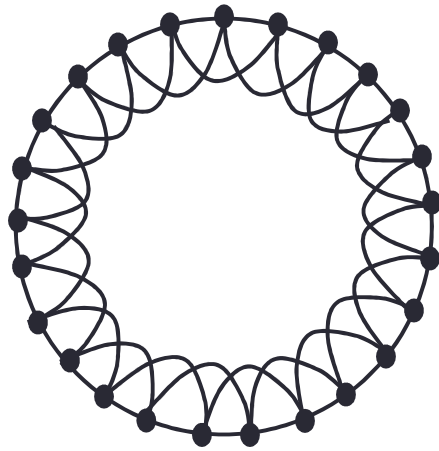


FROM SMALL-WORLD NETWORKS TO COMPUTATIONAL SOCIAL SCIENCE

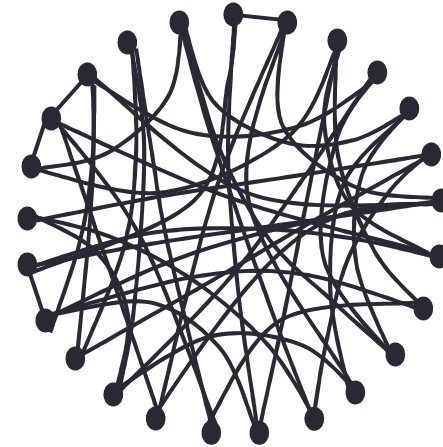
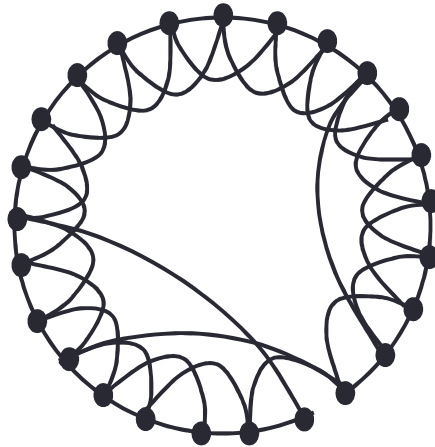
Duncan J. Watts
Microsoft Research

Microsoft[®]
Research

Small-World Networks (Watts and Strogatz, 1998)



$p = 0$



$p = 1$



Increasing randomness

DMS-9500948, \$180K, "Nonlinear dynamics of oscillator arrays", 7/1/95-6/30/98 (Steven H. Strogatz)
DMS-9627189, \$185K, "Mutual synchronization of biological oscillators," 8/15/96-7/31/00 (Strogatz)

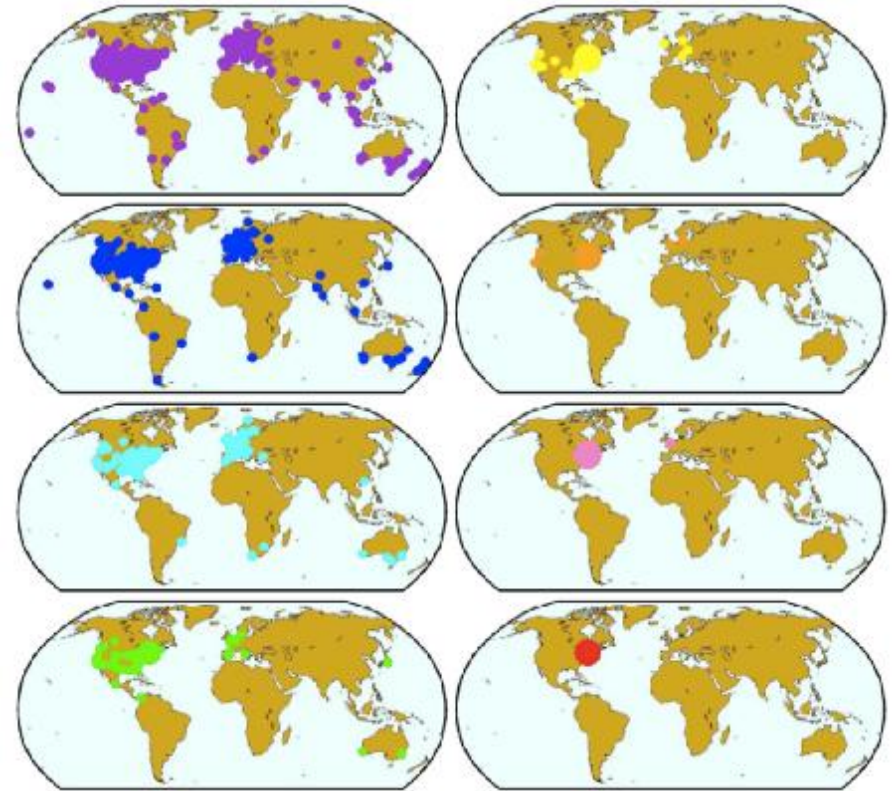
Network Science circa 2000

- Lots of interest from Physics and CS communities in previously social science questions
 - Generative models of network structure and growth, contagion on networks, influence maximization, dynamics of cooperation, etc.
- Many interesting theoretical results, but empirical progress impeded by relative difficulty of
 - Gathering population-scale observational data
 - Conducting large-scale experiments
- As it turned out, web was just starting to reveal it's importance to social science

Small World Experiment

Dodds, Muhamad and Watts (Science, 2003)

- Replicated Stanley Milgram's famous experiment
 - 1 target in Boston, 300 "letter chains", 64 completions
 - Led to "six degrees of separation"
- Used Email in place of letters
 - 18 Targets, 24,000 Chains, 60,000 participants in 166 countries
- Average length of chains = 4
 - But corrected median chain length = 7 (same as Milgram)
- Discovery of "bored at work" network



SES-0094162 \$371,877, "Career: Theory and Applications of Complex Social Networks," 09/01/01-08/31/06 (Duncan J. Watts)

Music Lab

Salganik, Dodds, Watts (Science, 2006)

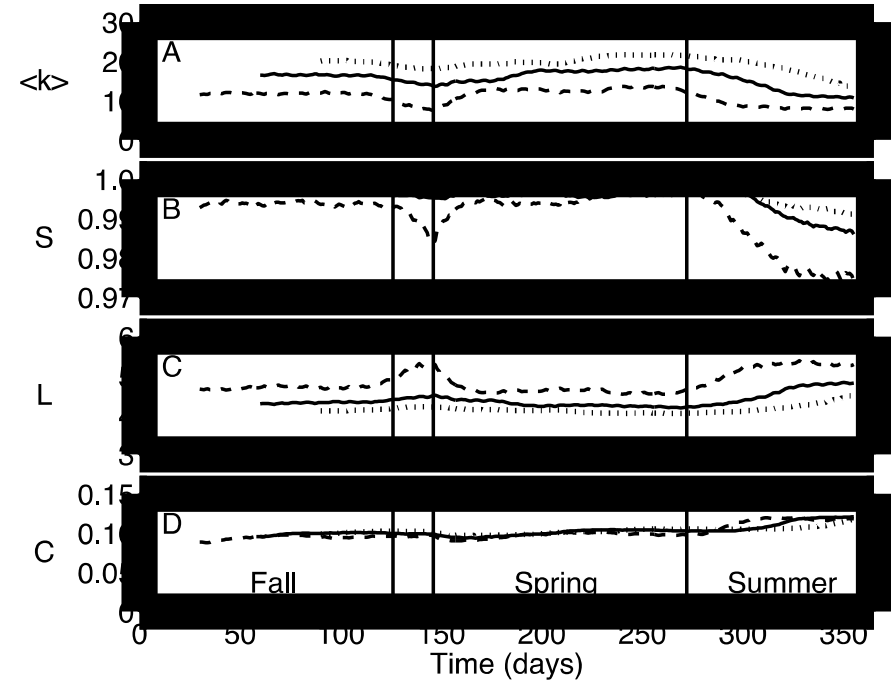
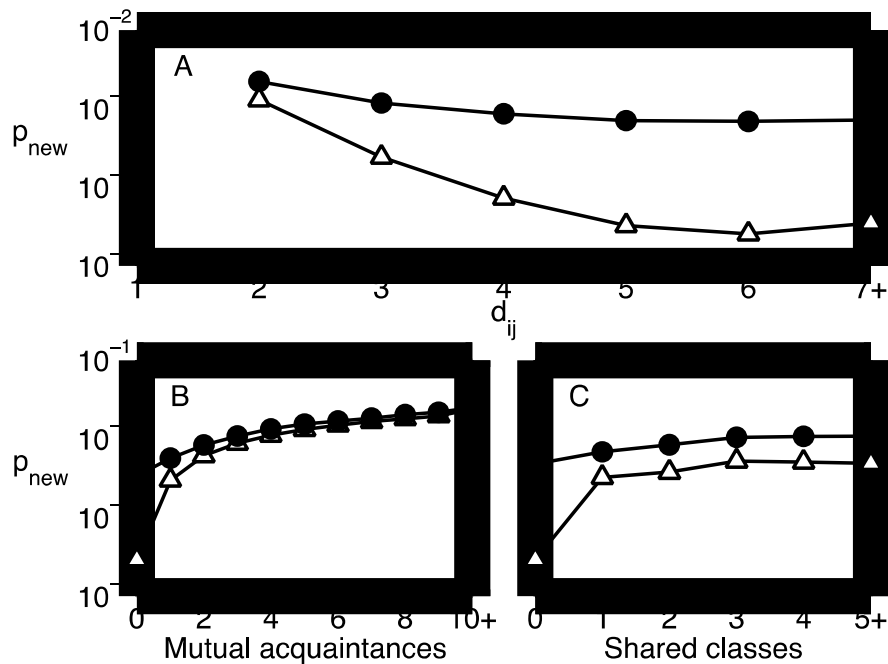
- Conducted experiment on social influence and market dynamics
 - 14,000 participants chose between 48 songs by unknown bands
 - Randomly assigned to 'social influence' and 'independent' conditions
- Social influence simultaneously increased inequality and unpredictability
 - Helps explain why hits are so unpredictable
 - Also showed that markets "construct" preferences as well as reveal them



#	Artist	Album	#	Artist	Album
1	THE WALKERS	"The Walkers"	25	THE WALKERS	"The Walkers"
2	THE WALKERS	"The Walkers"	26	THE WALKERS	"The Walkers"
3	THE WALKERS	"The Walkers"	27	THE WALKERS	"The Walkers"
4	THE WALKERS	"The Walkers"	28	THE WALKERS	"The Walkers"
5	THE WALKERS	"The Walkers"	29	THE WALKERS	"The Walkers"
6	THE WALKERS	"The Walkers"	30	THE WALKERS	"The Walkers"
7	THE WALKERS	"The Walkers"	31	THE WALKERS	"The Walkers"
8	THE WALKERS	"The Walkers"	32	THE WALKERS	"The Walkers"
9	THE WALKERS	"The Walkers"	33	THE WALKERS	"The Walkers"
10	THE WALKERS	"The Walkers"	34	THE WALKERS	"The Walkers"
11	THE WALKERS	"The Walkers"	35	THE WALKERS	"The Walkers"
12	THE WALKERS	"The Walkers"	36	THE WALKERS	"The Walkers"
13	THE WALKERS	"The Walkers"	37	THE WALKERS	"The Walkers"
14	THE WALKERS	"The Walkers"	38	THE WALKERS	"The Walkers"
15	THE WALKERS	"The Walkers"	39	THE WALKERS	"The Walkers"
16	THE WALKERS	"The Walkers"	40	THE WALKERS	"The Walkers"
17	THE WALKERS	"The Walkers"	41	THE WALKERS	"The Walkers"
18	THE WALKERS	"The Walkers"	42	THE WALKERS	"The Walkers"
19	THE WALKERS	"The Walkers"	43	THE WALKERS	"The Walkers"
20	THE WALKERS	"The Walkers"	44	THE WALKERS	"The Walkers"
21	THE WALKERS	"The Walkers"	45	THE WALKERS	"The Walkers"
22	THE WALKERS	"The Walkers"	46	THE WALKERS	"The Walkers"
23	THE WALKERS	"The Walkers"	47	THE WALKERS	"The Walkers"
24	THE WALKERS	"The Walkers"	48	THE WALKERS	"The Walkers"

SES-0094162 \$371,877, "Career: Theory and Applications of Complex Social Networks," 09/01/01-08/31/06 (Duncan J. Watts)

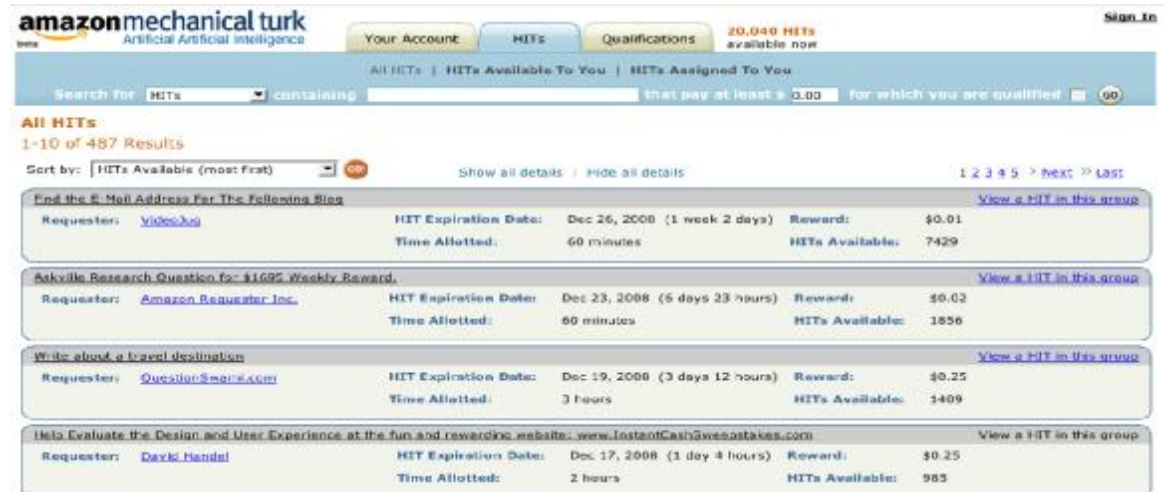
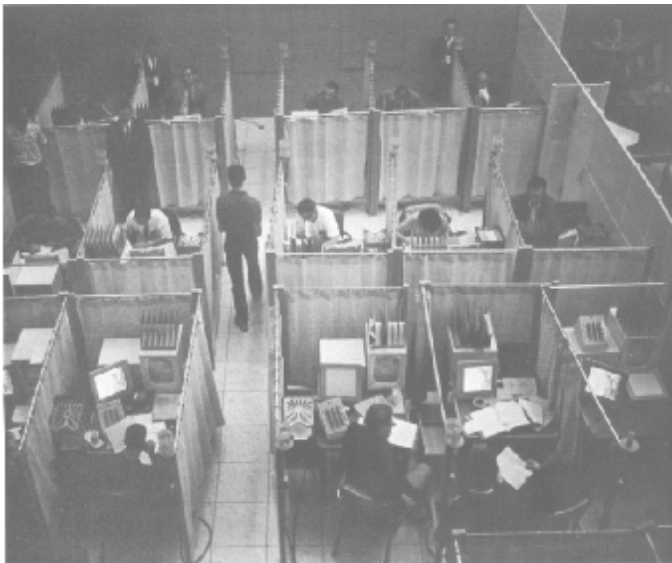
Dynamic Networks (Kossinets and Watts 2006)



SES-0339023, \$268,663, "EITM: The Structure, Evolution, and Function of Large-Scale Social Networks: Theory, Data, and Experiment," 04/23/04-04/22/06 (DJW)

Virtual Labs

- Amazon Mechanical Turk created in 2005
 - Since developed into generic “crowd-sourcing” site
- Since 2008, also used as platform for recruiting and paying participants in “virtual lab” experiments

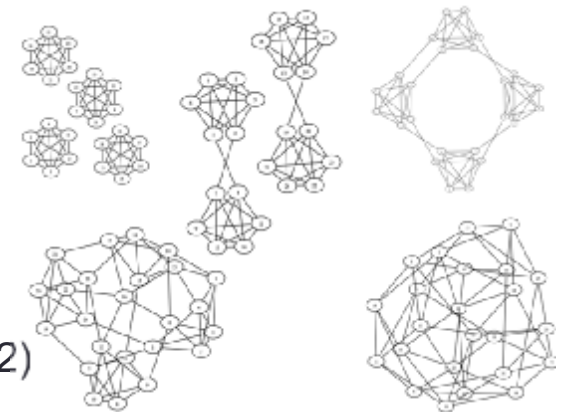
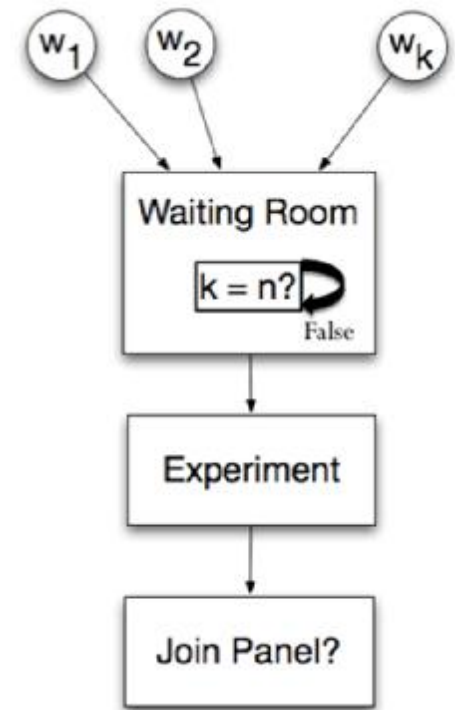


The screenshot shows the Amazon Mechanical Turk interface. At the top, there's a navigation bar with "amazonmechanicalturk" logo, "Artificial Intelligence", and buttons for "Your Account", "HITs", and "Qualifications". A notification says "20,040 HITs available now". Below the navigation bar, there's a search bar and a filter for "HITs" containing "that pay at least > 0.00". The main content area displays "All HITs" with "1-10 of 487 Results". The results are sorted by "HITs Available (most first)". The list includes four HITs with details like Requester, HIT Expiration Date, Time Allotted, Reward, and HITs Available.

Requester	HIT Expiration Date	Reward	HITs Available
VideoTag	Dec 26, 2008 (1 week 2 days)	\$0.01	7429
Amazon Requester Inc.	Dec 23, 2008 (5 days 23 hours)	\$0.02	1856
QuestionSema4.com	Dec 19, 2008 (3 days 12 hours)	\$0.25	1409
David Handa	Dec 17, 2008 (1 day 4 hours)	\$0.25	985

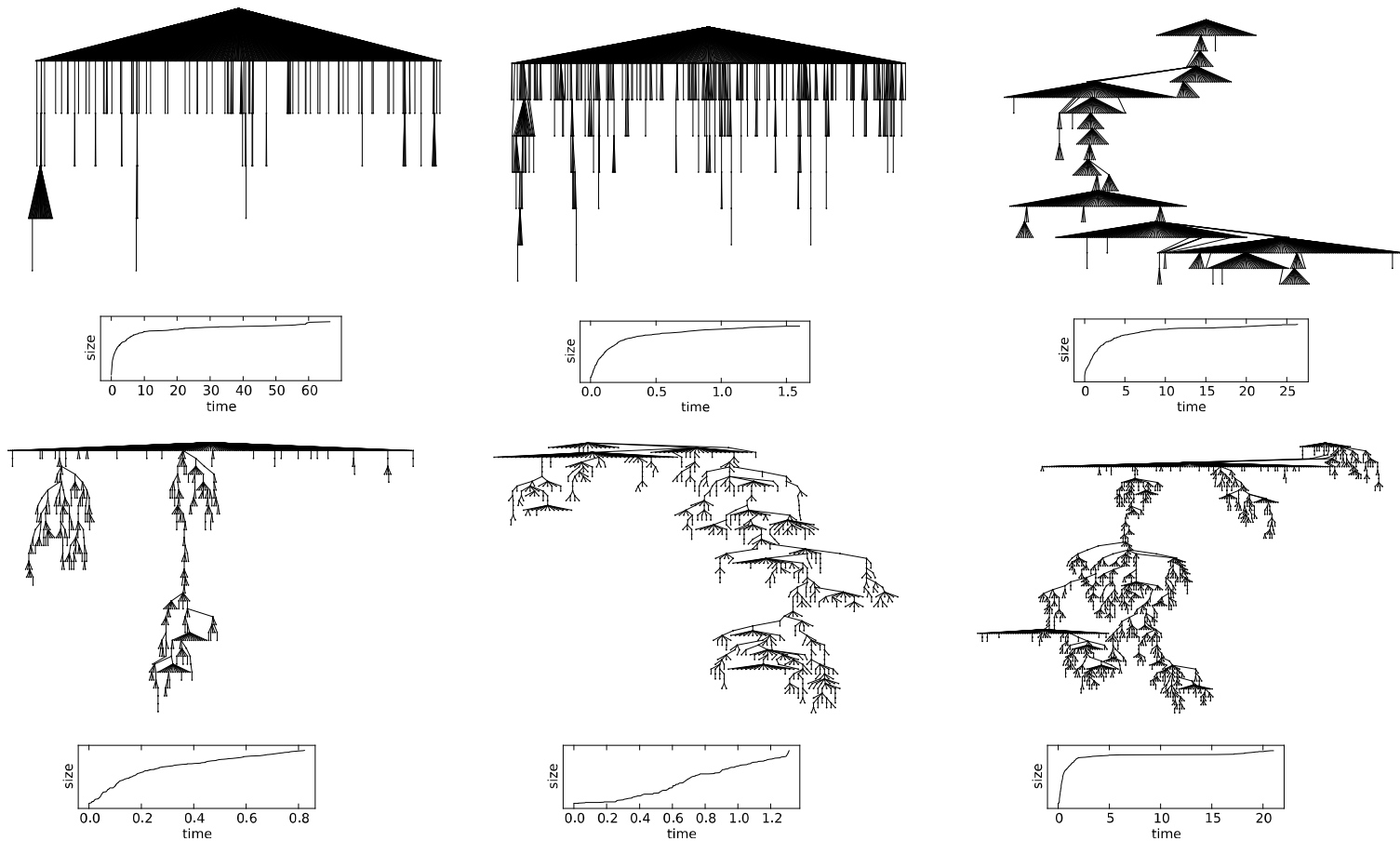
Networked Games

- Unit of analysis was still the individual
 - Ideally want $N \gg 1$ simultaneous participants
- Solution: construct a panel
 - Run a series of preliminary games with small N
 - In process recruit a panel of players who agree to provide details and to be contacted for subsequent games
 - Notify panel in advance of upcoming games
 - Use waiting room to get N players
- Have now run over 500 networked experiments
 - Cooperation in fixed networks (Suri and Watts 2011)
 - Cooperation in dynamic networks (Wang et al 2012)
 - Collaborative learning in fixed networks (Mason and Watts 2012)



Research conducted at Yahoo! Research using AMT

Structural Virality of Online Diffusion (Goel, Anderson, Hofman, Watts, 2015)



Research conducted at MSR using Twitter data

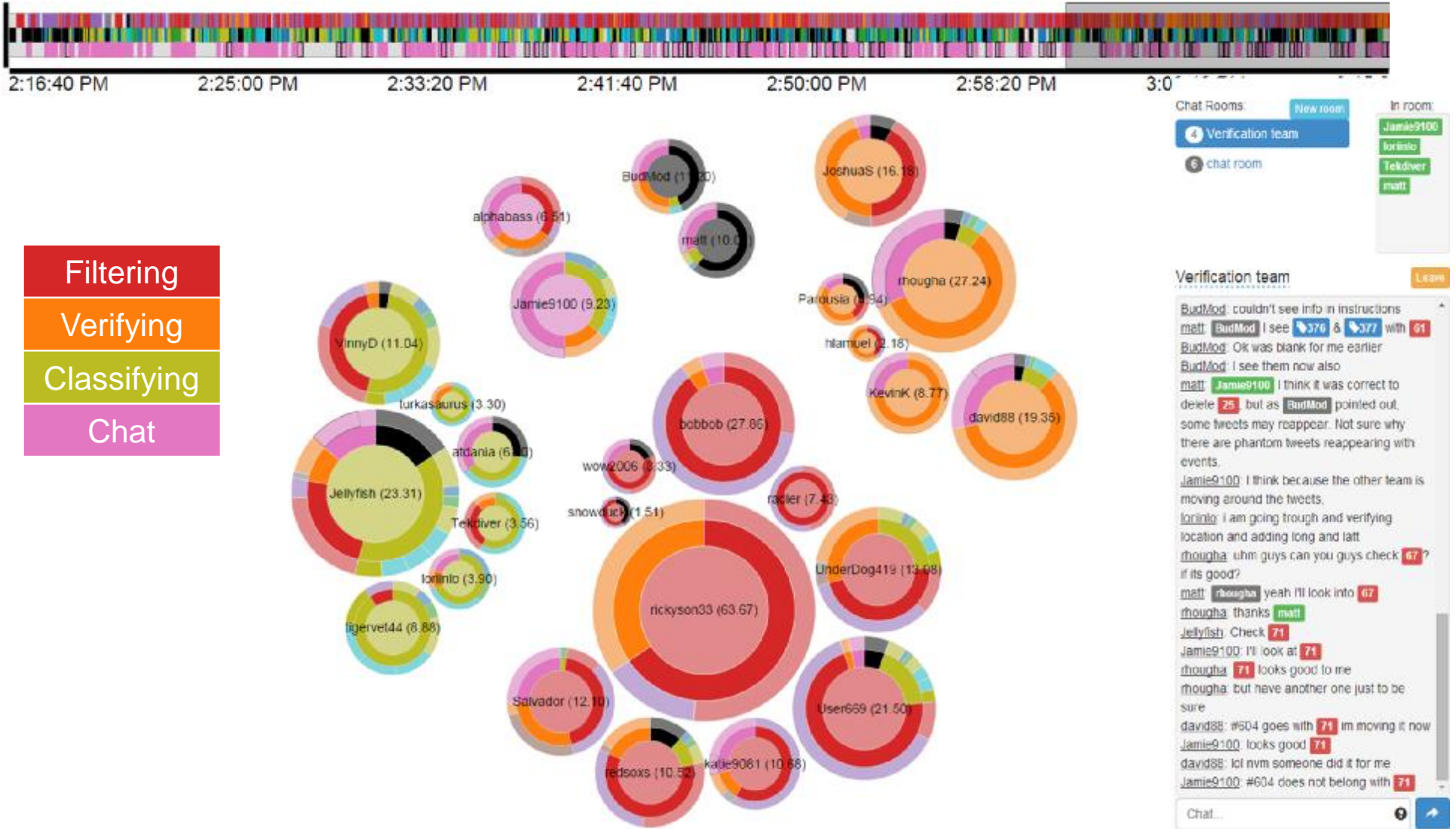
Collective Problem Solving (Mao, Suri, Mason, Watts 2015)

The screenshot displays a disaster response interface with three main components:

- Event List:** A table listing various events related to a typhoon. The table has columns for Source, Type, Description, Region, Province, and Location. The events include flooding, damaged infrastructure, damaged houses, damaged bridges, damaged roads, and deaths reported.
- Chat Window:** A chat interface titled "mapping chat" showing a conversation between users. The chat text includes: "Cebu: Yooo", "What would you guys do with things like, charity/support?", "where is negros oriental?", "left of cebu", "shearwater: 24 hr confirmed with", "Central Visayas region", "Not sure, it didn't really specify on what to do with support and assistance type things.", "Where is Puerto Princesa City on the map.", "Cebu", "Should we delete those?", "I guess they aren't specifically describing cities", "It'd be three times easier if we could search for a location on the map instead of blindly moving around", "I don't think we do anything with support and assistance unless they specifically mention other events", "That's what I figured", "You can google", "I just got to the mapping, I'm gonna start logging. If you want me to work on something specific, let me know".
- Map:** A map of the Philippines with several red location markers placed across the islands, primarily in the Visayas and Mindanao regions.

Research conducted at MSR using AMT + Meteor

Digital Ethnography?



Data Visualization with D3 (Heer, Bostock)

Some General Themes

- Social science is becoming a computational science
 - Driven first by computing power, then by data/platforms
 - CSS could be next Computational Biology
- Federal funding and Industry labs both critical
- Industry also critical as a source of data
 - Facebook, Twitter, Amazon, Yahoo!, Microsoft, Foursquare
- Open source software/platforms also important
 - R, Meteor, D3
- Research has arguably inspired industry
 - Facebook inspired by network science of late 1990s
 - BuzzFeed inspired by influence research of mid 2000s

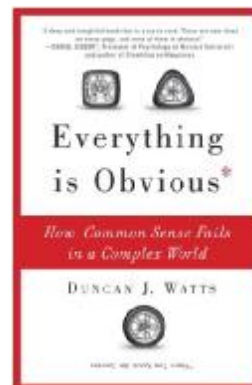
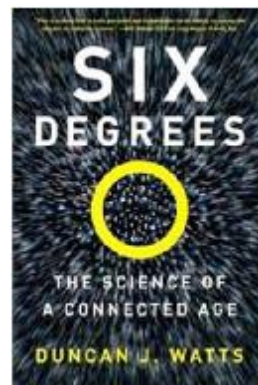
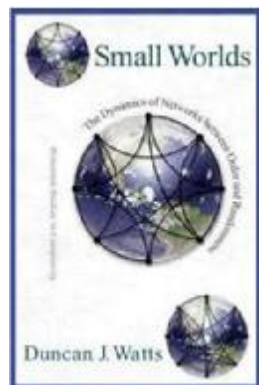
The Future

- Looking back 15 years, would have been hard to imagine then what is possible today
 - “A completely observable social network of a billion people? Inconceivable!” (Duncan Watts circa 1995)
- Equally hard to imagine what will be possible 15 years from now, but some trends are:
 - Smartphones/wearables as social sensors
 - Experimental macrosociology
 - Instrumentation of organizations
- One area in which surprisingly little progress has been made is integration of the disciplines / research methods
 - Will be needed to solve real problems

THANK YOU

<http://research.microsoft.com/en-us/people/duncan/>

<http://everythingisobvious.com>



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