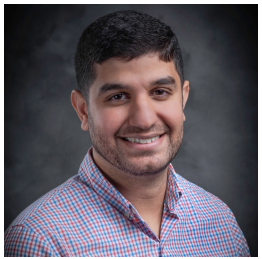
Building a Computational Model of Mobs Leveraging Social Science Theories

South Big Data Hub Social Cybersecurity Working Group



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UA LITTLE ROCK COSMOS
Collaboratorium for Social Media and Online Behavioral Studies

Outline

- Mobs
  - Types
  - Examples
  - Mobbers Types
- Studying Mobs (A Data Driven Approach)
  - Data Collection & Processing
  - Theories Used To Explain the Behavior
  - Methods and Tools Used to Study Mobs
- Studying Mobs (A Computer Simulation Approach)
  - Theoretical Framework
  - Simulating Mobs
  - Comparing Simulated Mobs to Real-world Mobs

Mobs

- A **mob** is an event organized via social media, emails, SMS, or other forms of digital communication technologies in which a group of people (who might have an agenda or not) get together online or offline **to collectively do something** then disperse (quickly or over a longer period of time).

- The term "**crowd**" refers to "*an organized event occurring within a defined space, which is attended by a large number of people. . . **not dependent on the reason for the gathering***" (Zeitz et al. 2009).

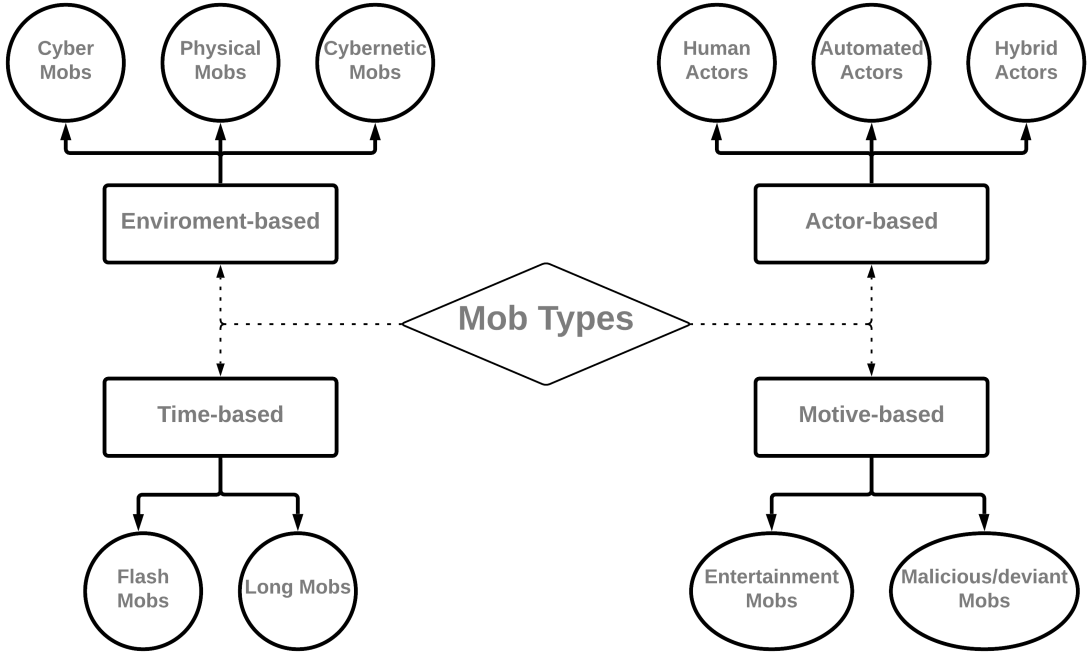
- Mob organization process has five phases, *planning*, *recruitment*, *execution*, *replaying and republishing*, and *evaluation* phase.

Al-khateeb, S., Agarwal, N. Flash mob: a multidisciplinary review. *Social Network Analysis and Mining.***11**, 97 (2021). https://doi.org/10.1007/s13278-021-00810-7

Mob Types

- We reviewed the literature and categorized mobs into four main categories. These categories are determined based on *the acting environment*, *actors' type*, *length of the mob*, and *the motive of the mobbers*.

Non-exclusive characterization



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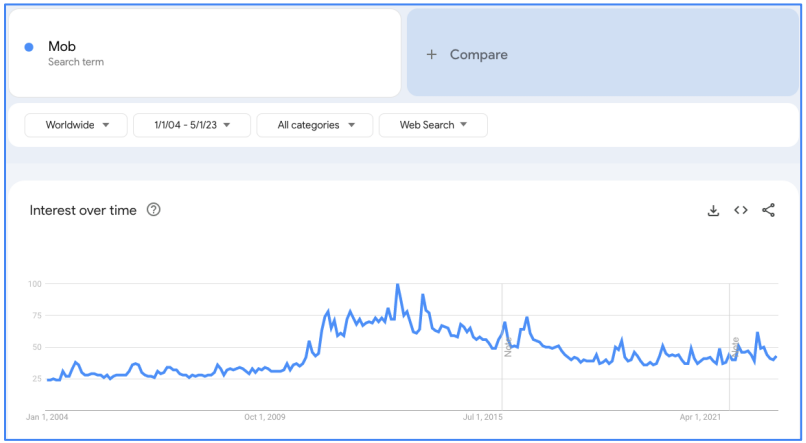
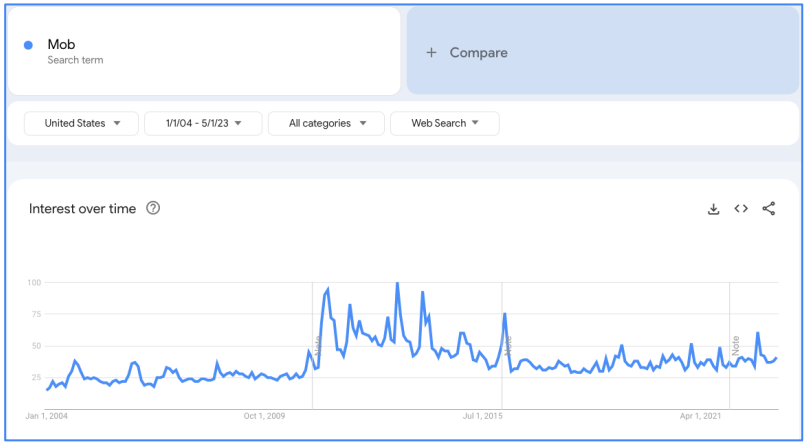
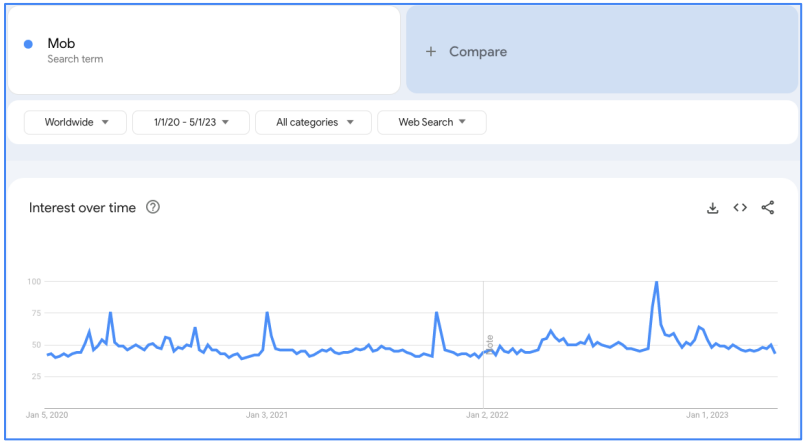
Google Trends showing interest over time for the word “Mob”

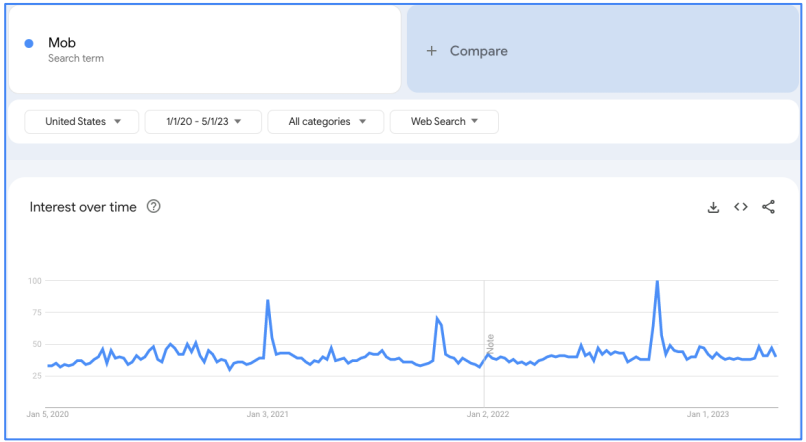


Trend line of the interest in the word “Mob” from January 1, 2004, - May 1, 2023 (Worldwide).



Trend line of the interest in the word “Mob” from January 1, 2004, - May 1, 2023 (in the USA).





Mob Examples

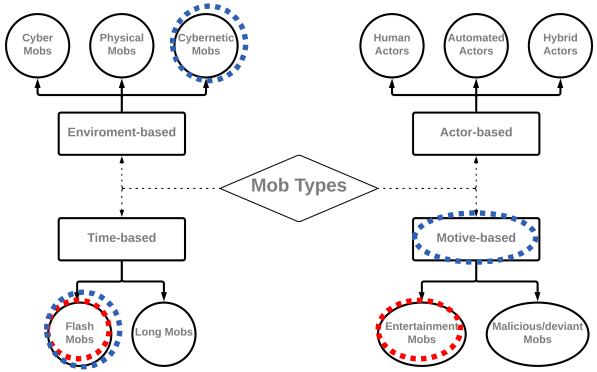
A flash mob that happened in Seattle on December 7, 2010

See You in the Crosswalk - Official Umbrella Flash Mob
http://youtu.be/S4CqTV9eEkI

Entertainment Flash Mobs

A flash mob that happened at a mall in Japan on October 24, 2016

Beethoven's Symphony No. 9 [Tokushima]
https://www.youtube.com/watch?v=1Fv3uZoB6c8



Political Cybernetic Flash Mob

A flash mob that happened in Thailand on December 14, 2019

Flash mob at Skywalk
https://youtu.be/O0QOziZtq3g

Mob Examples Cont…

Nebraska Josh fight: Horde of dudes named Josh fight for right to name

"4/24/2021, 12:00 PM, meet at these coordinates, (40.8223286, -96.7982002) we fight, whoever wins gets to keep the name, everyone else has to change their name, you have a year to prepare, good luck," the original Josh wrote to the other guys named Josh.

The victor was a four-year-old little Josh, who was coronated with a Burker King crown, according to KLKN reporter Yousef Nasser.

Josh Swain, left, the originator of the joke, takes on another Josh as they decide the rightful owner of the name Josh via a game of rock, paper, scissors in an open green space in Air Park on Saturday, April 24, 2021, in Lincoln, Neb. What started as a mid-pandemic joke took on life Saturday, as a mixed bag of individuals sharing only their name came to battle it out. The winner was to be declared the rightful owner of the name. ((Kenneth Ferriera/Lincoln Journal Star via AP))

Entertainment Cybernetic Flash Mob

The battle for dudes named Josh on Saturday raised more than $8,000 for the Children's Hospital & Medical Center Foundation and brought in non-perishable food for the Lincoln Food Bank.

Mob Examples Cont…

Video: Activists raid Burger King with chicken masks in Paris

AMSTERDAMFOX

Video: Activists raid Burger King with chicken masks in Paris

The animal rights defender association named ‘L214’ reacted to the cruelty of industrial breeding to chickens by pressing Burger King. The words “Squeeze like chickens” were affixed to the windows of the restaurant.

In Paris, the capital of France, animal rights activists raided the restaurant of the fast food chain Burger King with chicken masks, in response to the torture of industrial farming for chickens.

In the images shared on social media, it is seen that dozens of activists within the L214 animal rights defender association entered the restaurant with chicken masks on their heads.
It is noteworthy that the activists stand side by side with chicken masks and perform a standing action, in which the words “Squeeze like chickens” are affixed to the windows of the restaurant.

The French press reported that the activists took this action to refer to the “raising of industrial chickens in a confined space motionless and without seeing the light of day”. Activists launched a petition with the label “Squeeze like chickens” to protest fast food chains and the poor conditions of rearing chickens.

Physical Flash Mob

November 6, 2022
Article URL https://amsterdamfox.com/world-news/activists-raid-burger-king-with-chicken-masks-in-paris/

Mob Examples Cont…

One person opens the Shadertoy editor and types, and other people give typer instructions on what to write.

Shadertoy Mob Programming: Path Tracing 2 ◄····· Cyber Mob

Hosted By
Charles G. and 2 others

Graphics Programming Virtual Meetup
Public group

Wednesday, October 26, 2022
8:00 PM to 10:00 PM CDT

Online event
Link visible for attendees

Details

We will continue doing shadertoy mob programming this week! And we will continue working on where we left out last week

Format:
Similar to the past live coding event, the meeting will be structured as "mob programming." One person opens the Shadertoy editor and types, and other people give typer instructions on what to write.

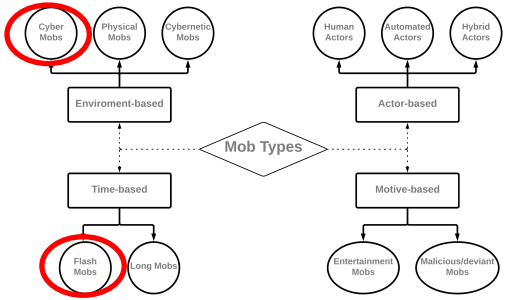
Join our discord server: https://discord.gg/6TTRA5h

WED, OCT 26 · 8:00 PM CDT
Shadertoy Mob Programming: Path Tracing 2

FREE ☆ Share Attend online

Mob Examples Cont…

Cyber Flash Mob

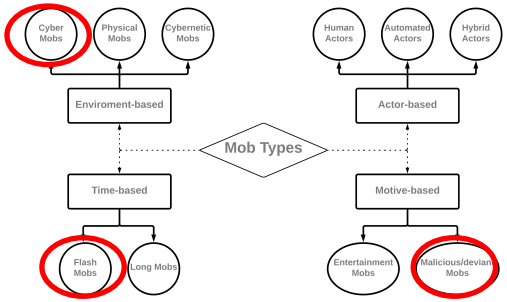


- In a recent incident, an army of small investors from all over the world used Reddit to coordinate "*flashmob investing*" to create a stock market frenzy causing GameStop's stock value to rise from $20 to $483 in less than a month.

[Reddit's flashmob won't be able to work its GameStop magic on silver]

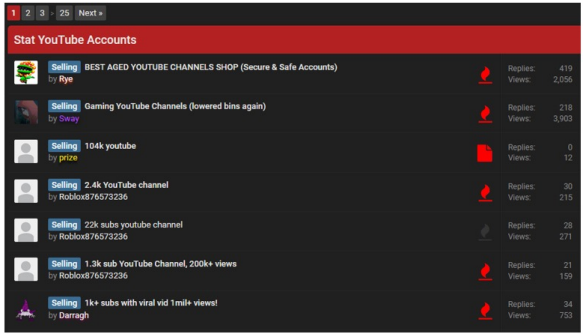
Mob Examples Cont.

Deviant Cyber Flash Mob



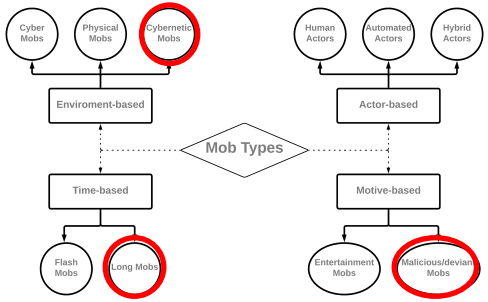
- The pages of many YouTube influencers especially from the auto and car community were hijacked via a coordinated cyber attack in September 2019
- Some of the channels attacked are:
  - Built
  - Troy Sowers
  - MaxtChekVids
  - PURE Function
  - Musafir
- The account hacks are the result of a coordinated campaign that consisted of messages luring users to phishing sites, where hackers logged account credentials.

[Massive wave of account hijacks hit YouTube creators]



Mob Examples Cont…

Cybernetic Long Deviant Mob



- More recently, the term “mob” has been increasingly used to remark an electronically orchestrated violence such as the recent attack on the State Capital in Washington by angry protesters that lead to property damages, government disruption, and injuries or death for some of the protesters.

[Our President Wants Us Here’: The Mob That Stormed the Capitol.]

[Woman Dies after Shooting in U.S. Capitol; D.C. National Guard Activated after Mob Breaches Building.]

Mob Examples Cont…

Brazen flash mob-style robbery of Walnut Creek Nordstrom

- More than 80 people stormed the Nordstrom department store Saturday November 20, 2021, and made off with merchandise
- Police say those cars, some with license plates covered helped suspects make a fast getaway but not all, three people were arrested.
- "We received reports of people dressed in masks and dark clothing, running into Nordstrom blocking streets with their cars, using crowbars running out with property," said Walnut Creek Police Lieutenant Holley Conners.

Deviant Cybernetic Flash Mob

- "This is obviously a coordinated activity, an organized group of people working together, using social media to communicate with each other," Wilk added.
- "There was a mob of people and police coming in, it was like something out of the movies, it was insane," said witness Brett Barrett.

Mob Examples Cont…

- On Monday, August 15, 2022, a crowd of people ransacked a 7-Eleven store during a street takeover in Los Angeles' Harbor Gateway area
- Dozens of people emptied shelves, threw snacks and beverages, and left with merchandise
- At least two people jumped over the front counter and threw items to the others in the crowd. A store employee, decisively outnumbered, hid in a back room of the store fearing for his life

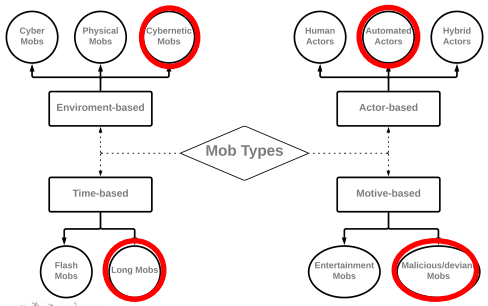
Street Takeover ‘Flash Mob' Swarms Los Angeles 7-Eleven

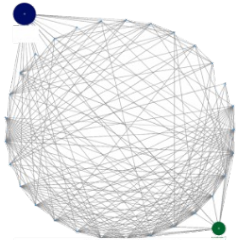
Deviant Physical Flash Mob

Mobbers Type

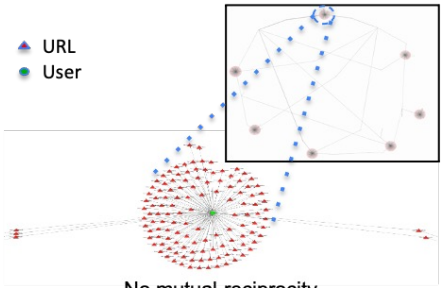
- In addition to humans participating in mobs, social bots help humans in disseminating the mob products such as recruitment messages, images, videos, on various social media platforms.

Cybernetic Long Deviant Mob with Automated Actors

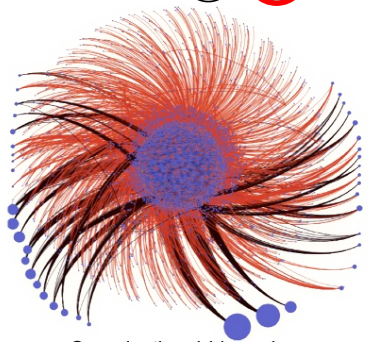




Mutual reciprocity.
IFYFM & FMIFY



No mutual reciprocity.
Coordination in information network



Organizational hierarchy.
Core and peripheral bots

COORDINATION/BEHAVIOR COMPLEXITY

Crimean Invasion 2014

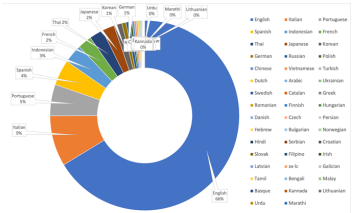
Dragoon Ride 2015

Trident Juncture 2015

ISIS Propaganda 2016

Agarwal N., Al-khateeb S., Galeano R., Goolsby R. (2017). Examining the use of botnets and their evolution in propaganda dissemination. Defence Strategic Communications, 2, 87-69. doi: 10.30966/2018.riga.2.4.

Recent Study: The Role of Social Bots During Cyber Flash Mobs

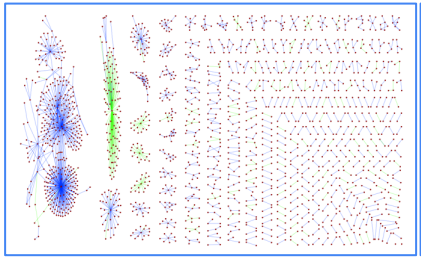


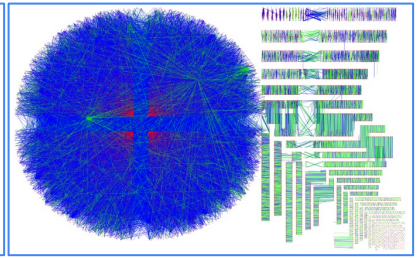
Social bots tend to share their location and language less than humans.

Social bots tend to post less toxic tweets than humans.

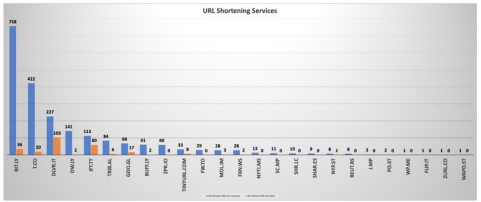
	Retweets	Mentions	(Retweet/Mentions) ratio
Bots	1,345	330	≈4.1
Humans	52,192	18,226	≈2.7

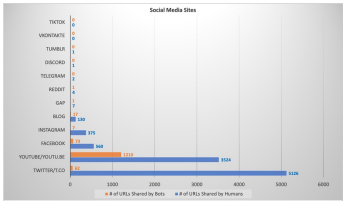
Both social bots and humans tend to retweet a lot, however, social bots have a higher tendency to retweet than humans.





The social bot's communication network is less divided (has fewer components) and less densely connected (has fewer connections within components) than the humans' communication network.





Humans share more URLs than bots regardless of the site type and Social bots tend to shorten URLs less than humans.

Samer Al-khateeb, Madelyn Anderson, and Nitin Agarwal. "*Studying the Role of Social Bots During Cyber Flash Mobs*". International Conference on Social Computing, Behavioral-Cultural Modeling and Prediction, and Behavior Representation in Modeling and Simulation (SBP-BRiMS 2021), July 06-09, 2021.

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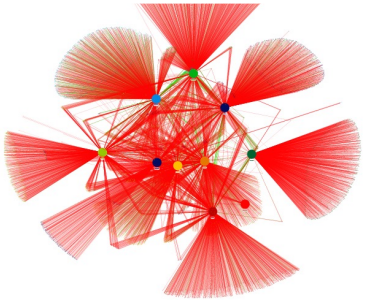
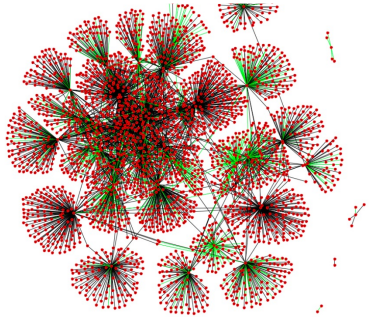
Collective Action Conceptual Framework & Operationalization

Table 2: Parameters used in the conceptual framework and their estimation using Twitter data.

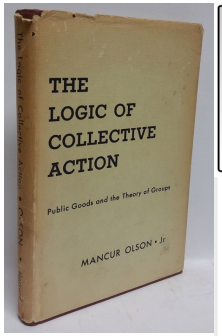
Parameter	Method of Estimation
Control (C)	In-degree Centrality
Interest (I)	$(Number\ of\ retweets + mentions)/(total\ number\ of\ tweets)$
Power (P)	Control $*$ Interest

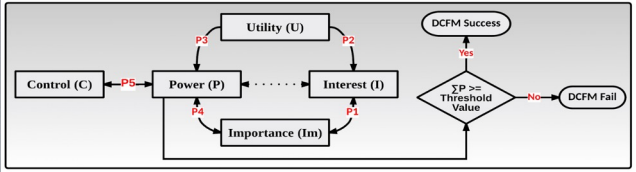


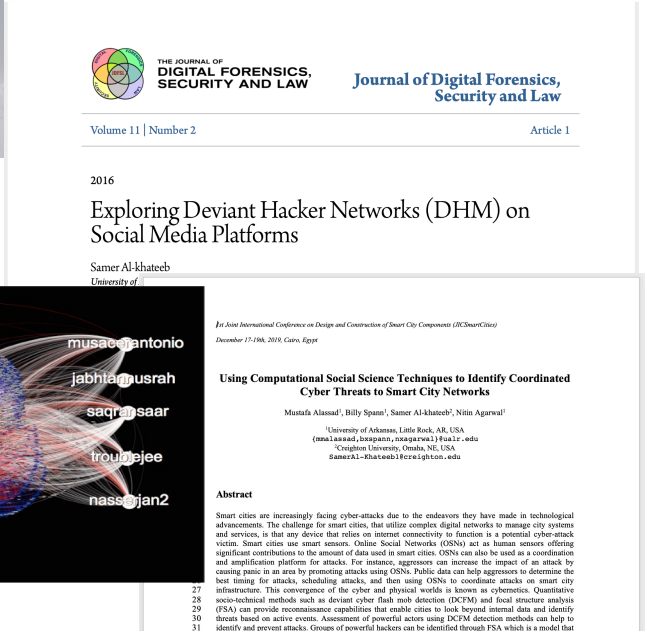
ISIS Recruitment Network

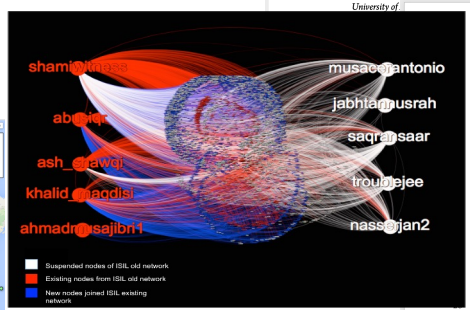


Black Hat Hacker Network





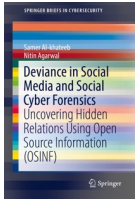




Samer Al-khateeb and Nitin Agarwal. Analyzing Deviant Cyber Flash Mobs of ISIL on Twitter. In Proceedings of the International Conference on Social Computing, Behavioral-Cultural Modeling, and Prediction (SBP15), March 31 April 3, 2015, UCDC Center, Washington DC, USA.

Samer Al-khateeb, Kevin J Conlan, Nitin Agarwal, Ibrahim Baggili and Frank Breitinger. Exploring Deviant Hacker Networks (DHN) On Social Media Platforms. Journal of Digital Forensics, Security and Law, Vol. 11. No. 2, pp. 7-20. 2016.

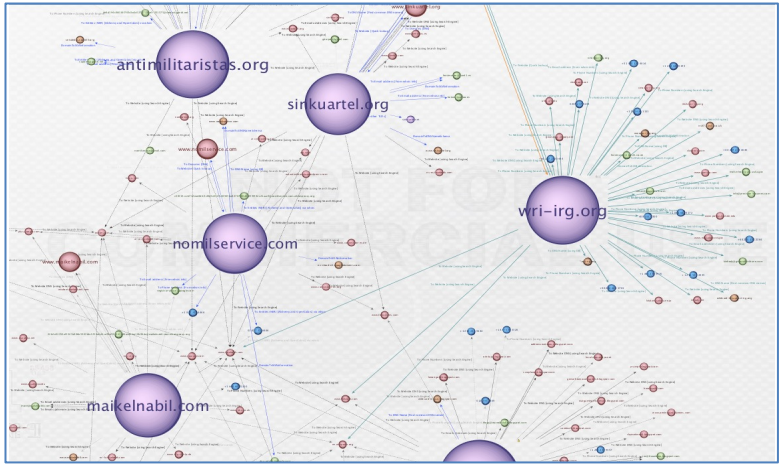
Studying Mobs - Social Cyber Forensic (SCF)



Cyber mobs during NATO Trident Juncture Exercise 2015

Social Cyber Forensic (SCF) analysis help us extract metadata of blogs such as:

- IP address
- Names under which the domain is registered
- Email addresses
- Phone numbers
- Other digital presence, for example:
  - Twitter handles,
  - YouTube URLs,
  - Facebook Profiles,
  - Other blogs.
- Web tracker codes (e.g., Google Analytics IDs).



SCF Analysis of Anti-NATO Blogs

Using SCF we found:

- the relations among the blogs and
- identified more blogs that we did not know before.

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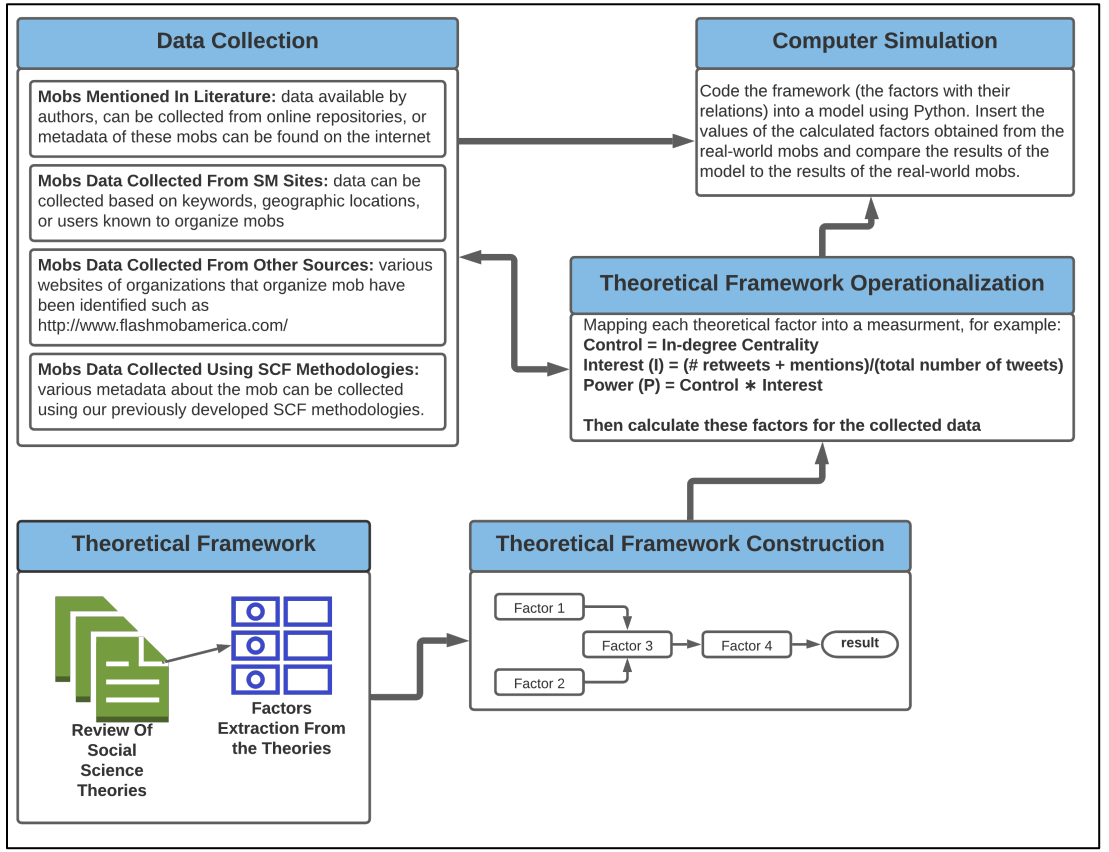
Studying Mobs (A Theory Driven Approach)

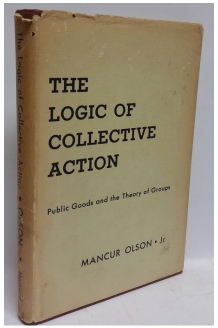
A three-year $660,000 grant is awarded by the U.S. Air Force Research Lab and the U.S. Office of Naval Research (Award# FA9550-22-1-0332) to build a computational model of mobs based on factors extracted from social science theories.

UA LITTLE ROCK COSMOS Collaboratorium for Social Media and Online Behavioral Studies

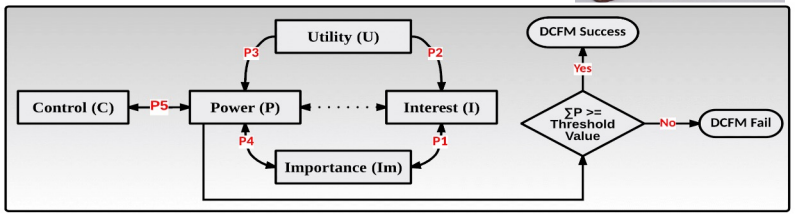


Simulating Mobs using the Monte Carlo Method

Simulating Mobs using the Monte Carlo Method



- From the **theory of collective action**, we extracted **factors** such as, ***interest***, ***control***, and ***power*** that affect the mobber decision when it comes to acting in mob or not. A mobber can face one of the following scenarios:
  1) If a mobber has interest and control, then the likelihood of the mobber's participation is the highest, i.e., the mobber will act.
  2) If a mobber has interest but doesn't have control, then the mobber has two choices:
     - either will act or
     - withdraw (i.e., has 50/50 chance)
  3) If a mobber does not have interest but has control then the mobber has two choices:
     - either will withdraw, i.e., will not act, or
     - execute power exchange (i.e., relinquish power to possibly gain control over other events (mobs) or to simply gain ***social capital***–as stated by Pierre Bourdieu, is *"the value that one gain from personal connections such as membership in a family, an ethnic association, elite clubs, or other solidarity groups*" (Biggart 2008). These mobbers can perfectly exchange power with mobbers of the second case above.
  4) If a mobber has no interest and no control, then the mobber will have two choices:
     - either will withdraw or
     - act against the group.



Samer Al-khateeb and Nitin Agarwal. "Studying Simulated Mobs Using Monte Carlo Method and the Theory of Collective Action". Modelling and Simulation of Social-Behavioral Phenomena in Creative Societies (MSBC 2022)

Simulating Mobs using the Monte Carlo Method Cont…

- By summing the power of all mobbers, we can determine the importance of a mob.
  - If the importance of a mob exceeds a certain (predetermined) threshold value, then we can hypothesize the mob will more likely succeed.
  - Otherwise, the mob is more likely to fail.
- Here, we named the sum of the power of all mobbers as the participation rate.
- We calculate the participation rate using two formulas shown below.

$$\text{Participation Rate} = \frac{(\text{the number of acting mobbers} + \text{the number of powerful mobers} - \text{the number of act against mobbers})}{\text{the number of invited mobbers}}$$

$$\text{Participation Rate} = \frac{(\text{the number of acting mobbers} + \text{the number of powerful mobbers})}{\text{the number of invited mobbers}}$$

- Equation 1 takes into consideration the effect of people who act against the mob (analogous to viewing what happens during a mob as two competing events where some people act while others act against them)
- Equation 2 does not take into consideration the effect of people who act against the mob (analogous to viewing the mob as one event represented by only those who act).

Samer Al-khateeb and Nitin Agarwal. ”Studying Simulated Mobs Using Monte Carlo Method and the Theory of Collective Action". Modelling and Simulation of Social-Behavioral Phenomena in Creative Societies (MSBC 2022)

Simulating Mobs using the Monte Carlo Method Cont…

- **RQ1**: Given the following parameters (Number of Invited People, Threshold Value of the Mob Success, the Number of Simulations (Mobs), the Number of Powerful Actors), what is the chance a mob will succeed?

- **RQ2**: Given the following parameters (Number of Invited People, Threshold Value of Mob Success, and the Number of Simulations (Mobs)), how many powerful actors are needed to have a successful mob?

- **RQ3**: Given the following parameters (Number of Invited People, Threshold Value of the Mob Success, the Number of Simulations (Mobs), the Number of Powerful Actors), how does the time it takes an invited participant to decide to join a mob affect the mobbers' participation rate?

Samer Al-khateeb and Nitin Agarwal. ”Studying Simulated Mobs Using Monte Carlo Method and the Theory of Collective Action". Modelling and Simulation of Social-Behavioral Phenomena in Creative Societies (MSBC 2022)

Methodology

- For the Monte Carlo Method we used Python's `randrange()` method from the random library to implement the four scenarios mentioned. The `randrange()` method was used to give each mobber a random `interest` and `control`; then a 50/50 chance of either acting or withdrawing (as in the second scenario); to withdraw or power exchange (as in the third scenario); and to withdraw or act against (as in the fourth scenario).
- Model input:
  - the total number of invited people,
  - the threshold value of the mob success,
  - the number of simulations (mobs), and
  - the number of powerful actors
- Model output:
  - the result of each mob simulated (success or fail),
  - number mobbers who: acted (participated), withdraw, did power exchange, acted against the mob of each mob
  - the participation rate of each mob.
  - The script also reports aggregate results:
    - the overall success and failure rate (how many simulated mobs succeeded and how many failed?).
    - the script reports the average participation rate of all the simulated mobs.
  - how many powerful mobbers were needed to make the failed mob a successful one

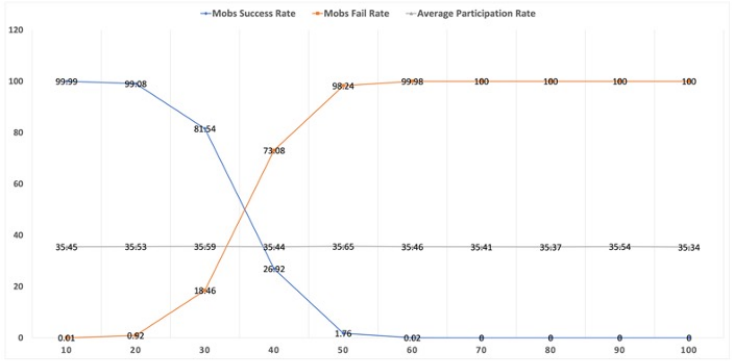
Experiment -1

- We set the:
  - number of invited people to 100 in all the experiments we conducted.
  - number of powerful actors to 0 to simulate the case when we do not know the number of powerful actors.
  - number of simulations for each case to 10,000 simulations (mobs).

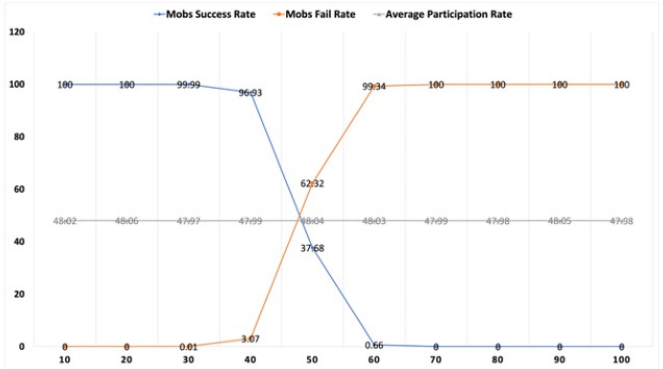
The **goal** here is to estimate the *average participation rate* that can be resulted from running the model without knowing the number of powerful actors.

Experiment -1 Findings

- We found that the mob success rate depends inversely on the threshold provided
- We also found that the average participation rate regardless of the provided threshold is around 35.5% when we used Equation 1 to calculate the participation rate and 48% when we used Equation 2.
    - This means that under the current model, if a mob has less than 35.5% (or 48%) threshold it will most likely succeed, however, if the threshold value is more than 35.5% (or 48%) the mob will most likely fail.
- We found a positive correlation between the participation rate and the number of mobbers who act.
- We found a negative correlation between the participation rate and the number of mobbers who: act against, withdraw, and power exchange
- Overall, the mobbers who are against the mob seem to have more negative effects on mob success than people who withdraw or power exchange



Average participation rate using the first equation is 35.5%. As the threshold (the x-axes) changes from 10-100, the mob success rate decreases while the mob fail rate increases



Average participation rate using the second equation is 48%. As the threshold (the x-axes) changes from 10-100, the mob success rate decreases while the mob fail rate increases

Experiment - 2

- The average threshold value the model was able to produce without knowing the number of powerful actors was around 35.5% (or 48% using Eq.2). We used these two values for the next set of experiments to answer the second research question.
- We varied the number of invited people from 10-100 then 100-1000 then 1000 – 10,000 to study the effect of the crowd size on the success (or failure) rate of the mob. This should also help in finding the relationship between the number of invited people and the needed powerful actors (organizers)
- We also simulated 10,000 mobs for each case.

The **goal** here is to estimate *the number of needed powerful actors (organizers) to make a mob succeed*.

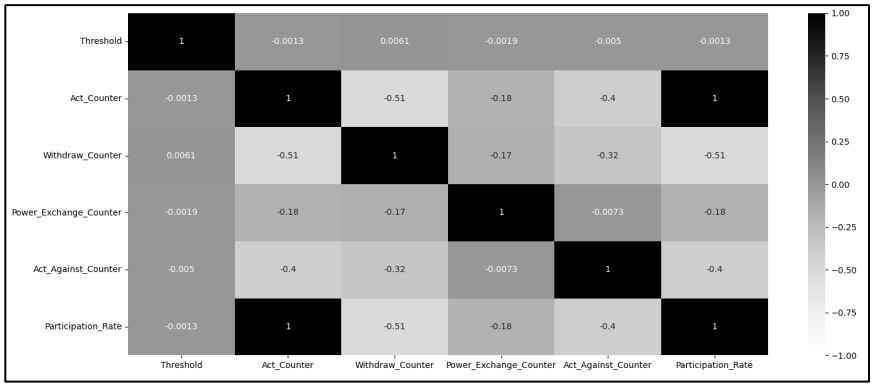
$$\mathrm{NPA} = \left(\frac{\mathrm{STho} * \mathrm{MP}}{100}\right) - \mathrm{AC} + \mathrm{AAC} \qquad (3)$$

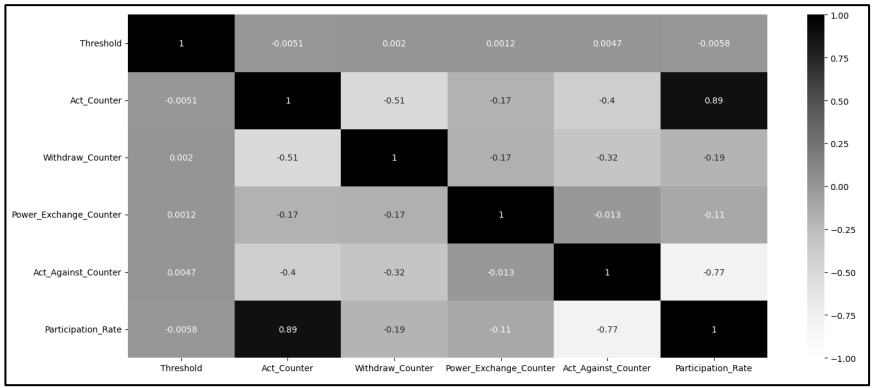
$$\mathrm{NPA} = \left(\frac{\mathrm{STho} * \mathrm{MP}}{100}\right) - \mathrm{AC} \qquad (4)$$

where ***NPA*** is the *number of needed powerful actors* (e.g., mob organizers), ***STho*** is the success threshold value, ***MP*** is the number of invited individuals, ***AAC*** is the number of individuals who act against the mob, and ***AC*** is the number of individuals who act/participate in the mob.

Experiment – 2 Findings

- We found that the average number of needed powerful actors is positively correlated with the number of invited people which means the *bigger the crowd size the more powerful actors we need to make a mob succeed*.
- When we ignore the people who might act against the mob (i.e., using Eq 2), the correlation becomes less, which means *less powerful actors (organizers) are needed when there are no people acting against the mob*.
- We found that in both cases (counting or ignoring the participants acting against the mob) there is a positive correlation between the number of invited people and the mob success rate. This means *if we have more people invited to a mob the chance of participation increases which also increases the chance of having a successful mob*.
    - This finding aligns with the findings of Sung-Ha Hwang (2021) who stated that larger group sizes favor punishers (in our case those who participate in the mob).





Experiment – 3 and Findings

- We set the
  - number of invited people to 10,000.
  - number of powerful actors to 0 to simulate the case when we do not know the number of powerful actors.
  - number of simulations for each case to 100 simulations (resulting in 200 mobs).
- We will not assign all the number of invited people interest and control randomly all at once, instead, it will assign them in "waves" (analogous to real-world scenarios, i.e., when individuals receive an invitation to join a mob, they do not all decide to join or not join the mob at the same time, they take time to think then decide).
  - We assume these "waves" correspond to periods (of time) in which people decide what to do (i.e., act, withdraw, power exchange, or act against the mob). The "wave" size is set according to the Euler method:

$$\text{wave size} = \text{number of invited people} / ((t * e) + 1) \qquad (5)$$

The **goal** here is to examine the effect of using the Euler method on the average participation rate

- ➢ We found that the average participation rate regardless of the provided threshold is around 37.3% (i.e., higher than 35.5% without the Euler method) when we used Equation 1 to calculate the participation rate and 49.78% (i.e., higher than 48% without the Euler method) when we used Equation 2.
  - ➢ This shows that *when people are given time to think about what to do*, the *overall participation rate goes up*.

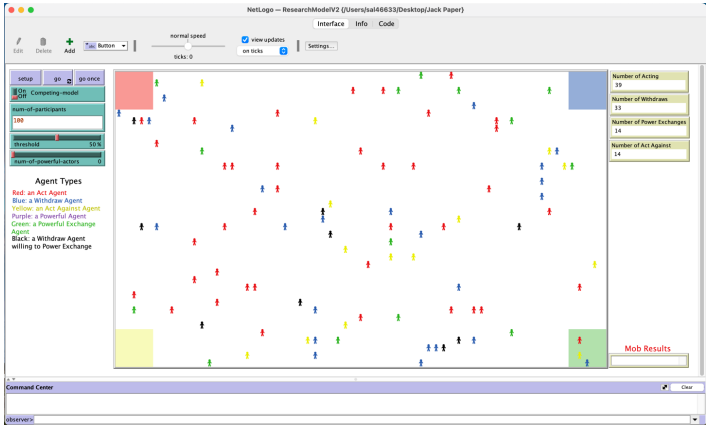
An agent-based modeling approach to study mobs

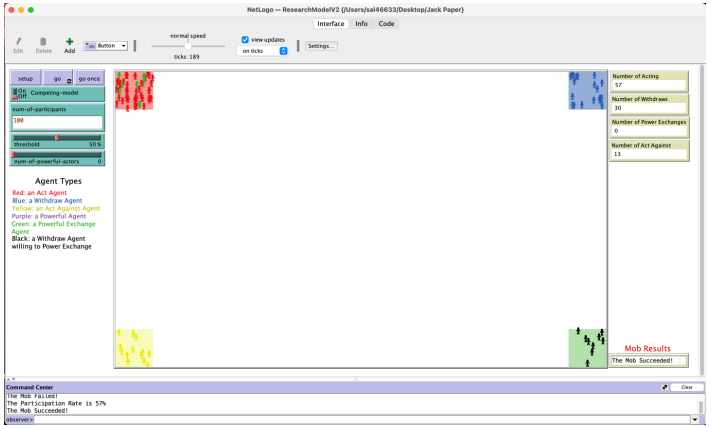
An agent-based modeling approach to study mobs

- **RQ1**: How can we use NetLogo to build an agent-based model of the mob phenomenon based on the **theory of collective action**?

- **RQ2**: What is the effect of the number of *invited people* on the participation rate? in other words, does the number of invited people to a mob affect the number of agents participating, hence affecting the success or failure of a mob?

- **RQ3**: How do the mob organizers affect the mob outcome?





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Methodology

- Clark Mcphail et al., (1992) stated that *purposive actors/agents in the same gathering can generate similar reference signals that result in varying forms of collective action of varying complexity*:
  1) **Independently**: assuming no communication between agents when they decide to act or not.
  2) **Interdependently**: assuming agents communicate with other agents to figure out what to do.
  3) **Voluntarily** or **Obediently**: assuming agents communicate with their bosses (e.g., powerful agents) and do what they are asked to do, i.e., to act the same way as the powerful agents.

- We conducted two experiments that simulate the forms described above to answer our research questions.

Experiment-1

- Using our model, we ran an experiment to answer the second research question, i.e., *does the number of invited people to a mob affect the number of agents participating, hence affecting the success or failure of a mob?*

- We simulated a total of 80 mobs:
  - 40 with the competing-model switch set to ‘On’ and the other 40 mobs with the switch set to ‘Off’ using the BehaviorSearch component in NetLogo.
  - The 40 mobs with each switch case (On and Off) resulted from simulating 4 sets of 10 mobs each. The *num-of-participants* in each set was equal to 10, 100, 1000, and 10,000 invited mobbers/agents.

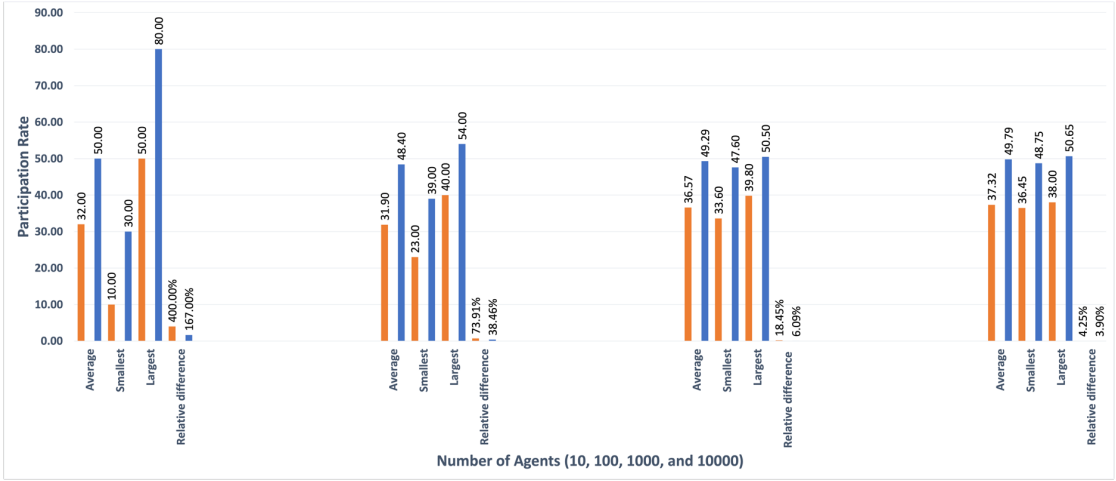
- In all the simulated mobs, we set the *number of powerful actors* to zero so we can calculate the participation rate without the effects of the powerful actors, i.e., to simulate the case when we do not know the number of mob organizers.

- This experiment is analogous to the first two forms mentioned mentioned by Clark Mcphail et al:
  - **Independently**: after agents are invited to participate in the mob, they decide what to do based on their interest and control and
  - **Interdependently**: agents in the second and third case communicate to do the power exchange so some of them decide to act while others decide to withdraw.

An agent-based modeling approach to study mobs- Findings

- The number of invited people does not affect the rate of participation, however as the number of invited people increases, the participation rate consistency (measured using the relative difference which is the [largest −lowest]/lowest) increases. This is due to the law of large numbers, i.e., the more samples (agents) we have, the better the result (more consistency).

- On average, the participation rate is higher (49.37% vs. 34.45%) when we do not have agents acting against the mob. We posit that this may be due to the fact that, in reality when there are no agents acting against a mob, the risk of mob participation will be lower, hence more agents/mobbers will be encouraged to participate.



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Experiment-2

- We also ran a second experiment to answer the third research question, i.e., *how do the mob organizers affect the mob outcome?*

- In this experiment, for each powerful agent if the agent has two or more neighbors within 1.5 patches, then these agents will follow what the powerful agent does, i.e., they will act.

- Using this setting, we simulated an additional 180 mobs:
  - 90 mobs with the competing-model switch set to 'On' while the other 90 mobs with the switch set to 'Off' using the BehaviorSearch component in NetLogo.

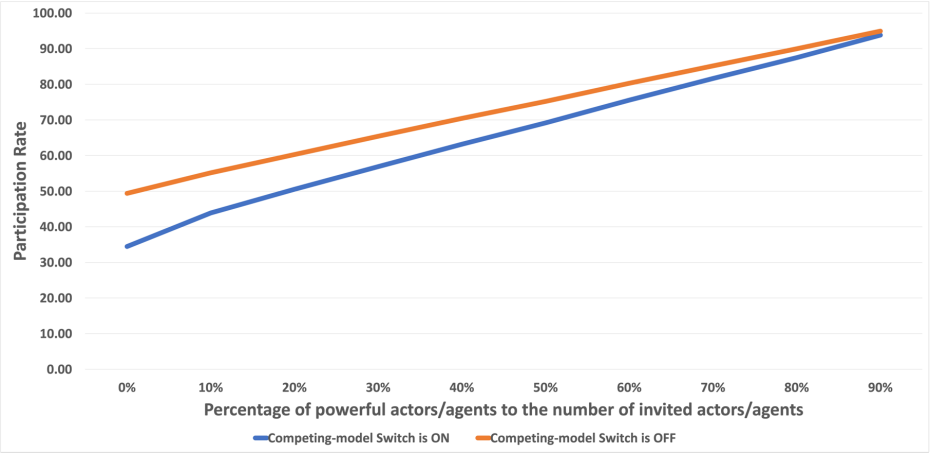
- In all simulated mobs, we set the *num-of-participants* to 10,000 while the number *num-of- powerful-actors* to be 1000 (i.e., 10% of the number of invited people), 2000 (i.e., 20%), 3000 (i.e., 30%), 4000 (i.e., 40%), 5000 (i.e., 50%), 6000 (i.e., 60%), 7000 (i.e., 70%), 8000 (i.e., 80%), and 9000 (i.e., 90%).

- This experiment is analogous to the third form mentioned by Clark Mcphail et al.
  - **Voluntarily** or **Obediently:** as they stated, "*Two or more persons might adopt the reference signals of a third party because they do not otherwise know what to do, or because they willingly do whatever their third-party peer proposes, or because they are dependent upon that third party for resources which the latter might withhold if they declined*"

An agent-based modeling approach to study mobs- Findings

- The mob organizers affect the mob outcome linearly, i.e., the more organizers (powerful actors) the higher the participation rate, hence the higher the chance of a mob being successful.

- As the number of powerful actors increases, the difference between the participation rate when the competing-model switch is set to On or Off decreases, which might be explained by the "**bandwagon effect**: *the tendency for people to adopt certain behaviors, styles, or attitudes simply because others are doing so. More specifically, it is a cognitive bias by which public opinion or behaviors can alter due to particular actions and beliefs rallying amongst the public*".



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Conclusion & Limitations

- Conclusion:
  - We simulated a total of 260 mobs using an agent-based model of the mob phenomenon built based on factors extracted from the theory of collective action.
  - The modeling is done using NetLogo, a widely used agent-based modeling tool, and the experiments were run using the BehaviorSearch component in NetLogo which can be used to simulate many mobs with different parameters value.
  - Understanding the mob phenomenon can greatly help in explaining other mob-like events that are becoming widespread globally due to the affordability of social media, ease of use, the effectiveness of individuals or groups in conducting coordinated acts, the anonymity of the internet, and various other factors.

- Limitation:
  - The findings of this model may not be generalized to real-world mobs yet because the model is not validated using ground truth data. However, this theoretically supported model should give us a good estimation.
    - We are currently collecting data that can be used to validate the model
  - This model is based on one theory, i.e., the theory of collective action, however, to better understand human behavior we would need more social, psychological, and political sciences theories.

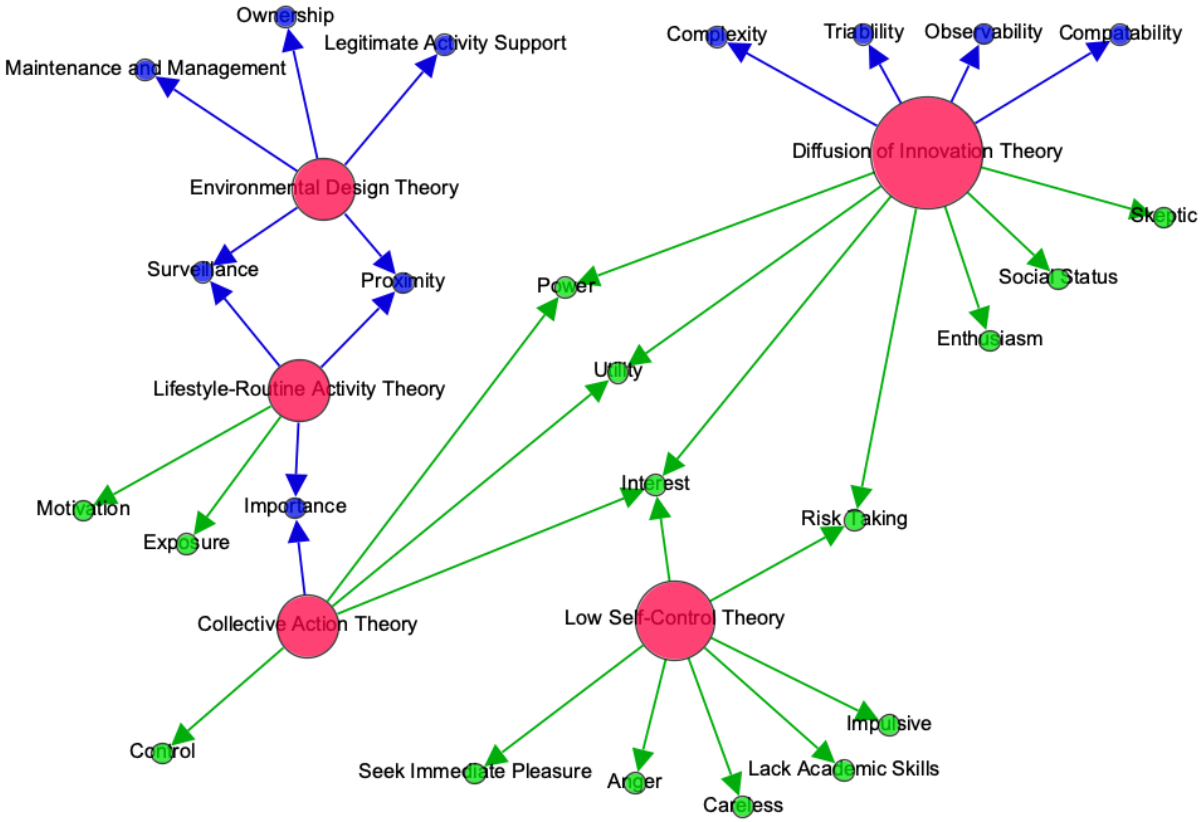
Next steps to address the limitations…

A Multi-Theoretical Frame(Net)work for Mobs Modeling

Our Multi-Theoretical Framework consist of:

- 5 theories (red nodes)
- 10 factors that are related to the mob (blue nodes)
- 15 factors that are related to the mobbers (green nodes)

These theories have some common factors (i.e., same factors mentioned by multiple theories) making our *multi-theoretical "framework"* a *multi-theoretical "network"*



Data Collection and Analysis

What is the total number of public mobs, groups, min and max groups size?

Total Public Mobs: 3,241
Total Public Groups: 28
- **Min Num of Members**: 2
- **Max Num of Members**: 9,210

Total Public Mobs that we can estimate its number of invited participants: 425
Total Groups: 15
- **Min Num of Members**: 32
- **Max Num of Members**: 9,210

What are the topics/categories of the public mobs we collected?

Mob Topic	Num Mobs with Topic
Theater	15
Creativity	15
Performing Arts	5
Fun Times	15
Social	15
Outdoors	10
Social Dancing	5
Social Networking	5
Dance and Movement	19
Make New Friends	19
Zombies	26
Flash Mobs	14
Dance Lessons	14

What is the max/min number of invited people? What is the max/min number of people who said Yes, No?

Public mobs
- Max invited: 50,000
  - Max yesCount: 680
    - Min yesCount: 0
  - Max noCount: 120
    - Min noCount: 0

Public mobs that we can estimate its number of invited participants:
- Max invited: 50,000
  - Max yesCount: 300
    - Min yesCount: 0
  - Max noCount: 101
    - Min noCount: 0

Data Collection and Analysis Cont…

Using the following assumptions:

- **NoCount** is the Withdraw
- **YesCount** is the Act
- **NumberOfInvitedPeople** = numEventOrganizers + [noMaxTickets + (noMaxTickets * allowedGuests)]
- **participationRate** = (YesCount/ NumberOfInvitedPeople)

What is the number of Cyber vs. Physical mobs?

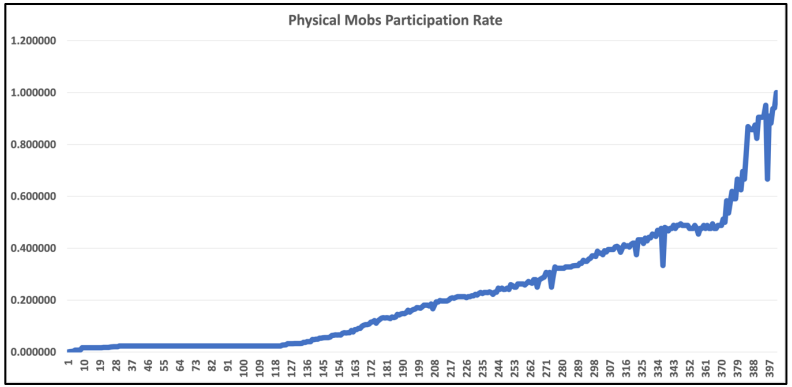
Public mobs (3,241**):**

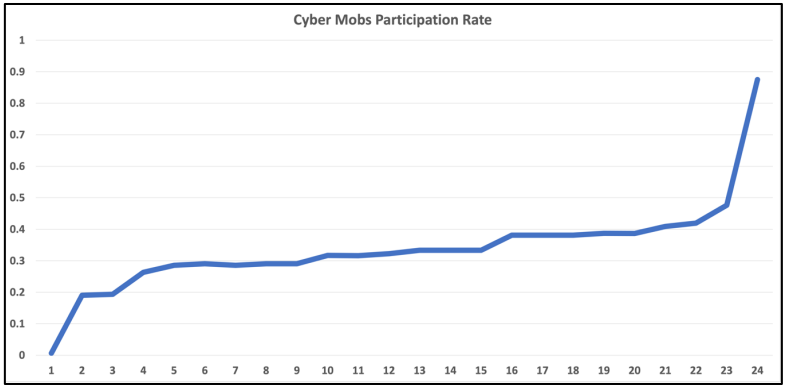
- Num of Physical Mobs: 3,190
- Num of Cyber Mobs: 51

Public mobs that we can estimate its number of invited participants (425**):**

- Num of Physical Mobs: 401 (average participation rate is 0.225256)
- Num of Cyber Mobs: 24 (average participation rate is 0.339485)

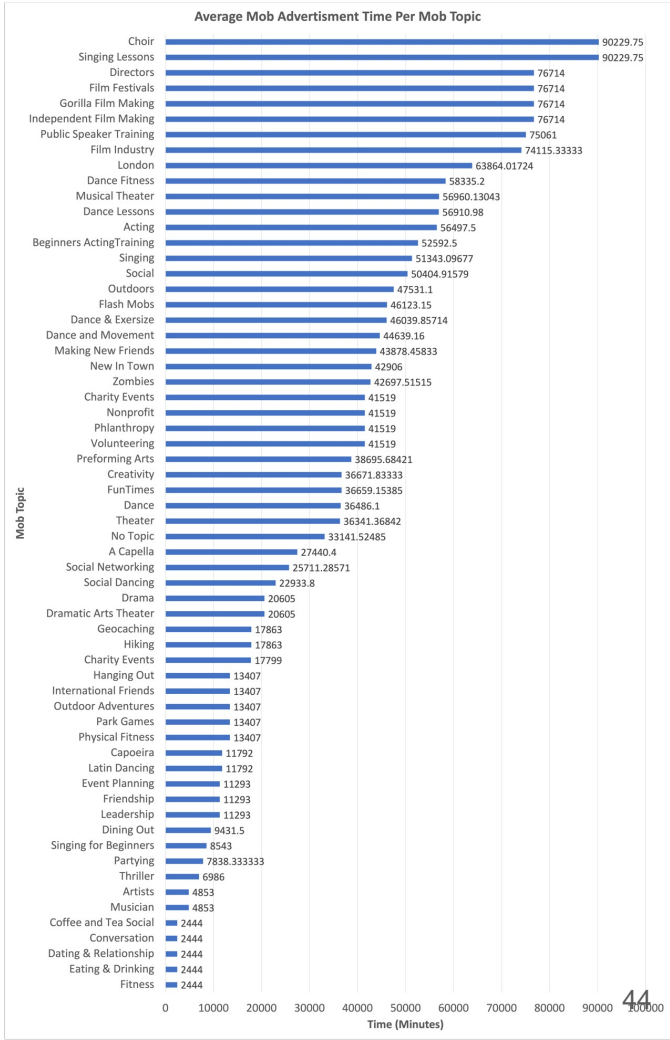
What is the participation rate for Cyber and Physical mobs?



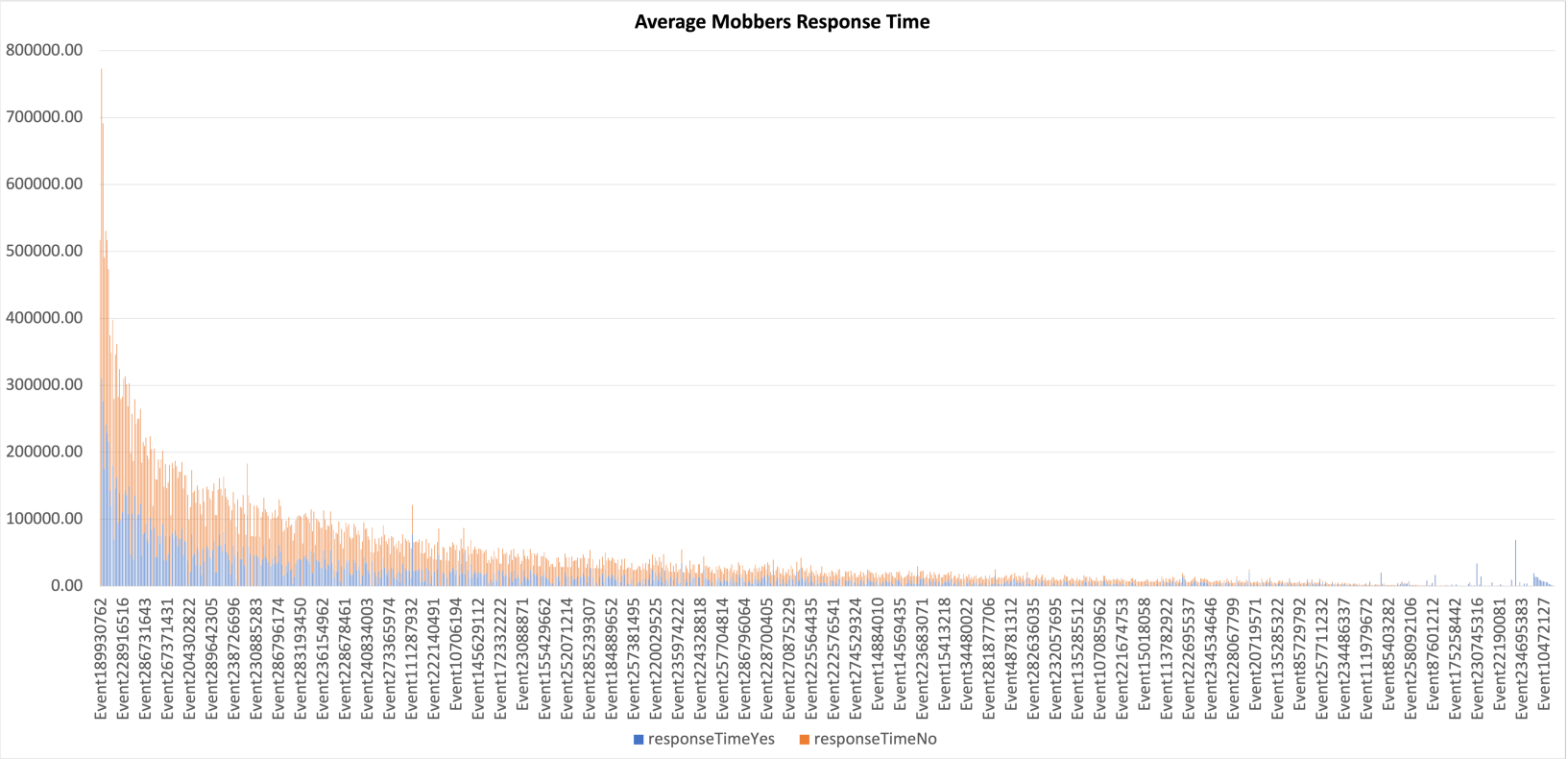


Data Collection and Analysis Cont…

- We found that the average mob advertisement time to be 33,678.42 minutes (23.35 days!)
  - The longest mob advertisement time is for the category *Choir* and *Singing Lessons* with average advertisement time of 90,299.750 minutes (62.7 days)
  - The *Flash Mobs* category is ranked as the 45th with average advertisement time of 46,123.15 minutes (32.03 days)
  - The shortest mob advertisement time is for the category *Eating & Drinking* and *Fitness* with average advertisement time of 2,444 minutes (1.7 days).



Data Collection and Analysis Cont…



On average, mobbers invited to participate in a mob take more time to say NO than to say YES

- Average Yes Time for all the mobs: 18,830.54 minutes (13.07 days)
- Average No Time for all the mobs: 30,806.84 minutes (21.39 days)

Acknowledgment

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Thank you!

Questions?

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