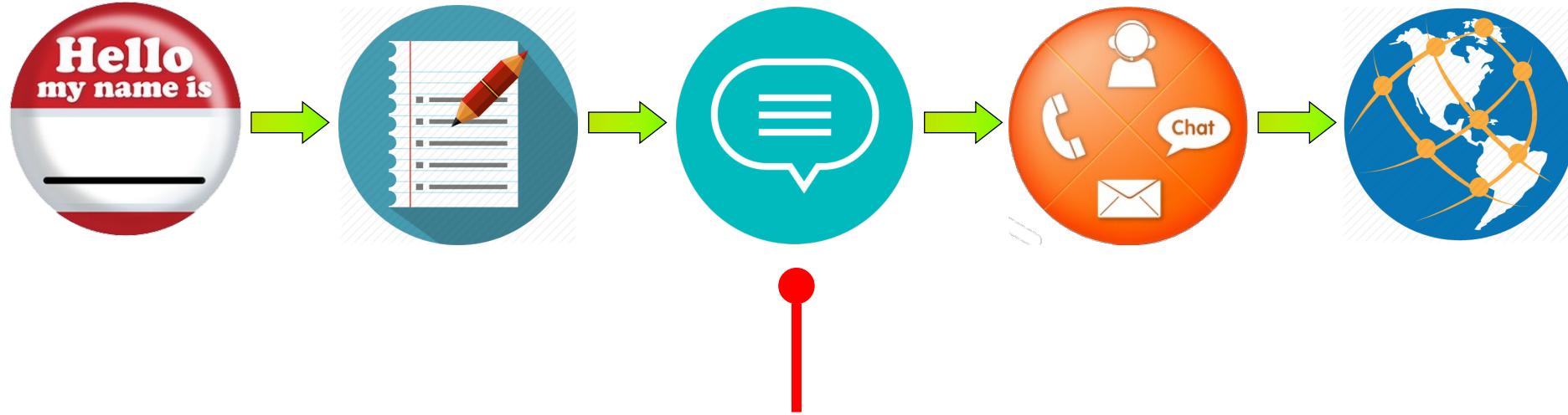
**Step 2:** Complete a brief demographic survey

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



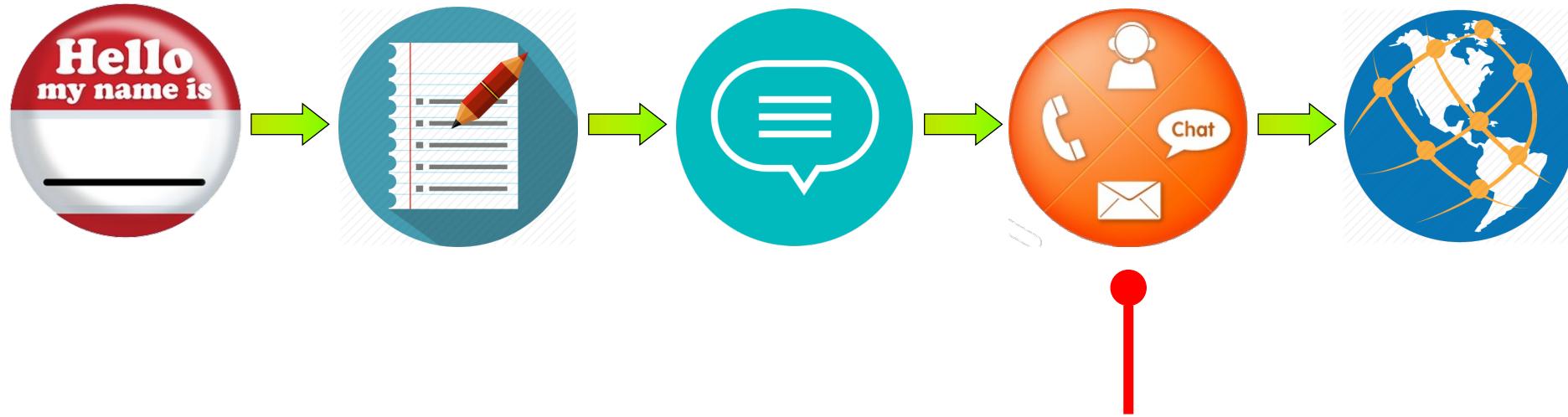
**Step 3:** Tell us about your personal experience with MTurk

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

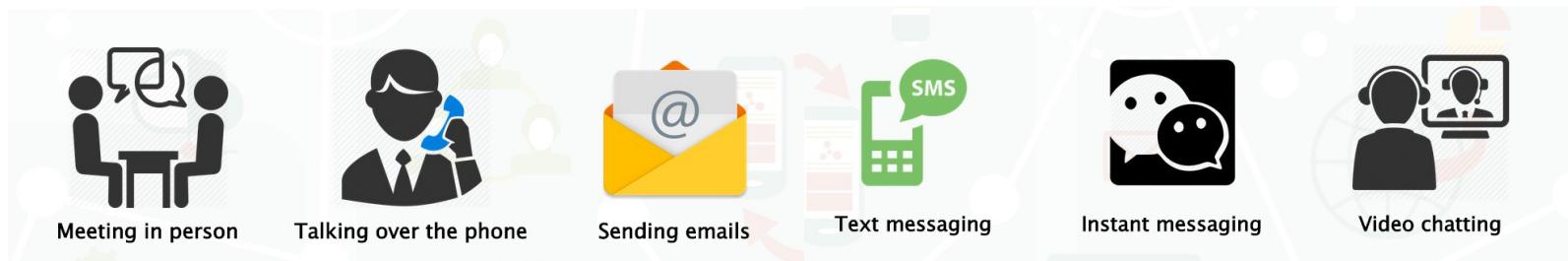
**(Selected based on a pilot study!)**

**Value back: What are other workers' Turkling stories?**

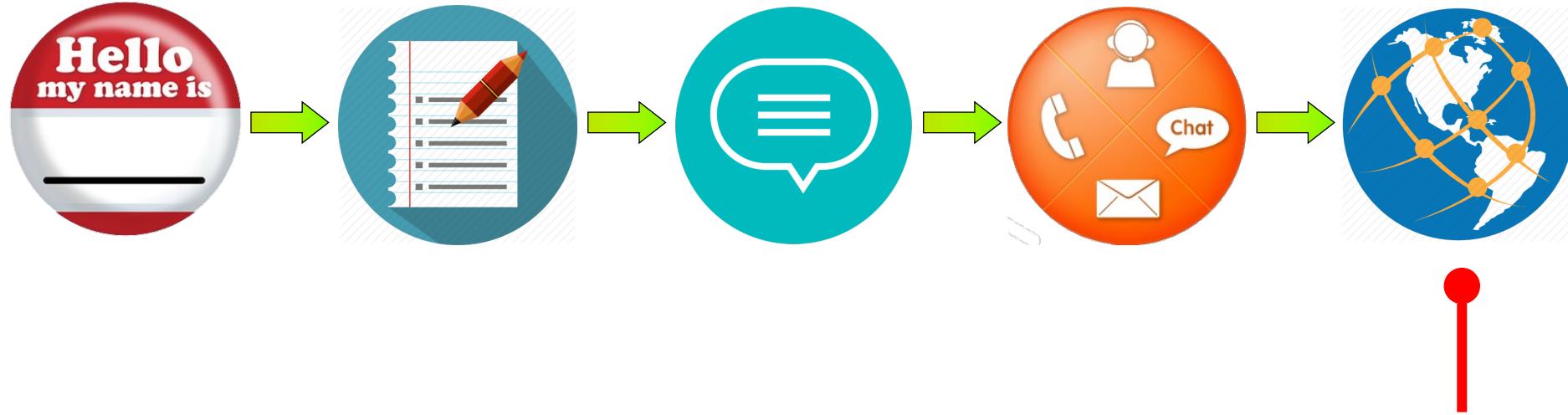
# The Network Mapping App



**Step 4:** Swap nicknames with Turkers you know

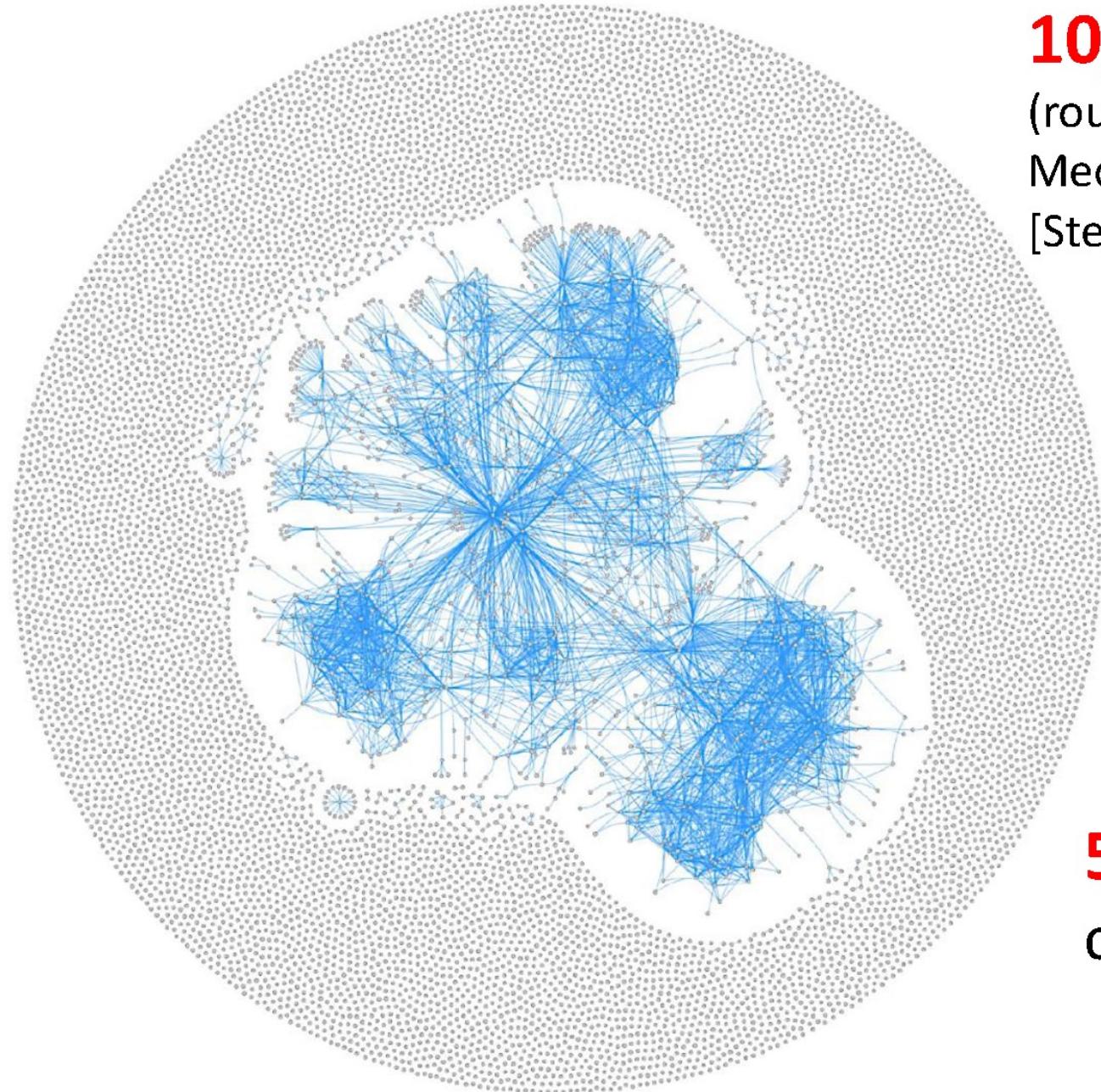


# The Network Mapping App



**Step 5:** Explore the Turker network

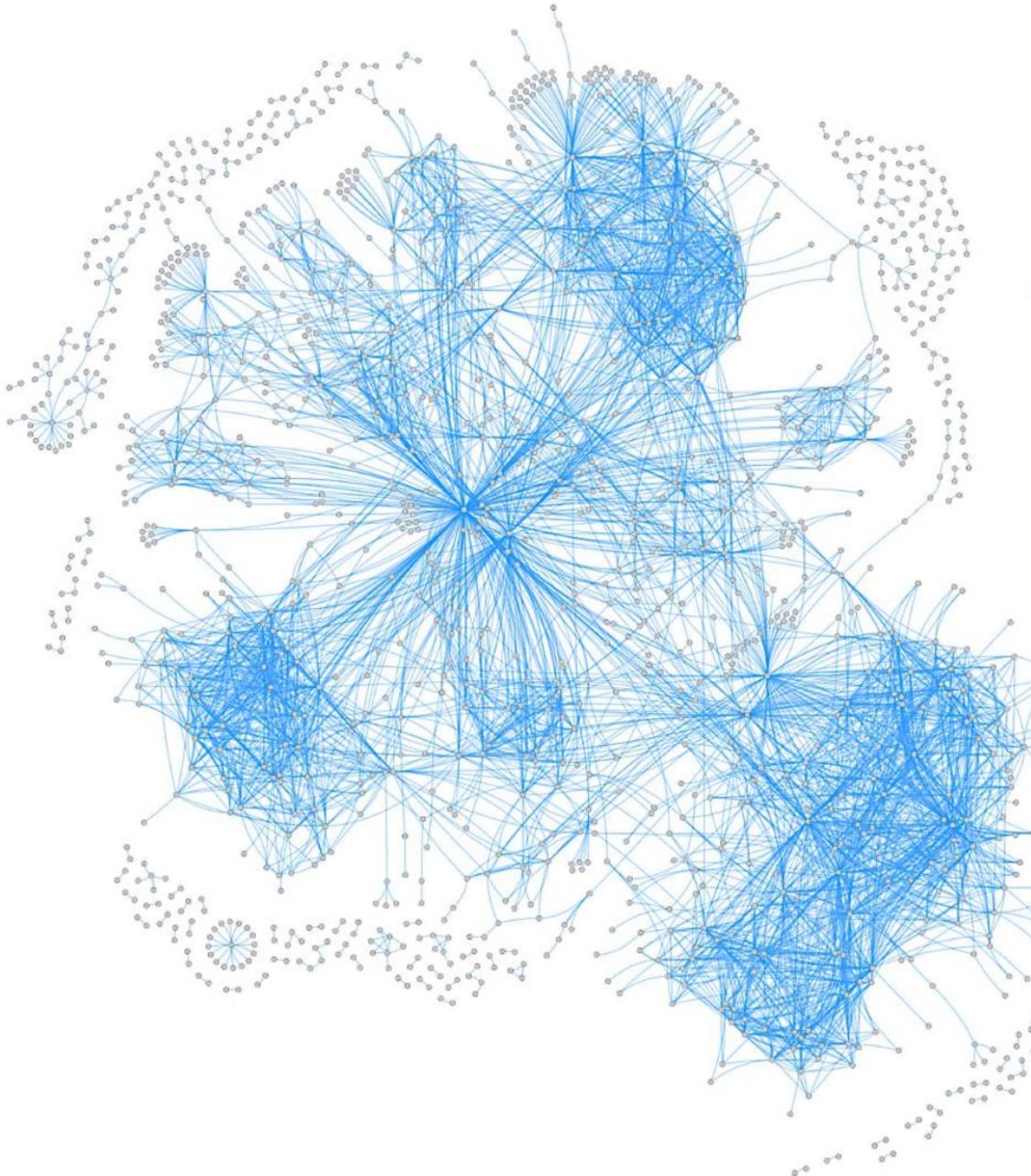




**10,354** workers  
(roughly a census of  
Mechanical Turk  
[Stewart et al. 2015])

**5268**  
connections

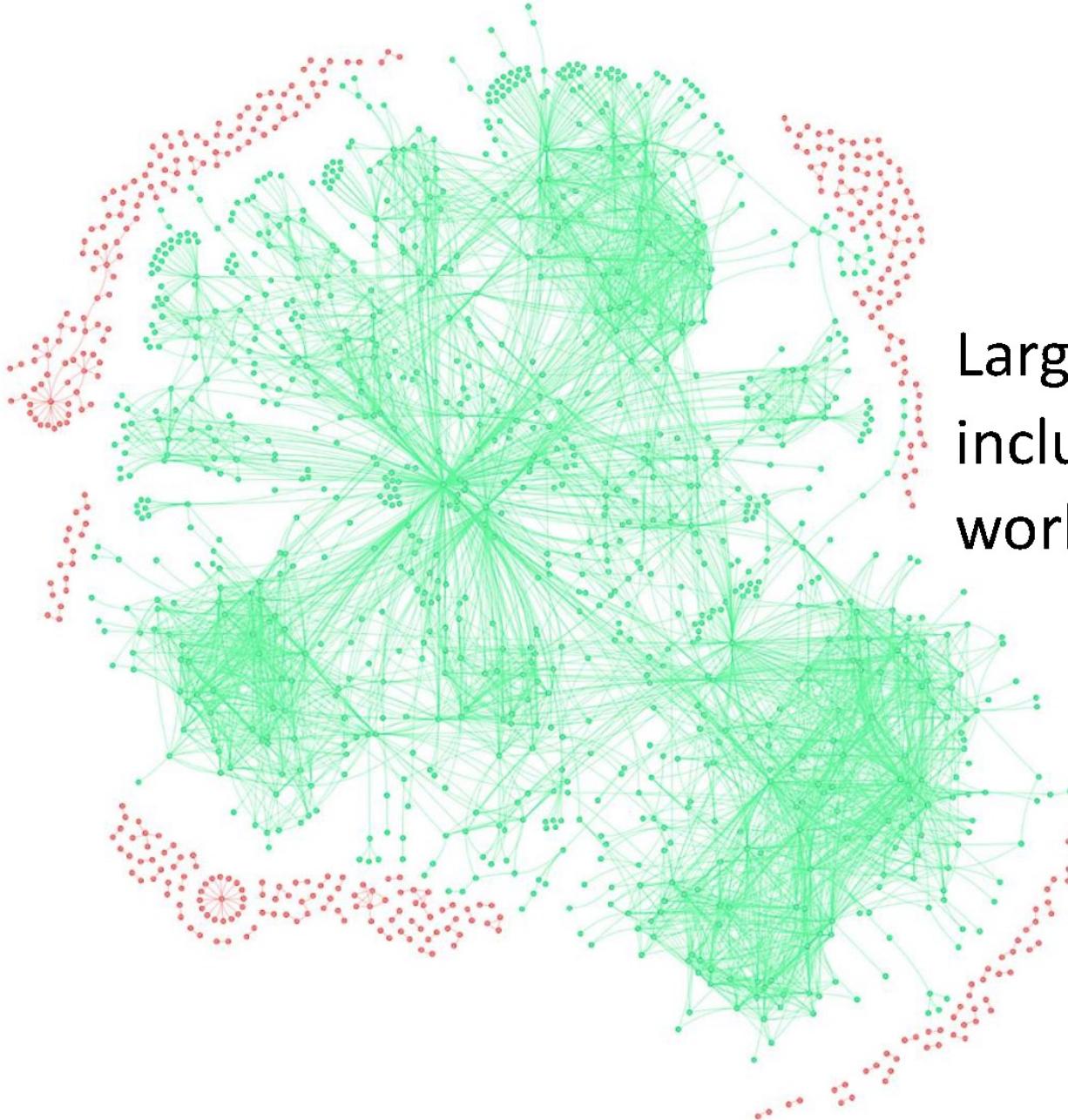
[Yin et al., 2016]



**1,389 (13%)**  
connected  
workers

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

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



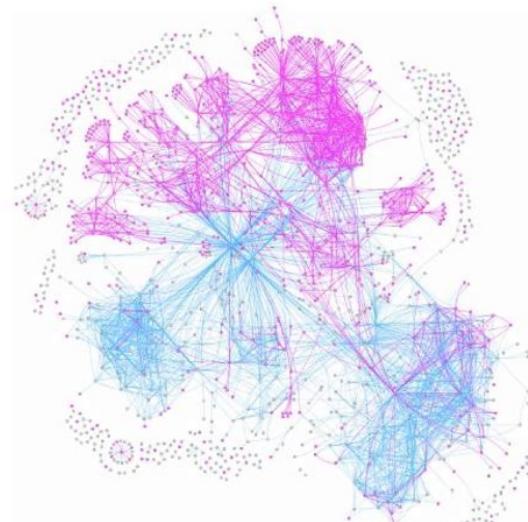
Largest component  
includes **994 (72%)**  
workers

[Yin et al., 2016]

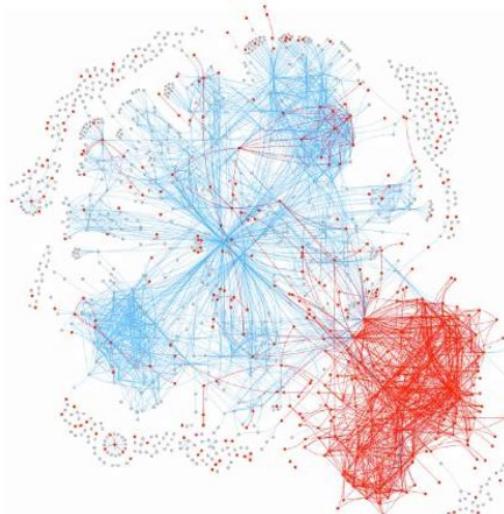
# A Network Enabled By Forums

- **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.

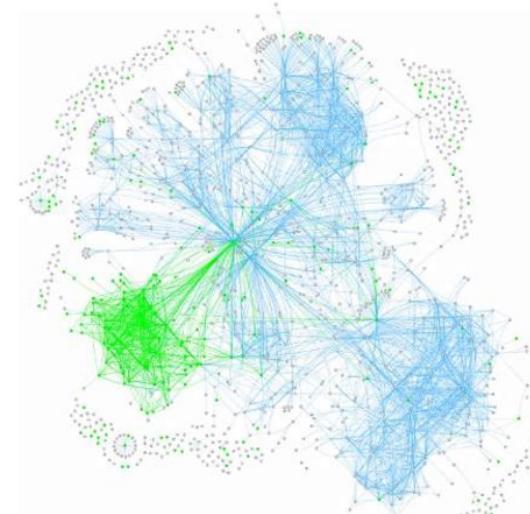
# Forums Create Subcommunities



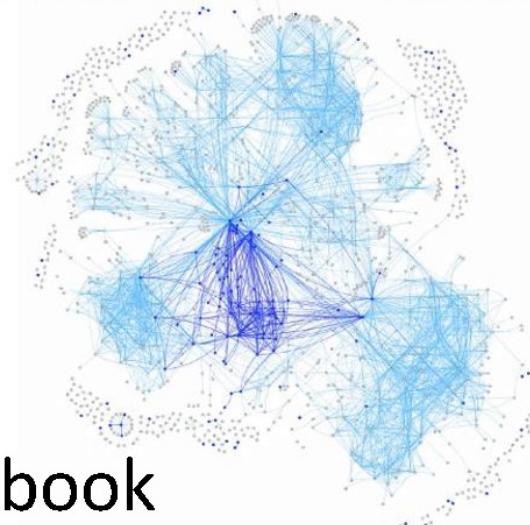
Reddit HWTF



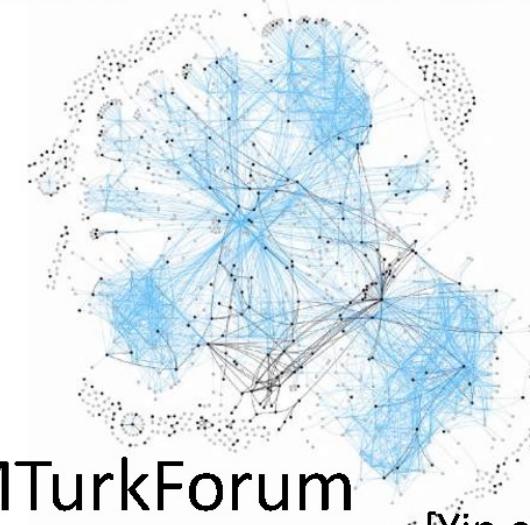
MTurkGrind



TurkerNation



Facebook



MTurkForum

[Yin et al., 2016]

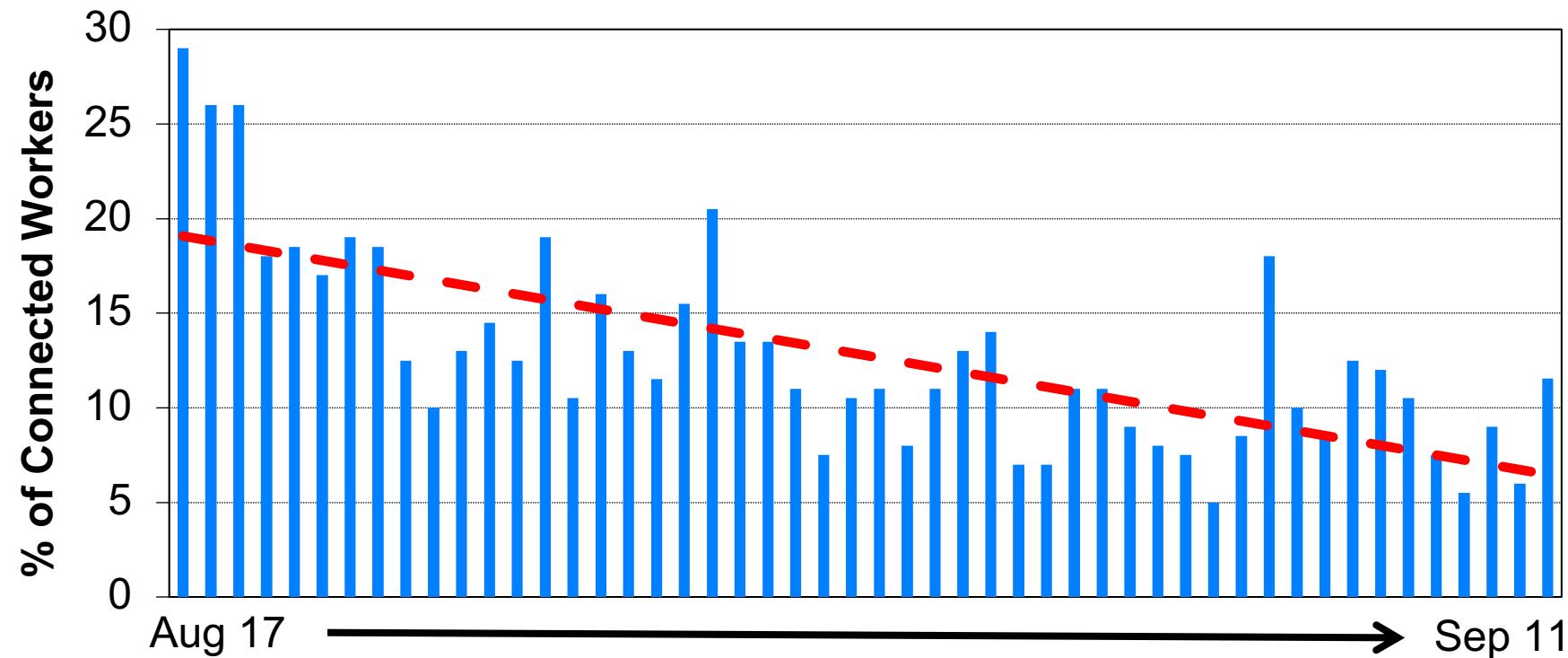
Are workers within communities  
more “successful”?

# 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%

[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?

## Practical Issues:

Non-Independent Work and Argumentation

### 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.

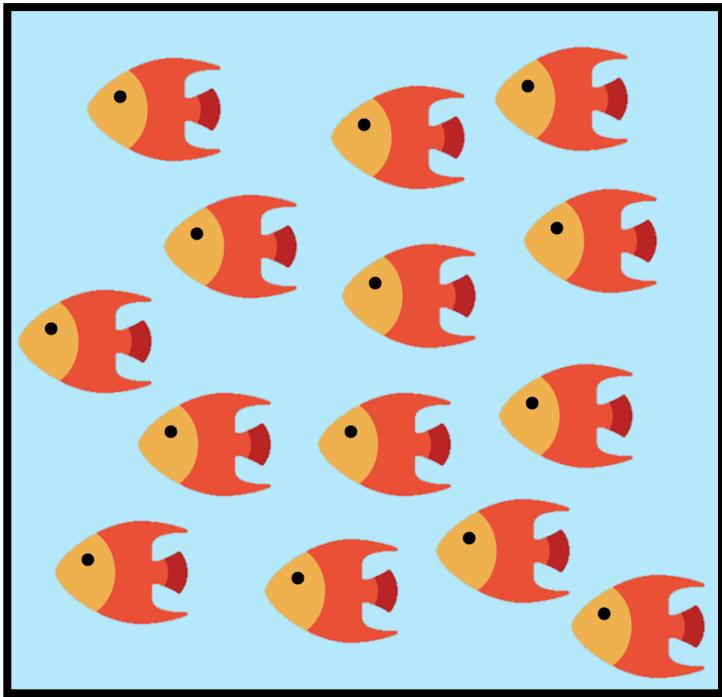
[Atelier: Repurposing Expert Crowdsourcing Tasks as Micro-Internships](#). Suzuki et al. CHI 2016.

[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

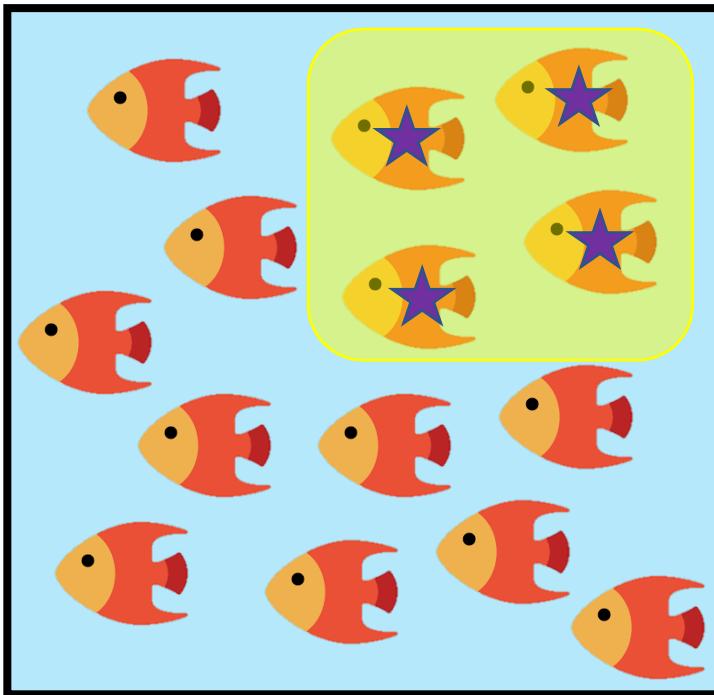
How Many Workers are There?

# How Many Fishes are in the Lake?

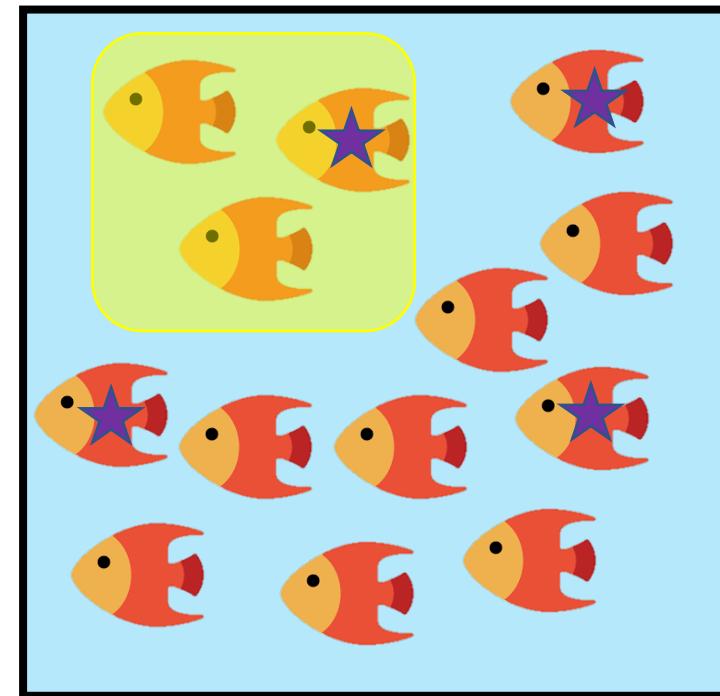


# How Many Fishes are in the Lake?

## The capture-recapture analysis



M fish,  $N_1$  captured (& marked)



$N_2$  recaptured,  $n$  marked

Assuming independence:

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

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

# 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.

# How Large is the Crowd?

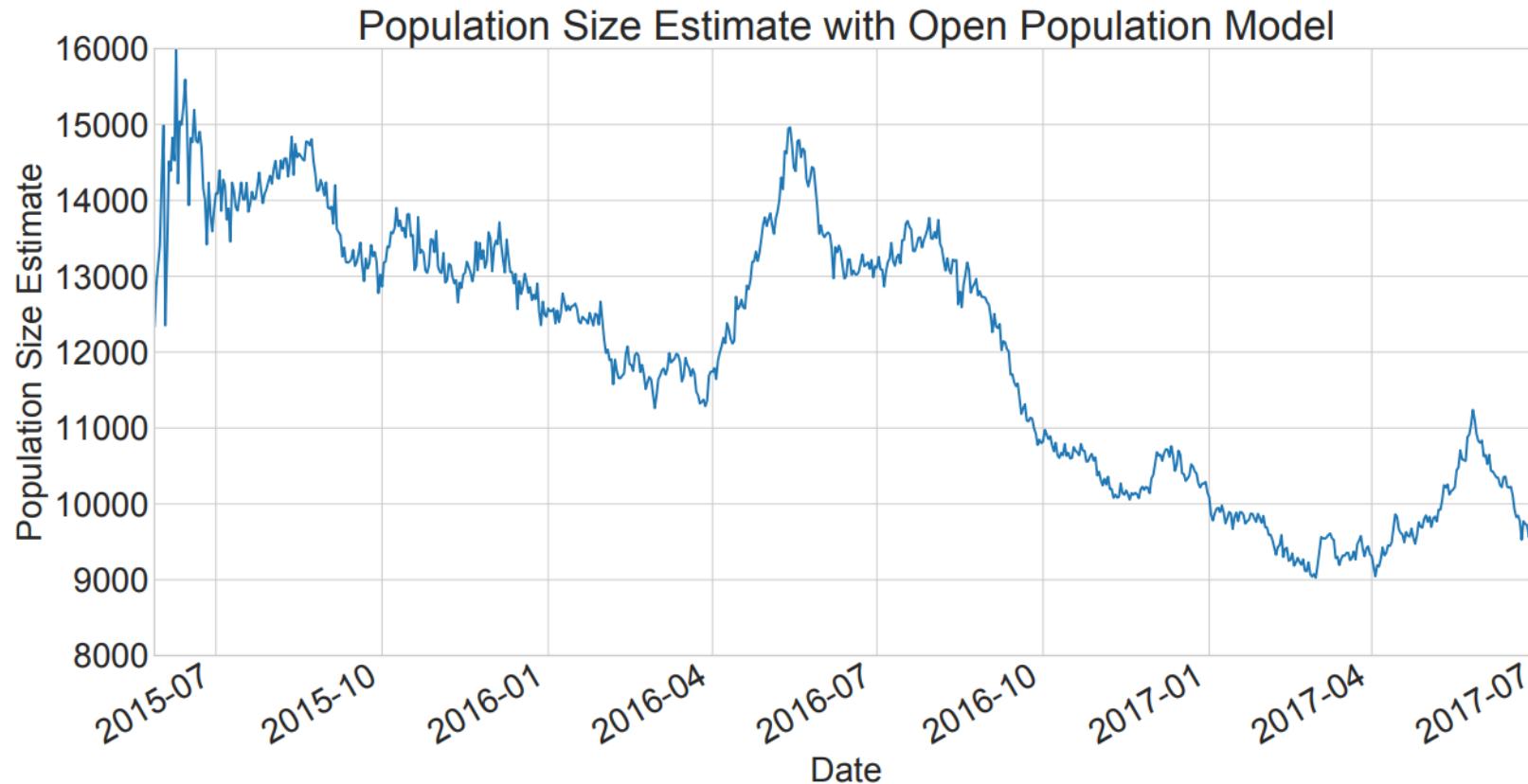
## Relaxing A1: Open population model

- 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  $d - t$ .

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

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

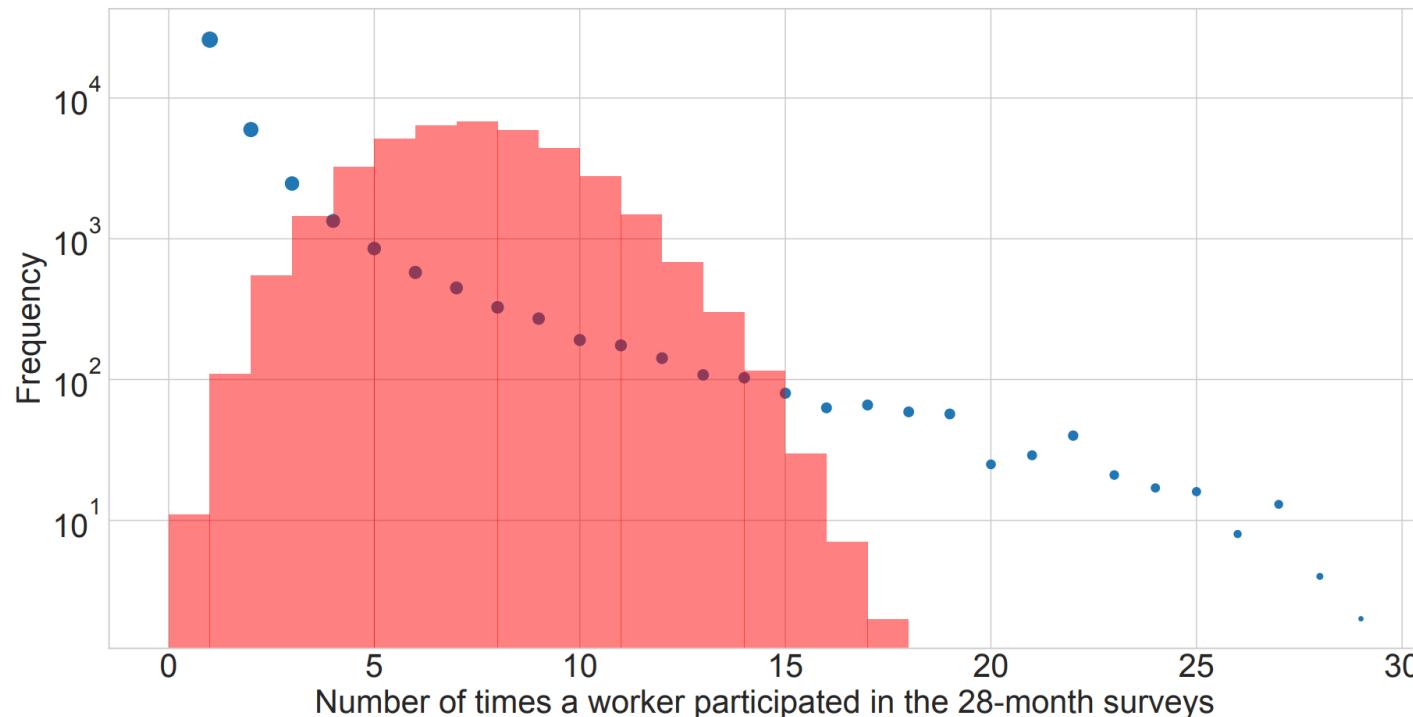
# How Large is the Crowd?



Half-life of the  
MTurk worker  
population is 404  
days

# 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,  $P(\text{capture}|a_i) = 1 - (1 - \frac{a_i}{\sum_{j=1}^N a_j})^{n_1} \approx \frac{n_1 a_i}{N E[a]}$
- Recapture  $n_2$  workers,  $P(\text{capture, recapture}|a_i) = \frac{n_1 n_2 a_i^2}{N^2 E[a]^2}$
- The expected number of workers participating in both surveys:

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

- Following this method, the estimate for the number of MTurk workers is [178,000](#).

# 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?