Understanding, Predicting, & Influencing Human Decision Making

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MAX PLANCK INSTITUTE FOR SOFTWARE SYSTEMS

Outline for my lectures

Lecture 1:

- Overview of (my) Social Computing Research

Lecture 2:

- On the **Temporality** of Trust and Privacy

Lecture 3:

 On Biases in Search & Recommendations in Crowdsourcing Systems

What do social computists do?

Look at societal problems through a computational lens

- Operationalization:
 - The process of defining a fuzzy concept so as to make it clearly distinguishable, measurable, and understandable in terms of empirical observations
 - Key step: How to quantify a concept?

What do social computists do?

Look at societal problems through a computational lens

- Operationalization:
 - The process of defining a fuzzy concept so as to make it clearly distinguishable, measurable, and understandable in terms of empirical observations
 - Key step: How to quantify a concept?

Operationalizing filter bubbles

- How to quantify societal polarization?
 - The fuzzy notion that different groups of people are being exposed to different types of information



- Insight: Leverage existing segregation measures
 - Evenness, Exposure, Clustering, Concentration, Centralization

Quantifying message impartiality

What do we mean by impartiality?

- No *precise* definition
- Intuitively understood
- Hard to operationalize due to subjectivity
 - Recasens et al., 2013; Yano et al., 2010

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- Intuitively understood
- Hard to operationalize due to subjectivity
 - Recasens et al., 2013; Yano et al., 2010
- Distinct but related concept: author affiliation

U.S. Immigration reform of 2014

U.S. Immigration reform of 2014

Democrats: in favor



Republicans: against





By the House's action, we are setting up a direct challenge to the president's unilateral actions on immigration next month... 3/4



John Boehner 📀

@SpeakerBoehner

Official Twitter account for former U.S. House Speaker John Boehner (R-OH)

Author affiliation easy to predict: partial message



Boehner: Stop Whining. Do Your Job. Pass A Bill.



Rick Cooley @rcooley123 Progressive, antiwar, humanitarian, environmentalist, civil liberties, human rights, Down Syndrome. #ConnectTheLeft. Backup account @cooleyrj

Author affiliation easy to predict: partial message



Obama to detail his executive action on immigration, setting up clash with GOP - The Washington Post



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Author affiliation hard to predict: impartial message

Affiliation hard to infer: Impartial message



Ö @SpeakerBoehner By the House's action, we are setting up a direct challenge to the president's unilateral actions on immigration next month... 3/4

John Boehner 🕗



Rick Cooley @rcooley123 Boehner: Stop Whining. Do You Bill.	¢ ► Follow r Job. Pass A	Partial
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Partial

2+ Follow

Definition of impartiality

A message is impartial if the affiliation of it's author cannot be inferred from it's text*

*given a context (Immigration reform debate) and set of possible affiliations (Democratic and Republican)

Operationalizing the definition

Event: U.S. government shutdown of 2013

Tweet: We can't stop the rain but together we can stop this shutdown. Enough is enough. #JustVote to reopen the govt

Operationalizing the definition

Event: U.S. government shutdown of 2013

Tweet: We can't stop the rain but together we can stop this shutdown. Enough is enough. #JustVote to reopen the govt

- Affiliation hard to infer: *no agreement* among humans
- Ask many humans (10 in this experiment)
 - agreement = max(dem, rep)

Human intuition: Ask humans directly

Human intuition: Ask humans directly



- Human intuition: Ask humans directly
- Facts: Message is impartial if it states facts

Human intuition: Ask humans directly

Facts: Message is impartial if it states facts



Human intuition: Ask humans directly

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- Human intuition: Ask humans directly
- Facts: Message is impartial if it states facts
- Author: Message is impartial if the author is impartial (and vice versa)

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Quantifying Search Bias: Investigating Sources of Bias for Political Searches in Social Media

Juhi Kulshrestha

joint work with

Motahhare Eslami, Johnnatan Messias, Muhammad Bilal Zafar, Saptarshi Ghosh, Krishna P. Gummadi and Karrie Karahalios









Social media as "search" platform

- Rich source of news & information
- Search is how users follow news about events & people
- Hashtags recommended queries



Social media as "search" platform

#obamacare

Social media as "search" platform

#obamacare Q	
Mark Meadows ♀ @RepMarkMeadows · Feb 23 ✓ I support @RandPaul and @RepSanfordSC's #Obamacare replacement plan a plan that will lower costs and put the focus back on the patient. ▲ 117 117 117 971	•
Still With Her @craftyme25 · Feb 23 Whoa. Arkansas is pissed. Woman says her husband will die without #ObamaCare. Asks @SenTomCotton "What kind of insurance do YOU have?" #CNN	,
Ryan ■ @Politicalry · Feb 22 Support for Obamacare growing! We do not need to #RepealAndReplace #Obamacare, fix it as is or keep it for the sake of the people's welfare.	•
 Charles Gaba @ @charles_gaba · Feb 22 but not everyone has to buy a Lamborghini, as Ted Cruz falsely claimed was the case under #Obamacare. 3 128 932 	•

Ranked list (according to importance)

Potential bias in search results

#obamacare	Q
Mark Meadows 🔄 @RepMarkMeadows	_ + Follow ∨
I support @RandPaul and @RepSanfo #Obamacare replacement plan a pla lower costs and put the focus back or patient.	rdSC's an that will n the



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Byon E	



Pres	Rvan	**
	@Politic	alry

. ♣ Follo	w
- Folic	W

Support for Obamacare growing! We do not need to **#RepealAndReplace #Obamacare**, fix it as is or keep it for the sake of the people's welfare.



Search can shape user opinion

- Users place greater trust in higher ranked items [Pan et al., 2007]
- Biased search results can influence voting patterns [Epstein & Robertson, 2015]

Search bias in the headlines

Search engine bias: What search results are telling you (and

what they're not)

How Google Shapes the News You See About the Candidates

Who would Google vote for? An analysis of political bias in internet search engine results

Donald Trump Accuses Google of Bias in Search Engine Results

How Google's search algorithm spreads false information with a rightwing bias

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How Google's search algorithm spreads false information with a rightwing bias

What does bias of a search system mean? How can we quantify it?






Identify sources of search bias Quantify bias of each source Study bias of political searches in Twitter

Quantifying Search Bias

CSCW 2017



search bias

Quantify bias of each source



Study bias of political searches in Twitter

Quantifying Search Bias

CSCW 2017





input (relevant items)









Output bias may stem from

• Bias introduced by the **ranking** system



Output bias may stem from

- Bias introduced by the **ranking** system
- Bias in the **input** relevant item set



Identify sources of search bias





Study bias of political searches in Twitter

Quantifying Search Bias

CSCW 2017

Quantifying bias of each source



Step 1: Quantify bias of an individual item

Step 1: Quantifying bias of a single item



Step 1: Quantifying bias of a single item



- We use **source bias** as a proxy
 - Infer bias of each individual item from the bias of the author
 - High scalability

Step 1: Quantifying bias of a single items



- We use **source bias** as a proxy
 - Infer bias of each individual item from the bias of the author
 - High scalability
- Prior work on inferring content bias
 - Could be plugged into our bias quantification framework















Step 1: Quantifying bias of a single items



Quantifying bias of each source



Step 2: Quantify bias of a set of items

Step 2: Quantifying bias of set of items



- Compute bias score (s) for each item
- Take the average over the whole set

$$IB(q) = \frac{\sum_{i=1}^{n} s_i}{n}$$

input (relevant items)

Quantifying bias of each source



Step 3: Quantify bias of a ranked list of items

Step 3: Quantifying bias of ranked list of items



Quantifying bias of each source



Step 4: Quantify bias introduced by ranking system

Step 4: Quantifying bias introduced by ranking

Ranking system

Ranking bias = Output bias - Input bias

ranking





Identify sources of search bias

Quantify bias of each source



Study bias of political searches in Twitter

@juhi153

Quantifying Search Bias

CSCW 2017

- Search queries for
 - 2016 Democratic and Republican presidential primary debates (#demdebate, rep debate, ...)
 - Presidential candidates (Hillary Clinton, Donald Trump, ...)

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 - **Output**: Twitter top search snapshots every 10 mins
 - Input: All tweets containing the query, using streaming api

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Non-personalized search data

- Search queries for
 - 2016 Democratic and Republican presidential primary debates (#demdebate, rep debate, ...)
 - Presidential candidates (Hillary Clinton, Donald Trump, ...)
- Data collected
 - **Output**: Twitter top search snapshots every 10 mins
 - Input: All tweets containing the query, using streaming api
- Computed input, ranking, and output bias for each of the 25 queries

Bias in Twitter search: Input bias vs. Ranking bias

@juhi153

Quantifying Search Bias

CSCW 2017

Bias in Twitter search: Input bias vs. Ranking bias

Does input bias matter?



Quantifying Search Bias

CSCW 2017

Impact of input bias

Query	Output Bias	Input Bias
Bernie Sanders	0.71	0.55
Martin O'Malley	0.64	0.57
Rand Paul	-0.37	-0.18
John Kasich	-0.09	-0.13
dem debate	0.52	0.29
#demdebate	0.57	0.56
republican debate	0.53	0.27
rep debate	0.31	0.40

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Input bias matters!

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Input bias varies across queries

Input bias across queries



Input bias varies across queries

@juhi153

Juhi Kulshrestha

CSCW 2017
Effect of query phrasing

Query	Input Bias
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Effect of query phrasing

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Even for the same event, query phrasing can greatly effect the bias

Bias in Twitter search: Input bias vs. Ranking bias

- Does input bias matter?
 - Input bias does matter
 - Can vary significantly based on the query
 - Even for the same event, different phrasings of queries have widely differing biases

Bias in Twitter search: Input bias vs. Ranking bias

- Does input bias matter?
 - Input bias does matter
 - Can vary significantly based on the query
 - Even for the same event, different phrasings of queries have widely differing biases
- Does the ranking bias exist?

Examining ranking bias

Query	Ranking Bias
Hillary Clinton	0.18
Bernie Sanders	0.16
Martin O'Malley	0.07
Donald Trump	0.10
Ted Cruz	-0.37
Marco Rubio	-0.29
Ben Carson	0.26

Examining ranking bias

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Ranking bias does exist...

Examining ranking bias

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... but no evidence of systemic bias

Bias in Twitter search: Input bias vs. Ranking bias

- Does input bias matter?
 - Input bias does matter
 - Can vary significantly based on the query
 - Even for the same event, different phrasings of queries have widely differing biases
- Does the ranking bias exist?
 - Yes and varies across queries
 - No evidence of systemic bias

@juhi153

Quantifying Search Bias

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Open challenge: How to address search bias?

@juhi153

Quantifying Search Bias

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Open challenge: How to address search bias?

- Modify ranking system to account for bias
 - Might lead to reduction in quality of results



Open challenge: How to address search bias?

- Modify ranking system to account for bias
 - Might lead to reduction in quality of results
- Make the bias transparent
 - Keep the current ranking
 - Inform the users about the bias they are seeing
 - Make biases related to query phrasing transparent



Ted Cruz 📀

Q Houston, Texas

i Father of two, **@heidiscruz**'s husband, fighter for liberty. Representing the great state of Texas in the U.S. Senate.

% tedcruz.org ∰ Joined Mar 2009

Ted Cruz is inferred to be republican leaning



https://tinyurl.com/bias-users







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John Oliver 📀

♀ New York
 i Comedian. @LastWeekTonight,
 @TheDailyShow, The Bugle
 Podcast (@hellobuglers)
 % iamjohnoliver.com
 i Joined Jun 2011

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Sean P. Goggins Columbia, MO Sociotechnical Data Scientist Sociotechnical Data Scientist Sociotechnical Data Scientist

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https://tinyurl.com/bias-users



Quantifying Search Bias

CSCW 2017

Quantifying Demographic Biases in Crowdsourced Recommendations

Abhijnan Chakraborty

joint work with

Johnnatan Messias, Fabricio Benevenuto, Saptarshi Ghosh, Niloy Ganguly and Krishna P. Gummadi





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Twitter trending topics

United States Trends · change

#motoRPS() different captures better, just like the new moto g plus Promoted by Moto India

Comey FBI Director James Comey testifies at Senate hearing

#wednesdaywisdom

Anthony Weiner

Clinton

Joe Budden

#BestAdviceIveEverHeard

#TwitterIsGreatBecause

The Dark Tower Fans are divided over The Dark Tower trailer

Wikileaks

Example of crowdsourced recommendations

Topics which exhibit highest spike in recent usage by Twitter crowd

United States Trends - Change

#motoRPS(A) different captures better, just like the new moto g plus Promoted by Moto India

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What are the trends?

Naaman et al., JASIST 2011



United States Trends · change #motoRPS

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What are the trends?

Entertainment

United States Trends - Change

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How are the trends selected?

Mathioudakis et al., SIGMOD 2010

Focus of this work

Who are the people behind these trends?



Focus of this work

Analyze the demographics of crowds promoting Twitter trends



United States Trends · change

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Promoters of a trend: who used a topic before it became trending.









Research Questions

1. How different are the trend promoters from Twitter's overall population? 2. Are certain socially salient groups underrepresented among the promoters? 3. Do promoters and adopters of a trend have different demographics? 4. What can promoter demographics tell about the trend content?

Demographic attributes considered

- Gender
 - Male/Female



Demographic attributes considered

- Gender
 - Male/Female
- Race
 - White/Black/Asian



Demographic attributes considered

- Gender
 - Male/Female
- Race
 - White/Black/Asian
- Age
 - Adolescent (<20)
 - Young (20-40)
 - Mid-Aged (40-65)
 - Old (>65)



Key challenge

How to infer demographic attributes at scale?







Used Face++, a neural-network based face recognition tool.

Inferring demographics from profile images





Mid-Aged, White, Male

Young, Asian, Female

Inferring demographics from profile images

- Also used in earlier works [Zagheni et al, WWW 2014; An and Weber, ICWSM 2016]
- Face++ performs reasonably well
 - Gender inference accuracy: 88%
 - Racial inference accuracy: 79%
 - Age-group inference accuracy: 68%
- Gathered demographic information of 1.7M+ Twitter users, covered by Twitter's 1% random sample during July - September, 2016

Gender demographics of Twitter population in US



Racial demographics of Twitter population in US


Age demographics of Twitter population in US



Research Questions

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Gender demographics of trend promoters



- Trend promoters have varied demographics
- Men are represented more among promoters of 53% trends

Racial demographics of trend promoters



- Similar pattern
 considering racial
 demographics
- Whites are
 represented more
 among promoters
 of 65% trends

Trend promoters differing significantly from overall population

Demographic attribute	% of trends
Gender	61.23 %
Race	80.19 %
Age	76.54 %

Where difference between the demographics of promoter and overall population is statistically significant.

Research Questions

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Under-representation of socially salient groups

• A demographic group is under-represented when its fraction among promoters is < 80% of that in overall population

• Motivated by the 80% rule used by U.S. Equal Employment Opportunity Commission

Under-representation of socially salient groups



Women, Blacks and Mid-aged people are under-represented most.

Under-representation of socially salient groups



Considering race and gender together, Black women are most under-represented.

Research Questions

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Importance of being trending



Topics get adopted by wider population after becoming trending

Research Questions

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Promoters and Trends

1. Trends express niche interest of the promoter groups.

2. Trends represent different perspectives during different events.

Trends expressing niche interest



Trends expressing niche interest

Blacks: #blackloveday, #BlackGirlsRock, #ThingsBlackpplFear

Asians: #FlyInNYC, #ButterflyKiss, #QueenHwasaDay

Adolescents: #NationalTeddyBearDay, #SuperJunior

Trends expressing different perspectives

During Dallas Shooting (7th and 8th July, 2016)



Trends expressing different perspectives

During Dallas Shooting (7th and 8th July, 2016)

Promoted by Blacks and Asians:

#BlackLivesMatter, #AllLivesShouldMatter, #BlackSkinIsNotACrime

Promoted by Whites:

#DallasPoliceShootings, #PoliceLivesMatter, #PrayForPeace

Need to know the promoters to understand the context for trends

Open challenge: How to address recommendation biases?

- How to achieve fair representation?
 - Representation proportional to numbers in society

- Fair Vote Gathering
 - Weighted random sampling
 - Over time: Weighted (Hierarchical) Fair queueing
- Fair Vote Counting
 - Ranked choice voting
 - Open ticket voting

Demo

Who-Makes-Trends: A public web service http://twitter-app.mpi-sws.org/who-makes-trends



What is social computing?

- What is Computer Science?
 - Science 1967
- Authors: Newell, Perlis, Simon

Funder of the authors: JCR Licklider