Emotional Contagion and its Relationship to Transient Affect

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ABSTRACT

Emotional contagion has been defined as "the tendency to automatically mimic and synchronize expressions, vocalizations, postures, and movements with those of another person's and, consequently, to converge emotionally" (Hatfield, Cacioppo, & Rapson, 1994, p. 5). This study explores the influence of short-term mood on emotional contagion. Specifically, we propose that people's susceptibility to emotional contagion will be affected by their short-term (primed) mood. Two competing theoretical traditions will be compared to investigate just *how* transient mood affects contagion.

Keywords: Emotional contagion, transient affect, mood, happiness

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Emotional contagion

This study uses the definition proposed by Hatfield, Cacioppo and Rapson for *primitive emotional contagion*, i.e. "the tendency to automatically mimic and synchronize facial expressions, vocalizations, postures, and movements with those of another person and, consequently, to converge emotionally" (1994, p. 5). This primitive emotional contagion is in contrast to the more complex process proposed by social philosopher Adam Smith, who described emotional contagion as a highly cognitive, imaginative, and analytical process (1759/1976). As emotional packages can be comprised of various components, e.g., facial expressions, behaviors, and psychophysiological reactions (Fischer, Shaver, & Carnochan, 1990), the process of emotional contagion has been theorized as a multi-level and multiply determined phenomenon (Hatfield, Cacioppo, & Rapson, 1993).

Emotional contagion has been cited to explain the facial expressions, vocalizations, postures, and behaviors of children with autism (Decety & Jackson, 2004); music lovers (Davies, 2011); religious fanatics, terrorists, and suicide bombers (Hatfield & Rapson, 2004); sports teams (Totterdell, 2000); people in crowds (Adamatzky, 2005) and in the workplace (Barsade, 2002), to name a few. While researchers have documented the occurrence of emotional contagion in such diverse circumstances, questions remain about what kinds of people in what kinds of relationships are most susceptible (or resistant) to emotional contagion, and under what conditions.

Hatfield, Cacioppo, and Rapson (1994) identify several features that make a person relatively susceptible (or resistant) to catching another's emotion: identity construal, awareness and reactivity, ability at reading emotions, propensity to mimicking, and attention. For example,

work by cross-cultural scholars suggests that individuals who define their *identity* as interdependent may be more disposed to catching the emotions of others than are those who define themselves as being very independent and self-reliant (Markus & Kitayama, 1991), although individual differences occur within a culture on the extent to which an individual may identify with being interdependent or independent. In this study, participants were recruited primarily from the same environment, i.e., from the University of Hawaii (UH), so differences in identity construal were not investigated in the present work. Although UH students tend to be very diverse in ethnic background, conducting a methodologically sound cross-cultural study (see Heine & Norenzayan, 2006; Matsumoto & Yoo, 2006; G. T. Smith, Spillane, & Annus, 2006) was outside the bounds of this investigation.

Additionally, individual differences have been found to exist in the ability to read the emotions of another person, which may then lead to differences in susceptibility to acquire such emotion. Haviland and Malatesta (1981) found gender differences in the ability and disposition to read the overall emotional cues of others, finding that women were better at reading emotion than were men. Other researchers have discussed the gender differences that may exist in the ability to read and thereby catch the emotions of others (Carlson & Hatfield, 1992; LaFrance & Banaji, 1992; Shields, 1987). In a meta-analysis, Hall (1984) summarizes these gender differences, suggesting that while men and women *feel* the same emotions, women may be better at reading the emotional displays of themselves and others. Wild, Erb, and Bartels (2001) tested the hypotheses by Hatfield et al. (1994) and found that women were more susceptible to emotional contagion than men, but only weakly so. The influence of gender was tested to further investigate gender differences in susceptibility to emotional contagion.

Attention

In considering what kinds of people are most (and least) likely to catch the emotions of another, it would seem likely that an individual would be more likely to pick up another's emotion if he/she was, quite simply, paying attention to that other person. Freud recognized that we often repress information we do not want to be aware of, and there may be significant differences in individual's disposition to pay attention to the feelings, thoughts, and behaviors of others. Some, the *Repressors*, pay little attention to other people, while *Sensitizers* are highly sensitive to what other people are doing, saying, thinking, and feeling; by paying attention to other people, sensitizers are thereby more likely to catch their emotions (Hatfield, et al., 1994).

The distinction between repressors and sensitizers is marked by their disposition to pay attention—a disposition impacted by mood, which is the central focus of this work. Ambady and Gray (2002) discuss how mood can have both informational and processing effects on attention. Affect can bias the information that is perceived by the subject; this type of effect is often associated with mood congruency, the tendency for bias in the direction of the prevailing affective state. It can also impact how information is processed, by altering the information-processing strategies used by the subject. Research on the informational and processing effects of transient and enduring affect will be briefly reviewed as they relate to two competing frameworks—the Addition and Interaction Theories.

The Addition Theory

Considering the informational effects of mood, affect has been found to exert strong effects on social information by priming mood-congruent material. For example, both children (Terwot, Kremer, & Stegge, 1991) and adults (Bouhuys, Bloem, & Groothuis, 1995; David, 1989) have been found to exhibit mood-congruent distortions in their perception of emotional displays after being exposed to a mood induction procedure. Affective states have also been

found to congruently bias global evaluations of other people, i.e., happy people tend to evaluate others more positively, while those in a negative mood make more negative judgments of other people (Forgas & Bower, 1987; Schiffenbauer, 1974). Accounts for this mood congruency range from models where mood *indirectly* affects informational accessibility (Isen & Daubman, 1984) and memory (Bower, 1981), to the more direct, mood-as-information model, where affect is a direct informational cue that judges rely on when making social decisions (Schwarz, 1990; Schwarz & Clore, 1983).

Taking this cognitive theory and applying it to emotional contagion, one might predict that if participants are in a positive frame of mind, or in a happy mood, they should be especially likely to catch happy emotions and especially resistant to catching sad ones (Isen, 1987; Isen, Clark, & Schwartz, 1976). If participants are in a neutral mood, they should be slightly more likely to catch happy emotions than sad ones. If they are already in a negative frame of mind or in a sad mood, they should be more likely to catch sad emotions and especially resistant to catching happy ones. In brief, *participants will be most likely to catch emotions that are congruent with their current mood state.* Because this theory suggests that background mood and the mood of the target person(s) sum in the contagion process, it will be referred to as the addition theory.

The Interaction Theory

The interaction theory posits that mood may exert distorted or asymmetrical effects on social judgment. Some cognitive psychologists argue that happy people are more attentive to incoming stimuli, better able to process it, and show better recall than do less happy people (Isen, 1987). In a study on how mood affects the way we learn about, judge, and remember characteristics of other people, Forgas and Bower (1987) found that positive mood had a more

pronounced effect on judgments and memory than did negative mood. Isen and colleagues found that induced positive affect significantly improved creative ingenuity over conditions of induced negative affect and a control group of affectless arousal (Isen, Daubman, & Nowicki, 1987); beyond impacting cognitive performance, the effect of good mood was also found to translate into higher levels of altruistic behavior (Isen, et al., 1976).

The interaction theory also draws upon the broaden-and-build theory of positive emotions, which suggests that positive affect may have an evolutionary function to open us up to new opportunities. When infused with positive emotions like love and joy, we are more trusting and open, able to cognitively "broaden" our perspective and from this open state, "build" more intellectual, physical, social, and psychological resources that will serve us in the future, such as social bonds like romantic partners and friends (Fredrickson, 2004). While negative emotions dispose us to specific action tendencies and close our field of vision (and that is necessary when we are fleeing an attacker, or when we need to be angry and take action in the face of some transgression), Fredrickson argues that positive emotions may also have an evolutionary purpose, i.e., to increase our cognitive awareness to new opportunities, resulting in an upward spiral of growth. Work on the broaden-and-build effect of positive emotion has shown that higher ratios of positive to negative emotion are associated with improved performance in business teams (Fredrickson & Losada, 2005) and increased satisfaction and longevity in romantic dyads (Gottman & Krokoff, 1989; Gottman & Levenson, 2000).

In line with this reasoning, it seems reasonable to predict that the happier people are, the more attentive and responsive to others' moods they will be, whether the target person is displaying happy or sad emotions. In sum, *the happier participants are, the more likely they will be to catch others' emotions—regardless of the type of emotion the target is expressing.* Because

this theory predicts that the participants' mood will interact with the target's emotions in determining the outcome of the contagion process, it will be referred to as the interaction theory.

In the present work, I test the relationship between transient mood and the emotional contagion of both happiness and sadness. The overall hypothesis for the present work is stated as follows: *Transient affect, i.e., a happy or sad mood state, will affect susceptibility to catching either positive or negative emotions*. We will explore which of the two theories—the addition theory, which states that participants will be most likely to catch emotions that are congruent with current affect, or the interaction theory, which states that the happier participants are, the more likely they will be to catch others' emotions—is the best fit for the data.

Method

Participants

The participant population consisted primarily of undergraduate students from the University of Hawai'i at Mānoa (UH) who were recruited from courses in the social sciences. These students also recruited their family and friends, for a total of 182 participants (37% male, 63% female) whose ages ranged from 18 to 72 years (M = 23 years). As participants were mainly recruited from UH, the sample was representative of the demography of the university in categories such as education level and race/ethnicity (21.4% Caucasian; 20.3% Japanese; 14.8% Filipino; less than 10% African, American Indian, Chinese, Hawaiian, Hispanic, Korean, Middle Eastern, Pacific Islander, Indian/South Asian, Other Asian, and Other/Choose Not to Disclose).

Participants signed up on an electronic spreadsheet, which randomly assigned them to one of six conditions by combination of mood manipulation (positive, neutral, or negative mood induction procedure) and stimuli, which was designed to induce positive or negative emotion. Following the experiment, participants were fully debriefed as to the full purpose of the study—

to see whether people tend to catch other people's emotions and if so, what impact a person's transient mood has on his or her susceptibility to such contagion.

Debriefing included the disclosure that their facial expressions to the video clips of positive and negative emotional displays were recorded to investigate whether outside ratings of their emotion would correspond to their own self-report, thus giving a more complete assessment of the participant's emotional state. Upon debriefing, participants were given the opportunity to delete the recording, an option no participant selected.

Participants were only allowed to participate if they were at least 18 years old. Students enrolled in certain courses at UH received extra-credit for their participation, however no other compensation was offered to participants in the study.

Measures

Two surveys (pre and post-experiment) were administered to the sample population via SurveyMonkey.com, an online survey and questionnaire tool of increasing popularity (Evans et al., 2009). All surveys were administered by Research Assistants (RAs) in the Hatfield Lab and were comprised of pre-tested measures with demonstrated validity and reliability. The measures included in both the pre- and post-experiment surveys are listed below and then described in further detail.

Pre-experiment:

- Demographic information

Post-experiment:

- Positive and Negative Affect Schedule, PANAS (Watson, Clark, & Tellegen, 1988)
- Joviality and Sadness scales from the Positive and Negative Affect Schedule – Extended Form, PANAS-X (Watson & Clark, 1999)

Positive and Negative Affect Schedule (PANAS). In the Positive and Negative Affect Schedule (PANAS), respondents are presented with words describing positive moods (e.g.,

excited) and negative moods (e.g., hostile), and asked to rate each according to the extent to which it describes them. As noted by Shiota and colleagues (2006), critics of the PANAS contend that several of the items on the tool are not actually emotions (e.g., determined, alert), and that several important positive emotions for wellbeing are absent from the scale (e.g., love, contentment, amusement).

A widely used scale across psychological and physical activity research, the PANAS thus consists of two 10-item mood scales for Positive Affect (PA) and Negative Affect (NA) that are shown to be highly internally consistent (0.86 – 0.90), largely uncorrelated, and stable at appropriate levels over a two-month time period (Watson, et al., 1988). The PANAS allows for temporal variations in the assessment; researchers may choose whether to ask for a rating "right now," "over the past few days," or simply "in general." In this study, participants were asked to indicate to what extent they felt the mood in question "right now, at this present moment."

Responses to the 20 items were measured using a seven-point response scale ranging from 0 (not at all) to 6 (extremely much). Ratings were then summed separately across the two scales, allowing positive affectivity to be calculated independent of negative affectivity, e.g., people can be high in both positive affect and negative affect. Scores on both scales could range from 10 to 50, with low scores indicating low positive or negative affect and high scores indicating high PA or NA (PA, $\alpha = .92$; NA, $\alpha = .75$).

Joviality and Sadness Scales from the Positive and Negative Affect Schedule—Extended Form (PANAS-X). Positive affect and negative affect have reliably emerged as the dominant dimensions of emotional experience across diverse descriptor sets, time frames, response formats, languages, and cultures (see Almagor & Ben-Porath, 1989; Mayer & Gaschke, 1988; Meyer & Shack, 1989; Watson, et al., 1988; Watson & Tellegen, 1999). Nevertheless, although

PA and NA account for most of the variance in self-rated affect, Watson and Clark (1999) found that specific emotional states can also be identified within these overarching dimensions. They proposed a hierarchical taxonomic scheme in which PA and NA describe the valence of 11 correlated, yet ultimately distinguishable affective states: Fear, Sadness, Guilt, Hostility, Shyness, Fatigue, Surprise, Joviality, Self-Assurance, Attentiveness, and Serenity.

In this study, the Joviality (Happiness) and Sadness scales were clearly the most relevant to the research questions and hypotheses. These two scales were selected to supplement the original 20 items from the PANAS on the post-experiment survey. The original Joviality scale from the PANAS-X includes eight items (happy, cheerful, joyful, excited, enthusiastic, lively, energetic, delighted), of which the latter three had the weakest varimax-rotated factor loadings, with lively and energetic loading onto separate factors as well (Watson & Clark, 1999). Thus, the three weakest performing items were excluded to form a five-item measure commensurate with the five-item Sadness scale. Scores on the Joviality and Sadness scales could range from 5 to 25, with low scores indicating low happiness/sadness, and high scores indicating high happiness/sadness (Joviality, $\alpha = .93$; Sadness, $\alpha = .83$).

Mood Induction

After completing the pre-experiment survey (demographic information only), participants engaged in a task designed to induce temporary affect. Imagery tasks were used as Mood Induction Procedures (MIPs), a form of affect induction common in studies involving laboratory mood manipulations (e.g., Delp & Sackeim, 1987; Larsen & Sinnett, 1991; Salovey & Birnbaum, 1989). This MIP has also been referred to as the autobiographical recollections method (Goodwin & Williams, 1982) or as self-generated imagery (Singer & Salovey, 1988).

Choosing a MIP can be a difficult task, as the literature on the effectiveness of MIPs is varied and conflicted (Coan & Allen, 2007; Philippot, 1993). One of the most common procedures, the Velten technique (1968), instructs the participant to read 60 self-referential statements that begin neutrally and become progressively more elated or depressed in content, depending on the particular induction. The technique has spawned several modifications (see Larsen & Sinnett, 1991; Pignatiello, Camp, & Rasar, 1986; Sinclair, Mark, Enzle, Borkovec, & Cumbleton, 1994) and continues to receive support (Finegan & Seligman, 1995) despite criticism for inducing demand characteristics (Buchwald, Strack, & Coyne, 1981; Polivy & Doyle, 1980). The Velten technique was considered for this study but eschewed for considerations of time (the procedure takes around 20 minutes) and efficacy.

Other MIPs considered include written procedures (Baker & Gutterfreund, 1993), listening to music (Pignatiello, et al., 1986; Västfjäll, 2001), and watching film clips[1] (Hewig et al., 2005). The imagery task was eventually selected after a review of several meta-analyses of MIP effectiveness and validity (see Gerrards‐Hesse, Spies, & Hesse, 1994; Larsen & Sinnett, 1991; Westermann, Spies, Stahl, & Hesse, 1996), which suggested that the imagery task would most efficiently induce stable and reasonably intense moods for the purpose of this study.

Using a between-subjects design, participants were manipulated into one of three affect conditions: positive, neutral, or negative. Three videos were created and put on YouTube to allow the video to be embedded within the online survey, along with the target video of either positive or negative emotion (see the following section on Stimuli). The MIP videos involved written directions that were shown on the screen while they were also read out loud by an actor

[1] The film clip MIP is evidently similar to the experimental design of the study, i.e., to have participants watch a clip of either positive or negative emotion. It may be that the film clip MIP works precisely through the process of emotional contagion, as the viewer "catches" the emotion of the target.

chosen for having a neutral and professional voice. Mood-congruent music was played in the background of each video to further enhance the affect induction (Pignatiello, et al., 1986; Västfjäll, 2001). The total length of each mood-induction video was approximately three minutes.

Each condition involved having participants read (and listen to) two written scenarios designed to induce the intended affect. Participants were asked to create a vivid image of themselves in each situation described by the scenarios. Before being guided through the affective scenarios, participants were told that they might be asked to recall parts of the scenarios later and that their memory would be improved if they could actually "get into the feeling" of each scene as they read and imagined it. Specifically, participants were instructed to do the following:

> Imagine the situation as vividly as you can. Picture the event happening to you. Try to imagine all the details of the situation. Picture in your "mind's eye" the surroundings as clearly as possible. See the people or objects; hear the sounds; experience the event happening to you. Think the thoughts you would actually think in this situation. Feel the same feelings you would feel in this situation. Let yourself react as if you were actually there.

After this preparation, the participant was guided through a pair of scenarios of the same hedonic tone depending on the experimental condition, with one minute following each statement in which he/she was asked to "Please concentrate on this scene, relax, close your eyes, and imagine being in that situation until you hear my voice again." The scenarios used in each condition are as follows:

1. Positive

   a. You have won $50,000 in a lottery and you are now taking a vacation to your dream destination.
   b. Now imagine that you are feeling relaxed and healthy as you take a walk on a beautiful day. You find a $5 bill on the ground.

2. Neutral
   a. You go to the supermarket.
   b. You go on a walk.

3. Negative
   a. A close friend of yours gets into a car accident. You go to the hospital and find out that he/she has just died an hour ago and you did not get the chance to say goodbye.
   b. You are going through a breakup with a significant other that you have been with for a while and you hear a sad song on the radio that reminds you of him/her.

Manipulation check. Following the MIP, participants were asked if they experienced any emotions, memories, or physical sensations. If emotions were reported, their intensity was rated on a 0 to 8 scale, with 8 equivalent to the strongest experience of that emotion in the participant's entire life. Participants were also asked to rate the difficulty of engaging or "getting into" the MIP using a 0 to 8 scale. This manipulation check was used successfully in a study by Levenson, Carstensen, Friesen and Ekman (1991) to assess the efficacy of a relived emotion task.

Stimuli

Stimuli consisted of two videos, or targets, commensurate with the two groups of experimental conditions—whether the participant was exposed to a Happy or Sad emotion. The clip of positive emotion (Happy Target) showed the response to David Freese's homerun to win Game 6 of the 2011 Major League Baseball World Series, i.e., the ensuing celebration by the Saint Louis Cardinals and their fans—their joyous faces, expressions of exultation and delight, and joyous postures. The clip of negative emotion (Sad Target) focused on the sad and disappointed reactions by the Texas Rangers and their fans; e.g., mournful faces, agonized moans, and hunched postures.[2] Both clips were approximately two minutes long.

Design

Participants were randomly assigned to one of six conditions through the interaction of three MIPs and two stimuli. Participants were first manipulated into one of three moods using a guided imagery task previously demonstrated to effectively induce a happy, neutral, or negative mood (Larsen & Ketelaar, 1991). They were later asked to watch a video clip of a target displaying either positive or negative emotion. The resultant MIP/stimuli combinations were as follows: 1) Positive MIP / Happy Target; 2) Neutral MIP / Happy Target; 3) Negative MIP / Happy Target; 4) Positive MIP / Sad Target; 5) Neutral MIP / Sad Target; and 6) Negative MIP / Sad Target. Both MIP condition and Target condition are between-subjects factors.

The outcome was measured in the following ways: 1) Self-report by the PANAS, which yields a score of Positive Affect (PA) and Negative Affect (NA), on the post-experiment survey; 2) Self-report by the Joviality and Sadness scales from the extended PANAS-X, on the post-experiment survey; and 3) Two raters trained using either the Micro Expression Training Tool

[2] To control for gender differences in reaction to the sports videos, gender will also be tested in the model as a covariate. The issue of gender-specific reaction to emotional stimuli is a different problem beyond the scope of this study.

(METT) or the Subtle Expression Training Tool (SETT)[3] evaluated two snapshots of the participant's facial expressions using an abridged version of the Joviality and Sadness scales of the PANAS-X. Thus, we had a total of six outcome measures: four self-report scales (PA, NA, Joviality, and Sadness), and two scores by raters. Since the raters used abbreviated versions of the Joviality and Sadness scales, further discussion of the scales used by the judges on the rating task will be referred to as JOV-R and SAD-R, to differentiate these variables from the self-report measures of Joviality and Sadness.

Considering the latter outcome measure (judges' ratings), the use of multiple raters, items, and occasions of assessment introduces a margin of error. Generalizability theory (G theory; Shavelson & Webb, 1991) is one approach that considers multiple errors in an evaluation design. A G theory preliminary study was conducted (see Arakawa and Heck, under review) to consider a number of different scenarios before deciding on the optimum combination of raters, items, and occasions that would yield data at an acceptable level of reliability.

Procedure

Six different electronic forms were used for the study (Forms C – H, as Forms A – B were used for Study 1), depending on the MIP / Target video condition. Each form included: 1) the pre-experiment survey; 2) the MIP video (inducing Positive, Neutral, or Negative affect); 3) the target video; and 4) the post-experiment survey. The RAs were blind to which target video was included in each form, to contain experimenter effects. Additionally, participants watched the video with headphones on, so that the RA was unable to hear the video and could not respond to it along with the participant.

[3] Again, sincere appreciation is extended to the Paul Ekman Group, LLC, for use of the METT and SETT programs.

1. *Pre-experiment survey*. The participant was welcomed into the lab by an RA and seated in front of a Mac laptop. The consent form was already loaded on the screen as the preliminary page of the pre-experiment survey. Participants were informed of the intent to possibly record their facial expressions in the consent form. The pre-experiment survey took under four minutes and ended on a page instructing the participant to wait for the RA to input a code: "Please STOP here. Please inform the research assistant that you have completed this survey."
2. *Mood Priming and Manipulation check*. The participant then watched a video to induce positive, neutral, or negative affect, depending on the assigned condition. The MIP videos were each approximately three minutes long, and were followed by two survey questions designed to assess the effectiveness of the mood induction. Data yielded from this manipulation check were not used in the main analyses, but will be discussed in a separate analysis of the efficacy of the mood induction procedure.
3. *Experiment*. After the participant completed the pre-experiment survey, when the RA entered the "code," he or she surreptitiously started the Photo Booth[4] program as well. As noted above, the RA was blind to which condition the participant was in, knowing only which form (C – H) the participant was assigned to. After starting the video, the RA sat in a corner, able to answer any questions that came up by the participant, but out of his/her viewing radius. The participant watched the target video while his/her facial expressions were simultaneously recorded.

[4] Photo Booth is a small software application by Apple Inc. for taking photos and videos with a camera built into the Mac. Other than a small green light at the top of the laptop, participants are not able to see themselves being recorded, minimizing the potential for distractions and induced participant effects.

4. *Post-experiment survey*. After watching the stimuli, the participant took the post-experiment survey comprised of the PANAS and the Joviality and Sadness scales from the PANAS-X. The post-experiment survey ended on a page that signified completion of the study. The participant was instructed to print this page in order to receive extra credit for his/her participation.
5. *Debriefing.* The participant was then informed of the full purpose of the study—to assess whether emotional contagion is affected by transient affect—and given the opportunity to review the recording of his/her facial expressions and delete it if desired (which no participant chose to do).
6. *Rating recordings.* The recordings of the participants' facial expressions were judged by outside raters and these scores were used as an outcome variable in addition to the self-report measures.
    a. A set of eight RAs was trained in recognizing emotion with the either the Micro Expression Training Tool (METT) or the Subtle Expression Training Tool (SETT), both administered online. The METT/SETT takes approximately one hour to complete, and trainees receive pre- and post-test scores of their accuracy in reading emotional cues. All RAs received over 80% accuracy on the post-test in order to participate in coding.
    b. The entire set of 34 videos from both Studies 1 and 2 was divided amongst four pairs of raters; thus, each pair rated the same 85 videos (for reliability analysis between raters), i.e., each participant's video was independently coded by two raters.

c. For each video coded, the RA watched the entire recording of the participant one time through, and then on the second viewing stopped the video at the two points or "occasions" at which the participant expressed the most emotion.

d. These two occasions were then rated using three items from the Joviality and Sadness scales of the PANAS-X (see the following section for further detail on the items selected). Raters were instructed as follows:

> This scale consists of a number of words and phrases that describe different feelings and emotions. Read each item and then indicate to what extent you think the person in the snapshot feels this way at that moment.

Items were evaluated on the following metric:

0	1	2	3	4	5	6
Not at all	Very slight	Somewhat	Moderate	Much	Very much	Extremely much

Inter-rater reliabilities. The reliability of the raters' scores is displayed below in Table 1, which shows the inter-rater reliability between each pair of raters, as well as the overall reliability and average reliability between pairs. While the reliability is relatively low for the judges' ratings (i.e., 0.659 on the JOV-R outcome and 0.285 on the SAD-R scale), one of the reasons that the rating data was included at Level 1 in the main multi-level model was to show that there are no "statistically significant" differences in the discrepancies between pairs of judges. In brief, the reliability of the rater pairs would be considered marginal for the JOV-R scale and poor for the SAD-R outcome, and the low inter-rater reliability is likely why there are few significant findings for the rater scores in the main model, as discussed in the results section. As discussed in the following analysis of judges' ratings using generalizability theory, the reliability of judges' ratings was predicted to be between 0.7 and 0.8; thus, an average reliability of 0.659 on the JOV-R scale is close to expectation.

Insert Table 1 about here

Analysis

Limitations of a traditional ANOVA/MANOVA design. Traditional experimental designs use either Analysis of Variance (ANOVA), if there is a single outcome, or Multivariate Analysis of Variance (MANOVA), if there are two or more outcomes. A limitation of the traditional ANOVA/MANOVA approach is its inability to handle individuals with partial data (i.e., where some observations may be missing). Subjects with any missing data are simply dropped, which is known as listwise deletion. Because this approach assumes missing cases are missing completely at random (MCAR), which is typically only the case when a random sample is drawn from a population, it will lead to biased model estimates in almost all situations (Hox, 2010).

A second limitation of this approach for the purposes of this study is the inability to incorporate data on discrepancies due to raters, occasions of measurement, or their interaction directly into the model, since this information is nested within the individual participants in the model (Hox, 2010). In the ANOVA or MANOVA approach, this would require averaging data on raters and occasions after they evaluated the recordings; that is, the information on each individual participant compiled from raters over occasions would be averaged and used along with the participants' self-reports as the outcome measures in separate ANOVAs, or analyzed together in a MANOVA, to see if the data supported the main effect of target condition by comparing the means for the outcome variables, i.e. the mean ratings by self-report and judges' ratings for participants who watched the video clip of either positive or negative emotion.

Mixed modeling approach. As discussed below, the traditional ANOVA/MANOVA design was replaced with a mixed (or random coefficients) design, which is a type of multilevel model where repeated measurements (e.g., occasions) and rater assessments are nested within

individuals. In its simplest form, this mixed model represents a type of two-level model where rater assessments compiled over one or more occasions are nested within individuals at Level 1 (within subjects), while the conditions having to do with the experiment, as well as any other covariates, are entered as Level 2 (between subjects) data.

There are a number of advantages for specifying the analyses in this manner. Most important for this study is the ability to include individuals with partial data in the analyses. In contrast to ANOVA or MANOVA, which use listwise deletion of any individuals with missing data, individuals with partial data can be included in the mixed modeling approach. This analysis makes use of full information maximum likelihood (FIML), which can provide efficient estimates in the presence of individuals with some missing data. FIML estimation will lead to unbiased estimates when it can be assumed that the data are missing at random (MAR); that is, if the probability of data being missing on the outcome is related to missing data on a covariate, but not to subjects' standing on the outcome, then the data are MAR (Hox, 2010). A second advantage for purposes of this study is that the mixed modeling approach allows the incorporation of error facets due to raters, occasions of measurement, or their interactions (as well as other potential sources of error) directly into the model, which will provide more efficient estimates of experimental conditions between subjects. A third advantage of the mixed modeling approach is that it can facilitate the examination of multiple dependent variables within one model (Hox, 2010).

As suggested previously, one of the advantages of using a mixed-model formulation is the ability to incorporate the measurement variability due to raters, occasions, and their possible interaction directly into the analysis. In this study, the Level 1 model to explain an individual's observed emotional score (Y_{1ij}) can be described as follows:

$$Y_{1ij} = \beta_{0j} + \beta_1 rater_{ij} + \beta_2 occasion_{ij} + \beta_3 rater_{ij} * occasion_{ij} + e_{ij}, \quad (1)$$

where β_{0j} is the adjusted score for individual *j* on assessment *i* after adjusting for possible discrepancies due to rater differences, the occasion they are assessing, and possible rater*occasion interactions, and e_{ij} represents residual variability in assessing each individual's emotional response. Once again, estimates at Level 1 (the within-group level) are log odds, since the outcome variable, i.e., the rater's score, is measured an ordinal scale (i.e., 0 to 6).

At Level 2, there are six experimental conditions (with condition 8 serving as the reference condition), along with the two demographic controls for gender and age:

$$\beta_{0j} = \gamma_{00} + \gamma_{01} cond3_j + \gamma_{02} cond4_j + \gamma_{03} cond5_j + \gamma_{04} cond6_j + \gamma_{05} cond7_j + \gamma_{06} female_j + \gamma_{07} age_j + u_{0j}, \quad (2)$$

where γ_{00} is the intercept representing the average score when watching the happy video (coded 0) and $\gamma_{01} - \gamma_{05}$ represent the coefficients for the between-subjects experimental conditions in Study 2 (with condition 8 serving as the reference group, $\gamma_6 - \gamma_7$ represent the coefficients for the demographic controls, and u_{0j} represents the random component, that is, variability in predicting the scores on the dependent variable across individuals. Through substitution of Eq. 2 into Eq. 1, the combined equation representing the within-subject and between-subject variables explaining the outcome rating is as follows:

$$Y_{ij} = \gamma_{00} + \gamma_{01} cond3_j + \gamma_{02} cond4_j + \gamma_{03} cond5_j + \gamma_{04} cond6_j + \gamma_{05} cond7_j + \gamma_{06} female_j + \gamma_{07} age_j + \gamma_{10} rater_{ij} + \gamma_{20} occasion_{ij} + \gamma_{30} rater_{ij} * occasion_{ij} + u_{0j} + e_{ij}, \quad (5.3)$$

Between individuals, the estimates for Eq. 2 and Eq. 3 are standardized ($M = 0$,

SD = 1), as both outcome variables, i.e., the rater's score and the participant's self-report, were measured on a continuous scale (Muthén & Muthén, 1998-2006).

The mixed-model approach also facilitates the specification of other relationships either within or between individuals. A second model can be specified between-individuals to consider the self-report outcome (Y_{1j}) between individuals:

$$Y_{1j} = \gamma_{00(1)} + \gamma_{01(1)}cond3_j + \gamma_{02(1)}cond4_j + \gamma_{03(1)}cond5_j + \gamma_{04(1)}cond6_j + \\ + \gamma_{05(1)}cond7_j + \gamma_{06(1)}female_j + \gamma_{05(1)}\ age_j + \ u_{(1)j} + \ e_j. \quad (4)$$

Again, as Eq. 4 indicates, there is no within-subjects model for the self-report outcome. Models were also estimated using Mplus (Muthén & Muthén, 2005), which facilitates estimating multilevel models with outcomes measured on different types of scales simultaneously. Figure 1 visually depicts the complete set of variables and predicted interactions in the two-level model.

Insert Figure 1 about here

Results

Descriptive Statistics

The descriptive results of the self-report data are presented in Table 2 below. As the Joviality and Sadness scales were transformed into factor scores, the scale means and standard deviations for the two conditions are standardized. Considering the results on the Joviality scale, we see participants in all three conditions who watched the happy target video did self-report higher positive affect than those in the three conditions watching the sad target video. When the outcome was measured by self-report on the Sadness scale, we see the same overall consistency in the main effect of stimuli condition; i.e., those in the Sad target conditions report higher sadness than those in the Happy target conditions.

Insert Table 2 about here

The descriptive results of the data from the judges' ratings are shown in Table 3, which presents the means and standard deviations of the JOV-R and SAD-R ratings on a seven-point ordinal scale. From the table, we see that the overall scoring of emotion was relatively low, as all the means are below 1.4 (on a 0 to 6 scale), suggesting that the raters saw very weak expression of emotion in the participants. We find that the means on the SAD-R scale are generally higher than on the JOV-R scale, i.e., the raters were identifying slightly more negative emotion on both conditions.

Insert Table 3 about here

Effectiveness of Mood Induction Procedures

To assess whether the affective imagery tasks produced the intended effect on participants' moods, a mixed model analysis of variance was conducted on the three main mood induction conditions, e.g., the Positive MIP / Happy Target and Positive MIP / Sad Target conditions were recoded into one new variable, as both conditions experienced the same Mood Induction Procedure (MIP) prior to viewing the stimuli. Table 4 below summarizes the self-reported intensity of the emotion experienced immediately following the MIP rated on a 0 to 8 scale, with 8 equivalent to the strongest experience of that emotion in the participant's entire life. The average answer to this question in the neutral condition was around 2.8, a fairly low intensity of emotion. Compared to the neutral MIP, those engaging in the negative induction procedure reported a 1.239 increase, i.e., an average of 4.031, which was significant at $p = .002$. Those engaging in the positive manipulation also reported a small (0.577) increase in the intensity of the emotion experienced, but this effect was not significant ($p = .144$).

Insert Table 4 about here

The aforementioned results are corroborated in Table 5, which presents the self-reported difficulty of engaging in the MIP. Overall, the participants seemed to have a hard time engaging in the imagery task, as the reported difficulty on the neutral condition was 5.180—above average on a 0 to 8 scale. Compared to the neutral condition, those engaging in the Negative MIP reported the task as being significantly less difficult ($\beta = -0.730$, $p = .033$). Participants assigned to the positive induction procedure also reported the task as being less difficult than the neutral condition (though by a smaller magnitude than those in the Negative MIP conditions), but this effect was not significant ($p = .694$).

Insert Table 5 about here

Two-level Model Results With Positive Affect Outcome Measures

In Table 6, the results of the main two-level model are presented when the outcome was measured on the JOV-R and Joviality scales and the baseline comparison is to the condition that engaged in the Negative MIP and watched the sad target video (Negative MIP / Sad Target). Considering the Between-Subjects (Level 2) results with the rating data, we see that participants who were put into a temporary sad mood before watching the happy stimuli (Negative MIP / Happy Target) were 0.233 of a standard deviation higher in observed happiness ($p = .01$) compared to the baseline group (Negative MIP / Sad Target). No other conditions were significantly different from the baseline. Considering the demographic factors, we see that age did significantly decrease the happiness of the participants ($\beta = -0.088$, $p = .005$), controlling for the other conditions in the model, but gender did not have a significant effect.

Although the judges' score and self-report measures were positively and significantly correlated ($r = 0.209$, $p = .005$), the magnitude of this correlation was low, suggesting that the JOV-R and Joviality are still defining separate constructs. We also note that the Within-Subject factors relating to the assessment of judges' scores were all non-significant, suggesting that occasions measured ($p = .981$), raters ($p = .561$), and their interaction ($p = .182$) were not significantly related to the outcome measured on the JOV-R scale.

Insert Table 6 about here

While the data by judges' ratings yielded only one significant difference by condition, the self-report data showed significant differences among three of the five conditions (the sixth being the baseline). Participants who experienced a happy transient mood state before watching the happy video (Positive MIP / Happy Target) had a 0.087 SD increase ($p = .000$) in self-reported happiness compared to participants who were induced into a sad mood before watching the sad stimuli (Negative MIP / Sad Target). Those in the Negative MIP / Happy Target condition also reported higher levels of positive affect on the Joviality scale compared to the baseline group ($\gamma = 0.139$, $p = .047$). Interestingly, being induced into a happy mood prior to watching the sad stimuli significantly decreased self-reported happiness compared to those who were induced into a negative affective state before watching the same video ($\gamma = -0.154$, $p = .044$). While age was a significant predictor using the judges' ratings as the outcome measure, neither age nor gender significantly predicted self-reported happiness. The significant findings from this model with self-reported happiness as the outcome measure are depicted below in Figure 2.

Insert Figure 2 about here

Two-level Model Results With Negative Affect Outcome Measures

In Table 7, the results of the main two-level model are presented when the outcome was measured on the SAD-R and Sadness scales and the baseline comparison is to the condition that engaged in the Negative MIP before watching the sad stimuli (Negative MIP / Sad Target). Considering the Between-Subjects (Level 2) results with the judges' rating data, there is no significant result observed by experimental condition or by demographic variables at a conventional significance level of 0.05. However, it should be noted that one experimental condition (the Neutral MIP / Sad Target) would be statistically significant at $p < .06$.

While the data by judges' ratings yielded only one possible significant difference by condition, the self-report data showed significant differences among two of the five conditions. Participants in the Neutral MIP / Happy Target condition had a 0.141 SD decrease ($p = .030$) in self-reported sadness compared to participants who were induced into a sad mood before watching the sad stimuli (Negative MIP / Sad Target). Those induced into a sad mood before watching the happy stimuli (Negative MIP / Happy Target) also experienced less negative emotion compared to the baseline group ($\gamma = -0.162$, $p = .044$). Neither age nor gender significantly predicted self-reported sadness.

We can also note that the SAD-R and Sadness outcome measures were positively and significantly correlated ($r = 0.141$, $p = .024$); however, the magnitude of this correlation was low, suggesting that the measures are consistent in defining separate constructs in each study. Additionally, at Level 1 (within subjects), these results may be impacted by the significant relationship of occasions ($p = .01$) to the outcome. This finding suggests that occasions were systematically contributing some variance to judges' scores on the SAD-R scale. Raters ($p =$

.091) and their interaction with occasions (p = .673) were not significantly related to the outcome measured on the SAD-R scale.

Discussion

Does Transient Affect Influence Susceptibility to Emotional Contagion?

In review, our hypothesis states: "Transient affect, i.e., a happy or sad mood state, affects susceptibility to catching either positive or negative emotions." The descriptive data on the self-report scales in Table 2 provides general support for the main effect of the Happy target condition, as the participants in the three conditions that watched the Happy Target all had higher means on the Joviality scale than the participants in the conditions who watched the Sad Target. The same main effect of target condition was also observed on the Sadness scale. Thus, the descriptive data provide preliminary support that emotional contagion did indeed take place as predicted.

However, to know whether transient mood actually affected susceptibility to emotional contagion, it is necessary that at least one of the experimental conditions be statistically significant. In Table 6, three of the five conditions (the sixth condition being the reference group) were significant, which supports the hypothesis that transient mood impacts emotional contagion. Having any of the mood conditions be significantly related to the outcome on the Joviality scale implies that transient affect did indeed affect susceptibility to emotional contagion; in order to investigate the process by which this contagion occurred, we can examine which specific conditions were significant.

Transient Affect and Emotional Contagion by Addition or Interaction?

With the hypothesis that transient affect affects emotional contagion evidentially supported, we can now consider the theoretical predictions for how mood may impact catching

another's emotions. In the two-level model, all conditions are compared to a baseline control group, which was selected to be the condition in which participants were induced into a sad mood prior to watching a sad video (Negative MIP / Sad Target). According to the addition theory, people should catch emotions congruent with their current mood state, with every condition predicted to have higher levels of positive affect than the Negative MIP / Sad Target condition.

Insert Figure 3 about here

According to the interaction hypothesis, people in a happy mood should be more susceptible to catching all emotions. Considering the inequality ("<") shape created by the prediction lines in Figure 4, we see that the baseline group is at the left-most point of conjunction—and that the Negative MIP / Happy Target group is predicted to be at roughly the same level of positive affect.

Insert Figure 4 about here

Moving upward along the top line of the inequality sign, which represents those watching the happy video, we see that the Positive MIP / Happy Target condition is predicted to be significantly higher than the baseline group, with the Neutral MIP / Happy Target somewhere in between. Moving downward along the bottom line of the inequality sign, representing those watching the sad video, we find the Positive MIP / Sad Target condition significantly lower in positive affect than the baseline group, with the neutral MIP condition in between.

To simplify the analysis, if the interaction theory holds, we can compare the positive affect levels of the three main points of the inequality sign and hope to find the following ascending order, beginning with the lowest group: 1) Positive MIP / Sad Target; 2) Negative

MIP / Sad Target; 3) Positive MIP / Happy Target. In other words, compared to the Negative MIP / Sad Target condition, the Positive MIP / Happy Target condition should be higher in positive affect, and the Positive MIP / Sad Target condition even lower in positive affect.

Consulting Table 6, we find that three of the conditions were significantly related to the baseline condition. Considering our first point of interest, we find that being induced into a happy mood prior to watching the sad stimuli (Positive MIP / Sad Target) did significantly decrease self-reported happiness compared to the baseline group by about 0.15 SD, i.e., the Positive MIP / Sad Target condition was lower in positive affect compared to the Negative MIP / Sad Target condition. This finding alone is the key point in support of the interaction theory, as it opposes the addition theory, which would predict every condition to be higher in positive affect than the baseline group.

Next, we see that participants who experienced a happy transient mood state before watching the happy video (Positive MIP / Happy Target) had a 0.087 *SD* increase in self-reported happiness compared to participants who were induced into a sad mood before watching the sad stimuli (Negative MIP / Sad Target). This finding completes the most simple checkpoints of the interaction theory, i.e., that positive affect be lower in the Positive MIP / Sad Target condition and higher in the Positive MIP / Happy Target condition than the baseline Negative MIP / Sad Target group.

According to the interaction theory, the final significant condition, Negative MIP / Happy Target, should be relatively close in affect to the baseline group, i.e., we find the two conditions at the same conjunction in the inequality-shaped prediction figure. While we do find that it is relatively close to the baseline, with an increase of only 0.14 *SD* over the Negative MIP / Sad Target group, this increase is actually higher than the Positive MIP / Happy Target group, which

does not conform to the prediction. This finding may be indicative of the strong power of positive emotional contagion, above the affect of current mood state; i.e., if you are in a sad mood, a positive emotional target can lift you up even higher than if you started in a happy mood.

Conclusion

In sum, this study suggests that transient mood does indeed affect susceptibility to emotional contagion. Moreover, this investigation suggests the relationship between mood and emotional contagion is an interactive one; i.e., that being in a happy mood makes a person more likely to catch the emotions of others.

A limitation of this study was the inability of the raters to strongly detect the participants' emotional displays. The literature on facial expressions and mimicking suggests that the participants should have expressed more emotion, and the inability of the raters to identify these displays is inconsistent.

Table 1
Rater Dependability (Reliability)

Variable	JOV-R	-R
Rater1 – Rater 2	0.573	0.488
Rater 3 – Rater 4	0.692	0.285
Rater 5 – Rater 6	0.608	0.267
Rater 7 – Rater 8	0.764	0.099
All Pairs	0.626	0.155
Average Rater Pairs	0.659	0.285

Table 2
Descriptive Statistics for Self-Report by Factor Scores Within Conditions by Joviality and Sadness Scales

		Joviality		Sadness	
Condition	*n*	*M*	*SD*	*M*	*SD*
Positive MIP / Happy Target	33	0.562	1.069	-0.090	1.048
Neutral MIP / Happy Target	23	0.256	0.970	-0.337	0.841
Negative MIP / Happy Target	32	0.402	0.824	-0.172	0.674
Positive MIP / Sad Target	32	-0.418	0.968	0.467	1.438
Neutral MIP / Sad Target	30	-0.051	0.942	0.316	0.986
Negative MIP / Sad Target	32	-0.547	0.677	0.349	1.130

Table 3
Descriptive Statistics for Judges' Ratings on an Ordinal Scale Within Conditions by JOV-R and SAD-R Items

		JOV-R		SAD-R	
Condition	*n*	*M*	*SD*	*M*	*SD*
Intercept		0.610	1.257	0.916	1.217
Positive MIP / Happy Target	33	0.661	1.265	1.158	1.155
Neutral MIP / Happy Target	23	0.662	1.375	1.190	1.317
Negative MIP / Happy Target	32	1.361	1.664	1.051	1.355
Positive MIP / Sad Target	32	0.808	1.419	1.082	1.356
Neutral MIP / Sad Target	30	0.697	1.242	1.334	1.204
Negative MIP / Sad Target	32	0.412	1.008	1.343	1.147

Table 4
Self-Reported Intensity of the Emotions Experienced During Mood Induction Procedure

Condition	Coefficient	Standard Error	Significance
Positive MIP	0.577	0.393	0.144
Negative MIP	1.239	0.395	0.002
Intercept (Neutral MIP)	2.792	0.292	0.000

Table 5
Self-Reported Difficulty of Engaging in Mood Induction Procedure

Condition	Coefficient	Standard Error	Significance
Positive MIP	-0.132	-0.335	0.694
Negative MIP	-0.730	-2.153	0.033
Intercept (Neutral MIP)	5.180	0.250	0.000

Table 6
Two-Level Model Estimates on the JOV-R Scale

Variables	Estimate	SE	T-Test	Sig.
Between Subjects (N = 182)				
Happiness Score[a]				
Positive MIP / Happy Target	0.025	0.021	1.203	0.229
Neutral MIP / Happy Target	0.014	0.021	0.696	0.487
Negative MIP / Happy Target	0.233	0.090	2.584	0.010
Positive MIP / Sad Target	0.052	0.074	0.699	0.485
Neutral MIP / Sad Target	0.058	0.071	0.820	0.413
Age	-0.088	0.031	-2.832	0.005
Female	0.078	0.063	1.235	0.217
Within Subjects[b]				
Occasions	-0.005	0.195	-0.023	0.981
Rater Teams	-0.203	0.355	0.581	0.561
Occasions x Rater Teams	-0.446	0.334	-1.336	0.182
Between Subjects				
Self-Report Happiness Intercept[a]	0.154	0.204	9.850	0.000
Positive MIP / Happy Target	0.087	0.026	3.407	0.000
Neutral MIP / Happy Target	0.025	0.022	1.138	0.255
Negative MIP / Happy Target	0.139	0.070	1.988	0.047
Positive MIP / Sad Target	-0.154	0.076	-2.019	0.044
Neutral MIP / Sad Target	-0.067	0.074	-0.908	0.364
Age	-0.020	0.051	-0.397	0.692
Female	-0.070	0.061	-1.156	0.248
Level 2 variance (Score)	0.195	0.042	4.624	0.000
Level 2 variance (Self-Report)	0.931	0.033	27.943	0.000
Correlation	0.209	0.074	2.822	0.005
Log likelihood	-3173.0			
Free parameters	23			

Note. [a] Between-subject estimates are standardized; [b] Within-subject estimates are log odds coefficients; thresholds not shown.

Table 7
Two-Level Model Estimates on the SAD-R Scale

Variables	Estimate	SE	T-Test	Sig.
Between Subjects (N = 186)				
Sadness Score[a]				
Positive MIP / Happy Target	0.148	0.095	1.555	0.120
Neutral MIP / Happy Target	0.076	0.095	0.801	0.423
Negative MIP / Happy Target	-0.011	0.111	-0.100	0.921
Positive MIP / Sad Target	-0.032	0.114	-0.276	0.782
Neutral MIP / Sad Target	0.179	0.094	1.908	0.056
Age	-0.093	0.088	-1.054	0.292
Female	0.048	0.032	1.477	0.140
Within Subjects[b]				
Occasions	0.347	0.134	2.589	0.010
Rater Teams	-0.437	0.258	-1.691	0.091
Occasions x Rater Teams	-0.096	0.228	-0.422	0.673
Between Subjects				
Self-Report Sadness Intercept[a]	0.413	0.244	1.693	0.091
Positive MIP / Happy Target	-0.141	0.096	-1.477	0.140
Neutral MIP / Happy Target	-0.176	0.081	-2.165	0.030
Negative MIP / Happy Target	-0.162	0.080	-2.019	0.044
Positive MIP / Sad Target	0.033	0.109	0.305	0.760
Neutral MIP / Sad Target	0.012	0.089	0.131	0.896
Age	-0.043	0.054	-0.795	0.427
Female	-0.005	0.036	-0.147	0.883
Level 2 variance (Score)	5.064	0.837	6.051	0.000
Level 2 variance (Self-Report)	1.080	0.226	4.771	0.000
Correlation	0.141	0.062	2.250	0.024
Log likelihood	-2667.0			
Free parameters	27			

Note. [a] Between-subject estimates are standardized; [b] Within-subject estimates are log odds coefficients; thresholds not shown.

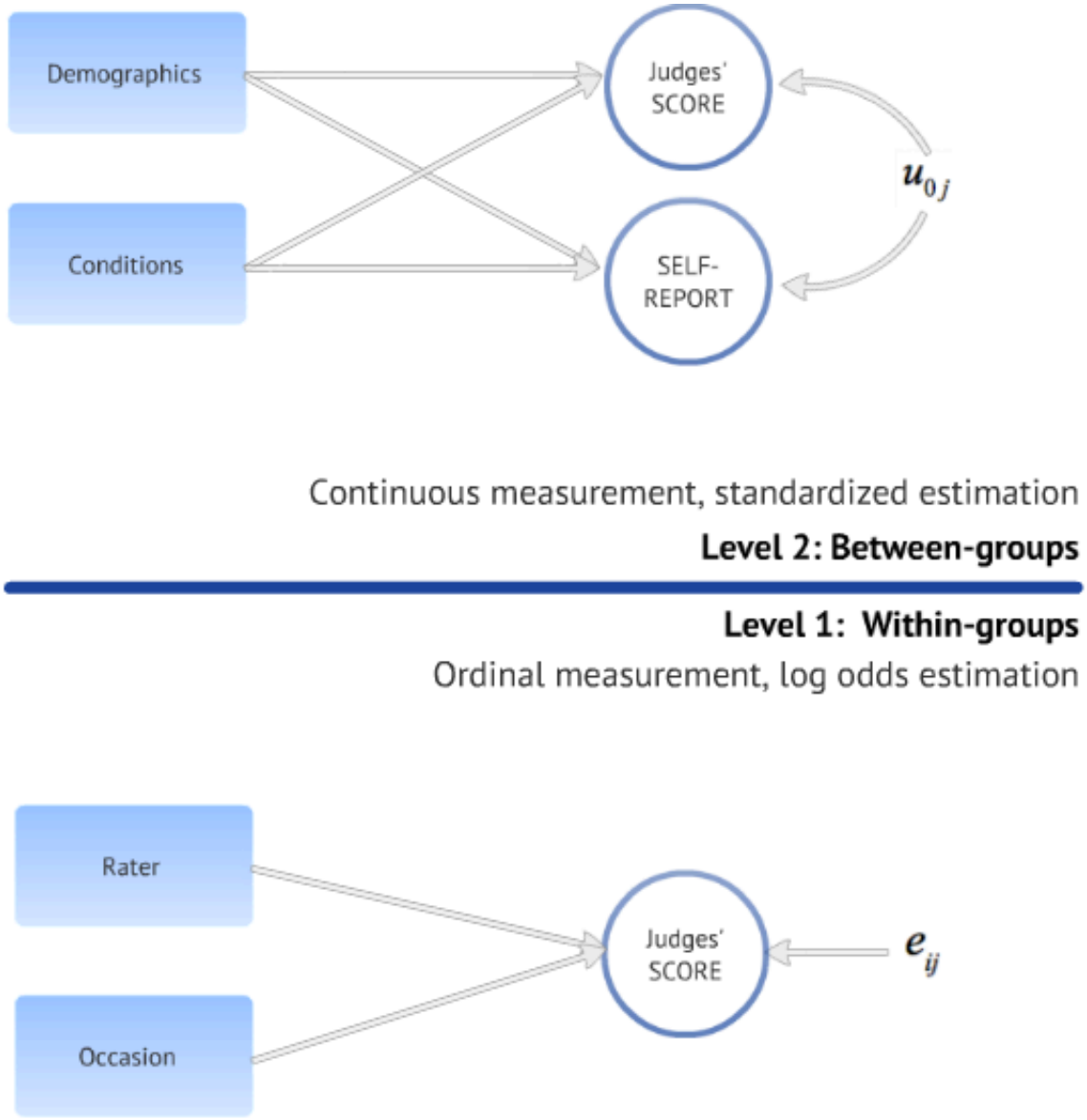

Figure 1. Two-level model.

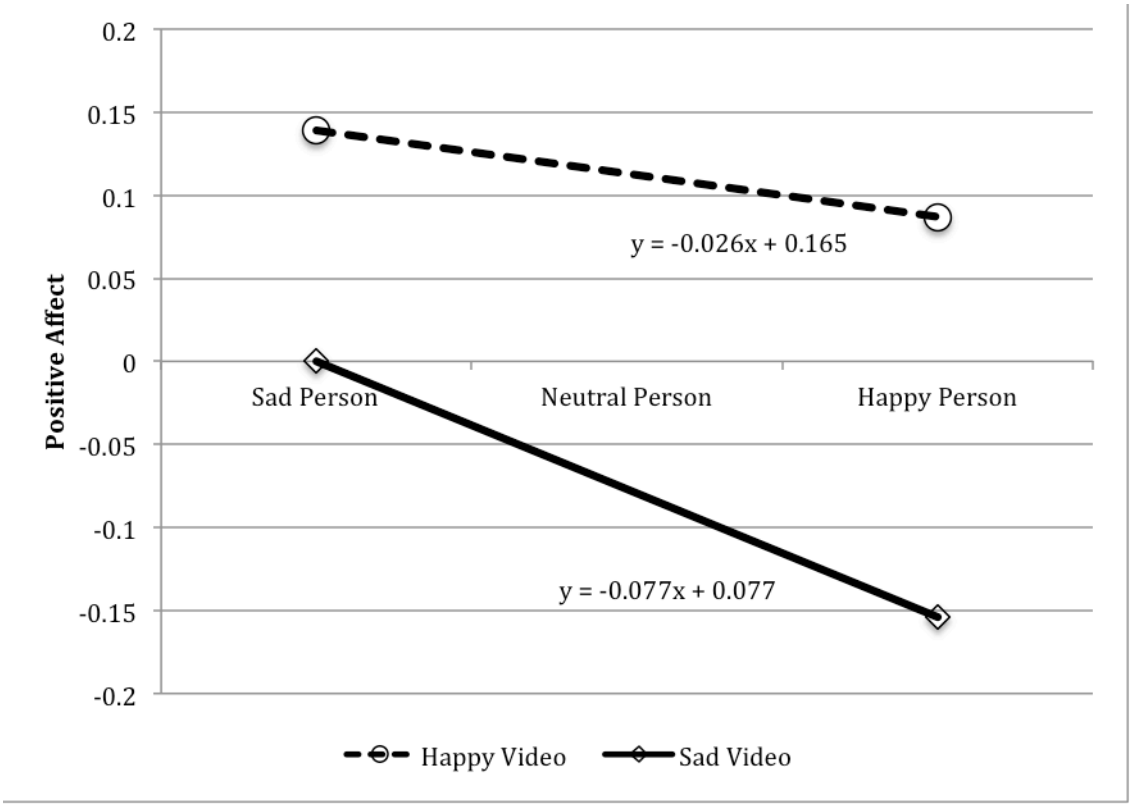

Figure 2. Outcome measured on the Joviality scale.

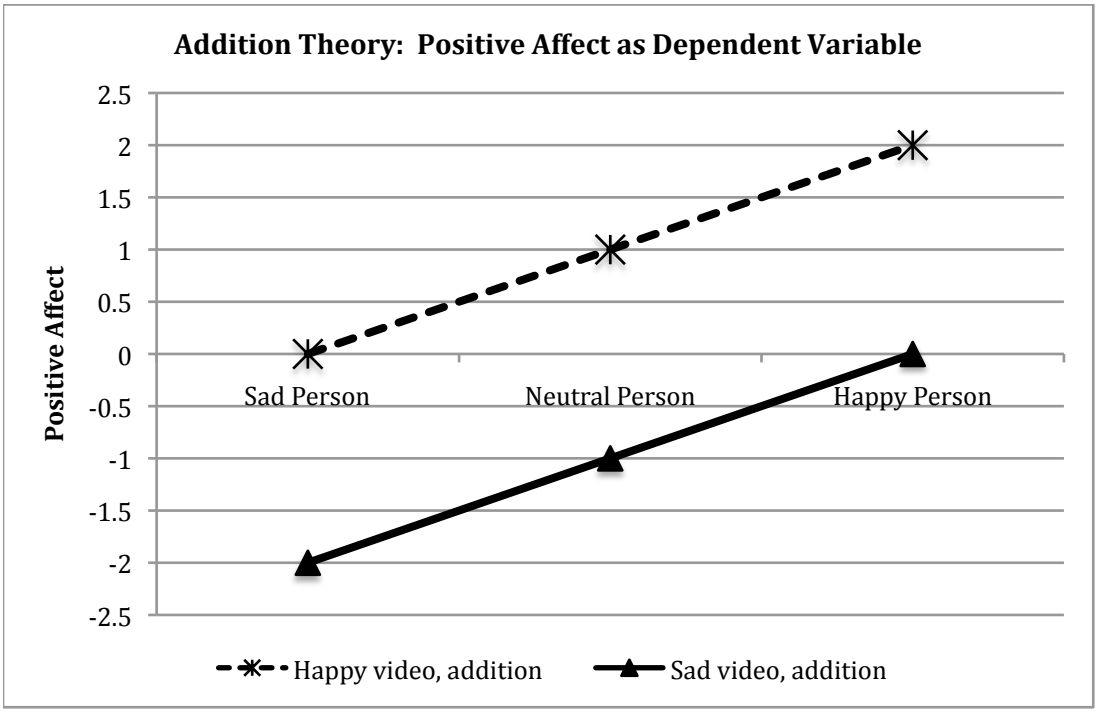

Figure 3. Addition theory: Positive affect as dependent variable.

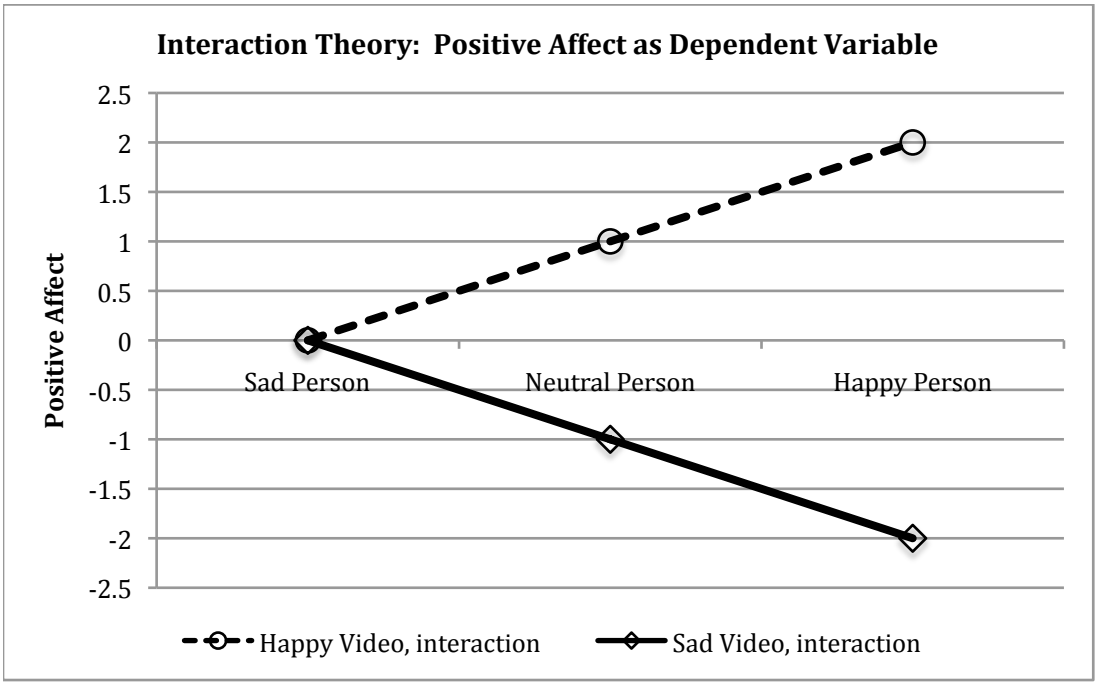

Figure 4. Interaction theory: Positive affect as dependent variable.

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