

# Experimental evidence of massive-scale emotional contagion through social networks

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Goal of Experiment

Problems to be solved in Experiment

Details of Experiment

Conclusions

# Experiment Goal

Study on contagion processes occur for emotions in massive social networks

- ▶ Emotional states can be transferred to others via emotional contagion, leading people to experience the same emotions without their awareness.

## Problems to be solved in Experiment

- ▶ Avoid interaction : Contagion may result from experiencing an interaction rather than exposure to a partner's emotion
- ▶ Avoid nonverbal behavior : Whether nonverbal cues are necessary for contagion to occur, or if verbal cues alone suffice
- ▶ Provide evidence : Whether contagion processes occur for emotions in massive social networks

# Groundwork

Three studies have laid groundwork for testing these processes via Facebook

1. Emotional contagion occurs via text-based computer-mediated communication<sup>1</sup>
2. Contagion of psychological qualities has been suggested based on correlational data for social networks generally<sup>1 2</sup>
3. People's emotional expression on Facebook predict friends' emotional expressions, even days later

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<sup>1</sup>Guillory J, et al. (2011) Upset now? Emotion contagion in distributed groups. Proc ACM CHI Conf on Human Factors in Computing Systems (Association for Computing Machinery, New York), pp 745–748

<sup>2</sup>Kramer ADI (2012) The spread of emotion via Facebook. Proc CHI (Association for Computing Machinery, New York), pp 767–770. 

# Experiment Settings

- ▶ Introduction of News Feed on Facebook
- ▶ Target Persons
- ▶ Experiment Content
- ▶ Experimental Data
- ▶ Hypothesis
- ▶ How to Test Hypothesis
- ▶ Experimental Result

## News Feed on Facebook

- ▶ People frequently express emotions, which are later seen by their friends via Facebook's "News Feed" product <sup>2</sup>.
- ▶ Because people's friends frequently produce much more content than one person can view, the News Feed filters posts, stories, and activities undertaken by friends.
- ▶ News feed is the primary manner by which people see content that friends share.

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<sup>2</sup>Kramer ADI (2012) The spread of emotion via Facebook. Proc CHI (Association for Computing Machinery, New York), pp767-770. 

# Target Persons

- ▶ The experiment manipulated the extent to which people ( $N = 689,003$ ) were exposed to emotional expressions in their News feed.
- ▶ People who viewed Facebook in English were qualified for selection into the experiment.

# Experiment Content

- ▶ Test whether exposure to emotions led people to change their own posting behaviors
- ▶ Especially consistent with the exposure, i.e exposure to verbal affective expression leads to similar verbal expressions, a form of emotional contagion

## Experiment Content Cont'd

- ▶ Two parallel experiments:
  - ▶ One in which exposure to friends' positive emotional content in their News Feed was reduced
  - ▶ One in which exposure to friends' negative emotional content in their News Feed was reduced
- ▶ When a person loaded their News Feed, posts that contained emotional content of the relevant emotional valence, each emotional post had between a 10% and 90% chance of being omitted from the News Feed.

## How to tell whether Positive or Negative?

- ▶ Posts were determined to be positive or negative if they contained at least one positive or negative word, as defined by Linguistic Inquiry and Word Count software(LIWC2007)<sup>3</sup>

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<sup>3</sup>Pennebaker JW, Chung CK, Ireland M, Gonzales A, Booth RJ (2007) The development and psychological properties of LIWC2007. Available at <http://liwc.net/howliwcworks.php>. Accessed May 10, 2014.

# Experiment Data

- ▶ During 1 week (January 11-18, 2012)
- ▶ Total of 155,000 participants per condition who posted at least one status update during the experimental period
- ▶ Over 3 million posts were analyzed, containing over 122 million words, 4 million of which were positive(3.6 %) and 1.8 million negative(1.6%)

# Hypothesis

- ▶ First measure, people in the positivity-reduced condition should be less positive compared with their control, and people in the negativity reduced condition should be less negative
- ▶ Secondary measure, we tested for cross-emotional contagion in which the opposite emotion should be inversely affected:
  - ▶ People in the positivity -reduced condition should express increased negativity
  - ▶ People in the negativity-reduced condition should express increased positivity

## Control Condition

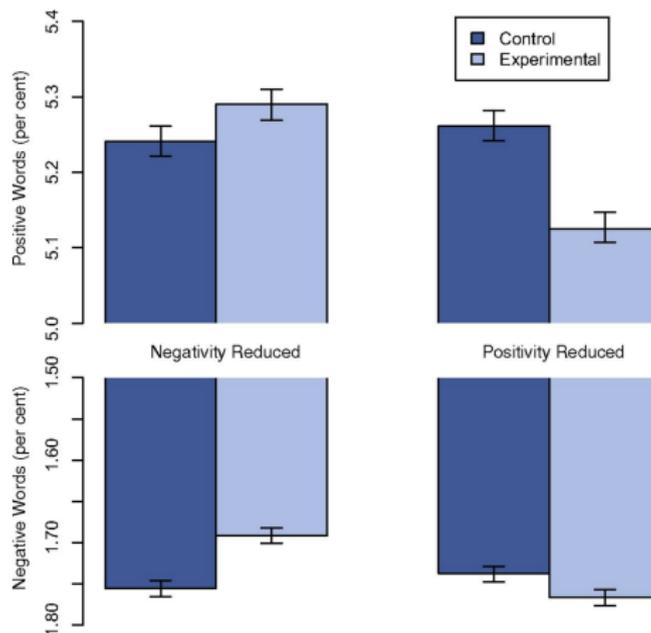
- ▶ Both experiments had a control condition, in which a similar proportion of posts in their News Feed were omitted entirely at random.
- ▶ Separate control conditions were necessary as 22.4% of posts contained negative words, whereas 46.8% of posts contained positive words
- ▶ So, for a person for whom 10% posts containing positive content were omitted, an appropriate control would withhold 10% of 46.8%(i.e 4.68%) of posts at random.

# How to Test Hypothesis

- ▶ Direct examination of frequency of positive and negative words would be inappropriate, It would be confounded with the change in overall words produced.
- ▶ Conduct weighted linear regressions predicting the percentage of words were positive or negative for condition (experimental versus control), weighted by the likelihood of that person having an emotional post omitted from their News Feed on a given viewing.
- ▶ No explicit model given in the paper, obscure description

# Experimental Result

Mean number of positive (Upper) and negative (Lower) emotion words (percent) generated people, by condition.



Adam D. I. Kramer et al. PNAS 2014;111:8788-8790



## Experimental Result cont'd

- ▶ As Figure illustrates, for people who had positive content reduced in their News Feed, a larger percentage of words in people's status updates were negative and a smaller percentage were positive.
- ▶ When negativity was reduced, the opposite pattern occurred.

## Review : Problem to be solved

- ▶ Contagion may result from experiencing an interaction rather than exposure to a partner's emotion
  - ▶ What is suitable experimental approach ?
- ▶ Whether nonverbal cues are necessary for contagion to occur, or if verbal cues alone suffice
  - ▶ How to avoid nonverbal cues?
- ▶ Whether contagion processes occur for emotions in massive social networks
  - ▶ Provide evidence

## Problem && Conclusion

- ▶ Contagion may result from experiencing an interaction rather than exposure to a partner's emotion
- ▶ News Feed content is not "directed" toward anyone, contagion could not be just the result of some specific interaction with a happy or sad partner. Failing to "overhear" a friend's emotional expression via Facebook is enough to buffer one from its effects.

## Problem && Conclusion

- ▶ Whether nonverbal cues are necessary for contagion to occur, or if verbal cues alone suffice
- ▶ These data suggest that contagion does not require nonverbal behavior: Textual content alone appears to be a sufficient channel.

## Problem && Conclusion

- ▶ Whether contagion processes occur for emotions in massive social networks
- ▶ Previous figure shows that the emotions expressed by friends, via online social networks, influence our own moods, constituting, to our knowledge, provides evidence for massive-scale emotional contagion via networks, so emotions do spread via contagion through a network.

## Additional Conclusion: Withdraw Effect

Withdraw effect: people who were exposed to fewer emotional posts in their News Feed were less expressive overall on the following days.

# Significance

They show, via a massive ( $N = 689,003$ ) experiment on Facebook, that emotional states can be transferred to others via emotional contagion, leading people to experience the same emotions without their awareness.

# Ethical issues about Experiment

## Privacy Claim by Author

1. Omitted content in News Feed, this part was always available by viewing a friends' content directly by going to that friends' "timeline".
2. LIWC was adapted to run on the Hadoop Map/Reduce system and in the News Feed filtering system, such that no text was seen by researchers.
3. Consistent with Facebook's Data Use Policy, to which all users agree prior to creating an account on Facebook, constituting informed consent for this research.

Actually, I don't know I agree with this experiment.....  
Most of conditions, I will not really read the several pages of agreement, and just click "I accept".....

# Good News

I did not post anything during 1.11 - 18, 2012.....

## Concern from Comments

The publication of this paper raises serious ethical issues regarding informed consent, the function of Internal Review Boards, and editorial oversight/judgement.

— Shilla Nassi, MD, PhD

I am writing to express ethical concerns not only about the research by Kramer, Guillory, and Hancock, but about the “Editorial Expression of Concern” that PNAS published some days after the article appeared. . . .

—Charles D. Claiborn

## Editorial Expression of Concern and Correction

It is nevertheless a matter of concern that the collection of the data by Facebook may have involved practices that were not fully consistent with the principles of obtaining informed consent and allowing participants to opt out.

Based on the information provided by the authors, it followed rules, PNAS editors deemed it appropriate to publish the paper.