



Avoidant individuals may have muted responses to social warmth after all: An attempted replication of MacDonald and Borsook (2010)☆



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HIGHLIGHTS

- MacDonald and Borsook (2010): avoidant participants responded positively to warmth.
- Replication attempt: how is attachment affected by a warm vs. cold confederate?
- Results not replicated; no effect of warmth for avoidant participants' feelings of closeness.
- Avoidant participants displayed neutral affect in response to a warm confederate.
- Avoidant individuals' responses to social reward and threat may be similar.

ARTICLE INFO

Article history:

Received 4 August 2016

Revised 24 November 2016

Accepted 24 November 2016

Available online 29 December 2016

Keywords:

Relationships

Attachment

Avoidance

Intimacy

Social threat and reward

Non-verbal behavior

ABSTRACT

Past research on individuals high in attachment avoidance has pointed to these individuals being relatively uninterested in intimacy. However, a small body of literature suggests that if presented with warmth and positive feedback, avoidant individuals will respond positively to intimacy to an even greater extent than secure individuals. The goal of the present study was to examine the replicability of the findings of one such study (MacDonald & Borsook, 2010), and additionally explore avoidant individuals' non-verbal responses to social warmth. After completing an attachment style questionnaire, participants completed a relationship closeness induction task with a confederate who was assigned to behave in either a warm or a cold manner. Participants then completed a closeness scale and filmed a video greeting for their "partner" (the confederate). The results did not replicate those of MacDonald and Borsook (2010), and instead suggested that highly avoidant participants felt less close to socially warm others than low avoidant individuals did. Possible reasons for the failure to replicate are discussed, as are the similarities in how avoidant individuals respond to social reward and attachment threat.

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Social reward is defined broadly as social stimuli that individuals experience positively (Foulkes, Viding, McCroy, & Neumann, 2014). Examples of experiences that people tend to find socially rewarding include achieving a sense of belonging within one's social group (Baumeister & Leary, 1995), self-disclosure and intimacy (Fareri, Niznikiewicz, Lee, & Delgado, 2012; Izuma, Saito, & Sadato, 2008; Worthy, Gary, & Kahn, 1969), and viewing smiling faces (Spreckelmeyer, Krach, Kohls,

Rademacher, Irmak, & Konrad, 2009). Research on the long-term effects of social reward corroborate that social reward is beneficial for health outcomes and wellbeing (Siegrist, 2000; Siegrist, Vond dem Knesebeck, & Pollack, 2004). When individuals experience a deficit in social reward, they search for socially rewarding relationships, suggesting that social reward may be crucial to fulfilling the need to belong (Spielmann, MacDonald, & Tackett, 2012).

Individuals high in avoidant attachment, however, have a more complex relationship with social reward than do secure individuals. According to attachment theory, in childhood, people develop an attachment style through their interactions with parents or guardians: their "primary attachment figures" (Ainsworth, 1979; Bowlby, 2005). When in the presence of threat or stress, individuals seek their attachment figures or conjure mental representations of their attachment figures (Mikulincer, Gillath, & Shaver, 2002; Mikulincer & Shaver, 2008). The type of feedback and support that children receive from these attachment figures as they develop, especially when they are in distress,

☆ The authors would like to acknowledge the contribution of Jaimie Henderson, without whom this study would have been impossible. Jaimie was an outstanding, and highly professional confederate of the experiment. Additionally, we would like to thank the Faculty of Arts and Science at the University of Toronto for their funding contribution to this study. Finally, we wish to thank the Canadian government for their continued support of research in the social sciences. Inquiries about any aspect of this study should be directed to: aviva.philipp.muller@gmail.com.

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informs the attachment style that emerges from the relationship (Ainsworth, Blehar, Waters, & Wall, 2015; Mikulincer & Shaver, 2010; Simpson, 1990). These attachment tendencies can be categorized along 2 dimensions: *anxious* and *avoidant* (Mikulincer & Shaver, 2010), with secure attachment being defined by the low ends of both dimensions.

High attachment anxiety is often characterized by a fear of abandonment and a preoccupation with relationships (Bowlby, 2005; Mikulincer & Shaver, 2010). Anxious individuals are often characterized as “clingy,” and tend to seek more intimacy in relationships than others do. High attachment avoidance is characterized by a tendency to dismiss attachment-related feelings. These individuals value their autonomy over interpersonal closeness, and seek intimacy less than others do (Bartholomew, 1990; Collins & Feeney, 2000; Griffith & Bartholomew, 1994). The developmental history of avoidant individuals theoretically includes multiple trials of reaching out for closeness and experiencing frustration, disappointment, or loss (MacDonald, 2009).

Individual differences in attachment style become most apparent in times of attachment system activation. Typically, attachment system activation is discussed in the literature as a response to perceived threat, such as a threat to an attachment relationship (Mikulincer et al., 2002; Mikulincer, Birnbaum, Woddis, & Nachmias, 2000; Shaver & Mikulincer, 2002), which leads individuals to seek comfort in ways that vary according to their attachment style. For avoidant individuals, attachment system activation leads to distancing behaviors and blunted affect as they attempt to deactivate the attachment system (Mikulincer & Shaver, 2005) by suppressing attachment-related thoughts and feelings (Cassidy, 1994; Cassidy & Kobak, 1988; Fraley, Davis, & Shaver, 1998; Shaver & Mikulincer, 2007).

Since intimacy is associated with punishment for avoidant individuals, attachment system activation may also occur in response to social reward. That is, closeness and social reward may trigger emotional pain in avoidant individuals, thus leading to attempts at attachment system deactivation (MacDonald, Borsook, & Spielmann, 2011). Social reward has been shown to elicit defensive responding in avoidant individuals (Spielmann, Maxwell, MacDonald, & Baratta, 2013), which can lead them to inhibit emotional expression, especially if these emotions are intimacy-related (Schachner, Shaver, & Mikulincer, 2005). This emotional inhibition can result in reduced expression of emotions such as anger or joy (Mikulincer & Shaver, 2005; Schachner et al., 2005). Indeed, avoidant individuals smile less and display fewer expressions of happiness than do secure individuals (Magai, Hunziker, Mesias, & Culver, 2000; Spangler & Zimmermann, 1999).

There is mounting evidence of avoidant individuals having an inhibited response to social reward. Avoidant individuals seemingly experience minimal reward from social experiences, even close relationships, gaining less pleasure from social interactions than do low avoidant individuals (Troisi, Alcini, Coviello, Croce Nanni, & Siracusano, 2010). Avoidant individuals are likely to perceive lower levels of reward as present in their relationships than do secure individuals (Gere, MacDonald, Joel, Spielmann, & Impett, 2013; Spielmann et al., 2013), even on a physiological level (Strathearn, Fonagy, Amico, & Montague, 2009; Vrtička, Andersson, Grandjean, Sander, Vuilleumier, 2008). They are also less likely to engage in the socially rewarding aspects of relationships and intimacy, such as non-sexual, physical intimacy (e.g., hugging) (Fraley & Shaver, 1998).

Recent studies, however, have found that when presented with highly positive relationship cues, avoidant individuals sometimes seek intimacy even more than their anxious or securely attached counterparts. In one such study, participants were asked to rank their supposed “fellow participants” based on online profiles (the profiles of these participants were fabricated), and were told that their “fellow participants” would also be ranking their profiles (Carvalho & Gabriel, 2006). In the experimental group, the participants were told that they were ranked the highest out of all the other participants in the study. Following this manipulation, avoidant individuals reported an even higher level of

positive affect and self-esteem than low avoidant controls did (Carvalho & Gabriel, 2006). Similarly, another study found that if avoidant individuals perceived that intimacy was welcomed, they actually sought greater intimacy with their partners than baseline (Slotter & Luchies, 2014).

One study within this body of research that is central to the present study found that when avoidant participants were presented with an unequivocally positive social interaction in a closeness induction task, they reported greater feelings of closeness with their partner than did low avoidant participants (MacDonald & Borsook, 2010). In that study, participants interacted with a confederate whom they were told was a fellow participant. The participants were told to ask each other a series of increasingly intimate questions (Sedikides, Campell, Reeder, & Elliot, 1999). Participants were randomly assigned to interact with a confederate who behaved either positively (warmly) or negatively (coldly) with them. The confederate was a trained actor, and she was either highly responsive and empathetic (the positive condition), or apathetic and aloof (the negative condition). Following the interaction, participants completed a connection scale where they rated how connected they felt to their “partner” (Sedikides et al., 1999). Attachment avoidance was a significant predictor of closeness in the positive condition, such that highly avoidant participants reported higher levels of closeness to their partner than low avoidant participants did. These results suggest that with large degrees of positive social feedback, it is possible to overcome avoidant individuals’ barriers against intimacy.

However, there were several limitations to the MacDonald & Borsook (2010) study that suggest the results should be accepted with caution, pending replication. First, the study was low in power, with a total sample size of only 30 for a test of a condition by individual difference interaction. Second, given that the MacDonald & Borsook (2010) methodology required the same confederate to perform in all study sessions, any effects produced by the study could be due to idiosyncratic characteristics of that confederate. Finally, the MacDonald and Borsook study was embedded within a larger study on pain perception (Borsook & MacDonald, 2010), so the participants may have already experienced attachment system activation due to the potential stress of pain testing.

The present study therefore sought to replicate the MacDonald and Borsook study while addressing the potential shortcomings listed here. Further, given that the findings of the original study were somewhat anomalous (only a few other studies have found similar results), replication would be important to affirm the results found in MacDonald & Borsook (2010). To accurately test the results of the MacDonald & Borsook (2010) study, the present study attempted to mimic the methods of the original study as closely as possible. Specifically, the materials used, the training provided to the confederate, and the central statistical analyses were kept identical to the MacDonald & Borsook (2010) study. A few additional similarities exist in this study that are atypical of replications. First, the study was conducted in the identical laboratory space, with even the same computers as the original study. Second, since this study was conducted at the same university as the original study, the participant pool was also the same, albeit five years later. The few exceptions that do exist are noted, and explanations are provided for these differences.

Beyond replicating past research, the present study sought to ask additional questions not asked in the original study regarding effects of attachment and condition on how participants approached their “partner” both verbally and non-verbally following an intimate exchange. Given the tendency of individuals high in avoidant attachment to keep emotional experience from conscious awareness (e.g., Mikulincer, Shaver, & Pereg, 2003), we reasoned that a measure of emotional experience that bypassed self-report may be of value. We asked participants to record a video message for their partner following the interaction. These videos were processed using *FaceReader 5.0* software from Noldus to examine non-verbal reactions, and they were additionally evaluated by trained coders to examine the overall messages communicated by participants. This portion of the study was largely

exploratory and was not included in the original study. Given that these additional measures occurred after the replication component of the study, it is highly unlikely that they would affect our ability to determine replication.

To examine the effects of intimacy on avoidant individuals, participants completed attachment questionnaires and were randomly assigned to interact with a confederate (their “partner”) who behaved either warmly or coldly towards the participants in an intimate exchange. Though in the original study the two conditions were labeled as positive and negative, we now believe the terms warm and cold are more descriptive. Functionally, however, the conditions were identical to the original study. Participants next completed questionnaires regarding the closeness they felt towards their partner, then filmed greeting videos for their partner in which they expressed their thoughts about the interaction and their desire for further contact. Given the results of the original MacDonald and Borsook study, we tested the hypothesis that attachment avoidance would be a positive predictor of feelings of closeness in the condition in which the confederate acted warmly. For the greeting video portion of the study, we had no *a priori* predictions about these results and approached it as an exploratory research question. We hoped it would shed light on how avoidantly attached individuals respond to intimacy, thus allowing us to compare between verbal and non-verbal responses.

1. Method

1.1. Participants

Sixty participants volunteered to take part in this study. Forty-five of them participated in exchange for course credit. These students were members of an introductory psychology participant pool, and they received one credit for their participation in this study. The remaining 15 participants in this study were recruited as paid participants, and they received \$10 for their participation in this study. These participants were also students in the introductory psychology class, and they had expressed interest in being contacted by email to participate in paid studies in a mass-testing questionnaire. One participant's data were discarded due to suspicion (in the warm condition), and one participant's data were discarded for failing to complete a significant portion of the survey questions (in the cold condition). No other exclusions were necessary. The final sample consisted of 44 females and 14 males, ranging in age from 16 to 25 years (average age = 18.7 years), for a total of 58 participants. No additional data collection was conducted following data analysis. The method for determining the final sample size was as follows: given that the original effect was found using a sample of 30, a sample size of 60 was deemed adequate to reveal the same effect if it was reliable. However, the practical difficulties of scheduling sessions suited to our volunteer confederate's schedule made a sample size larger than 60 unfeasible.

1.2. Procedure

Participants were told that they were participating in a friendship study that measured compatibility between strangers. The experimenter explained that the participants would complete several questionnaires, film a brief test video (which would be used as a calibration for the subsequent video filmed), participate in a structured “ice breaker” task with another participant (the confederate), fill out some questionnaires in response to the interaction, and finally, that they would film a “greeting video” for their fellow participant. The participant was given the opportunity to ask questions and informed consent was obtained. These methods are identical to the methods used in the original study, save for the greeting video and the calibration video, which compose the additional questions addressed in the present study. The experimenter said that “the other participant” had already arrived, and was filling out her questionnaires. It is worthwhile to note that this study

was conducted in the same laboratory facility, using the same rooms and computers as the original study.

1.2.1. Questionnaires (1)

Participants were brought to a private testing room to complete their questionnaires. The questionnaires all appeared online via the survey software, *Qualtrics*, and participants completed their questionnaires on a computer. Participants completed the *Attachment Style Questionnaire* (ASQ), a demographics questionnaire, and the *Big Five Personality Inventory* (BFI) (see Measures section for details). All of the questionnaires used in the present study are identical to the ones used in the original study, except for the BFI, for reasons elaborated upon in the discussion.

1.2.2. Calibration video

Next, participants were asked to create a calibration video. Participants entered a room with the experimenter where they were asked to film a video lasting approximately 10 s, in which they could say anything they liked. (Participants typically stated their age and birth date). Participants were informed that the purpose of this video was to obtain their base-rate facial expressions to serve as a comparison (or “calibration”) to the subsequent video they would film after the interaction. After the participants filmed their calibration videos, they were asked to leave the room while the confederate also supposedly filmed a calibration video. The confederate did not actually film any videos. As the participants of the original study did not film any videos, the calibration video is a deviation from the original study, which is elaborated upon in the discussion.

1.2.3. Relationship Closeness Induction task

Participants were then brought into a room with a confederate of the experimenter, whom they were told was a fellow participant. The experimenter explained the *Relationship Closeness Induction Task* (Sedikides et al., 1999) to both the real participant and the confederate. They were each given a sheet of paper that included 3 lists of increasingly intimate questions (e.g.: from List I, “What do you think you might major in? Why?”, and from List III “Describe the last time you felt lonely”). List I had 7 questions, List II had 12 questions, and List III had 10 questions. They were told to alternate the order of asking the questions, and to each answer a given question before continuing on to the next question. Participants were also told that three timers had been set (one for 3 min, one for 8 min, and one for 23 min), and to continue to the next list (or finish the task, if it was the final list) when the timer rang. Participants were not prohibited from switching lists early or from completing the task before the final timer rang. Participants were then left with the confederate in a testing room to complete the relationship closeness induction task. The *Relationship Closeness Induction Task* is the identical task to the one used in the original study.

As in the MacDonald and Borsook study (2010), the confederate was a trained actor. The actor recruited to play the confederate was chosen for her natural warmth and socially rewarding personality. She was also chosen for her resemblance to the confederate used in the original study (her personality, physical appearance, and even her name were strikingly similar to that of the first confederate). The confederate received extensive training, and her responses were workshopped over the course of several months so that they would resemble the original confederate's responses. Through random assignment, half of the participants experienced the confederate as empathic and accepting (warm condition). For the warm condition, the confederate was told to behave naturally (she has a naturally warm personality), which allowed the participants to achieve a genuine connection with her. In this condition, the confederate used kind words in response to the participant, made consistent eye contact, provided verbal and physical evidence that she was listening, and provided lengthy responses when it was her turn to answer questions. With the other half of the participants, the confederate was curt and aloof (cold condition). In this

condition, she used neutral and unemotional language in response to the participant, she rarely made eye contact, she provided minimal verbal or physical evidence that she was listening, and provided very short and emotionally bare responses when it was her turn to answer questions. For ethical reasons, the confederate was asked to provide honest responses to the questions so that, after debriefing, participants would not feel that their interaction with the confederate was insincere. (The only false response she gave was that she told participants that she was in her fifth year of undergraduate study, when in reality, she had graduated several months prior to the start of the study). Before the study was officially launched, the actor piloted her responses with several volunteers who were naive to the methods of the study. Manipulation and deception checks were completed for these pilot participants, and the actor was found to elicit appropriate responses from these participants without arousing suspicion.

1.2.4. Questionnaires (II)

Upon completing the relationship closeness induction task with the confederate, the participants returned to their testing rooms to complete the *Closeness Scale* (Sedikides et al., 1999), which again appeared on their computers via *Qualtrics*. Once again, this is identical to the questionnaire used in the original study. The original MacDonald & Borsook, 2010 study ended at this point, so though the following measures are deviations from the original study, they would not have affected the results of the replication.

1.2.5. Greeting videos

The experimenter brought the participants back into the filming room, and informed them that they had the opportunity to create a greeting video for their partner to watch. They were told to express their thoughts about the interaction and state whether or not they wished to continue the friendship. The participants were also told that they could provide their contact information for their partner if they so desired. The participants were told that their partner would watch the greeting video and respond to it with a greeting video of her own. The participants were then left alone to privately record the greeting video. Once the participants had completed their videos, the confederate entered the video room to “watch the video” (the confederate never actually watched any of the videos), while the experimenter began debriefing the participant.

1.2.6. Debriefing

Participants were probed for suspicion using a three-step variation on “funnel” debriefing (Chartrand & Bargh, 1996). First, in the final question of the questionnaires participants were asked what they believed the purpose of the study to be. Second, immediately preceding oral debriefing, participants were asked by the experimenter what they thought of the study and whether there was anything they found suspicious about the study. Third, after the experimenter informed the participants that their “partner” in the experiment was actually a confederate, participants were asked whether they suspected this deception. No participants were accurate in divining the purpose of the study in the first portion of the debriefing process. One participant suspected that the confederate was an actor in the second portion of the debriefing process. That participant's data were discarded. No other participants claimed to suspect the confederate in the third portion of the debriefing process.

Part way through the debriefing, the confederate exited the video room to join in the debriefing process. In the warm condition, the confederate reassured participants that, despite being a confederate of the experiment, the interaction they just had was a genuine one. In the cold condition, the confederate apologized for her standoffishness, and provided participants with a glimpse of her true, warm personality.

1.3. Materials

1.3.1. Survey measures

1.3.1.1. Attachment Style Questionnaire. The *Attachment Style Questionnaire* (ASQ; Feeney, Noller, & Hanrahan, 1994) is a 40-item measure of attachment, from which 2 scales can be extracted: avoidant (16 items e.g., “I prefer to depend on myself rather than on other people”) and anxious attachment (13 items e.g., “I find that others are reluctant to get as close as I would like”). To ensure that excluding the secure scale (the remaining questions) did not grossly affect our results, we conducted an analysis controlling for it, and found virtually no differences in effects. Participants responded to these questions using a 6-point Likert-type scale with 1 = *Totally Disagree* and 6 = *Totally Agree*. The ASQ was found to be reliable, for the anxiety scale (Cronbach's $\alpha = 0.83$) and for the avoidance scale (Cronbach's $\alpha = 0.81$).

1.3.1.2. Demographics questionnaire. The demographics questionnaire is a 7-item measure in which participants reported demographic variables such as age, gender, and sexual orientation.

1.3.1.3. Big Five Personality inventory. The *Big Five Personality inventory* (BFI; John, Donahue, & Kentle, 1991; John, Naumann, & Soto, 2008) is a 44-item measure that lists statements regarding personality variables, to which participants can either agree or disagree (e.g.: “I am someone who does a thorough job”). Participants responded to these questions using a 5-point Likert-type scale with 1 = *Disagree Strongly* and 5 = *Agree Strongly*. The items on the questionnaire each served to assess to what degree participants possessed each of the Big Five personality variables (openness, conscientiousness, extraversion, agreeableness, and neuroticism). The BFI was found to be reliable for openness (Cronbach's $\alpha = 0.81$), conscientiousness (Cronbach's $\alpha = 0.76$), extraversion (Cronbach's $\alpha = 0.86$), agreeableness (Cronbach's $\alpha = 0.78$), and neuroticism (Cronbach's $\alpha = 0.82$).

1.3.1.4. Closeness scale. The closeness scale (Sedikides et al., 1999) is an 8-item measure that lists questions regarding how close participants felt to their partner (e.g.: “How much do you feel you clicked with your partner?”), following the *Relationship Closeness Induction Task*. Participants responded to these questions using a 9-point Likert-type scale with the anchors varying slightly depending on the question, with “1” always representing the low anchor and “9” always representing the high anchor, (e.g.: for the above question: 1 = *didn't click at all* and 9 = *clicked very much.*). The closeness scale was found to be reliable (Cronbach's $\alpha = 0.96$).

1.3.2. Face reading software. *FaceReader 5.0* from Noldus was used to analyze the participants' videos. This face reading software provided 2 outputs: the state log and the detailed log. Both outputs calculated the presence of 7 emotional states: neutral, happy, sad, angry, surprised, scared, and disgusted.

1.3.2.1. State log. The state log is an output that lists the single most dominant facial expression displayed by the participants for every 0.5-second interval, in sequential order. This log includes time stamps denoting when the most dominant emotion switched. Using the state logs provided by the face reading software, proportion scores were calculated for all 7 emotions for each participant, which correspond to the proportion of the total video spent displaying each emotion.

1.3.2.2. Detailed log. The detailed log provides a potency score for each of the 7 emotional states for every time interval (lasting 1/10 of a second). The potency scores range from 0 to 1, with 1 being the strongest potency possible (e.g., maximum happiness) for any given emotion. Average potency scores were calculated for each of the 7 emotional states for each participant.

1.4. Manual coders

To supplement Face Reader analysis of the videos, trained coders also evaluated participants' greetings. These ratings allowed for subjective perceptions of participants' greetings as well as additional

evaluations of non-verbal behaviors. Raters were trained together to improve inter-rater reliability.

Each coder completed a 28-item questionnaire regarding each of the videos. The coders responded to the items on a 5-point Likert scale with 1 = *Strongly disagree* and 5 = *Strongly agree*. Raters were asked to watch each video completely before answering any questions, and to provide answers that reflected their overall impressions of each video. The first 5 items required the coders to consider how friendly, open, interested, cold, and rude the participants were in their videos. The following 6 questions were meant to assess perceived attachment behavior displayed in the videos (e.g.: “this person seemed comfortable” is an example of an attachment security item, “this person seemed worried whether or not I would like them” is an example of an attachment anxiety item, and “this person seemed a bit standoffish” is an attachment avoidance item). The next 10 items were from the Social Threat and Reward Scale (STARS; Spielmann, MacDonald, & Tackett, 2012), which asks raters about the potential social rewards or threats they would expect to experience from interacting with the participant in the video (e.g.: “I think I could develop a meaningful connection with this person” is an example of a social reward item and “If I were to say something dumb during the interaction, it would bother me all day” is an example of a social threat item). Finally, coders were asked to provide ratings for each of the 7 emotional expressions assessed by the face reading software (happy, sad, angry, surprised, scared, disgusted, and neutral).

An inter-class correlation score was calculated for each question for all the raters. Any question with a correlation of <0.7 was discarded and not used in subsequent analyses, as anything less would introduce too much variance among coders to provide accurate data. The items regarding friendliness, openness, interestedness, coldness, and rudeness were all found to be inter-rater reliable, as were the attachment items, the STARS reward (but not threat) items, the neutrality item, and the happiness item.

Using factor analysis, the first five items (friendliness, openness, interestedness, coldness, and rudeness) were found to compose one factor. In fact, all the manual coder items were found to compose one factor using factor analysis. However, given the strong theoretical reasons to consider attachment, the social threat and reward scale, and emotional states as separate scales, these scales were analyzed independently. The first five items were averaged for each participant into a single factor called a “Likeability” score ($\alpha = 0.97$). Since all the attachment items factored together, they were also averaged into one factor called an “Attachment” score, which ranged from comfort with intimacy to discomfort with intimacy ($\alpha = 0.96$). Since the avoidance items had a strong negative correlation with the security and anxiety items, they were reverse coded before being averaged into the “Attachment” score. The Social Threat and Reward Scale (STARS) is already divided into a threat dimension and a reward dimension, with 5 questions belonging to each. Of the ten STARS items, the 5 reward items were all inter-rater reliable, whereas the 5 threat items were unreliable. The threat questions were therefore not analyzed. The reward questions were all averaged for each participant to create a “Social Reward” score ($\alpha = 0.98$). For a full summary of the inter-rater reliability for each cluster and emotional state, as well as the Cronbach’s alpha for each cluster, see supplementary materials. No other measures or manipulations were used in this study, and the full extent of the method used in the present research is outlined above.

2. Results

2.1. Closeness scale analysis

Analyses of the interaction between experimental condition and individual differences in attachment were conducted using regression analysis (Aiken & West, 1991). The anxiety and avoidance scales were centered. The main effects of condition (dummy coded with 0 =

warm and 1 = cold), anxiety, and avoidance, were entered in Step 1. The 2-variable interactions of avoidance by condition (the key test of our hypothesis), avoidance by anxiety, and condition by anxiety (as covariates) were entered in Step 2. A condition by avoidance by anxiety three-way interaction was entered in Step 3, however, there was not enough power for this interaction to be reliable, and so it is not reported here.

A significant main effect of experimental condition was found, $\beta = -0.52$, $t(51) = -4.60$, $p < 0.001$, $R^2 = 0.26$, with participants reporting higher levels of connection in the warm condition ($M = 6.99$, $SD = 1.30$) than the cold condition ($M = 5.11$, $SD = 1.71$). A significant main effect of avoidance was also found, $\beta = -0.43$, $t(51) = -2.29$, $p = 0.03$, $R^2 = 0.03$, with highly avoidant participants feeling less connected to the confederate than participants who were low in avoidance. Though not conventionally significant, the interaction between avoidance and condition was trending towards significance, $\beta = 0.30$, $t(51) = 1.64$, $p = 0.11$, $R^2 = 0.03$ (See Fig. 1).

Since these effects were crucial for comparison to the original MacDonald & Borsook (2010) study, simple effects analyses were conducted. These analyses revealed that low avoidant participants felt significantly closer to the warm than cold confederate, ($\beta = 2.25$, $t(51) = 2.56$, $p = 0.01$). However, high avoidant participants’ reports indicated no significant difference in closeness across the warm and cold conditions, ($\beta = 1.51$, $t(51) = 0.04$, $p = 0.48$). Alternatively phrased, for participants in both the warm ($\beta = 0.60$, $t(51) = 5.64$, $p < 0.001$) and cold ($\beta = 0.22$, $t(51) = 3.81$, $p < 0.001$) conditions, avoidance was a robust predictor of feelings of closeness.

Additional regression analyses of the central effect were conducted: one controlling for agreeableness and one controlling for extraversion as these were the 2 BFI variables that correlated significantly with avoidance (for a summary of descriptive statistics regarding the BFI variables, see supplementary materials). Agreeableness or extraversion was centered and entered in Step 1, in addition to centered anxiety, centered avoidance, and condition. The potential interaction variables anxiety by avoidance, BFI variable (either extraversion or agreeableness, depending on the analysis) by avoidance and BFI variable by condition were entered in Step 2. When controlling for extraversion, there was still a significant main effect of condition on connection score, $\beta = -0.55$, $t(51) = -5.40$, $p < 0.001$, $R^2 = 0.49$, a trending main effect of avoidance on connection score, $\beta = -0.22$, $t(51) = -1.28$, $p < 0.21$, $R^2 = 0.18$ and a marginally significant condition by avoidance interaction, $\beta = 0.288$, $t(51) = 1.71$, $p = 0.09$, $R^2 = 0.02$. When controlling for agreeableness, there was still a main effect of condition on connection score, $\beta = -0.50$, $t(51) = -4.33$, $p = 0.001$, $R^2 = 0.38$ but a non-significant effect of avoidance on connection score, $\beta = -0.19$, $t(51) = -0.90$, $p = 0.37$, and a non-significant interaction effect of avoidance by condition on connection score, $\beta = 0.16$, $t(51) = 0.71$

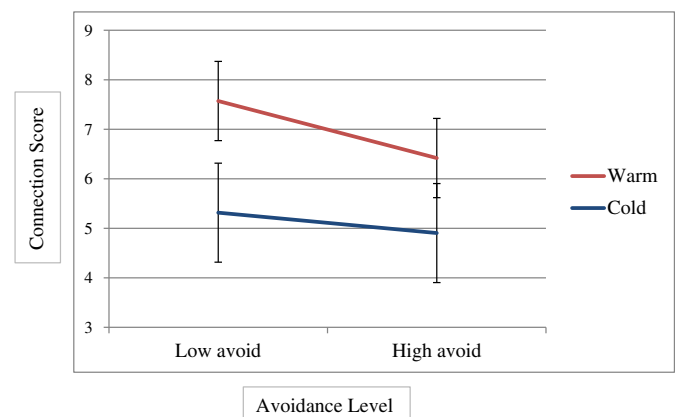


Fig. 1. The effects of avoidance and condition on feelings of connection plotted at -1 to $+1$ standard deviations for avoidance, with standard error bars.

Table 1

Summary of mean proportions and standard deviations for the 7 emotions analyzed in the warm and cold conditions, as well as the effects of condition, avoidance, and the interaction thereof on affect proportions.

	Warm	Cold	Effect of condition	Effect of avoidance	Effect of interaction
Neutral	M = 0.31, SD = 0.12	M = 0.30, SD = 0.13	$\beta = -0.01$ $t = -0.36$	$\beta = 0.07^{**}$ $t = 2.17$	$\beta = -0.08^*$ $t = -1.94$
Happy	M = 0.25, SD = 0.20	M = 0.21, SD = 0.18	$\beta = -0.04$ $t = -0.69$	$\beta = -0.06$ $t = -1.22$	$\beta = 0.01$ $t = 0.22$
Sad	M = 0.21, SD = 0.20	M = 0.26, SD = 0.21	$\beta = 0.04$ $t = 0.73$	$\beta = -0.02$ $t = -0.31$	$\beta = 0.03$ $t = 0.43$
Angry	M = 0.003, SD = 0.02	M = 0.11, SD = 0.11	$\beta = 0.05^{**}$ $t = 2.29$	$\beta = 0.003$ $t = 0.13$	$\beta = 0.01$ $t = 0.56$
Surprised	M = 0.12, SD = 0.15	M = 0.11, SD = 0.14	$\beta = -0.02$ $t = -0.40$	$\beta = -0.01$ $t = -0.15$	$\beta = 0.03$ $t = 0.60$
Scared	M = 0.08, SD = 0.15	M = 0.07, SD = 0.13	$\beta = -0.01$ $t = -0.30$	$\beta = 0.01$ $t = 0.27$	$\beta = -0.01$ $t = -0.19$
Disgusted	M = 0.01, SD = 0.05	M = 0.002, SD = 0.01	$\beta = -0.01$ $t = -1.25$	$\beta = 0.001$ $t = 0.08$	$\beta = 0.001$ $t = 0.10$

* $p < 0.10$.

** $p < 0.05$.

$p = 0.48$. These results suggest that agreeableness may account for a considerable degree of the effects of avoidance in our study.

2.2. Video Analyses

2.2.1. Face reading software analyses

The greeting videos and calibration videos were analyzed using the face reading software, *FaceReader 5.0* from Noldus. Unfortunately, the calibration videos did not provide sufficient footage for the software to run “individual calibration” (where the greeting video is compared to the previously made calibration video), and instead, “continuous calibration” (where the software establishes calibration as it analyses) was used.

2.2.1.1. State log analysis

Two videos were eliminated from the face reader analysis because a significant portion of the video contained error messages due to the software's inability to detect a face.¹ There were therefore a total of 56 videos ($n = 56$) analyzed by the face reading software. Mean proportions and standard deviations in both conditions, as well as the main effects of condition, main effects of avoidance, and interaction effects for each of the 7 emotions are reported in Table 1.

The effects of condition and avoidance on each emotion were calculated using a general linear model. Avoidance and anxiety were centered prior to analysis. Avoidance and Condition were entered as independent variables, as was anxiety, to control for its effects. The avoidance by condition interaction was entered into the model, controlling for any anxiety by avoidance and anxiety by condition interactions. All 7 emotional states were entered as multivariate dependent variables in the model to account for any shared variance between the various emotions.

A significant main effect of condition on anger was found, $\beta = 0.05$, $t(49) = 2.29$, $p = 0.03$, $R^2 = 0.03$, with participants displaying more anger in the cold condition than in the warm condition. Avoidance was found to have a significant effect on the displays of neutrality, $\beta = 0.07$, $t(49) = 2.17$, $p = 0.04$, $R^2 = 0.04$, with high avoidant participants displaying more neutrality than low avoidance participants. This main effect was qualified by a marginally significant avoidance by condition interaction, $\beta = -0.08$, $t(49) = -1.94$, $p = 0.06$, $R^2 = 0.07$. Simple effects analyses revealed that high avoidant participants did not differ in their display of neutral affect across the warm and cold conditions, ($\beta = 0.09$, $t(49) = 1.61$, $p = 0.06$), and neither did low avoidant participants ($\beta = 0.07$, $t(49) = 1.20$, $p = 0.12$). Analyzed differently, for participants in the cold condition, there was no effect of avoidance on neutral affect expression, $\beta = 0.01$, ($t(49) = 0.16$, $p = 0.44$). However, for participants in the warm condition, high avoidant participants had significantly higher proportions of neutral affect expression than low avoidant participants, $\beta = 0.20$, ($t(49) = 2.28$, $p = 0.01$) (See Fig. 2).

¹ The face reading software's inability to detect a face may be caused by covering the face, turning the head away, or another obstruction of the face. The experimenters instructed the participants to avoid blocking their faces.

2.2.1.2. Detailed log analysis

Since the detailed logs calculated emotional expressions at a far more minute level than the state logs did, there were substantially more participants that were discarded due to the face reader's failure to find a face. If the detailed log contained error messages for 50% of the video or more, they were discarded. A total of 47 videos ($n = 47$) were used for the detailed log analysis, reducing the power of this secondary analysis. Despite the reduced power of this analysis, all 7 emotion scores for the detailed log analysis correlated significantly with those for the state log analysis. Mean potency scores and standard deviations for both conditions, as well as the main effects of condition, main effects of avoidance, and interaction effects for each of the 7 emotions are reported in Table 2.

Average potency scores for each emotional expression were calculated for each participant. To avoid diluting the average potency score by including potency scores for emotions that were absent during a given time interval, only potency scores > 0.1 were included. Thus, each average potency score represents the average potency of a given emotion for when that emotion was expressed. Avoidance and anxiety were once again centered prior to any analyses. Using a general linear model once again, avoidance and condition were entered as independent variables, controlling for length of video and anxiety. Once again, the avoidance by condition interaction was entered into the model, controlling for any anxiety by avoidance interaction and anxiety by avoidance interaction. Emotional potency scores (neutral, happy, sad, angry, surprised, scared, and disgusted) were each entered as multivariate dependent variables to account for any shared variance.

A significant main effect of condition on anger was once again found, $\beta = 0.04$, $t(40) = 2.45$, $p = 0.03$, $R^2 = 0.21$, with participants in the cold condition displaying higher anger potency scores than participants in the warm condition. There were no other main effects of condition or avoidance for any other emotion. There were also no significant interactions of avoidance and condition for any of the emotional expressions.²

2.2.2. Manual coders' analysis

Regression analyses were conducted for each of the clusters formed in the manual coding process. Each of the clusters, (e.g. “Likeability” or “Attachment Security”) were entered as dependent variables. For each regression analysis, centered avoidance, condition, and centered anxiety were entered in Step one, the 2-way interactions of avoidance by condition, avoidance by anxiety, and anxiety by avoidance were entered in Step 2, and the 3-way interaction of avoidance by anxiety by condition was entered in Step 3, however once again it is not reported here due to a lack of power. The main effects of condition, avoidance, and the interaction of avoidance by condition, as well as the means and standard deviations in both conditions are summarized for each cluster, in Table 3.

² There was also a significant main effect of anxiety on anger such that anxious participants displayed more anger ($\beta = 0.024$, $p = 0.02$, and $R^2 = 0.071$).

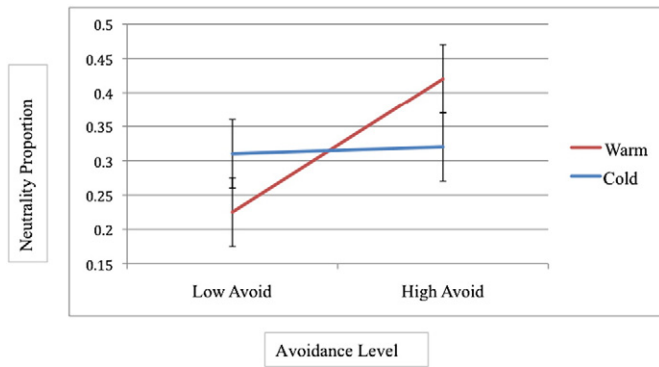


Fig. 2. The effects of avoidance and condition on neutral affect expression, plotted at -1 to $+1$ standard deviations for avoidance, with standard error bars.

For neutrality, the effect of condition was trending towards significance, ($n = 58$) $\beta = 0.20$, $t(51) = 1.5$, $p = 0.14$, $R^2 = 0.05$, with participants in the cold condition appearing more neutral than participants in the warm condition. There was also a marginally significant effect of avoidance on neutrality, $\beta = 0.46$, $t(51) = 1.75$, $p = 0.09$, $R^2 = 0.01$, with high avoidant participants appearing more neutral than low avoidant participants. There was no significant interaction effect for neutrality, $\beta = -0.33$, $t(51) = -1.24$, $p = 0.22$.

3. Discussion

This study attempted to replicate the findings of MacDonald & Borsook (2010). As in the original study, participants engaged in an intimacy-inducing task with a confederate who either behaved in a warm or a cold manner. In the MacDonald & Borsook (2010) study, highly avoidant participants felt more connected to a warm confederate than did low avoidant participants. The present study instead found the reverse: individuals lower in attachment avoidance felt closer to the warm confederate than individuals higher in attachment avoidance. Indeed, although low avoidant participants felt significantly closer to a warm than a cold interaction partner, those high in avoidance felt no significant difference in closeness whether their partner was warm or cold. Thus, MacDonald & Borsook's (2010) findings did not replicate.

The lack of replication of MacDonald & Borsook (2010) can be explained several ways. One possibility is that the original findings were spurious, perhaps due to the study's low power. It is also possible the current findings are the ones that are spurious, but this is less likely given the higher-powered analyses in the current research. Second, different women played the "partner participant" in the two studies. Since, for ethical purposes, the confederates were required to provide honest answers to the questions in the relationship closeness induction task, their responses varied from one another. However, in pilot testing, the present confederate's behavior in the two conditions was perceived as intended (*i.e.*, it was perceived as warm in the warm condition and cold in the cold condition) as in the original study. The confederates also inevitably each had their own idiosyncrasies in speech and facial

expressions. However, given the extensive training given to the second confederate, we took all possible steps to minimize the likelihood that differences in mannerism or appearance would cause stark contrasts in the results of the two studies. Third, the MacDonald & Borsook (2010) study was conducted as part of a larger investigation into physical pain, whereas the current study was not. In the physical pain study, participants were exposed to pain which had the potential to be attachment system activating for the participants. It is possible that in the context of stress and pain, avoidant individuals may be more receptive to warmth or intimacy. Further evidence would be required to determine whether the effects found in the original study were in fact due to an interaction between pain, attachment, and warmth provided in a social interaction. In any event, in light of the current results, it is difficult to feel confident in the reliability of the original effect.

The present study was kept as similar as possible to the original study, with several similarities not often found in replication studies. In addition to the identical measures used, the study was conducted in the same laboratory, with the same equipment, and even the same principal investigator. Though they were kept to a minimum, there were a few differences between the original and present studies, apart from the different confederates, that are worth mentioning here. First, though the present study included an additional task of filming a greeting video, this was conducted after the point at which the original study ended. Thus, this change seems highly unlikely to account for any differences across studies. Second, in the present study, participants filmed calibration videos in between the first set of questionnaires and the interaction with the confederate. Given how little participants stated in these videos, (they were each approximately 10 s long), and how impersonal they were (participants typically just stated their birthdays and their ages, information that was captured in the preceding questionnaires) it seems unlikely that the calibration video can account for the differences between the original and present studies. Finally, the present study included the *Big Five Inventory*, a measure not included in the original study. It was included in the present study for the purposes of controlling for personality variables that could potentially offer competing explanations for the effects. Indeed, we found that agreeableness may account in part for the effects of avoidance on connection score.

Overall, then, the current findings sit more comfortably within the body of literature suggesting that avoidant individuals are less receptive to social rewards than are secure individuals (Gere, MacDonald, Joel, Spielmann, & Impett, 2013; Spielmann, Maxwell, MacDonald, & Baratta, 2013). Indeed, a meta-analysis including 118 independent samples (Li & Chan, 2012) showed that avoidantly attached individuals experienced lower levels of connection in romantic context compared to non-avoidant individuals. It would thus appear that the plurality of evidence, so far, points to avoidant individuals being fairly unresponsive to intimacy, and that the few studies that found the inverse are exceptions. In determining whether the present results are more reliable than those of the original study, it is important to compare the differences in sample size between the two studies. According to the guidelines for replication power put forth by Simonsohn (2015), a sample size of 2.5 times the original sample size has approximately 80% power to reject a detectable effect. Thus, an even larger sample size for the present

Table 2
Summary of mean potency scores and standard deviations for the 7 emotions analyzed in the warm and cold conditions, as well as the effects of condition, avoidance, and the interaction thereof on affect potency scores.

	Warm	Cold	Effect of Condition	Effect of Avoidance	Effect of Interaction
Neutral	M = 0.31, SD = 0.09	M = 0.31, SD = 0.11	$\beta = 0.02$ $t = 0.41$	$\beta = 0.03$ $t = 0.50$	$\beta = -0.05$ $t = -0.90$
Happy	M = 0.25, SD = 0.15	M = 0.23, SD = 0.08	$\beta = -0.04$ $t = -0.93$	$\beta = -0.06$ $t = -0.98$	$\beta = 0.06$ $t = 0.93$
Sad	M = 0.17, SD = 0.08	M = 0.21, SD = 0.09	$\beta = -0.02$ $t = -0.38$	$\beta = -0.04$ $t = -0.64$	$\beta = 0.02$ $t = 0.32$
Angry	M = 0.05, SD = 0.04	M = 0.12, SD = 0.10	$\beta = 0.04^{**}$ $t = 2.45$	$\beta = -0.04$ $t = -1.76$	$\beta = 0.04$ $t = 1.57$
Surprised	M = 0.22, SD = 0.13	M = 0.18, SD = 0.10	$\beta = -0.03$ $t = -0.32$	$\beta = -0.05$ $t = -0.47$	$\beta = 0.03$ $t = 0.23$
Scared	M = 0.10, SD = 0.09	M = 0.15, SD = 0.09	$\beta = 0.03$ $t = 0.47$	$\beta = 0.03$ $t = 0.43$	$\beta = -0.05$ $t = -0.67$
Disgusted	M = 0.14, SD = 0.14	M = 0.07, SD = 0.05	$\beta = -0.04$ $t = -0.67$	$\beta = -0.02$ $t = -0.26$	$\beta = 0.04$ $t = 0.49$

** Significant effect at $p = 0.05$.

Table 3

Summary of means, standard deviations, and effects for each cluster analyzed by manual coders.

	Warm	Cold	Condition	Avoidance	Interaction
Likeability	M = 3.62, SD = 0.81	M = 3.21, SD = 0.79	$\beta = -0.24^* t = -1.84$	$\beta = -0.34 t = -1.27$	$\beta = 0.12 t = 0.47$
Attachment	M = 3.19 SD = 0.79	M = 2.74 SD = 0.79	$\beta = -0.27^{**} t = -2.09$	$\beta = -0.40 t = -1.57$	$\beta = 0.12 t = 0.47$
Social reward	M = 3.22, SD = 0.87	M = 2.88, SD = 0.72	$\beta = -0.20 t = -1.49$	$\beta = -0.50^* t = -1.89$	$\beta = -0.34 t = 1.29$
Neutrality	M = 2.92 SD = 1.03	M = 3.31 SD = 0.81	$\beta = 0.20 t = 1.50$	$\beta = 0.46^* t = 1.75$	$\beta = -0.33 t = -1.24$

* $p < 0.10$.** $p < 0.05$.

study would have been ideal. However, given the limitations of scheduling a trained actress to come to the lab to interact with each participant, running more participants for the current study was not feasible. It is also worth noting that the present study did not merely fail to find the effect found in the original study, but rather it found the opposite effect. Given that the present study found significant effects in the opposite direction from the initial study, the contradiction is even stronger than had we found no effect in either direction. Though the present study is by no means the final word on the topic, the imbalance in evidence suggests that if there are ways to convey intimacy to avoidant individuals, the tactics used in the majority of present and past studies have been insufficient.

With regard to the exploratory component of the study, the facial expression analyses in the videos recorded by participants yielded little in the way of significant findings. The most reliable finding appeared to be that participants displayed more anger following a cold *versus* warm interaction, suggesting the *FaceReader* analyses have at least some degree of validity. Why then might there have been so few effects, especially involving interactions between condition and attachment avoidance? In retrospect, it might have been valuable to include some sort of neutral condition in our study if the primary focus had been non-verbal reactions. If individuals high in avoidant attachment respond to social rewards similarly to attachment threats, then the confederate in both the warm and cold condition may have in fact motivated avoidant individuals to deactivate their attachment systems. If so, this could explain why their reactions were similar across conditions for several measures, though differences might have emerged if contrasted against a more neutral control condition.

Indeed, the one intriguing effect that did tentatively emerge in this study's non-verbal measures is consistent with the notion that social reward can activate the attachment system of highly avoidant individuals. High avoidant participants appeared to display more frequent neutral affect in the warm than cold condition, which may reflect attempts at attachment system deactivation. Although previous studies have found that high avoidant individuals suppress attachment-related thoughts and emotions following a socially threatening experience (Dewitte, Koster, De Houwer, & Buysse, 2007; Ein-Dor, Mikulincer, & Shaver, 2011; Mikulincer, Gilath, & Shaver, 2002; Mikulincer & Shaver, 2007), the same may be true following a socially rewarding interaction. The attachment literature provides ample support for findings of this nature, as avoidant individuals would attempt to avoid bids for intimacy, which are often elicited by positive or negative affect. The potential influences that may mediate the relationship between attachment and affect expression, such as genetics (Troisi et al., 2011) or neuroanatomy (Vrticka & Vuilleumier, 2012) will help shed light on the dynamics of avoidant individuals' relationship with intimacy. Thus, future research should consider the attachment system activating potential of social reward for highly avoidant individuals, as well as the possible mechanisms that can explain that process.

Despite the apparent lack of response avoidant individuals have to intimacy and social reward, there may be ways to help them overcome these barriers to intimacy that are worth exploring in future research. Highly avoidant individuals are far more receptive to instrumental or practical support than emotional support (Girme, 2015; Girme, Overall, & Simpson, 2015). Future studies could explore whether highly avoidant individuals might be responsive to social reward that is

expressed instrumentally or is accompanied by more instrumental behavior. This may be a way to help avoidant individuals ease into comfort with emotional intimacy. Indeed, despite our findings suggesting that highly avoidant individuals were not responsive to a warm interaction, this is not to say that avoidant individuals cannot achieve comfort with intimate interactions. However, unlocking how to express social reward to avoidant individuals will be an important direction for attachment research.

Funding

This work was supported by the Social Sciences and Humanities Research Council [grant number 435-2013-0728] and the Faculty of Arts and Science at the University of Toronto.

Appendix A. Supplementary data

Supplementary data to this article can be found online at <http://dx.doi.org/10.1016/j.jesp.2016.11.010>.

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