Emotional Contagion with Virtual Characters

(Extended Abstract)

Jason Tsai[1], Emma Bowring[2], Stacy Marsella[3], Milind Tambe[1]

[1]University of Southern California, Los Angeles, CA 90089
{jasontts, tambe} @usc.edu
[2]University of the Pacific, Stockton, CA 95211
ebowring@pacific.edu
[3]USC Institute for Creative Technologies, Playa Vista, CA 90094
marsella@ict.usc.edu

ABSTRACT

In social psychology, emotional contagion describes the widely observed phenomenon of one person's emotions mimicking surrounding people's emotions [8]. While it has been observed in human-human interactions, no known studies have examined its existence in agent-human interactions. As virtual characters make their way into high-risk, high-impact applications such as psychotherapy and military training with increasing frequency, the emotional impact of the agents' expressions must be accurately understood to avoid undesirable repercussions.

Categories and Subject Descriptors

I.2.11 [**Artificial Intelligence**]: Distributed Artificial Intelligence–*Intelligent agents*

General Terms

Human Factors

Keywords

Virtual Agents, Emotional Contagion, Social Influence

1. INTRODUCTION

Emotional contagion is defined as the tendency to catch the emotions of other people [8]. While initial work focused on documenting its existence, recent research has moved to understanding its impacts on everyday life. In the workplace, researchers have examined its influence on promoting employee efficiency and client happiness [12]. Research in administrative sciences has shown emotional contagion to improve cooperation, decrease conflict, and increase perceived task performance in groups and organizations [1]. Small et al. have shown substantial impacts on charitable donation amounts with only a still image [15]. Though its effects are often felt, in-depth understanding of emotional contagion remains an open area of research.

A variety of hypotheses regarding factors that influence emotional contagion have been explored in social psychology. A popular one examines differences in the strength of emotional contagion felt by men and women, with many researchers finding that women are significantly more responsive to emotional contagion than men [4, 16]. Researchers have also found that contagion increases in cases where the subject shares the same ethnicity as the stimulus [4] and when the expression is stronger [18]. Finally, attraction to the stimulus has been shown to have a positive effect on the contagion experienced by subjects [16].

The vast majority of emotional contagion research, however, has come from the social sciences and examines the spread of emotions from humans to other humans. Emotional contagion's impact in virtual agents' interactions with humans, however, is a largely untouched area of research. Specifically, while many researchers have worked to understand immersion, rapport, and influence in other contexts [7, 9], far fewer have looked into the emotional impact that the mere presence of virtual character emotions can have on people. The effects are assumed to either be nonexistent and therefore overlooked entirely or to mimic human-human emotional influences. However, as this work demonstrates, these are both poor assumptions to make and can be harmful to users in sensitive domains. As virtual agents enter high-risk and emotionally delicate applications such as virtual psychotherapy [13, 14], for example, researchers must be cognizant of all potential emotional influences characters can have on users.

Attempting to confirm the aforementioned social psychology findings in agent-human emotional contagion forms the basis of this work. Pursuant of this goal, three sets of studies are conducted. The first study examines the pure contagion case by simply showing subjects a still image of a virtual character with either a happy expression or a neutral expression and then assessing the subject's mood thereafter. The use of a still image as a manipulation follows from previous studies in emotional contagion [15, 18].

The second study adds the presentation of a game-theoretic situation known as a Stag Hunt along with the character image to assess both the contagion the behavioral impact of the virtual character in a strategic setting. While studies have shown that emotional contagion can impact one's propensity to trust and enhance perceived cooperation among other findings [1, 5], there has been far less work showing behavioral impacts in strategic situations. Although people may report themselves to be more trusting, for example, this may not result in any meaningful impact on behavior in a strategic situation. Thus, we also attempt to examine whether behavioral impacts arise in strategic situations from agent-human contagion to better understand its potential impacts in real-world agent applications. Finally, the third study examines the post-hoc hypothesis

Appears in: *Proceedings of the 11th International Conference on Autonomous Agents and Multiagent Systems (AAMAS 2012)*, Conitzer, Winikoff, Padgham, and van der Hoek (eds.), 4-8 June 2012, Valencia, Spain.
Copyright © 2012, International Foundation for Autonomous Agents and Multiagent Systems (www.ifaamas.org). All rights reserved.

that the presentation of a decision to the user dampens the emotional contagion effect. Specifically, we present the same strategic situation as in the second study, but with the decision already made for the subject. These studies present the first attempt to assess emotional contagion from virtual characters to human users.

2. BACKGROUND & RELATED WORK

Emotional contagion research in the agents literature falls primarily into three categories: models of emotional contagion, creating rapport between virtual agents and humans, and the impact of agent mood expressions on behavior. Models of emotional contagion have been explored in a computational context that focus on crowd or society simulation. For example, [2, 6, 11] each present alternative models of emotional contagion in agent crowds, while [17] proposes a comparison technique to evaluate such models. This body of work is an attempt to mimic human-human contagion and not an exploration of agent-human contagion which we seek to understand here.

There also exists a large body of work on the interaction between virtual agents and humans [3, 7]. The entire area of virtual rapport, for example, focuses on user opinions of the virtual agents and their interaction. The primary goal is to create agents that users enjoy, appreciate, and relate to. Recent work has looked at the impact of agent expressions in a strategic negotiation setting [3] as well. However, their work focuses on the behavioral impact of varying the intent of agent expressions on user behavior without examining the emotional impact or the mechanism by which the change is induced. Neither of these works explicitly examine the impact of virtual character expressions on the emotions of subjects.

In the social sciences, the literature on emotional contagion is far more expansive. Hatfield et al. [8] popularized the area by compiling a plethora of situations in which the phenomenon had been observed in their work as well as the work of other researchers. Follow-up research by the co-authors as well as researchers in related fields such as managerial and occupational sciences [1, 12, 15] continued to detail the effects of the phenomenon in new domains. Recently, there have been works beginning to quantify emotional contagion and explore cross-cultural variations in attributes that affect emotional contagion [10].

In light of the extensive evidence of emotional contagion's effects in human-human interactions, our work extends the understanding of this phenomenon into the realm of agent-human interactions. While some studies have been conducted with live people as the stimulus, a large body of social psychological studies of emotional contagion features an image or video of only a person's face as the origin of the contagion [15, 18]. With the rapid improvements in virtual agent facial displays, and the accepted assumption that the facial display of emotion plays a key role in emotional contagion, we would expect to see a contagion of emotions from an image of a virtual agent's face to humans. The intricacies of this contagion and its differences with human-human contagion are the subject of this work.

3. ACKNOWLEDGEMENT

This research is supported by the United States Department of Homeland Security through Center for Risk and Economic Analysis of Terrorism Events (CREATE). This research was sponsored in part by the U.S. Army Research, Development, and Engineering Command (RDECOM) Simulation Training and Technology Center (STTC). The content or information presented does not necessarily reflect the position or the policy of the Government, and no official endorsement should be inferred.

4. REFERENCES

[1] S. G. Barsade. The Ripple Effect: Emotional Contagion and Its Influence on Group Behavior. *Administrative Science Quarterly*, 47:644–675, 2002.

[2] T. Bosse, R. Duell, Z. A. Memon, J. Treur, and C. N. V. D. Wal. A Multi-Agent Model for Emotion Contagion Spirals Integrated within a Supporting Ambient Agent Model. In *PRIMA-09*, 2009.

[3] C. de Melo, P. Carnevale, and J. Gratch. The Effect of Expression of Anger and Happiness in Computer Agents on Negotiations with Humans. In *AAMAS-11*, 2011.

[4] W. Doherty, L. Orimoto, T. M. Singelis, E. Hatfield, and J. Hebb. Emotional Contagion: Gender and Occupational Differences. *Psychology of Women Quarterly*, 19(3):355–371, 1995.

[5] J. R. Dunn and M. E. Schweitzer. Feeling and Believing: The Influence of Emotion on Trust. *Psychology of Personality and Social Psychology*, 88(5):736–748, 2005.

[6] F. Durupinar. *From Audiences to Mobs: Crowd Simulation with Psychological Factors*. PhD thesis, Bilkent University, 2010.

[7] J. Gratch, A. Okhmatovskaia, F. Lamothe, S. Marsella, M. Morales, R. J. van der Werf, and L.-P. Morency. Virtual Rapport. In *IVA-06*, 2006.

[8] E. Hatfield, J. T. Cacioppo, and R. L. Rapson. *Emotional Contagion*. Cambridge University Press, 1994.

[9] P. Kulms, N. C. Krämer, J. Gratch, and S.-H. Kang. It's in Their Eyes: A Study on Female and Male Virtual Humans' Gaze. In *IVA-11*, 2011.

[10] L.-O. Lundqvist. Factor Structure of the Greek Version of the Emotional Contagion Scale and its Measurement Invariance Across Gender and Cultural Groups. *Journal of Individual Differences*, 29(3):121–129, 2008.

[11] G. Pereira, J. Dimas, R. Prada, P. A. Santos, and A. Paiva. A Generic Emotional Contagion Computational Model. In *ACII-11*, 2011.

[12] S. D. Pugh. Service with a smile: Emotional contagion in the service encounter. *Academy of Management Journal*, 44(5):1018–1027, 2001.

[13] A. Rizzo, J. Pair, P. J. McNerney, E. Eastlund, B. Manson, J. Gratch, R. W. Hill, and W. Swartout. *Development of a VR Therapy Application for Iraq War Military Personnel with PTSD*, volume 111 of *Medicine Meets Virtual Reality*, pages 407–413. IOS Press, 13th Annual Medicine Meets Virtual Reality Conference, Long Beach, CA, 2005.

[14] B. O. Rothbaum, L. F. Hodges, D. Ready, K. Graap, and R. D. Alarcon. Virtual reality exposure therapy for vietnam veterans with posttraumatic stress disorder. *Journal of Clinical Psychiatry*, 63(8):617–622, August 2001.

[15] D. A. Small and N. M. Verrochi. The Face of Need: Facial Emotion Expression on Charity Advertisements. *Journal of Marketing Research*, 46(6):777–787, December 2009.

[16] N. Stockert. *Perceived Similarity and Emotional Contagion*. PhD dissertation, University of Hawaii at Manoa, Dept. of Psychology, 1994.

[17] J. Tsai, E. Bowring, S. Marsella, and M. Tambe. Empirical Evaluation of Computational Emotional Contagion models. In *IVA-11*, 2011.

[18] B. Wild, M. Erb, and M. Bartels. Are emotions contagious? evoked emotions while viewing emotionally expressive faces: quality, quantity, time course and gender differences. *Psychiatry Research*, 102(2):109–124, 2001.