Emotional Contagion and its Relationship to Enduring Affect

Dana Rei Arakawa, PhD

Elaine Hatfield, PhD

Ronald Heck, PhD

University of Hawaii at Manoa

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 personality on emotional contagion. Specifically, we propose that people's susceptibility to emotional contagion will be affected by their stable disposition towards happiness/sadness. Two competing theoretical traditions will be compared to investigate just *how* stable mood affects contagion.

Keywords: Emotional contagion, personality, enduring affect, mood, happiness

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Background

When we are in a certain mood, whether elated or depressed, we often communicate this mood to others. Similarly, when we spend time with people in a positive or negative mood, we may have experienced "catching" their emotional state. This giving and catching of emotion may be so familiar to us that we take it for granted—a process occurring so naturally in our interactions with others that we barely register its occurrence or effects. We may have experienced this process of giving and taking emotion in our personal lives, but is this a "real," or scientifically proven, phenomenon?

In *Emotional Contagion*, Hatfield, Cacioppo and Rapson (1994) define emotional contagion as the "tendency to automatically mimic and synchronize facial expressions, vocalizations, postures and movements with those of another person and, consequently, converge emotionally" (p. 5). The authors note that the existence of emotional contagion has been well documented across a variety of disciplines, including social and developmental psychology, history, cross-cultural psychology, experimental psychology, and psychophysiology. Clinicians (Coyne, 1976), sociologists (Le Bon, 1896), primatologists (Hurley & Chater, 2005a), life span researchers (Hurley & Chater, 2005b), neuroscientists (Iacoboni, 2005; Wild, Erb, & Bartels, 2001; Wild, Erb, Eyb, Bartels, & Grodd, 2003) and historians (Klawans, 1990) have all provided evidence that people do in fact catch one another's emotions at various times, in all societies, and perhaps on a very large scale. Indeed, researchers from a breadth of disciplines and using a variety of techniques have concurred that emotional contagion is not just an anecdotal phenomenon: it is an important area of study in interpersonal relations meriting further investigation.

Susceptibility to Emotional Contagion

Although the existence of emotional contagion has been well documented, we have yet to fully understand its mechanisms and enabling or disabling factors. As emotional contagion is the give and take of emotion between people, two major areas of research include the giving of emotion (e.g., What makes someone good at infecting others with their mood?) and the taking of it (e.g., Who are the people particularly susceptible to catching emotion?). This study further investigates one contributing factor within the latter area of research, i.e., susceptibility to emotional contagion.

Hatfield, Cacioppo, and Rapson (1994) identify six features that make a person relatively susceptible (or resistant) to catching another's emotion: 1) whether or not the person is paying *attention*; 2) how the individual self-defines their *identity*, as either interdependent or independent; 3) how adept the person is at *reading* the emotions of others; 4) how disposed he/she is to *mimicking* the facial expressions, vocalizations, and postures of others; 5) how *aware* the individual is of his/her own emotions, i.e., of feedback; and 6) how *receptive* the person is biologically to emotion.

This study is concerned with the first feature of susceptibility to emotional contagion, i.e., the hypothesis proposed by Hatfield, et al. that "People should be more likely to catch others' emotions if their attention is riveted on others than if they are oblivious to others' emotions" (1994, p. 148). In considering whether individual differences in susceptibility to emotional contagion are influenced by the degree to which one attends to the emotions of others, the influence of mood on attention comes into question. Some theorists argue that we are especially susceptible to catching certain emotions, or all emotions, when we are happy or sad. The

resultant purpose of this project is to investigate the relationship between one's mood and susceptibility to catching the emotion of others.

Happiness/Sadness

Throughout history, we find the topic of happiness as a concern among religious leaders and theologians like Jesus, the Buddha, Mohammed, Thomas Aquinas, and many others. Philosophers, from Aristotle and the Athenian philosophers in the West, to Confucius and Lao-Tsu in the East (Dahlsgaard, Peterson, & Seligman, 2005), have grappled to pin down a clear and all-encompassing definition of happiness (e.g., Aristotle's *Nicomachean Ethics*). Similarly, scientists have endeavored to demystify the concept of happiness. Although there is no consensus as to its definition (Snyder, Lopez, & Pedrotti, 2010), there are several synonyms used throughout the literature to describe a general state of wellbeing, e.g., happiness, self-actualization, contentment, adjustment, economic prosperity, and quality of life (Hefferon & Boniwell, 2011).

One way to operationally define happiness is as subjective wellbeing (SWB), a combination of satisfaction with life, high positive affect, and low negative affect (Diener, 1984). Thus, happiness, or SWB, encompasses how people evaluate their own lives in terms of affective and cognitive explanations (Diener, 2000). Some of the known objective consequences of subjective wellbeing are high income (Diener & Seligman, 2002), positive health outcomes (Pressman & Cohen, 2005), strong relationships, and educational and workplace achievement (Lyubomirsky, King, & Diener, 2005).

To measure SWB as an affective trait, there are multiple scales with very high levels of validity and reliability, including the Satisfaction with Life Scale (Diener, Emmons, Larsen, & Griffin, 1985) and Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999), among

others. These tools converge with mood reports, expert ratings, experience sampling measures, reports of family and friends, and smiling (Diener, Lucas, Oishi, & Suh, 2002). In this study, the trait of happiness is assessed by the SHS, which measures strong happiness at one extreme and deep unhappiness, or sadness, at the other. The personality variable is thus considered on a continuum, with sadness being the absence of happiness; we therefore speak of happiness/sadness.

Hypothesis

As noted by Hatfield, Cacioppo, and Rapson (1994), disposition to emotional contagion is likely susceptible to a number of situational forces and internal states. In this work, we explore the effect of enduring affect on emotional contagion. To date, no research has been conducted on this relationship; however, research on the effects of mood on social judgment and cognition provide general support for the approach of this study.

First, we propose that mood should influence emotional contagion as it governs attention or information-processing strategies. Research on affect and social information processing has found that the judgments (Bodenhausen, Sheppard, & Kramer, 1994; Van den Bos, 2003) and memories (Bower, 1981; Ellis, Thomas, & Rodriguez, 1984; Forgas, 1992) of people are affected by broad categories of positive and negative affect, i.e., a happy or sad mood can greatly impact how one perceives, thinks about, and remembers other people. A great deal of research has explored how mood elicits widespread effects on social decision-making (Forgas, 1992; Forgas & Bower, 1987; Park & Banaji, 2000) and mood has also been found to influence the accuracy of such social judgments (Ambady & Gray, 2002). We propose that mood should affect susceptibility to emotional contagion, paralleling its broad effects on social judgment.

Second, the present work is concerned with exploring the effects of enduring affect on emotional contagion. At the trait level, research on enduring or stable affect has often centered on depression. Of significance to the mimicking-process theory of emotional contagion, depressed individuals often display a negative bias when judging facial expressions (Gur et al., 1992; Hale, 1998), rendering them less accurate than non-depressed controls at recognizing emotions from facial displays (Giannini, Folts, Melemis, Giannini, & Loiselle, 1995; Persad & Polivy, 1993). However, findings on the effects of enduring affect often appear incompatible, supporting the relevance of further research to begin to parcel out the impact of personality-based mood.

In sum, this study explores whether a happy/sad personality may influence susceptibility/resistance to emotional contagion. The following hypothesis is tested: *Trait-based affect, i.e., a happy or sad personality, will affect susceptibility to catching either positive or negative emotions.* Additionally, mood is hypothesized to affect susceptibility to emotional contagion by one of two processes: addition or interaction.

The Addition Theory

The Addition Theory has its roots in mood congruency, a cognitive theory referring to a match in affective content between a person's mood and his or her thoughts (Eich, Kihlstrom, Bower, Forgas, & Niedenthal, 2000). The theory proposes that affect may influence cognitive organization, as people who are experiencing a certain emotion may be especially likely to perceive, attend to, process, and recall material consistent with that emotion. Thus, 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 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.

It is important to note that the addition theory assumes that a happy or sad mood should have symmetrical effects on participants' tendency to attend to, process, and remember congruent information. However, the Pollyanna Principle would suggest that this is not the case, as people are naturally motivated to maintain a positive state and change an unhappy one (Matlin & Stang, 1978). Thus, while one might expect happy people to show far more willingness to attend to, process, and recall happy material than sad, sad people may not be equally willing to deal with sad material. There may also be structural differences in the way happy and sad material is processed (Isen, 1987). For example, negative material has been found to be more salient and leave a longer lasting impression than positive information (Skowronski & Carlston, 1989), i.e., "bad emotions, bad parents, and bad feedback have more impact than good ones, and bad information is processed more thoroughly than good" (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001, p. 323). These processing effects will be further discussed in the following section on the interaction theory. However, for clarity's sake, the addition theory is stated in its starkest form, as this study seeks to contrast two very different theories on the process of emotional contagion—additive or interactive.

The Interaction Theory

A second theoretical perspective would lead to a very different prediction as to how mood should affect susceptibility to emotional contagion. Researchers have pointed out that sad people may find it difficult to attend to, process, and recall incoming information. At the trait

level, negative affect is theorized to systematically distort social perception. Depressed individuals are found to exhibit a negative bias in social perception, including the judgment of facial displays (Gur et al., 1992; Hale, 1998) and the global interpretation of the behavior of those around them (Gotlib & Meltzer, 1987). Using an information-processing paradigm, Gotlib et al. (2004) examined the attentional biases in clinically depressed participants against participants with generalized anxiety disorder (GAD) and a nonpsychiatric control group, finding that depressed participants directed their attention selectively to sad faces. Relevant to the present work on emotional contagion through facial mimicry, systematic attentional bias may render depressed individuals less accurate than nondepressed controls at recognizing emotion through facial displays as well as other verbal and nonverbal cues (Giannini et al., 1995; Persad & Polivy, 1993).

The notion that depressed individuals are always subject to systematic distortions in social perception has been challenged by a line of research on depressive realism, the theory that depressed people may be more accurate than nondepressives in judging their personal control over events (Alloy & Abramson, 1979). Depressed individuals have been found to be more accurate in their perception of the impressions they convey to others (Lewinsohn, Mischel, Chaplin, & Barton, 1980) and to be less susceptible to the fundamental attribution error, or pervasive tendency to underestimate the impact of situational forces and overestimate the role of dispositional factors when making social judgments (Forgas, 1998). In a study replicating their original paradigm, Alloy and colleagues (1981) induced depressed and elated mood states in naturally nondepressed and depressed students, respectively, to assess the impact of these transient mood states on susceptibility to the illusion of control. They found that naturally nondepressed women made temporarily depressed accurately judged the degree of their personal

control while naturally depressed women made temporarily elated showed an illusion of control and overestimated their impact on an objectively uncontrollable outcome. This finding supports the depressive realism proposition that negative mood may make individuals more realistic in social perception while positive affect leads to a distorted illusion of control.

However, empirical support for depressive realism has been inconsistent (see Campbell & Fehr, 1990; Dunning & Story, 1991; Gotlib & Meltzer, 1987) with the original paradigm criticized for a lack of realism, i.e., depressed individuals tend to show traditional negative biases and inaccuracy when more realistic, personally relevant stimuli were used in the experiment (Ambady & Gray, 2002). Pacini, Muir, and Epstein (1998) suggest that depressive realism may hold in artificial laboratory conditions but not in more realistic or emotionally engaging situations, due to an inability of depressed individuals to exercise rational control in more consequential situations.

Sadness and depression are of course different emotional states. Yet, researchers have observed that both sad and/or depressed people seem more preoccupied with themselves than with other people or with what is going on in the world around them. Thus, not surprisingly, they show deficits in attention (American Psychiatric Association, 2000; Beck, Rush, Shaw, & Emery, 1987; Friedman, Prince, Riggio, & DiMatteo, 1980), which should result in less susceptibility to emotional contagion.

In line with this reasoning, it seems reasonable to predict that the sadder people are, the less attentive and responsive to others' moods they will be, whether the target person is displaying happy or sad emotions. In sum, *the sadder participants are, the less 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. We now have a pair of competing theories for how mood is predicted to affect contagion:

- *Addition theory.* Participants will be most likely to catch emotions that are congruent with current affect, i.e., happy people will be more susceptible to catching positive emotions and more resistant to catching negative emotions; sad people will be more susceptible to catching negative emotions and more resistant to catching positive emotions. Affectively-neutral people should be equally susceptible to catching positive or negative emotions.
- *Interaction theory.* The sadder participants are, they less likely they will be to catch others' emotions—regardless of the type of emotion the target is expressing, i.e., sad people will be less susceptible than both happy and neutral people to catching both positive and negative emotions. In effect, sadness insulates a person from emotional contagion of any sort, as it closes one off from attending to the emotions of others. Thus, affectively neutral people will be more susceptible than sad people to emotional contagion.

Method

In this study we test the hypothesis that trait-based affect, i.e., a happy or sad personality, will affect susceptibility to catching either positive or negative emotions. We explore which of 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.

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 158 participants (38% male, 62% female) whose ages ranged from 18 to 72 years (M = 22 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 (25% Caucasian; 20.9% Japanese; 14% 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 that randomly assigned them to one of two conditions by the target video, 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 does a person's personality have 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 comprised of pre-tested measures with demonstrated validity and reliability. The following measures were included in the pre- and post-experiment surveys:

Pre-experiment:

- Demographic information
- Subjective Happiness Scale, SHS (Lyubomirsky & Lepper, 1999)
- Emotional Contagion Scale, ECS (Doherty, 1997)
- Life Orientation Test-Revised, LOT-R (Scheier, Carver, & Bridges, 1994)[1]

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)

Subjective Happiness Scale (SHS). Subjective wellbeing, or happiness, encompasses how people evaluate their own lives in terms of both affective and cognitive explanations (Diener, 2000) and was measured using the Subjective Happiness Scale (SHS; Lyubomirsky & Lepper, 1999; See Appendix B) a four-item measure comparable to the five-item Satisfaction with Life Scale (SWLS; Diener, Emmons, et al., 1985). Both tools have been shown to converge with mood reports, expert ratings, experience sampling measures, reports of family and friends, and smiling (Diener et al., 2002).

As the key measure of trait-based mood, the SHS would ideally be used in tandem with other assessments of personality; e.g., comparisons to in-person interviews or anonymous questionnaires by outsiders to contain impression management, experience sampling methods to reduce memory biases, or physiological measures to reduce subjective biases associated with self-report scales. While Hefferon and Boniwell (2011) rightly argue that the future of happiness

[1] The LOT-R is included to collect additional information, but is not part of the formal hypotheses.

measurement should include more experience sampling, qualitative methods, physiological measures, and longitudinal designs, many studies, as is this one, will be practically dependent on self-report questionnaires given on a single occasion.

The SHS consists of four items on a seven-point Likert scale, with high internal consistency and reliability. Construct validation studies of convergent and discriminant validity have confirmed the use of this scale to measure the construct of subjective happiness (Lyubomirsky & Lepper, 1999). A single composite score for global subjective happiness is computed by averaging responses to the four items (the fourth reverse-coded), resulting in a possible range of scores on the SHS from 1.0 to 7.0, with higher scores reflecting greater happiness ($\alpha = .70$).

Emotional Contagion Scale (ECS). Susceptibility to emotional contagion was measured using the Emotional Contagion Scale (ECS; Hatfield et al., 1994), a 15-item measure assessing individual differences to catching the five basic emotions of happiness, love, fear, anger and sadness (See Appendix C). The ECS is a reliable and valid measure of susceptibility to others' emotions based on mimetic tendency, which has been shown to predict people's responses to various emotional expressions and to be associated with emotionality, sensitivity to others, and empathy (Doherty, 1997).

Responses to the items were measured using a four-point response scale ranging from 1 (never true for me) to 4 (always true for me) and were summed to give an overall score for emotional contagion; the higher the total score, the more susceptible to emotional contagion a person is said to be ($\alpha = .81$).

Life Orientation Test – Revised (LOT-R). Dispositional optimism, as measured by the Life Orientation Test – Revised (LOT-R; See Appendix D), is a general assessment of whether

one views the proverbial glass half-full or half-empty; hence, whether one's overall disposition is sunny or gloomy (Scheier et al., 1994). The LOT-R is a short 10-item questionnaire with no 'cut-offs' for optimism or pessimism; higher scores reflect higher levels of optimism, and lower scores reflect lower levels of optimism, i.e., pessimism. Although not part of the formal hypotheses of this study, the LOT-R was included in the pre-experiment survey as an exploratory measure designed to collect additional information on how personality may influence susceptibility or resistance to emotional contagion ($\alpha = .70$).

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 (See Appendix E). 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; See Appendix E). 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. Thus, the PANAS-X measures mood at two different levels.

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, $\alpha = .83$).

Stimuli

Stimuli consisted of two videos, or Targets, commensurate with the two experimental conditions—whether the participant was exposed to Happy or Sad emotional displays. 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 two conditions (Happy or Sad), where they would watch a video clip of people displaying either positive or negative emotion (Target). Participants' scores on the personality scale measuring general tendency towards happiness/sadness (SHS) were used in a multivariate, multilevel model (see the following section on analyses), to test whether trait-based mood (a happy or sad personality) affects susceptibility to catching either happy or sad emotion.

In each condition, the outcome was measured in the following three 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] 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.

2. Self-report by the Joviality and Sadness scales from the extended PANAS-X, on the post-experiment survey.
3. Two raters trained using either the Micro Expression Training Tool (METT) or the Subtle Expression Training Tool (SETT), created by the Paul Ekman Group, LLC,[3] evaluated two snapshots of the participant's facial expressions using three items each from the Joviality and Sadness scales of the PANAS-X. Since the raters used abbreviated versions of the aforementioned scales, further discussion of the ratings as outcome measures will be referred to as Joviality – Revised (JOV-R) and Sadness – Revised (SAD-R), to differentiate these variables from the self-report measures of Joviality and Sadness.

Procedure

Two different electronic forms were used for the study, depending on the target video condition: form A—Happy and form B—Sad. Each form included: 1) the pre-experiment survey; 2) the target video; and 3) 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.

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 possibility of recording their facial expressions in the consent form (See Appendix A). The pre-experiment survey took under 10 minutes and ended on a page

[3] The author would like to thank Dr. Paul Ekman for his generosity in offering the METT and SETT training to our team of RAs.

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. *Experiment*. After the participant completed the pre-experiment survey, when the RA inputed 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 (A or B) the participant was assigned to. After starting the video, the RA sat in a corner, ready and able to answer any questions that occurred to the participant, but out of his/her viewing radius. The participant watched the video clip of positive or negative emotion on the computer, while his/her facial expressions were simultaneously recorded.
3. *Post-experiment survey*. After watching the clip, 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 signifies completion of the study and the participant was instructed to print this page in order to receive extra credit for his/her participation.
4. *Debriefing.* The participant was then informed of the full purpose of the study—to assess whether emotional contagion is affected by enduring 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).
5. *Rating recordings.*

[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.

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 received pre- and post-test scores of their accuracy in reading emotional cues. All RAs were required to receive over 80% accuracy on the post-test in order to participate in coding.

b. The entire set of 340 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 the three-item JOV-R and SAD-R scales (abridged versions of the Joviality and Sadness scales of the PANAS-X, respectively). 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. On an index from 0 to 1, we see that the average reliability across the pairs for the JOV-R outcome is about 0.64, which is just short of 0.70, a commonly accepted standard of reliability. On the SAD-R outcome, however, we can see the reliabilities are very low, with an average of 0.347. This low inter-rater reliability is likely why there are few significant findings for the rater scores in the main model and a statistically significant discrepancy between rater pairs, as seen later in the results section. In brief, the reliability of the rater pairs would be considered marginal for the JOV-R scale and poor for the SAD-R outcome.

Insert Table 1 about here

Analyses

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. Participants' scores on the personality scale measuring general tendency towards happiness/sadness (SHS) would be used to break the participants into three groups: 1) those with a low score on the SHS (habitually sad); 2) those with a medium score on the SHS (affectively neutral); and 3) those with a high score on the SHS (habitually happy). Thus, the ANOVA/MANOVA would investigate the difference in emotional contagion between groups distinguished by differences in trait-based happiness/sadness. One of the disadvantages of this approach, however, is that need to split the participants into three groups based on artificial cutoffs in their SHS score in order to implement the comparative analysis between target conditions.

A second 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 third limitation of this approach 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. Use of this sophisticated multivariate and multilevel model thereby negates the need to justify artificial groupings in the data based on arbitrary cut-offs on the SHS measure.

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).

Proposed model. The proposed models are presented in Figures 1 through 4. From these figures, we can see the overall predictions for how happiness/sadness is expected to influence susceptibility to emotional contagion, based on the two competing hypotheses and using the different outcome measures (positive or negative affect, based on either self-report or judges' ratings). The theoretical model assumes that there will be differences in trait-based affect (i.e., a happy or sad personality) leading to different susceptibilities to catching the positive or negative affect of others. Information about the measurement qualities of the

assessments is not shown in Figures 1 – 4, but is added to the within-subjects part of the model (described in the next section).

Insert Figures 1 – 4 about here

Two-level models. As noted previously, mixed, or random coefficients, modeling is appropriate in research situations where data are nested within individuals. For each participant in the study, there is a measurement model nested within the individuals. More specifically, in the final models, two raters provided information on participants' responses on two occasions which also covered multiple items. Such designs, which require individuals to assess participants under various conditions, have the potential to introduce considerable measurement error, which should be considered in the analyses to explain participant responses to the experimental stimuli. What was needed was a design that would include possible variability due to various errors facets (e.g., raters, occasions, interactions) as part of the analyses (Marcoulides, 1998).

These measurement facets were included in the model at Level 1 (where the assessment information is nested within subjects). 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.[5] Level 1 (the within-group level) estimates are presented in a log odds metric, since the outcome variable, i.e., the rater's score, is measured on an ordinal scale (i.e., 0 to 6).

At Level 2, the experimental condition (i.e., whether the person was watching a happy or sad video) was added to the model, along with the emotional contagion score, the subjective happiness score, the interaction between condition and subjective happiness (to test between the addition and interaction theories), as well as demographic controls for gender and age:

$$\begin{aligned}\beta_{0j} &= \gamma_{00} + \gamma_{01} condition_j + \gamma_{02} emotcont_j + \gamma_{03} subhappy_j + \\ &\gamma_{04} subhappy_j * condition_j + \gamma_{05} female_j + \gamma_{06} age_j + u_{0j},\end{aligned} \quad (2)$$

where γ_{00} is the intercept representing the average score when watching the happy video (coded 0) and γ_{01} represents the change in the average score due to watching the other condition (i.e., the sad video), $\gamma_{02} - \gamma_{06}$ represent the coefficients for the other between-subjects predictors, 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 1, the combined equation representing the within-subject and between-subject variables is as follows:

$$\begin{aligned}Y_{ij} &= \gamma_{00} + \gamma_{01} condition_j + \gamma_{02} emotcont_j + \gamma_{03} subhappy_j + \\ &\gamma_{04} subhappy_j * condition_j + \gamma_{05} female_j + \gamma_{06} age_j + \\ &\gamma_{10} rater_{ij} + \gamma_{20} occasion_{ij} + \gamma_{30} rater_{ij} * occasion_{ij} + u_{0j} + e_{ij}.\end{aligned} \quad (3)$$

The mixed-model approach also facilitates the specification of other relationships either within or between individuals. In this case, a second model can be specified between-individuals. This second equation considers the self-report measure (Y_{1j}) as the between-subjects outcome:

[5] Note that "items" were not included as a measurement facet in the main model. This decision was made based upon the preliminary Generalizability Theory study discussed in Chapter 5.

$$\beta_{0j} = \gamma_{00(1)} + \gamma_{01(1)} condition_j + \gamma_{02(1)} emotcont_j + \gamma_{03(1)} subhappy_j + \gamma_{04(1)} subhappy_j * condition_j + \gamma_{05(1)} female_j + \gamma_{06(1)} age_j + u_{0(1)j}. \quad (3.4)$$

As Eq. 4 indicates, there is no within-subjects model, since the outcome is a self-report measure. Between-individual estimates for Eq. 3 and Eq. 4 are presented as standardized ($M = 0$, $SD = 1$), since ordinal variables are treated as measured on an underlying continuous scale at Level 2 in Mplus (Muthén & Muthén, 1998-2006), and each participant's self-report was measured on a continuous scale. The mixed model was estimated using Mplus 6.12 (Muthén & Muthén, 2005), a statistical software package which can be used to estimate multilevel models with outcomes measured on different types of scales simultaneously. Figure 5 visually depicts the complete set of variables and predicted interactions in the two-level model.

Insert Figure 5 about here

Preliminary Analyses. In review, prior to watching the target video in the main experiment, participants in Study 1 took a pre-experiment survey that included the Subjective Happiness Scale (SHS), the Emotional Contagion Scale (ECS), and the Life Orientation Test-Revised (LOT-R). After viewing the target video, participants took a post-experiment survey including the Positive and Negative Affect Schedule (PANAS), and the Joviality and Sadness scales from the extended version of the PANAS (PANAS-X). Collectively these data will be referred to as the self-report database.

As the goal is to provide a preliminary test of the proposed relationships, it is assumed that the available sample may not fully represent the population at large; therefore, the results should not be extrapolated beyond this particular sample. A preliminary step in the data analysis process was to use exploratory factory analysis to improve the psychometric properties of the self-report data prior to testing the study's main hypotheses. More specifically, it is important to

first ensure that the variables were appropriately and reliably measured before the data is used in the main analysis to examine the effects of the various experimental conditions on subjects' responses.

Field (2009) identifies three purposes of factor analysis: 1) to understand the structure of the latent variable(s) behind a set of variables; 2) to construct a scale to measure an underlying variable; and 3) to reduce a data set to a more manageable size while retaining as much of the original information as possible. In this study, principal component analysis (PCA) was used for the latter purpose; that is, as a data reduction method, rather than a theoretical approach, to weight the specific items defining their proposed underlying constructs.

The goal was to create a single scale, or one "weighted" component, in which each of the items is weighted according to the strength of its relationship to the dimension. For example, merely adding three items together assumes that they contribute equally to the dimension, i.e., they are given the same weight. However, in fact, one item may be more strongly related to the dimension than the other two items and should be given greater weight, which will yield a more accurate estimate than not accounting for differences in the strength of the relationship between each item and the dimension. Each item is allowed to contribute to the component through its weighted factor score, and the researcher can then investigate how the reliability (Cronbach's alpha) of the scale would be affected by the removal of the item. This process reduces problems of multicollinearity, as the correlated items are combined to form a factor.

To conduct the PCA, variables that are reverse scored on the original measures were recoded (e.g., SHS4r in Table 2 is a reverse score "r" of item 4 in the Subjective Happiness Scale) to positively correlate with the scales. Reliability analyses were then conducted, and items whose deletion would most increase the reliability of the scale were removed to adopt a

minimum of α = 0.70 for each scale. See Tables 2 – 8 for the resultant component matrices and reliability scores of each scale.

Insert Tables 2 – 8 about here

It is noted that one item was removed from the SHS (item 1) and one item was removed from the LOTR (item 10), in addition to the filler items that should be excluded from the scoring of the original LOTR scale (items 2, 5, 6, and 8). In sum, PCA was used to create weighted factor scores ($M = 0$, $SD = 1$) for each variable that were then saved into the database for use in the main analyses. The self-report measure, now "weighted" in terms of each item's contribution to the underlying construct, was then brought into the main multilevel model at Level 2 (between subjects), where condition effects and other between-subjects variables should be.

Another benefit to the PCA is the ability to identify the best performing outcome measure of the four self-report scales (PA, NA, Joviality, Sadness). Overall, the positive affect measures (PA and Joviality) had greater reliability (alphas) than the negative affect scales (NA and Sadness). Indeed, we might select just the highest performing measure, the Joviality scale (α = 0.93), for use as the self-report outcome variable in the main two-level model. However, for consistency, it was desirable to keep a measure of negative affect in the analysis as well. Therefore, both the Joviality and Sadness measures were used as the self-report outcome variables, in addition to the JOV-R and SAD-R scores from the judges' ratings. While the collection of data on the full PANAS was instructive, including the PA and NA scales as additional outcome measures in the main model would be redundant, as the Joviality (α = 0.93) and Sadness (α = 0.83) scales outperform the PA (α = 0.92) and NA scales (α = 0.75), respectively.

Results

Descriptive Statistics

The descriptive results of the self-report data are presented in Table 9 below. As the Joviality and Sadness scales were transformed into factor scores, the scale means (*M*) and standard deviations (*SD*) for the two conditions are standardized. The means for the two conditions reflect how far each group's mean deviates from the sample mean ($M = 0.0$, $SD = 1$). For example, considering the Joviality scale, participants who watched the sad target video, as expected, reported lower positive affect ($n = 81$, $M = -0.388$, $SD = 0.838$) at the end of the experiment than participants in the Happy condition ($n = 77$, $M = 0.350$, $SD = 1.037$), indicating a statistically significant difference in means of 0.738 ($t(156) = 4.866$, $p < .001$), i.e., a considerable difference in perceptions between the two experimental conditions. In contrast, when the outcome was measured by self-report on the Sadness scale, participants in Happy condition reported less sadness than average ($n = 77$, $M = -0.186$, $SD = 0.962$); however, those exposed to the sad stimuli did as well ($n = 81$, $M = -0.062$, $SD = 0.800$). The overall difference in standardized means between the two conditions was much smaller on the Sadness scale (0.124) than the Joviality scale (0.738), and non-significant.

Insert Table 9 about here

The descriptive results of the data from the judges' ratings are shown in Table 10, which presents the means and standard deviations of the JOV-R and SAD-R ratings on a 7-point ordinal scale. From the table, we get a sense that the overall scoring of emotion was relatively low, as all the means are close to zero, suggesting that the raters evaluated the participants as having very little visible signs of emotion. Overall, while not definitive, since both differences are small and non-significant, the results in Table 10 imply that raters identified slightly more expressed emotion regarding the sad stimuli for both scales (i.e., the means on both the JOV-R and SAD-R

scales are higher sad stimuli). Table 10 also suggests that the JOV-R scale provided more variability (higher standard deviations) in terms of emotional response, which was interpreted as supportive evidence for emphasizing the JOV-R scale to determine the effects of the various experimental conditions on participants.

Insert Table 10 about here

Summary of Two-Level Model Results with Positive Affect Outcome Measures

We refer to the proposed model presented in Figure 5. Between subjects, there are two between-subjects (Level 2) outcomes in the model. The first is the judges' score (on the JOV-R or SAD-R scales) and the second is the subjects' self-report factor score (on the Joviality or Sadness scales). Within subjects (Level 1), only the judges' score is shown, since this outcome is dependent on ratings over two occasions.

In Table 11, the results of the main two-level model with positive affect outcome measures are presented. Between subjects, the JOV-R score represents judges' ordinal ratings of subjects' displayed emotion. The second outcome is subjects' self-report factor score on the Happiness scale. Both are standardized ($M = 0$, $SD = 1$) between subjects. The reference condition for both outcomes is the Happy condition (watching the happy target video).

Insert Table 11 about here

For the judges' ordinal outcome, we can see that participants in the Sad condition were evaluated as expressing less happiness on average (-0.063) than the participants who watched the happy target video when controlling for other variables in the model; this relationship is in the right direction but was not significant ($p = .322$). Emotional contagion, as measured by the Emotional Contagion Scale (ECS), had an estimated effect on JOV-R judges' ratings in the

predicted direction (though non-significant); that is, a one standard deviation increase on the ECS, reflecting higher susceptibility to emotional contagion, would predict a .061 increase in emotion as measured by the JOV-R scale. Similarly, enduring affect, as measured by the Subjective Happiness Scale (SHS), also influenced JOV-R scores in the predicted direction—according to both the addition and interaction hypotheses, higher levels of trait-based happiness would predict higher susceptibility to picking up happy emotion. Although the relationship between subjective happiness and judges' ratings of participant happiness was in the predicted direction (γ = .170), it was non-significant (p = .494). The interaction between SHS and condition (i.e., the Sad Target) was also not significant (γ = -0.098, p = .735).

While the data by judges' ratings yielded no significant results, turning to the self-report factor scores (for Joviality), Table 11 suggests that participants watching the sad target video reported significantly lower self-report happiness scores (γ = -0.365, p < .001) compared to their peers watching the happy target video. This finding suggests that participants in the Sad condition reported their happiness level on the Joviality scale to be 0.37 of a standard deviation less than those who watched the Happy target video. Importantly, an increase in subjective happiness of one standard deviation would result in a 0.666 *SD* increase in self-reported happiness (on the Joviality scale) when assigned to the Happy condition (p = .004), controlling for the other variables in the model. At α = .10, the interaction between condition and SHS is significant (γ = -.379, p = .077). These findings are graphically depicted in Figure 6 below.

Insert Figure 6 about here

Considering the other covariates in the model, a one *SD* increase on the ECS would result in an increase of 0.136 (p = .075) in observed emotion; this finding is significant at the more

lenient alpha level of .10. The influence of demographic characteristics such as age and gender was not significantly related to the outcome on either measurement scale.

Importantly, the non-significance of the Level 1 (within subjects) variables for the JOV-R score in Table 4.3 suggests little possible impact of differences between occasions measured (p = .939), raters (p = .867), or their interaction (p = .256); i.e., variability on these components is not significantly predicting the outcome measured on the JOV-R scale. We can also note that the JOV-R and Joviality outcome measures are positively, but non-significantly correlated (r = 0.091, p = .295), suggesting that the rater scoring and participants' self reports may be tapping into different constructs.

Two-level Model Results With Negative Affect Outcome Measures

Table 12 presents the results of the main model with judges' scores on the SAD-R scale and the self-report Sadness scale used as outcome measures. Again, the baseline comparison is to the Happy condition. In contrast to the data collected on the positive affect measures, there were no significant relationships found on either the SAD-R or Sadness scales, even at the more lenient alpha of $\alpha = .10$.

Again, we find a non-significant, small correlation between the SAD-R and Sadness scales (r = -0.025, p = .896), suggesting that raters' scoring and participants' self reports are not measuring the same thing. None of the Level 1 (within subjects) variables contributed significant variance to these estimates, suggesting that raters, occasions, and the interaction between these terms did not affect judges' scores on the SAD-R scale.

Insert Table 12 about here

Discussion

Positive vs. Negative Affect

There is strong consensus for the presence of two main structures of self-reported mood at its broadest level—positive and negative affect (Diener, Larsen, Levine, & Emmons, 1985; Larsen & Diener, 1985; Russell, 1978, 1979; Watson & Tellegen, 1999). Given these findings, it seemed theoretically important to measure positive and negative affect separately on univariate scales, rather than on a bivariate continuous measure, with happiness on one extreme and sadness on the other (happiness being the absence of sadness and vice versa). Thus, the outcome measures in this study assessed positive and negative affect separately, and both types of measurement were included in the main two-level model. However, preliminary analyses-—including a factor analysis of the self-report measures, a generalizability study of the raters' scores (see Arakawa and Heck, under review), and a review of the descriptive data—all suggested that positive affect might provide a more reliable and useful scale of outcome measurement.

Factor analysis. A factor analysis was conducted to investigate the reliability of the self-report scales used to measure the outcomes, i.e., the Positive Affect (PA), Negative Affect (NA), Joviality, and Sadness scales from the Positive and Negative Affect Schedule – Extended Form (PANAS-X). Principal Component Analysis (PCA) yielded a component matrix for each scale showing which items contributed most strongly to the main component and its overall reliability (alpha).

When considering the matrices of the PA, NA, Joviality, and Sadness scales (Tables 5-8), we found that the positive affect measures (PA and Joviality) had greater reliability, or alpha levels, than the negative affect scales (NA and Sadness). Although this finding presents the

opportunity to use only the highest performing measure, the Joviality scale ($\alpha = 0.93$), as the self-report outcome variable in the main two-level model, we decided to keep a measure of negative affect in the analysis for consistency. Therefore, both the Joviality and Sadness measures were used as self-report outcome variables, in juxtaposition to the JOV-R and SAD-R scores from the judges' ratings. However, the Joviality scale clearly outperformed the Sadness scale (by an alpha difference of .10); an effect even more pronounced on the general scales, where the reliability of the PA scale was 0.17 higher than the reliability of the NA scale. Thus, when interpreting the results of the study, the preliminary factor analysis may justify prioritizing data on the positive affect dimension.

Descriptive statistics. In evaluating the relative merits of the positive and negative affect outcome measures, we can compare the descriptive results on each type of scale. Considering the self-report descriptive data in Table 9, we see the standardized means and standard deviations for the Joviality and Sadness scales, previously transformed into factor scores. The Joviality scale picked up considerable differences between the two experimental conditions in the predicted direction, i.e., participants watching the Happy stimuli reported higher happiness than those in the Sad condition, with a mean difference of 0.738. In comparison, the Sadness scale yielded a mean difference between conditions of only 0.124, with those watching the Sad stimuli actually reporting slightly less sadness, in non-conformance to the prediction. Additionally, on both the self-report (Table 9) and raters' data (Table 10), the positive affect scales (Joviality and JOV-R) provided more variability—i.e., higher standard deviations—than the negative affect scales (Sadness and SAD-R). Again, scales yielding higher variability are often desirable in assessment, to allow possible differences between subjects to be observed. Moreover, the ability of the Joviality scale to pick up a much larger mean difference between experimental conditions

than the Sadness scale also suggests that it is a better measure for our purposes, consistent with the findings from the factor analysis.

Altogether, considering the preliminary factor analysis, G study, and descriptive data, we have a case to exclude the negative affect outcome measures from our main analyses, and concentrate on interpreting the data gathered on the Joviality and JOV-R scales.

Does Enduring Affect Influence Susceptibility to Emotional Contagion?

In review, this study tested the hypothesis that "Trait-based affect, i.e., a happy or sad personality, affects susceptibility to catching either positive or negative emotions." Table 11 presented the results of the main two-level model with positive affect outcome measures. Considering the between-subjects results on the Joviality scale, we found that participants watching the sad target video reported significantly less happiness (γ = -0.365, $p < .001$) compared to their peers watching the happy target video, i.e., the main effect of emotional contagion by condition was demonstrated.

Next, given that participants in the Sad condition reported their happiness level on the Joviality scale to be 0.37 of a standard deviation less than those who watched the Happy target video—i.e., evidence of emotional contagion—we turn to the influence of enduring affect on this process. Here, we find that the variable measuring trait-based mood was significantly related to Joviality scores: an increase on the Subjective Happiness Scale (SHS; the measure of enduring affect) of one standard deviation would result in a 0.67 *SD* increase in self-reported happiness when assigned to the Happy condition (p = .004), controlling for the other variables in the model. The significance of the SHS variable supports the research hypothesis and supports the view that trait-based affect does indeed affect susceptibility to emotional contagion.

Enduring Affect and Emotional Contagion by Addition or Interaction?

Given that personality-based mood did significantly affect susceptibility to emotional contagion, we then examined the competing theories on how this process may operate, i.e., by addition or interaction. According to the addition theory, participants will be more likely to catch emotions that are congruent with their affective state. For example, people who tend towards habitual sadness will be more likely to catch sad emotion from a target. In contrast, the interaction theory predicts that happier people will be more likely to catch all emotions, in other words, a happy personality increases susceptibility to emotional contagion.

To test this theory, we return to the finding of a significant relationship between SHS and Joviality. The significance of this relationship means that as a person becomes habitually happier (i.e., as indicated through a one standard deviation increase in SHS), he/she picks up more happy emotion (0.67 *SD*, to be exact) when watching a happy video. However, both the addition and interaction theories predict that a happy personality will increase susceptibility to emotional contagion when watching a happy video. To test between the theories, we need to look at the interaction term in the model, Subjective Happiness*Sad Target, which is essentially a test of whether the lines are parallel, as in Figure 1, or non-parallel, as in Figure 3.

At a lenient test of significance ($\alpha = .10$), the interaction between condition and SHS was significant ($\gamma = -.379$, $p = .077$). This finding provides cautious support for the premise that a person with a happy personality (i.e., with a high score on the SHS) will decrease in happiness by an additional .379 of a standard deviation when watching a sad video. In essence, the interaction term tests whether the relationship between the target type (happy or sad) and self-reported emotional response is contingent on reported subjective happiness. More specifically, the finding suggests that having a self-reported happy personality becomes an added disadvantage in the Sad Target condition, which then gets added to the person's overall score.

Thus, if a person's average reported happiness is already declining by being in the Sad Target condition (-0.365), an individual with a reported happy personality (i.e., 1-*SD* above the mean) will have a greater decrease in happiness (-0.369 + -0.379 = -0.748) than someone at an average level of happiness by-trait. Thus, if we decide to accept the interaction term at a lenient level of significance, it provides support for interaction theory as the process by which mood affects emotional contagion; i.e., happy people are more susceptible to catching both happy and sad emotions, as shown in Figure 3.

Conclusion

In sum, this study suggests that enduring affect does indeed affect susceptibility to emotional contagion. Moreover, this investigation suggests that 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 lack of a stronger correlation between the judges' ratings and self-reports of emotion, which points to an area of future research. What accounts for the differences in performance between the self-report and observational measures? An investigation of the lower performance of the judges' ratings would improve our understanding of how emotion is experienced, expressed, and measured.

Table 1
Rater Dependability (Reliability)

Variable	JOV-R	SAD-R
Rater 1 – Rater 2	0.667	0.483
Rater 3 – Rater 4	0.602	0.312
Rater 5 – Rater 6	0.680	0.448
Rater 7 – Rater 8	0.616	0.146
All Pairs	0.607	0.312
Average Rater Pairs	0.641	0.347

Table 2
Component Matrix of SHS

	Component
	1
SHS2	.800
SHS3	.873
SHS4r	.709

$\alpha = 0.70$

Table 3
Component Matrix of ECS

	Component
	1
ECS1	.578
ECS2	.484
ECS3	.584
ECS4	.596
ECS5	.404
ECS6	.443
ECS7	.406
ECS8	.638
ECS9	.612
ECS10	.473
ECS11	.544
ECS12	.533
ECS13	.413
ECS14	.628
ECS15	.445

$\alpha = 0.81$

Table 4

Component Matrix of LOTR

	Component
	1
LOTR1	.552
LOTR3r	.669
LOTR4	.749
LOTR7r	.688
LOTR9r	.702

$\alpha = 0.75$

Table 5

Component Matrix of PA Scale (PANAS)

	Component
	1
PA1	.755
PA2	.577
PA3	.638
PA4	.803
PA5	.857
PA6	.842
PA7	.808
PA8	.705
PA9	.782
PA10	.813

$\alpha = 0.92$

Table 6
Component Matrix of NA Scale (PANAS)

	Component
	1
NA1	.575
NA2	.513
NA3	.606
NA4	.388
NA5	.613
NA6	.438
NA7	.616
NA8	.617
NA9	.706
NA10	.579

$\alpha = 0.75$

Table 7

Component Matrix of Joviality Scale (PANAS-X)

	Component
	1
Happy1	.893
Happy2	.904
Happy3	.906
Happy4	.884
Happy5	.839

$\alpha = 0.93$

Table 8

Component Matrix of Sadness Scale (PANAS-X)

	Component
	1
Sad1	.850
Sad2	.810
Sad3	.729
Sad4	.706
Sad5	.767

$\alpha = 0.83$

Table 9
Descriptive Statistics for Self-Report by Factor Scores Within Conditions by Joviality and Sadness Scales

		Joviality			Sadness		
Condition	*n*	*M*	*SD*	T-Test	*M*	*SD*	T-Test
Happy Stimuli	77	0.350	1.037	4.866**	-0.189	0.963	-0.894
Sad Stimuli	81	-0.388	0.838		-0.062	0.800	

Note. **$p < .001$

Table 10
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*	T-Test	*M*	*SD*	T-Test
Happy Stimuli	77	0.849	1.402	1.100	1.039	1.019	-1.694
Sad Stimuli	81	0.767	1.538		-0.062	1.147	

Table 11
Two-Level Model Estimates on the JOV-R Scale

Variables	Estimate	SE	T-Test	Sig.
Between Subjects (N = 158)				
Happiness Score[a]				
Sad Target	-0.063	0.079	-0.795	0.322
Emotional Contagion	0.061	0.110	0.553	0.612
Subjective Happiness	0.170	0.289	0.591	0.494
Subjective Happiness*Sad Target	-0.098	0.291	-0.338	0.735
Age	-0.063	0.060	-1.047	0.295
Female	-0.020	0.095	-0.216	0.829
Within Subjects[b]				
Occasions	0.018	0.241	0.076	0.939
Rater Teams	0.059	0.355	0.167	0.867
Occasions x Rater Teams	-0.400	0.352	-1.137	0.256
Between Subjects[a]				
Self-Report Happiness Intercept	1.171	0.464	2.524	0.012
Sad Target	-0.365	0.068	-5.356	0.000
Emotional Contagion	0.136	0.076	1.780	0.075
Subjective Happiness	0.666	0.230	2.901	0.004
Subjective Happiness*Sad Target	-0.379	0.214	-1.770	0.077
Age	0.015	0.085	0.173	0.836
Female	-0.109	0.073	-1.488	0.137
Level 2 variance (Score)	10.882	1.883	5.778	0.000
Level 2 variance (Self-Report)	0.727	0.081	9.014	0.000
Correlation	0.091	0.087	1.046	0.295
Log likelihood	-1620.5			
Free parameters	25			

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

Table 12
Two-Level Model Estimates on the SAD-R Scale

Variables	Estimate	SE	T-Test	Sig.
Between Subjects (N = 158)				
Sadness Score[a]				
Sad Target	-0.068	0.087	-0.776	0.438
Emotional Contagion	0.062	0.110	0.561	0.575
Subjective Happiness	0.165	0.289	0.571	0.586
Subjective Happiness*Sad Target	-0.090	0.291	-0.308	0.758
Age	-0.058	0.061	-0.952	0.341
Female	-0.025	0.095	-0.261	0.794
Within Subjects[b]				
Occasions	-0.170	0.208	-0.816	0.414
Rater Teams	-0.244	0.981	-0.248	0.804
Occasions x Rater Teams	0.071	0.626	0.114	0.910
Between Subjects[a]				
Self-Report Sadness Intercept	-0.205	0.425	-0.482	0.630
Sad Target	0.102	0.081	1.259	0.208
Emotional Contagion	0.149	0.138	1.085	0.278
Subjective Happiness	-0.058	0.240	-0.244	0.807
Subjective Happiness*Sad Target	-0.111	0.241	-0.460	0.645
Age	-0.054	0.041	-1.329	0.184
Female	-0.015	0.076	-0.198	0.843
Level 2 variance (Score)	10.893	1.125	5.237	0.000
Level 2 variance (Self-Report)	0.745	0.188	3.962	0.000
Correlation	-0.025	0.190	0.130	0.896
Log likelihood	-1621.0			
Free parameters	25			

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

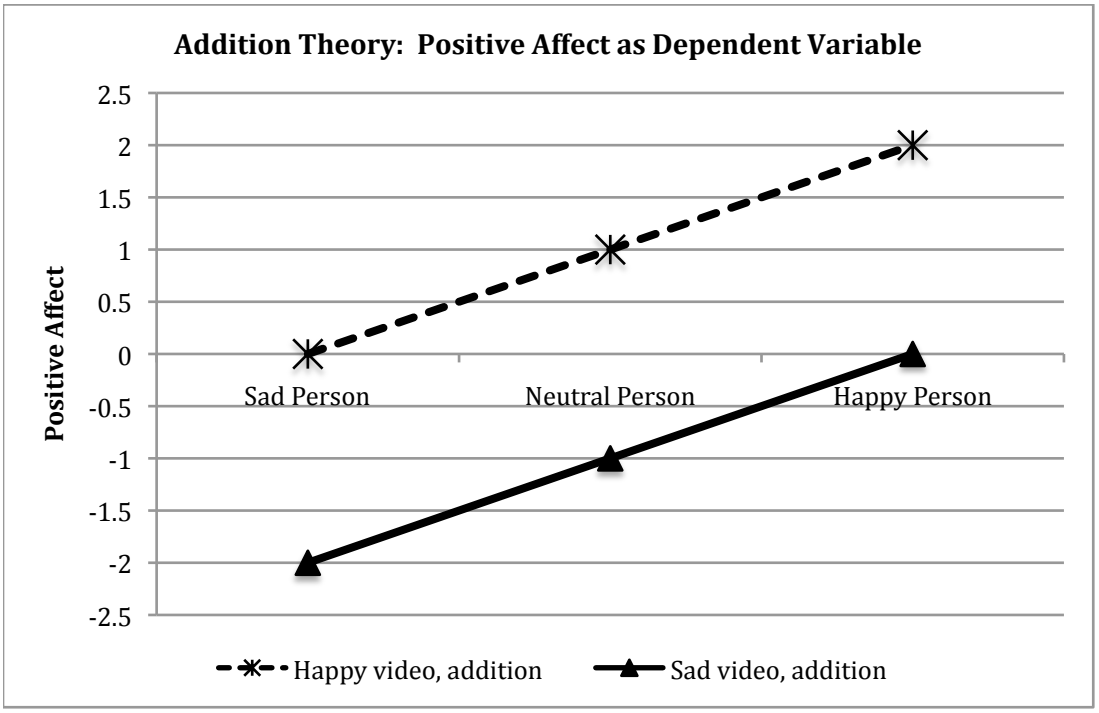

Figure 1. Addition theory: Positive affect as dependent variable

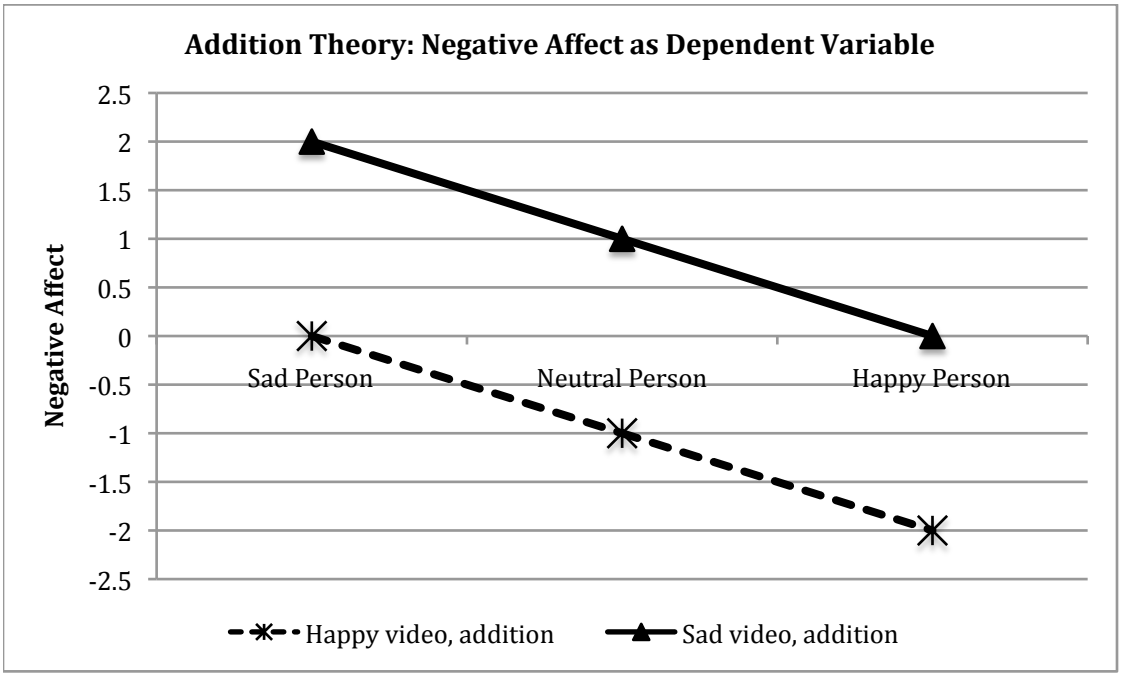

Figure 2. Addition theory: Negative affect as dependent variable

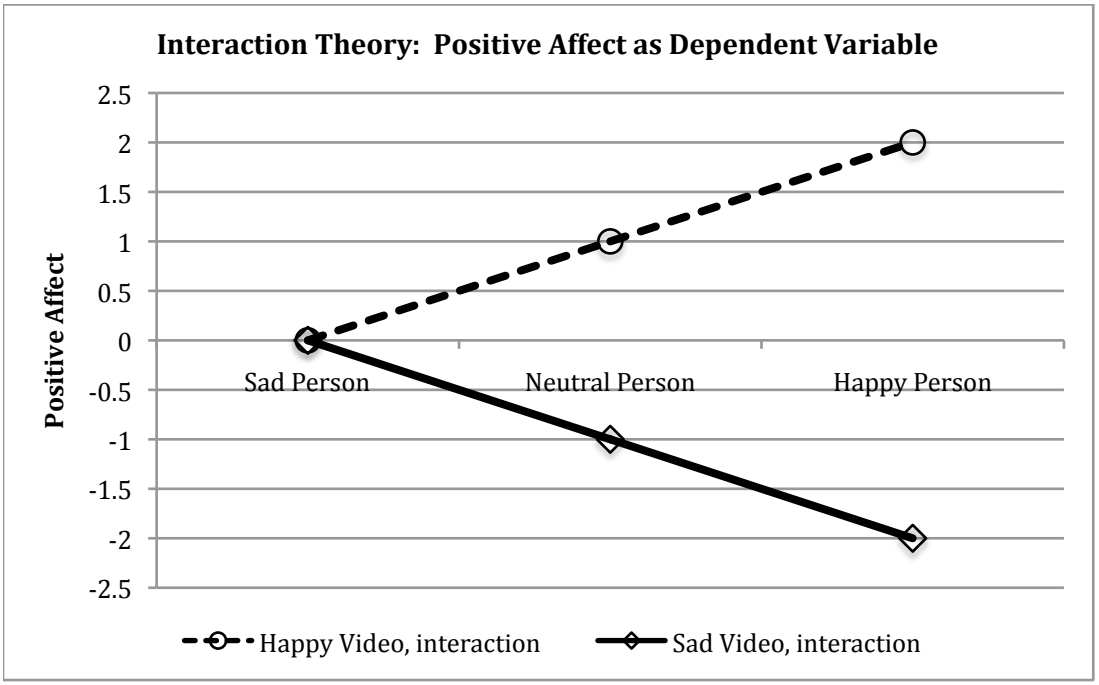

Figure 3. Interaction theory: Positive affect as dependent variable

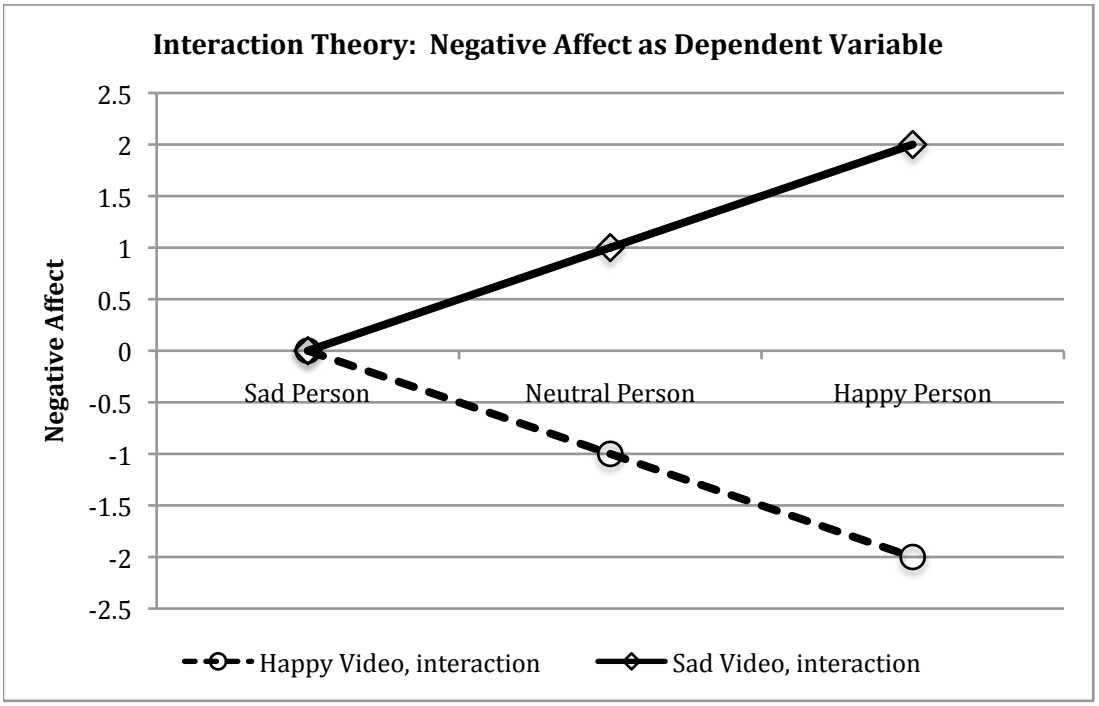

Figure 4. Interaction theory: Negative affect as dependent variable

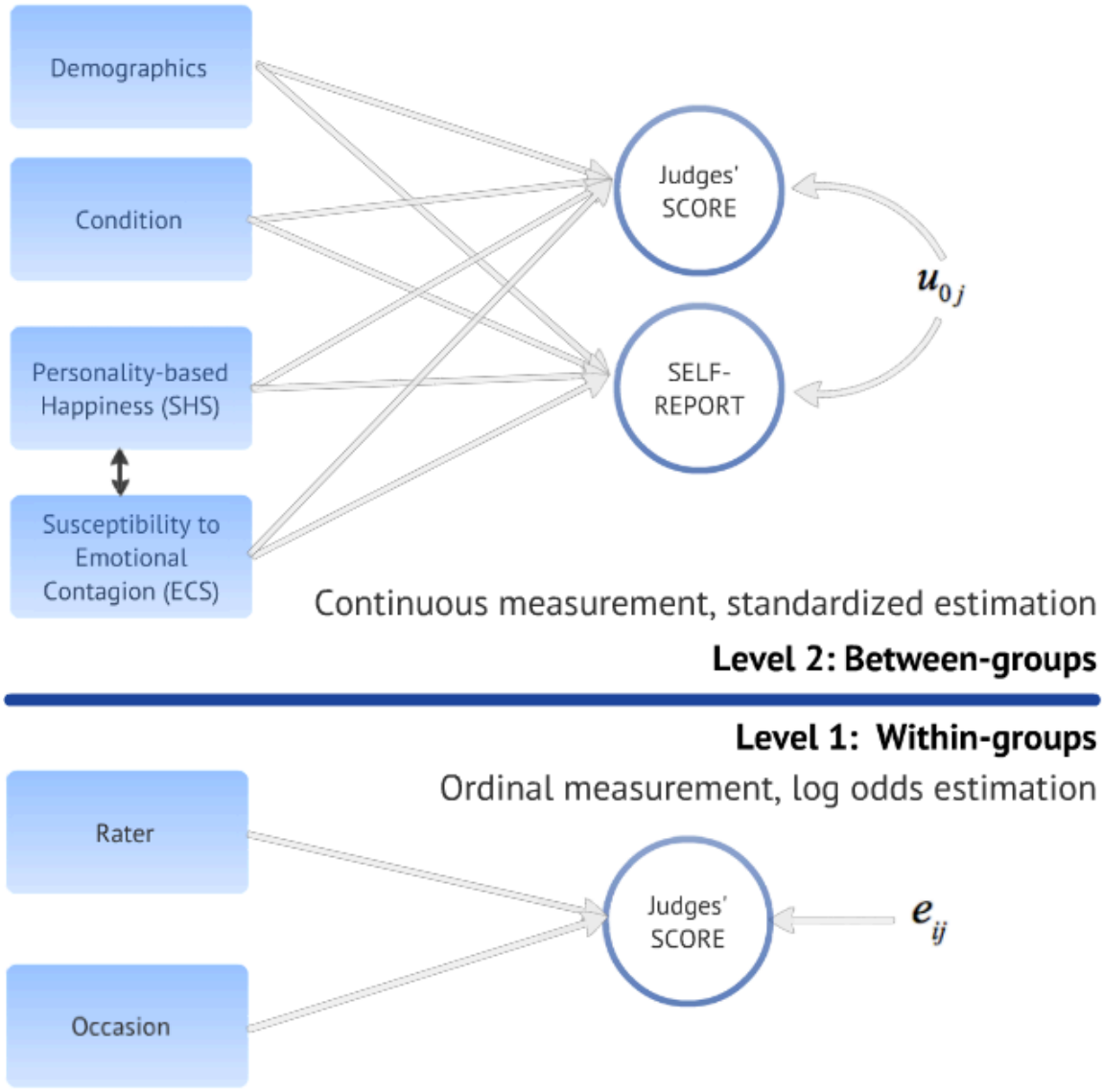

Figure 5. Two-level model

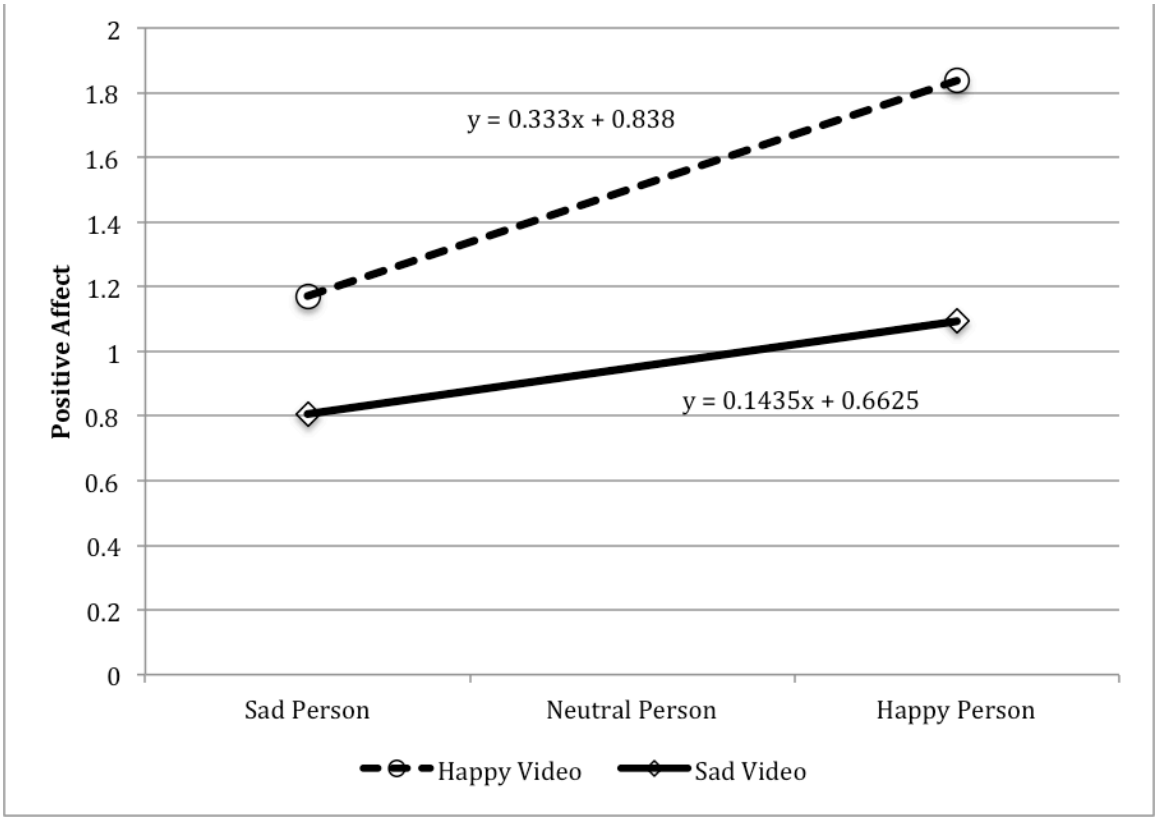

Figure 6. Outcome measured on the Joviality scale.

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