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Sulleen V. Kauffman

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The Relation Between Trustworthy Behavior and Facial Mimicry: An Examination of Behavior in a Trust Game

A thesis submitted in partial fulfillment of the requirement for the degree of Bachelor of Arts in Psychological Sciences from The College of William and Mary

by

Sulleen Vanessa Kauffman

Accepted for Honors

(Honors)

Joanna Schug, Ph.D., Director

Christy Porter, Ph.D.

Jaime Settle, Ph.D.

Williamsburg, VA
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The Relation Between Trustworthy Behavior and Facial Mimicry: An Examination of Behavior in a Trust Game

Sulleen V. Kauffman

College of William and Mary
Can you determine whether or not someone is trustworthy just from the expressions on their face? This study sought to explore the relation between facial mimicry of emotional expressions and trustworthy behavior in a trust game. Using the Facial Action Coding System (FACS), we examined whether participants mimicked specific action units (AUs) of facial expressions associated with the emotions of happiness and sadness, when asked to infer a target’s emotional state or a target’s age. We examined trustworthiness of participants using a trust game, in which participants were entrusted with a sum of money by another player, and chose to either split the endowment between themselves and the other player or to keep it for themselves. We found that trustworthy individuals display more mimicry of happiness, but not sadness, in conditions in which they are motivated to understand a target’s emotional state. No relation between trustworthiness and facial mimicry was found when participants were not motivated to infer the target’s emotional state.

*Keywords*: FACS, facial mimicry, emotional expressivity, trustworthiness
The Relation Between Trustworthy Behavior and Facial Mimicry: An Examination of Behavior in a Trust Game

There have been countless movies, television shows, and books about the art of deceit. How can we lie and get out of a punishment from our parents or out of a speeding ticket? How many criminals have fooled their juries by looking despondent and innocent? In addition to extensive pop culture media centered on this concept, common knowledge often emphasizes various ways to accomplish such a task. Look calm, avoid fidgeting, make eye contact. However, there are some things that we cannot control, such as those minute facial expressions that flicker across our faces in the span of less than a second. We may be attempting to remain cool and collected, but that flash of anger or that glimmer of sadness may still shine through, if only for a moment. Although there are many cues that may signal one’s true intentions, making decisions about dishonesty based on facial expressions is a risky endeavor. Perhaps it is better to look for those who are honest instead of trying to weed out the liars.

A growing body of scientific research has sought to examine whether emotional expressions can be used to discern “good” people (such as those who are telling the truth or have prosocial or altruistic dispositions) from “bad” people (such as those who are lying or have antisocial traits). While various facial expressions have been studied as possible cues that signal trusting behavior, one of the most prominent expressions involves the smile. In general, those who display more smiles are more likely to cooperate than those who do not and are more likely to be trusted (Reed & DeScioli, 2017; Scharlemann, Eckel, Kacelnik, & Wilson, 2001). This is consistent with the concept that smiles act as a predictive signal of cooperation. Furthermore, happy partners are trusted more than angry partners (Kret, Fischer, & De Dreu, 2015). Smiling predicts affiliative intent in that those who display more genuine smiles tend to return more
money to partners in an investor game (Danvers & Shiota, 2018). The act of expressing positive emotions, as portrayed through smiles, may serve as a signal of affiliative intent. Therefore, if we want to be trusted more in an interaction or investment game, we should smile more frequently.

Much of the research on facial expressions and prosocial behavior has been conducted from an evolutionary perspective. These studies generally propose that facial expressions, especially genuine displays of happiness, can serve as honest signals of cooperative intent. During genuine displays of happiness, known as “Duchenne” smiles, the facial musculature around the eyes known as the orbicularis oculi contracts, creating creases in the corner of the eyes and narrowing the eyes. This musculature is extremely difficult for individuals to consciously control or “fake”, thus many studies have proposed that Duchenne smiles can signal true affiliative intent.

The idea that “unfakeable” attributes can increase cooperation is long standing in the evolutionary biology literature. One classic theory known as the “green beard” theory of altruism (Hamilton, 1964) proposes that any marker that signals true cooperative intent can allow cooperation to flourish in a population. This occurs when a specific, perceptible trait is recognized by others and those individuals are given preferential treatment. The theory was given the name “green beard” due to the example of using green beards as one of these signals of altruistic intent. For instance, if all cooperative individuals had a green beard, and no non-cooperative individuals had a green beard, then cooperative individuals could easily identify each other and selectively interact only with those with green beards. This phenotypic representation of a gene for behavioral altruism may be favored by natural selection if the altruism is directed at those who share the same gene. Because we cannot see our genetic code, a physical representation allows individuals to make educated distinctions. Furthermore, this signal
recognition must elicit social acts that are beneficial to the recipients while being costly to the proposers. Such a cost prevents individuals from lying and faking the signal; the benefit would not be worth the cost. Positive facial expressions of emotion like smiling serve as reliable predictors as long as they are impossible to fake or costly to produce; if not, expressions would be mimicked with great ease and be deemed unreliable. If we demonstrate an honest signal of altruistic intent, the recipient would benefit and see us as a trustworthy partner for future interactions. Perhaps the emotional expression of true happiness can serve as the “green beard” signal of altruism.

Other scholars have argued that positive facial expressions of emotion may not be unique in their ability to signal prosociality. Indeed, displays of happiness can be associated with “duping delight,” one of the three most common types of emotion associated with deceit: fear, guilt, and excitement (Vrij, Roberts, & Bull, 2000). The third emotion of excitement is an example of how positive emotions can indicate antisocial tendencies. Thus, these scholars argue that we cannot simply rely on the display of only positive emotions to determine the trustworthiness of another individual.

Overall emotional expressivity has been proposed to be helpful in the cooperative process. Emotional expressivity is defined as the accuracy with which an individual communicates their emotions (Boone & Buck, 2003), and can help to reveal the desires and intentions of the individual while allowing others to make decisions about their intent to cooperate. Such expressiveness allows others to lower their degree of uncertainty when considering the other person’s decisions. The cost associated with emotional expressivity means that trustworthiness is more difficult to fake: any intent to defect would be immediately discernible on the face, making it increasingly difficult to hide motivational intentions. Because
emotionally expressive individuals may find it more difficult to hide their expressions, it may be in their best interests to be trustworthy. The immediate effect of emotional expressivity on our first impressions of others allows us to successfully cooperate with strangers.

We pay more attention to individuals who are emotionally expressive because we get a glimpse into their possible motivations. A study on visual attention found that the character’s facial expression immediately influenced the participant’s length of fixed attention (Schrammel, Pannasch, Graupner, Mojzisch, & Velichokovsky, 2009). The duration of fixed attention was longer for angry and neutral expressions than for happiness. This could be a consequence of noting threat-related expressions. In the neutral case, these results may indicate that the individual is waiting for subsequent facial movement to signal the character’s intention. The ability to recognize fear and sadness is related to prosocial behavior and social value orientation (Kaltwasser, Hildebrandt, Wilhelm, & Sommer, 2017). This study suggests that prosocial individuals are more sensitive to stimuli indicating distress, helplessness, and dominance. Evolutionarily, this sensitivity would be beneficial as such prosocial tendencies would allow us to recognize distressed or weaker individuals and provide aid. If these individuals were not expressive and unable to portray the pain they were feeling, they might not have received help and consequently, they might not have survived.

While emotional expressivity has been shown to be a reliable predictor of cooperation and trustworthiness, some facial expressions have demonstrated diminished cooperation. Reed, Zeglen, and Schmidt (2012) found that anger, fear, and enjoyment serve as honest signals of cooperative intent. Contempt, however, was shown to lead to reduced cooperation. When a sender displayed a contemptuous facial expression, fewer receivers were willing to cooperate. In competitive relationships, facial mimicry has been shown to be a reaction to the emotion
displayed by the other individual (Hess & Fischer, 2013). This suggests an antagonistic, rather than affiliative, frame of mind. The results of this study indicate that we do not mimic the actual expressions displayed by others but rather our understanding of the other person’s emotional intentions. However, those who are more emotionally expressive were shown to be more likely to reveal their motivational intentions. These studies demonstrate that the relationship between emotional expressivity and trustworthiness is positive but not always clear.

Overall, the belief or disbelief in the trustworthiness of the partner can distinctly influence the trusting behavior of non-altruistic individuals (Macko, Malawski, & Tyszka, 2014). Although those who display increased levels of emotional expressivity in general are more likely to cooperate, that does not necessarily mean that their partners will reciprocate.

Theories of emotional expressivity propose that any emotion may signal cooperative intent or prosociality, provided that the emotion is genuine and displayed in a situation in which the emotion can signal their prosocial distribution. For instance, when individuals are put into a situation in which they are presented with unfair or immoral behavior, prosocial individuals tend to show increasing expressions of disgust, anger, and sadness, along with fewer expressions of happiness (Chapman, Kim, Susskind, & Anderson, 2009). These results suggest that moral transgressions trigger facial motor activity that is also triggered by disgust stimuli. Thus, these feelings of disgust were found to be the strongest predictors of decision making in reference to unfair offers, though not necessarily trusting behavior. Similarly, Schug, Matsumoto, Horita, Yamagishi, and Bonnet (2010) compared the emotions displayed by pro-self and prosocial individuals in the context of an economic game. Compared with unfair proposers, fair proposers were found to be more likely to express all types of emotion. Additionally, proposers who
display relatively cooperative tendencies seem to be more emotionally expressive when confronted with unfair treatment (Schug et al., 2010; Centorrino et al., 2015).

**Empathy and Facial Mimicry**

In addition to the above lines of research, other studies propose that empathy is related to prosociality. Empathy has been defined as an emotional response to our perception of others’ emotional experiences (Rymarcyzk, Żurawski, Jankowiak-Siuda, & Szatkowska, 2016). Highly empathic individuals display greater mimicry of emotional expressions, suggesting that automatic mimicry may be a component of emotional empathy. Individuals seem to mimic not only the smiling and frowning that is associated with positive and negative emotions, respectively, but they also mimic discrete emotions such as fear and disgust. Fear and disgust represent negative reactions to a situation: fear from an angry and/or threatening individual or event and disgust from an appalling or possibly dangerous stimulus.

Perspective taking is our ability to put ourselves in the other person’s position. In this vein, Chartrand and Larkin (2013) claim that dispositional empathy occurs when individuals high in perspective taking mimic their interaction partners more than those who are low in perspective taking. Trusting behaviors tend to increase after a person had been mimicked. We can infer that the outcome is likely to be more favorable for people if they demonstrate increased levels of mimicking. Because empathetic individuals have been shown to display higher levels of mimicry, these empathetic individuals may receive better interaction outcomes from their partners than those who are less empathetic, and thus, lower in perspective taking (Rymarcyzk et al., 2016; Chartrand & Larkin, 2013). Although empathetic individuals have been shown to display a higher degree of facial mimicry, the outcome in a trust situation may be affected by the
emotion associated with the mimicked expression. Mimicry of positive emotions such as smiles may lead to increased cooperation when compared to negative emotions.

Studies show that mimicry of facial expressions of emotion may be related to prosocial behavior. Facial mimicry is the replication of another person’s facial expression(s) and has been suggested to be a quick, reflex-like movement beyond our control. Spontaneous facial mimicry has been shown to be facilitated by the inference of the partner’s emotional state (Murata, Saito, Schug, Ogawa, & Kameda, 2016). Studies have also shown that mimicry increases helpfulness and prosocial behavior toward others in general (van, Holland, Kawakami, & Ad, 2004). So, if an individual wants to elicit prosocial behavior from someone else, the likelihood of achieving that goal increases if they mimic the other person. Individuals who demonstrate high levels of mimicry show increased emotional expressivity and increased empathy. It is possible that this increased emotional expressivity is linked with increased empathy through the objective of perspective taking. They must attempt to understand what the other person is feeling, which may lead to increased mimicry.

Current Study

The current study seeks to examine the hypothesis that facial mimicry will be higher in individuals who are considered trustworthy. To measure trustworthiness, we will examine prosocial behavior in a trust game with the explicit instruction to infer either the target’s age or emotional state. The particular domain of emotional expression that we will examine is mimicry of facial expressions. As described previously, facial mimicry has been indicated as a potential behavioral manifestation of empathy, which is related to prosocial behavior. Specifically, we will examine mimicry of positive and negative emotions: happiness and sadness. By focusing on the
mimicry of both happy and sad facial expressions, we can examine the divergent predictions made by the previous literature.

The empathy perspective or the overall expressivity point of view predicts that both positive and negative expressions will be positively related to prosocial behavior, particularly the mimicry of these expressions. Thus, the prediction is that both positive and negative expressions of emotion will positively relate to trustworthy behavior. The literature on evolutionary theory proposes that specifically positive emotions are indicative of prosocial tendencies. Thus, it would be believed that the mimicry of happiness, but not sadness, will relate to trustworthy behavior.

Previous research (Murata et al., 2016) has shown that facial mimicry does not always occur spontaneously, particularly when individuals are not specifically motivated to infer the emotional state of a target. A study was conducted to examine facial mimicry in two conditions, one in which participants were asked to infer the emotional state of the target, and another in which participants were asked to infer a non-emotional attribute, such as the target’s age or weight. In our study, we observed spontaneous facial mimicry in response to stimuli in conditions in which participants were instructed to infer the target’s emotion or age.

**Hypotheses and predictions**

Overall, the current study sought to examine several hypotheses. Some of these hypotheses are based on well-established literature, while others are more exploratory in nature. The first hypotheses we test in this study are intended to replicate results of previous studies. First, we expected this study to generally replicate the effects of Murata and colleagues’ (2016) study, which showed that facial mimicry was more likely to occur when participants were instructed to infer the emotional state of a target, but did not occur as often when participants
were asked to infer a non-emotional attribute, such as the target’s body weight or age. Thus, our first prediction is that

Prediction 1: Participants will show more mimicry overall in the emotion inference condition relative to the age inference condition.

The second prediction is similarly based on existing literature. Research on reciprocity in the trust game has demonstrated strong effects of reciprocity, whereby people tend to behave in more trustworthy ways when they have been trusted more by their partner. The trust game implemented in this study consisted of two roles wherein the allocator determined the amount of money to be sent and the responder determined how to split that amount of money. Participants played both roles in our study. Behavior in the role of the allocator represents trusting behavior, whereas behavior in the role of responder represents trustworthy behavior. Responders decide what they would do based on the various possible allocation amounts, which allows for assessment of trustworthy behavior across all six levels of trust.

Prediction 2: We expected that the more an individual is trusted (i.e., the larger the portion of the endowment is sent by the allocator), the more likely they are to respond with trustworthy behavior (i.e., will be more likely to split the endowment, rather than take it for themselves).

**Exploratory Hypotheses.** As described above, there are several theories that could be used to generate hypotheses relating facial mimicry to trustworthy behavior. While each of these theories
predicts some positive relation between facial mimicry/expression and trustworthy behavior, they differ slightly in their specific predictions.

First, as Murata and colleagues (2016) showed that facial mimicry was more likely to occur when participants were asked to infer the emotional state of a target rather than non-emotional attribute, we speculate that mimicry shown when participants are asked to infer a target’s emotional state may more directly assess overall empathic tendency than when participants are not focused on inferring a target’s emotional state. If so, we can predict that mimicry observed when participants are asked to infer a target’s emotion (but not their age) will relate to trustworthiness. That is, observing facial mimicry shown by participants when participants are told to attend to a target’s emotional state may be a better measure of empathy and prosocial tendency. Thus, we predict that:

Prediction 3: Trustworthy individuals will be more likely to mimic emotion in the emotion inference condition rather than the age inference condition.

The last two predictions are two competing hypotheses that have been described above. The first is the hypothesis that positive facial expressions of emotion are particularly useful in signalling prosocial intent. This hypothesis argues that facial expressions of happiness will be more likely to be mimicked by trustworthy individuals, leading to

Prediction 4a: Trustworthy individuals should show more mimicry of happiness compared to facial expressions of sadness.
However, other studies suggest that positive displays of emotion are not unique in their propensity to signal prosociality; in certain contexts, negative facial expressions of emotion can also signal prosociality. In this sense, people who are generally more expressive overall may show both positive and negative facial expressions of emotion, which might signal trustworthy intentions. Thus, emotional expressivity overall can signal prosociality, which would propose that

Prediction 4b: Trustworthy individuals will show more mimicry of both happiness and sadness than non-trustworthy individuals.

Method

Participants

The participants consisted of 110 students\(^1\) from the College of William and Mary recruited through SONA. We included 67 women and 37 men, while the remaining did not report gender or were missing data for gender. Mean age = 18.98, SD age = 1.097, ranging from 18 to 24 years old.

Procedure

Participants arrived at the lab and took part in the experiment in groups of three (3) to four (4). Participants were greeted and immediately ushered to private cubicles; they did not meet or interact with other participants in the laboratory.

Trust Game. Participants took part in a trust game in the role of both the allocator and the responder. The trust game was administered using a computerized task programmed in z-tree (Fischbacher, 2007). Participants were given an initial endowment of $6 and decided how much of that endowment to send to a responder, in $1 increments. Any amount sent to the responder

\(^1\) Of these students, 108 completed both the facial mimicry task and the trust game task.
was tripled. Participants were informed that they would be paired with another participant currently in the lab, but were not told which of the other participants they would be paired with. The responder would choose whether to either a) split the money equally between him/herself and the participant (i.e., the allocator) or b) take all of the money for him/herself.

Next, all participants played the trust game in the role of the responder. Participants were not informed in advance that they would play the trust game in both roles. Trustworthy behavior was assessed using the strategy method (see Brandts & Charness, 2011, for a review). In the strategy method, participants decide, for each possible allocation, whether to either a) split the allocation evenly or b) take all of the money for themselves. Thus, each participant makes six decisions to split or take the money, for amounts of $3, $6, $9, $12, $15, and $18 (i.e., the tripled amount of the proportion of the allocation sent by allocators).

The trust game and its variants have been frequently used as a behavioral measure of trust and trustworthiness. Behavior in the role of the allocator represents trust: the more participants trust the responder, the larger the portion of the endowment they should send to the responder. However, if the participants do not trust the responder, they should send a smaller portion of the endowment, or none at all. Thus, the amount sent by allocators to the responder represents the extent to which they trusted the responder. Behavior in the role of the responder represents trustworthiness, which is the main focus of the current study. Trustworthy individuals should send back half of the endowment to the allocator, while individuals who are not trustworthy will keep all of the money for themselves.

**Facial Mimicry Task.** To assess participants’ tendency to mimic facial expressions of emotion, we employed a computerized task whereby participants were presented with stimuli of

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2 No deception was used in this study: participants’ payments were determined by the actual outcome of one of the transactions that took place during the study.
facial expressions and their facial movements were observed. Participants sat behind a modified teleprompter box with a computer monitor positioned behind a wooden divider. The monitor was connected to a computer controlled by the experimenters while the teleprompter box had a shelf to hold the mouse used to navigate the experimental program. A mirror slanted at approximately 45 degrees was placed in the ceiling of the box in order to reflect the image of the computer monitor. This allowed the image to appear directly in front of the participant instead of below. A video camera was placed behind the mirror to record the participants’ facial expressions. Participants were informed that their facial expressions would be recorded.

The program for presenting stimuli was designed in an open-source, Python-based program called OpenSesame version 2.8.1 (Mathôt, Schreij, & Theeuwes, 2012). The video camera was activated before beginning the mimicry task. Prior to engaging in the facial mimicry task, participants were asked to produce three facial expressions of emotion: anger, happiness, and sadness, and held the selected facial expression for five seconds. This task was included to test the camera and ensure that the participant’s face was visible, as well as to allow participants to become accustomed to having their facial expressions recorded. After the first portion, participants alerted the experimenter that they had finished so that the experimenter could adjust the video camera.

The second portion of the experiment did not begin without the experimenter pressing a specific key on their computer. After this key was pressed, the second part of the experiment instructed participants to infer either the age or feelings of the person in the video based on a series of videos. Stimuli consisted of 24 videos including 12 European faces and 12 Japanese faces; there was a gender breakdown of six (6) men and six (6) women for each ethnicity.
The European faces were pulled from the Japanese and Caucasian Facial Expression of Emotion (JACFEE) database (Matsumoto & Ekman, 1998) while the Japanese videos were taken from the Advanced Telecommunication Research International (ATR) database (Kamachi et al., 2001). In both databases, the facial expressions were certified by Emotion Facial Action Coding System (EMFACS; Friesen & Ekman, 1978) to be representative of the appropriate emotions. Two (2) stimuli videos were created for each expression including anger, sadness, and happiness, as well as for each gender/ethnicity combination for a total of six (6) videos. These emotions were selected on the basis of Ekman’s six universal emotions and the fact that these three emotions were most frequently mimicked in the study by Murata et al. (2016).

Each video was a morph from a neutral expression to an emotional expression that was created using Popims Animator (Guigan, Vinther, Scarbroug, & Guigan, 2010). Each morph lasted 3.9 seconds and consisted of 20 frames: a neutral frame lasting 2000 ms followed by 18 frames in the morph lasting 50 ms per frame, and ending with 1000 ms of the fully-morphed expression. This timing is consistent with the study conducted by Murata et al. (2016). Four (4) counterbalanced versions of the program were created that varied in both the order that the videos were presented as well as which videos were primed with an age or emotion inference.

Prior to video presentation, participants were primed with the question to be answered: “How does this person feel?” or “How old is this person?”. A fixation cross was shown for 500 ms followed by a beep to signal the start of the video. An additional beep was used to signal the end of the video, followed by 500ms of a blank, black screen. After this blank screen, a multiple-choice question was presented with one of the previous questions: “How does this person feel?” or “How old is this person?”. The possible answer choices to the first question consisted of six (6)

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3 As the focus of this thesis is on general facial mimicry and its relation to trustworthy behavior, rather than effects of target gender or race, we do not examine the effects of target gender and race on mimicry behavior.
universal emotions including sad, happy, angry, fearful, surprised, and disgusted (Ekman, 1972). Participants received unlimited time to answer the question; answer selection automatically triggered a third beep at a different frequency than the previous two beeps. Then there was another 500 ms of blank screen, followed by the next prime-fixation-video-blank-question sequence. After completing the video portion of the study, the participant proceeded to a separate booth, where they filled out a Qualtrics survey with demographic information.

**Coding of facial expressions of emotion**

To examine facial mimicry of emotional expressions, we used the Facial Action Coding System (FACS). FACS was developed by Ekman and Friesen in 1978. This system was created through the examination of all of the possible muscle movements, and combinations of those movements, in the human face. These individual groupings of co-occurring muscle movements are labeled action units (AU) and are assigned numbers ranging from 1 to 92. Ekman and Friesen (1978) were determined that no preconceptions be made to link particular muscle movements to particular emotions. However, these links were explained after the creation of FACS through the examination of various emotional facial expression studies (Ekman, Friesen, & Hager, 1978).

The current study utilized an abridged version of FACS known as Emotion FACS, or EMFACS, to target emotionally relevant AUs (Friesen & Ekman, 1978). Many studies have confirmed the links between Ekman’s six basic emotions (happiness, sadness, anger, distrust, fear, and surprise) and the corresponding FACS-coded facial expressions. This abbreviated version of FACS allows increased efficiency in the coding of facial expressions through the removal of AUs that have not been implicated in the expressions of the six major emotions (Friesen & Ekman, 1983). The current study examined the facial expressions of happiness and sadness using EMFACS.
For each video, 14 action units (AUs) were coded using EMFACS. The coder was blind to condition and content of the stimulus-video for each face they coded. AUs were coded at the sound of beeps in the videos; expressions occurring between the beeps were not coded.

The majority of the videos were roughly seven minutes; coding usually began after one minute of introduction and various trial facial expressions. Depending on the number of facial expressions present throughout the video, coding each video took between ten minutes and 30 minutes. This variety in time is due to the fact that the coder repeated certain video segments to ensure accuracy, sometimes covering half of the screen in order to isolate the upper or lower face.

Occasionally, certain AUs would not be coded if that expression (e.g. breathing through one’s mouth) appeared to be the participant’s neutral expression. Furthermore, certain AUs could not always be coded due to various circumstances, such as participants covering portions of their faces with their hands or shadows resulting from insufficient lighting. In these cases all AUs were recorded as missing data.

To check for reliability of coding, generally FACS codes must be confirmed by two or more coders who show high-interrater reliability in their assessments of the appearance of AUs. In this undergraduate honors thesis, data from only one coder (the student author) was used. As the reliability of the codes cannot yet be verified, all results reported below should be considered preliminary.

**Results**

First, we sought to replicate the results of Murata et al.’s (2016) study, which found that individuals are generally more likely to mimic others when they are motivated to infer the target's emotional state. To examine mimicry of facial expressions in each condition, we
computed the mean number of trials that each action unit (AU) was observed in,\(^4\) then compared mimicry of AUs relevant to each emotional expression across the age inference condition (in which participants inferred the target’s age) and the emotion inference condition (in which participants inferred the target’s emotional state).

We were particularly interested in determining whether AUs specifically related to facial expressions of happiness and sadness would be more likely to be observed when participants viewed a target showing each expression and were asked to infer the target’s emotional state (emotion inference condition), relative to when participants were asked to infer the target’s age (age inference condition).

Although 14 AUs were coded for all of the videos, we narrowed down this list to six AUs to demonstrate the emotional expressions that interested us in the context of this study. Sadness was indicated by three AUs: AU1, AU4, and AU15. AU1 is labeled the inner brow raiser because this movement isolates the central portion of the large muscle in the scalp and forehead, causing the eyebrows to raise. In contrast, AU4 is termed the brow lowerer to indicate the muscle, consisting of three strands, that pulls together and lowers the brow. AU15 is called the lip corner depressor because this muscle, which begins in the side of the chin and goes upward to attach near the corner of the lip, pulls the corners of the lips downward.

To isolate the expressions of happiness, we examined AU6 and AU12. Named the cheek raiser and lid compressor, AU6 consists of the muscle that circles the eye and extends toward the eyebrow (the orbicularis oculi); the activation of this AU pulls skin downward from the eyebrows and upward from below the eye, creating characteristic “crow feet” wrinkles in the

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\(^4\) Although videos were coded by the intensity of emotional expressions on a scale from 0 (not observed) to 5 (extreme high intensity), we were primarily interested in whether an emotional expression occurred or not. Thus, the following analysis examines whether an AU was present or not for each trial, and does not take intensity into account.
outer corner of the eye upon contraction. AU12 focuses on the zygomatic major muscles high in the lower face, near the cheekbones, that attach to the corners of the lips. Aptly named the lip corner puller, this muscle movement pulls the lip corners toward the cheekbones in an oblique direction. The mean proportion of trials in which each AU was observed is shown in Figure 1. The top panel shows AUs observed in response to facial expressions of happiness, while the bottom panel shows AUs observed in response to facial expressions of sadness.

As shown in the top panel of Figure 1, for trials when participants were asked to infer the target’s emotional state (relative to trials when participants were asked to infer a target’s age), AU12 (lip corner puller) was observed in a larger proportion of trials, $t(109)=2.09, p=.03, d=.199$. In addition to AU12, we also found that AU20 (lip stretcher) was similarly more likely to be observed in response to facial expressions of happiness in the emotion condition, relative to the age condition, $t(110)=1.99, p=.0488, d=.189$. No other significant differences were observed between the two conditions, including AU6.

For sadness, the only AU that differed between the two conditions was AU4 (brow lowerer), which, as predicted, was observed more frequently in the emotion inference condition relative to the age inference condition, $t(108)=2.47, p=.0152, d=.236$. Other AUs relevant to expressions of sadness, such as AU1 and AU15, did not significantly differ by condition.

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AU20 (the lip stretcher) is typically observed in facial expressions of fear, but in very low intensities the facial movement may appear similar to AU12. The lip stretcher consists of the muscle beginning near the back of the jaw that attaches to the lip corner. This action pulls the lip laterally toward the ears. The high frequencies of AU20 observed in the positive emotion condition may indicate coding errors whereby AU12 may have been confused with AU20.
Figure 1. The percentage of trials in which each AU was observed. The top panel shows responses to facial expressions of happiness, while the bottom panel shows responses to facial expressions of sadness. Error bars represent standard errors of the mean.
Trustworthiness and Reciprocity

Next, we examined behavioral responses of participants in the role of the responder in the trust game. As described previously, participants used a strategy method, whereby they reported their decision for each possible choice of their partner, before knowing their partner’s decision. That is, we asked participants to report whether they would either a) take all of the money or b) split the money evenly for each possible division allocators could potentially have made, prior to learning the choice of the player that they were randomly paired with. This method allows us to examine the degree to which participants would behave in a trustworthy manner in response to being trusted entirely (when the allocator sends the entire $6 endowment to the responder), compared to when the allocator sends a smaller portion of the endowment.

Many previous studies have shown that people tend to behave in more trustworthy ways when they are trusted by another, which may elicit reciprocity (e.g., Pillutla, Malhotra, & Murnighan, 2003). To study whether this effect would also be present in our data, we examined the proportion of participants who behaved in a trustworthy manner. Here, trustworthiness is operationalized as the responder’s decision to split the (now tripled) endowment between themselves and the other player, rather than keep the entire endowment to themselves (in which case, the allocator would lose any money they had sent).

The proportion of participants who behaved in a trustworthy manner, as a function of the degree to which they were trusted by the proposer, is shown in Figure 2. As shown in the figure, participants were much more likely to behave in a trustworthy manner when they were trusted by the other player.
Figure 2. The proportion of participants who behaved in a trustworthy manner, as a function of the degree to which they were trusted by the allocator. Error bars represent standard errors of the mean.

Facial mimicry and trustworthiness

Next, we examined the extent to which facial mimicry of positive (happiness) and negative (sadness) facial expressions of emotion related to trustworthy behavior in the trust game. As described above, participants’ decisions to behave in a trustworthy manner were strongly impacted by the degree to which they were trusted by the allocator, as participants were much more likely to behave in a trustworthy manner when the other player sent them a larger portion of the endowment, indicating a higher level of trust. Thus, we examined a model predicting trustworthy behavior with facial expressions that simultaneously takes the degree to which participants were trusted into account.
As the six decisions were binary outcomes (take all vs. split evenly), we used a statistical model known as a Generalized Estimating Equation (GEE) model with a logit link function which is suited to repeated measures with binary outcomes. This multi-level analysis was used to examine whether facial mimicry in each condition predicted trustworthy behavior, while controlling for the degree to which participants were trusted. For each target, we computed the mean of the emotion-specific AUs shown (AU1, AU4, and AU15 for sadness; AU6 and AU12 for happiness) for both the age inference condition and the emotion inference condition, to examine the extent to which mimicry occurred in each emotion and inference condition. The results for the first model are shown in Table 1.

Table 1

<table>
<thead>
<tr>
<th></th>
<th>b</th>
<th>se</th>
<th>95% CI</th>
<th>Z</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount trusted</td>
<td>0.90</td>
<td>0.11</td>
<td>0.68</td>
<td>1.12</td>
<td>7.92</td>
</tr>
<tr>
<td>Mimicry of happiness</td>
<td>1.06</td>
<td>0.45</td>
<td>0.17</td>
<td>1.95</td>
<td>2.35</td>
</tr>
<tr>
<td>Mimicry of happiness</td>
<td>0.51</td>
<td>0.53</td>
<td>-0.54</td>
<td>1.55</td>
<td>0.95</td>
</tr>
<tr>
<td>Mimicry of sadness</td>
<td>-0.38</td>
<td>0.66</td>
<td>-1.67</td>
<td>0.91</td>
<td>-0.58</td>
</tr>
<tr>
<td>Mimicry of sadness</td>
<td>-1.13</td>
<td>0.56</td>
<td>-2.22</td>
<td>-0.03</td>
<td>-2.02</td>
</tr>
<tr>
<td>Intercept</td>
<td>-2.59</td>
<td>0.38</td>
<td>-3.35</td>
<td>-1.84</td>
<td>-6.75</td>
</tr>
</tbody>
</table>

Notes. Results of a GEE model predicting participants’ choice to behave in a trustworthy manner in the trust game with mimicry of happiness and sadness in the emotion and age inference condition.

The results find support for Predictions 2, 3, and Prediction 4a. That is, there was a strong effect of the degree to which participants were trusted on their trustworthy behavior (Prediction 2), and only positive emotion (Prediction 4a) in the emotion inference condition (Prediction 3) showed a positive relationship to trustworthy behavior. In opposition to Prediction 4b, which
argued that trustworthy individuals would show more facial mimicry overall, mimicry of sadness in the emotion inference condition was negatively related to trustworthy behavior.

Table 2. Correlations between trustworthy behavior and mimicry, by condition and target emotion.

<table>
<thead>
<tr>
<th>Condition</th>
<th>Target Emotion</th>
<th>Amount sent (received)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$1($3)</td>
</tr>
<tr>
<td>Emotion-</td>
<td>Happiness</td>
<td>-.09</td>
</tr>
<tr>
<td>inference</td>
<td>Sadness</td>
<td>-.12</td>
</tr>
<tr>
<td>Age-</td>
<td>Happiness</td>
<td>-.07</td>
</tr>
<tr>
<td>inference</td>
<td>Sadness</td>
<td>-.09</td>
</tr>
</tbody>
</table>

Note. N=105-107, †p <.10, *p <.05

Next, we examined the correlations between trustworthy behavior and mimicry, for each level of allocator trust, by condition and target emotion. The results are shown in Table 2. These results suggest that mimicry of positive emotion in the emotion inference condition was only related to trustworthy behavior in the mid-range of trust (when the allocator sent $3 or $4 to the responder), but not for very large or very small levels of trust. This result suggests that the tendency for reciprocity (whereby individuals are more likely to behave in a trustworthy manner when shown high levels of trust by the other player) overrides individual differences in trustworthiness. Interestingly, the negative relation between mimicry of sadness and trustworthiness appeared to be observed more strongly at higher levels of trust shown by the allocator.

**Discussion**

Facial expressivity and detection of deceit have been a subject of controversy for centuries. While some hail their ability to uncover the liars through an eyebrow twitch or a
mistimed smirk, such detection is rarely simple. FACS was created by Ekman and Friesen (1978) to make the process more objective, removing the emotional association and separating each expression into individual action units (AUs). Various theories have been developed in order to explain emotional expressivity and facial mimicry of emotion, from an evolutionary perspective to empathy hypotheses. We were interested in uncovering when such facial mimicry occurs in a trust game through the possibility of either an emotion inference or age inference condition.

Our study supports our various predictions. Participants did indeed show more mimicry in the emotion inference condition when compared to the age inference condition, supporting the results found by Murata et al. (2016) as well as Prediction 1. This finding also supports Prediction 3 in that trustworthy individuals mimicked emotion more frequently in the emotion inference condition than in the age inference condition. This increased level facial mimicry may be attributable to the participants’ overall empathy and prosociality. Prediction 2 found support in that those individuals who were entrusted more responded with greater levels of trustworthy behavior. When the allocator sent an endowment equal to or greater than half of the original amount, the responder was more likely to split the endowment with their partner. When it comes to our final prediction, we considered two competing hypotheses based on the varying theories and previous studies. Our data support Prediction 4a: we found that mimicry of positive emotions, specifically happiness, occurs more frequently in trustworthy individuals. We found contradictory results to the competing hypothesis, Prediction 4b. Trustworthy individuals did not show more facial mimicry overall because mimicry of sadness in the emotion inference condition was actually negatively correlated with trustworthy behavior. Thus, we may assume that negative facial expressions of emotion are not accurate signals of prosociality.
Our data suggest that when people are trusted more, they respond with more trustworthy behavior. These results indicate that when a partner places more trust in an individual, this individual is more likely to return the money in a fair manner (i.e., split it evenly). Our data demonstrate that trustworthy behavior increased dramatically once the allocator dollar amount was half of the total amount or greater (see Figure 2). Thus, if the allocator wants to increase the probability of receiving a higher payout in the end, they should place more trust in their partner by giving at least half of the original endowment.

These results concerning the level of predicted trustworthiness are useful when considering real relationships that we encounter in our everyday lives. Our friends are more likely to respond positively if we place more trust in them. Of course, we must take into account their past behavior if, for instance, we are loaning them money and they have demonstrated a tendency to gamble. Yet, for the most part, demonstrations of trust in other individuals may increase the likelihood that these individuals exhibit trustworthy behavior to be worthy of that trust. Perhaps there exists a certain sense of obligation once a responder has been trusted, leading the responder to return a fair amount of money.

If a person were consistently known to renege on their promises and not respond to trust with trustworthy behavior, we would be less likely to place trust in that individual in the future. We would consider this person a poor investment of money, time, or effort. People do not like being taken advantage of. Much of our world functions on the reliability of cooperation in relationships. If everyone were to suddenly be pro-self as previously described by Schug et al. (2010), the benefits provided by prosocial relationships would vanish because we would not be able to trust others to be reliable in making prosocial decisions. If there were no trust in the first place, the allocator would send little to no money (as shown in our data). This would lead to the
responder sending little to no money back because they have not been trusted. Furthermore, when the allocator does not place trust in their partner, they illustrate pro-self behavior. This is because the allocator feels they will be better off with keeping the small amount of money for themselves instead of relying on their partner to respond in a prosocial manner. Prosocial relationships entertain a certain level of risk, but so do all relationships based on trust.

We found that people who mimic happiness seem to be more trustworthy, supporting our second hypothesis. However, this is only observed when they mimic happiness as a tool to understand someone’s emotion. This relates with the positive emotion theories in that participants demonstrate prosocial, cooperative behavior where the smiles represent a signal of altruistic intent. Previous studies have indicated that happy partners are trusted more than angry partners (Kret et al., 2015), so this may account for the negative correlation between mimicry of sadness and trust. Furthermore, mimicry of smiling, but not mimicry of sadness, is predictive of affiliative intent because these smiling individuals tend to return more money to their partners (Danvers & Shiota, 2018). Because the nature of the trust game instills a certain level of competition, we can assume that the facial mimicry displayed is representative of a reaction to the other individual’s actual expression (Hess & Fischer, 2013). The mimicry constitutes the participant’s interpretation of the emotion and may indicate their motivational intention.

We found that the overall effect of the mimicry of happiness, though not sadness, is correlated with trustworthy behavior in the emotion condition but not the age inference condition. This result supports the conclusions drawn by Murata et al. (2016). Additionally, this happiness mimicry effect demonstrates the impact of inferring another’s emotional state on the participant’s level of mimicry as well as their trustworthy behavior. Mimicry has been shown to increase prosocial behavior wherein the behavioral consequences can be generalized to other
individuals beyond the mimicker (van et al., 2004). Once individuals engage in facial mimicry, they are more likely to demonstrate prosocial behavior toward the surrounding people. This facial mimicry garners a positive effect for others wherein they can all reap the benefits.

We are interested in the result that indicates that facial mimicry occurs, but only in the emotion inference condition. The mimicry only occurs when participants are trying to infer the emotional state of the other individual, implying that the mimicry is not entirely spontaneous. If facial mimicry followed the empathy theories, we would see very empathetic people mimicking in both the emotion and age inference conditions. However, as demonstrated above, this is not the case. Even when considering within-participants, we see variety concerning the degree of facial mimicry portrayed and significant differences between the age and emotion inference conditions. Prosocial behavior cannot be predicted unless the participant is told to infer the target’s emotional state and that emotion should be, according to our data, happiness. To achieve the prosocial outcome concerning allocation, mimicry of happiness should occur. Sadness, however, does not seem to have the same effect. This relates to Hamilton’s (1964) green beard theory as the smile is representative of an individual’s willingness to engage in a cooperative relationship, allowing the individual to recognize others who may wish to engage in a similar relationship. Such a facial expression may allow others to detect altruistic tendencies. When sharing material resources, the employment of Duchenne smiles indicates an individual’s altruistic intentions while the simultaneous use of an open smile can influence the responder’s positive feelings (Mehu, Grammer, & Dunbar, 2007). When considering the variety of smile types and frequency of smiles, the type of interaction and altruistic intentions have more weight than self-reported happiness. These results demonstrate the importance of facial behavior, specifically smiles, in cooperative relationships.
Facial mimicry is significant when we examine the positive emotion of happiness as measured by AU12, yet does not occur concerning sadness. These smiles predict positive behavior only when the participants were told to predict the other person’s emotional state. Perhaps those who are predisposed to sadness are then less likely to cooperate. If cooperation is decreased when we encounter negative emotions like sadness, there exists a certain level of risk when attempting to utilize pity or other negative emotions to gain prosocial, cooperative behavior from another individual. Parents may feel guilty when their child is upset, but as we grow up, our parents are less likely to mimic our sadness. However, when we ace an exam or get a new job, our parents may mimic our happy expression of AU12 and share in that excitement.

Similar to most studies, we encountered our own set of limitations. Videos were coded over the span of three years. Therefore, there may be discrepancies throughout the coding process as the current coder became more comfortable and adept while progressing through the remaining videos. The results must be considered preliminary because the FACS codes have not been verified by an additional coder. There were some possible errors in coding. During the original data collection, participants sometimes did not remove obstructive hats or eyewear, consequently limiting the visibility of some upper facial AUs. Additionally, lighting was not consistent across all participants wherein some videos produced low visibility of the participants’ faces, creating difficulties when it came to coding their expressions. Any instances when a section of the face was covered led to those blocked AUs to be coded as missing data. Due to the length of each video, participants often did not remain still, shifting in their seats and covering parts of their faces with their hands. Once again, this limited the ability to code certain AUs. Despite these limitations, we were able to attain significant results concerning the facial mimicry of happiness as demonstrated through AU12 (lip corner puller) and the level of trustworthiness.
To add to this vein of research concerning facial expressions and mimicry, future studies may consider the facial expression of disgust. Previous studies have shown that when we encounter unfair situations, our levels of general facial expressivity, especially disgusted expressions, increase (Chapman et al., 2009; Centorrino et al., 2015; Schug et al., 2010). While trusting behavior is unclear, feelings of disgust have been shown to be the strongest predictors of decision making. This implies that disgust is the strongest emotion when it comes to making decisions. As the visual expression of our disgust becomes more prominent, our partners will be able to more accurately predict our future decisions. Based on the results of our study and previous studies, future studies may examine the facial expression of disgust during a trust game. Because the expression of disgust occurs when we encounter unfair situations, this negative emotional display is likely to indicate that we will not demonstrate trusting behavior.

We believe it would be interesting to consider how these results may be used in the interview process. During the hiring phase, employers could utilize this paradigm to detect trusting/trustworthy interviewees. We think that it is important to uncover the degree of trustworthiness of future employees, especially if the employment concerns sensitive information. Many governmental institutions and the like are concerned with insider threat; if the employees are not trustworthy, classified information may be leaked to the public or be sold in an act of espionage. Methods such as the polygraph are not always reliable, so implementing a facial mimicry task or facial expressivity analysis may be beneficial as a secondary precaution. Although time consuming, such analyses may uncover possible threats, which would allow for a more thorough analysis into suspicious individuals.

From the view concerning the detection of criminal behavior, police and similar law enforcement professionals may employ this paradigm to determine the trustworthiness of
witnesses and the possible innocence of suspects. Of course, this paradigm should not be the only method. Many crimes contain a variety of avenues to explore and should not be simplified down to only one aspect. Furthermore, reliability of this method must be determined before it is employed on a widespread basis. However, such facial mimicry analyses may be helpful during the criminal interrogation and interview processes and even in selecting jurors for trials.
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