ANXIOUS TO DETECT DECEIT?:
AN EMPIRICAL INVESTIGATION OF SOCIAL DEFENSE THEORY

BY

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DISSERTATION

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ABSTRACT

An extension of attachment theory called Social Defense Theory (Ein-Dor et al., 2010) holds that insecure attachment reflects an adaptive reaction called *sentinel behavior* – the tendency to notice ambiguous signs of threat, and warn others about that threat (Ein-Dor et al., 2010). Although Social Defense Theory provides an intriguing way to understand the adaptive consequences of insecure attachment, previous work has not been positioned to examine what "detection" means in the kind of detail needed to fully test the theory. The present dissertation aims to empirically examine whether the association between attachment anxiety and lie detection (i.e., claiming that something is a lie) is a result of two separable processes: discrimination and bias. Self-reports of attachment were collected from 254 adults who were asked to watch a series of videos in which they had to determine whether the people in them were lying or telling the truth. Multi-level logistic models (MLLMs) were used to assess the associations between individual differences in attachment and lie detection. The findings revealed that highly anxious participants did *not* demonstrate superior discrimination compared to their less anxious counterparts. Rather, attachment anxiety was positively associated with a tendency to detect lies regardless of trial type, revealing that highly anxious participants were more biased to detect deceit. Taken together, these findings underscore the importance of revising or abandoning Social Defense Theory, as it does not afford an adaptiveness explanation with respect to deception judgments.

Keywords: adult attachment, lie detection, social defense theory, multi-level modeling

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Dedicated to all the present and future Ph.D. students out there:

Remember, it's not about what you become, but rather, who you become as a result of your

doctoral journey. Stay the course and keep the faith.

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CHAPTER 1: INTRODUCTION

People differ in their characteristic ways of approaching close relationships (Gillath, Karantzas, & Fraley, 2016; Mikulincer & Shaver, 2018). A core premise of attachment theory is that these approaches, or attachment styles, reflect conceptualizations of the *self* and *others* – for example, how worthy of love one is and beliefs about peoples' availability, warmth, and responsiveness. People with secure attachment styles are thought to view themselves as worthy of care and affection, and others as reliable sources of support. On the other hand, those with insecure attachment styles are thought to view themselves as unworthy of care and others as unreliable.

Generally speaking, secure attachment fosters a view of the world as being relatively safe and predictable, with most people being trustworthy. However, security may not be adaptive when the world is unsafe and unpredictable (Szepsenwol & Simpson, 2019). For instance, in harsh or unpredictable environments, one must be vigilant and mindful of possible dangers and risks. Insecurely attached people may be better prepared for such environments (Ein-Dor, Mikulincer, Doron, & Shaver, 2010, p. 132). Rather than reflecting suboptimal attachment-system functioning, insecure attachment orientations may be conditionally adaptive.

Although there are a variety of environments that can be characterized as harsh or unpredictable, I have chosen to empirically examine attachment with respect to deception. Deception can be defined as intentionally sending a false message or making a misleading statement to others (Ekman, 1997). Deception is fairly pervasive. In fact, there appears to be an average of one lie in every two social interactions (DePaulo & Kashy, 1998). Given such environmental uncertainty, there is value in having skills to detect deception. For instance, there are interpersonal consequences of failing to detect lies, such as harming trust and impairing

individuals' general ability to accurately detect others' emotions (Lee, Hardin, Parmar, & Gino, 2019). It is worthwhile to note that, although lie detection may be adaptive in unpredictable environments, it is likely not the case that accurate lie detection is maladaptive in predictable, safe environments.

Given that people are only approximately 50% accurate in tests of their ability to differentiate truth from lies (Bond & DePaulo, 2006), some scholars have sought to determine whether individual differences – such as one's attachment style – are reliable predictors of peoples' ability to detect deceit (Ein-Dor & Perry, 2013; Ein-Dor et al., 2017). An extension of attachment theory called Social Defense Theory (Ein-Dor et al., 2010) holds that insecure attachment is associated with better lie detection. The ability to do so is thought to reflect an adaptive reaction called *sentinel behavior* – the tendency to notice ambiguous signs of threat, and warn others about that threat (Ein-Dor et al., 2010). Although Social Defense Theory provides an intriguing way to understand the adaptive consequences of insecure attachment, previous work has not been positioned to examine what "detection" means in the kind of detail needed to fully test the theory. Lie detection (i.e., claiming that something is a lie) can emerge from at least two separable processes.

First, some people may conclude that others are being deceitful because they have a *liberal threshold* (bias) for claiming that a statement is a lie. In situations in which lies are pervasive, having a lower threshold for claiming that others are lying will lead to a lot of hits-- the correct detection of actual lies. If anxious people are correct in such situations, it may seem that they are skilled at detecting lies. But if those "hits" reflects the use of liberal thresholds, anxious people will also have a lot of false alarms, which would undermine the purported adaptiveness explanation of Social Defense Theory.

Second, some people may actually be better skilled than others at separating lies from non-lies--what I'll refer to as *discrimination* in the present work. According to Social Defense Theory, insecure individuals are better skilled at lie detection--that is, they can accurately separate lies from non-lies. If this is the case, it should be possible to demonstrate that their ability to detect lies stems from an ability to discriminate lies from non-lies rather than merely reflecting the use of a more liberal threshold for detecting lies.

In order to understand which of these explanations best accounts for insecure adults' lie detection performance, one can use the logic and methods of Signal Detection Theory (Macmillan & Creelman, 2004) in which judgements are made for trials in which a signal (i.e., a lie) is present and absent to make inferences about people's thresholds or criteria for responding, as well as their ability to separate signals from noise. Social Defense Theory predicts that insecure people have high discrimination abilities and not merely liberal thresholds. However, it is possible that insecure lie detection is simply a result of insecure people adopting more liberal thresholds. This would lead them to be able to detect lies when lies are present--something compatible with Social Defense Theory. But it would also imply that they construe others as lying even in situations where people are being truthful. This possibility would likely lead to social conflict, misunderstandings, and alienation, and would not be compatible with the group-based adaptive explanation of insecurity offered by Ein-Dor and his colleagues. Taken together, the present research will first attempt to replicate previous studies which have shown that insecure people are better able to detect lies than their more secure counterparts. I will then use tools from signal detection theory to test alternative explanations for the phenomenon--whether insecure people show bias and/or a true ability to distinguish lies from non-lies.

1.1 Origins and Development of Attachment Theory

Attachment theory emphasizes the role of parental relationships in providing a foundation for psychological development. That is, the quality of parental relationships can help us understand how people function in other relationships and it provides insight into their broader psychological adjustment across the life course. Attachment theory was first conceptualized by John Bowlby (Bowlby, 1969/1982). Bowlby proposed that attachments with parents and other caregivers are important for psychological functioning throughout the life course. Working to understand distress in children who were separated from their parents, Bowlby observed that infants would seek to prevent separation from their caregivers and regain proximity to them through various behaviors such as clinging, crying, or searching. Bowlby proposed that these infants were displaying *attachment behaviors* under a motivational-behavioral control system he called the *attachment behavioral system*. Drawing on concepts of ethology, Bowlby proposed that parent-child attachments help to ensure that infants and children are protected and will survive until they can function independently. That is, the attachment system increases survival via motivation to maintain proximity to the *attachment figure*. Over time, children develop internal representations or "internal working models" (Bowlby, 1969) of themselves and others based on their caregivers' availability and responsiveness to them. Internal working models of the *self* reflect individuals' beliefs about their lovability and competence. Internal working models of *others* reflect individuals' beliefs about other people's availability, warmth, and responsiveness. Bowlby proposed that these working models shape our relationships "from the cradle to the grave" (p. 129).

Building off of Bowlby's earlier work, Mary Ainsworth devised the Strange Situation procedure (Ainsworth & Wittig, 1969) to assess the quality of an infant's attachment to his or her

caregiver. In this procedure, an infant's behavior is observed in an unfamiliar room with toys, while the infant's mother and a stranger (an unfamiliar woman) move in and out of the room in a structured series of situations. The key observations focus on the infant's reaction to the mother's leaving and returning, both when the stranger is present and absent, and on the child exploring the situation (i.e., the room and toys in it). Ainsworth and her colleagues (Ainsworth, Bell, & Stayton, 1971) found three types of attachment relationships – secure, insecure-avoidant, and insecure-ambivalent. Later, researchers added a fourth type of insecure attachment, insecure-disorganized (Main & Solomon, 1986).

Secure attachment is indicated by the infant exploring the situation freely in the presence of the mother, displaying distress when the mother leaves, and being soothed by her return. *Insecure-avoidant* attachment is shown by exploration but minimal interest in the mother, the infant showing little distress when the mother leaves, and avoiding her when she returns. *Insecure-ambivalent* attachment occurs when the infant seeks closeness to the mother and does not explore the situation, has high levels of distress when the mother leaves, and demonstrates ambivalent behavior when she returns by clinging to and pushing away from her. About two-thirds of infants are found to have a secure attachment, and the other third insecure attachments.

1.2 Attachment Theory and Research in Adulthood

Extending Bowlby's work, a number of attachment scholars have investigated attachment in adults. Hazan and Shaver (1987) carried out the first empirical study of adult attachment based on the theoretical assumption that romantic relationships may also function as attachments. That is, adult relationships may work in ways that are similar to infant-caregiver relationships. The authors developed three short paragraphs, each describing an adult classification of one of the three attachment types that Ainsworth had identified in her work with infants: secure, anxious-

ambivalent, and avoidant. *Secure* adults were conceptualized as those comfortable with emotional intimacy and unconcerned about rejection from close others. *Anxious-ambivalent* adults were thought to have an excessive desire for emotional intimacy and to worry about rejection from others. *Avoidant* adults were defined by those who were uncomfortable with intimacy and distrustful of others. Using this classification system, Hazan and Shaver (1987) found that people with different attachment styles varied in how they recalled their early relationships with their parents. For example, secure adults tended to report that their parental connections were more affectionate and caring than those reported by insecure adults.

Hazan and Shaver's (1987) study inspired a large body of research on adult attachment. Over the years, some of the central tenets of the theory have received considerable empirical support, whereas others have been called into question. One debate that has garnered much attention is the function of insecure attachment (see Fraley, 2019). Attachment theory is built on the assumption that security is evolutionarily adaptive, yet we observe a paradox whereby many people are, in fact, insecure (Ein-Dor et al., 2010). In recent years, scholars have begun to ask whether anxious peoples' hypervigilance may benefit themselves and others to the extent that they notice ambiguous cues of danger and alert others to the threat.

1.3 The Attachment Paradox: Is Insecurity Adaptive?

Attachment researchers have traditionally viewed security as embodying optimal functioning of the attachment system (Bowlby, 1969/1982; Ainsworth, 1989). However, contemporary research has challenged this assumption. Some scholars have attempted to resolve ambiguities concerning the association between attachment patterns and adaptation, finding that insecurity may, in fact, not be maladaptive as previously believed (e.g., Fraley & Bonanno, 2004). Moreover, it has been suggested that many of the positive outcomes of secure attachment

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should be less beneficial in harsh and/or unpredictable environments (e.g., Szepsenwol &

Simpson, 2019). In such environments, insecure (i.e., anxious and avoidant) attachment may

yield adaptive benefits.

In the context of threat and danger, work by Ein-Dor and colleagues (2010) suggests that

each attachment style may confer unique adaptive advantages. These scholars liken their

argument to Nettle's (2006) thesis that variation in personality traits can be understood in terms

of cost and benefit tradeoffs:

> "Behavioral alternatives can be considered as tradeoffs, with a particular trait producing
>
> not unalloyed advantage but a mixture of costs and benefits such that the optimal value
>
> for fitness may depend on very specific local circumstances" (Nettle, 2006, p. 625).

In essence, rather than reflecting suboptimal attachment-system functioning as previously

believed, insecurity may be adaptive. This competing theoretical view is referred to as Social

Defense Theory (Ein-Dor et al., 2010).

Although Social Defense Theory is a promising approach to understanding the function

of insecure attachment, it is not without its fair share of criticism. For instance, a commentary

written by Frankenhuis (2010) casts doubt on the adaptationist nature of Social Defense Theory

for three main reasons. First, the author questions Ein-Dor et al. (2010)'s claim that insecure

people are "evolutionary altruists" (p. 1), stating that Social Defense Theory fails to integrate

evolutionary and developmental science. That is, scholars have yet to measure fitness effects in

humans (i.e., undertake an investigation in which the number of viable offspring of individuals

with insecure versus secure attachment styles is assessed). Second, the criteria for biological

adaptation proposed by Ein-Dor and colleagues (2010) is not met because the features of

insecure attachment that may be fitness-relevant are not discussed at length "with sufficient

precision, economy, and efficiency" (p. 2). Third, Ein-Dor et al. (2010) present cognitive and behavioral evidence to support their hypothesis that insecure attachment evolved for advantages at the group-level, but the empirical evidence cannot disentangle individual-level and group-level benefits.

1.4 Social Defense Theory

Social Defense Theory posits that each attachment style provides unique adaptive advantages that either increase or decrease the inclusive fitness (i.e., survival benefits) of individuals. More specifically, each attachment style includes a working model, or script, that is activated under threat. According to Ein-Dor et al. (2010), this script effectively renders the person to act in a way that is consistent with his/her attachment style. This section will briefly outline the theory itself in light of the costs and benefits associated with secure and insecure attachment (i.e., avoidance, anxiety).

Advantages and Disadvantages of Attachment Security

At first glance, it would seem plausible that securely attached individuals may detect and respond to danger/threat more readily than their less secure counterparts, particularly on the basis of the negative association between security and risk-taking (e.g., Kim & Miller, 2020). Moreover, people who are secure with respect to attachment are better at leading and coordinating group activities (which would serve people well in the event of danger), although these advantages are partially offset by disadvantages (e.g., Rom & Mikulincer, 2003). That is, although "optimistic, comforting mental representations" associated with *felt* security (Ein-Dor et al., 2010, p. 130) may help secure people in challenging or stressful situations, actual *physical* security could lead a person to delay their recognition, or response to, an imminent threat. Accounts of natural disasters (Mawson, 2012) suggest that the ordinary human response is to

seek the proximity of familiar people (e.g., close relatives), even if this puts people in danger. In fact, Bowlby (1973) noted that during and after disasters, "no member of a family is content, or indeed able to do anything else, until all members of the family are gathered together" (p. 91). Therefore, proximity seeking is sometimes not the safest strategy and could be maladaptive (Ein-Dor, 2014). Taken together, this reasoning suggests that the desire to remain close to others may incur more harm than good in some situations, possibly leading to slower identification of threat and non-optimal reactions to danger.

Advantages and Disadvantage of Attachment Avoidance

Avoidant people tend to dismiss threats, pain, and vulnerability; they also cognitively or behaviorally withdraw from sources of stress and distress (e.g., Fraley & Shaver, 1997). Therefore, they might be less vigilant to threat and perceive that they are in danger later than others. At the same time, avoidant individuals tend to be self-interested and motivated to save themselves (Ein-Dor, 2014). When encountering danger, they may quickly discover a way 'out' because they exercise "self-protective fight-or-flight reactions" (Ein-Dor et al., 2010, p. 132). In fact, research using a threatening laboratory situation–whereby the room gradually filled with smoke–indicated that the typical response of avoidant people was fleeing to the adjunct corridor. Attachment avoidance was linked with quicker escape time (i.e., self-preservation) and with better appraisals of effective reactions when dealing with the situation (Ein-Dor, Mikulincer, & Shaver, 2011). This is in stark contrast to anxiously and securely attached individuals who are more likely to stay in harm's way because they are concerned about the whereabouts and welfare of close associates.

Advantages and Disadvantages of Attachment Anxiety

People who are high in attachment anxiety tend to possess hyperactivating tendencies (e.g., Mikulincer & Shaver, 2003). Compared with people who are securely attached, those who are anxious are more likely to become distressed when under threat, engage in catastrophizing, focus on threat-related information, and seek proximity to others (see Mikulincer & Shaver, 2007, for a review). However, it is possible that these hyperactivating strategies may be advantageous. Such a possibility is supported by previous research suggesting that anxious attachment may be socially adaptive – those high in anxiety appeared to be more accurate than less anxious people in their perceptions of facial expressions (see Fraley, Niedenthal, Marks, Brumbaugh, & Vicary, 2006).

According to Social Defense Theory, attachment-related anxiety, but not avoidance or security, is associated with an adaptive reaction called *sentinel behavior* – noticing ambiguous signs of threat and warning others about the threat (Ein-Dor et al., 2010). The authors suggest that other people may benefit from having anxious sentinels present – for instance, they are the first to pick up on signs of danger and alert others to its presence. In the aforementioned 'smoke study', those who scored highest on anxiety detected the presence of smoke and alerted group members more readily than others (Ein-Dor, Mikulincer, & Shaver, 2011).

Although Social Defense Theory discusses adaptive benefits for attachment security, avoidance, and anxiety, I will focus on attachment anxiety henceforth, as the empirical work on attachment and lie detection makes specific predictions about this attachment style. This research will be discussed at length in the next section.

1.5 Empirical Work on Attachment Styles and Lie Detection

Evolutionary biologists have indicated that "social exchange cannot evolve in a species unless those who engage in it are able to detect cheaters" (Ermer, Cosmides, & Tooby, 2007, p. 138). Some scholars have sought to determine whether individual differences – such as one's attachment style – are reliable predictors of peoples' ability to detect deceit. Much of the research on attachment and lie detection has been spearheaded by Ein-Dor and his research team (Ein-Dor & Perry, 2013; Ein-Dor et al., 2017). Collectively speaking, this work is built upon the assumption that Social Defense Theory can be extended to the detection of deceit – namely, that those who are high in attachment anxiety are better able than others to quickly and accurately detect lies on the basis of sentinel behavior (i.e., noticing ambiguous signs of threat and warning others about the threat).

In an initial foray into attachment and lie detection, Ein-Dor and Perry (2013) conducted three studies[1]. In Study 1, 202 participants watched a series of interpersonal interactions in the form of seven short video clips. The interactions consisted of an exchange between two professional actresses that had subtle clues to the honesty (4 clips) or dishonesty (3 clips) of the speakers telling their stories. Participants were asked to indicate whether the main character was being honest or dishonest. The researchers calculated the number of deceitful stories and the number of truthful stories that were accurately identified.

In Study 2, 58 participants watched 10 short video clips in which cues to the honesty or dishonesty of the main characters were absent; this was done in an effort to build upon the limitation of the previous study insofar that the external cues did not mimic real lies (i.e., the

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[1] The method and results of Study 3 will not be explained in detail because the study was based on a small sample size (N = 35) and may not have been positioned to produce robust findings. The method employed for Studies 1 and 2 are of interest insofar as the proposed research will attempt to replicate and build upon this work.

cues could have easily disproven or authenticated the characters' stories). Participants were asked to judge whether the main characters were honest (4 clips) or dishonest (6 clips). Those who told a truthful story described an event that genuinely happened to him or her; those who told a dishonest story described an event that happened to one of the research team's members, but not themselves. The four outcome variables were (1) the number of deceitful stories accurately identified, (2) the number of truthful stories accurately identified, (3) reaction time (in milliseconds) for deceit detection, and (4) reaction time for truth detection.

Taken together, the results of both studies indicated that the higher a person's attachment anxiety, the more accurate he or she was in detecting deceitful statements. At the same time, participants high in attachment anxiety were *not* quicker to identify deceitful statements (as assessed with RT in Study 2). These findings provide preliminary support for Social Defense Theory. However, these results should be interpreted with caution for two primary reasons. First, attachment anxiety was unrelated to the ability to detect truthful statements (or the time taken to do so). In other words, anxious people were better able than others to detect lies but they were not necessarily better than others at detecting truths. Such a finding is counterintuitive from an Social Defense Theory framework. If people high in attachment anxiety possess the ability to detect lies, then it logically follows that they should be more accurate than their less-anxious counterparts in detecting truthful stories as well. Second, if anxiety is truly 'adaptive' per se, anxious participants should be quicker in identifying deceit. The authors make this very claim when stating that those who are high in attachment anxiety "are more able than others to quickly and accurately detect threats and danger" (p. 83).

In another investigation by Ein-Dor and colleagues (2017), 68 non-professional card players were asked to play the game *Bullshit* (18 groups, 3-4 players each). The objective of

game is to get rid of all of your cards. Since the cards are discarded face down, players do not, in fact, have to play the rank they are calling (e.g., a player calls "two Sevens" even though he or she has no Sevens). Any player who suspects that the card(s) discarded by a player do not match the rank called can challenge the play by calling out loud: "Bullshit!" Then the cards played by the challenged player are exposed and one of two things happens. If they are all of the rank that was called, the challenge is false, and the challenger must pick up the whole discard pile; if any of the played cards is different from the called rank, the challenge is correct, and the person who played the cards must pick up the whole discard pile. While playing the game, two research assistants (RAs) served as coders and sat behind the players (players were instructed to show their cards to them). RAs coded the amount of hits or successful lie-detecting (correctly calling BS when a player cheated), false alarms in lie-detecting (calling BS when the player did not cheat), successful cheats (cheating without someone calling BS), and unsuccessful cheats (cheating and someone calling BS). Each group played 2-3 rounds of the game and for each participant, the following three outcomes were measured: (1) his/her ability to cheat (successful cheats – unsuccessful cheats); (2) ability to detect cheating (hits – false alarms in lie detecting); (3) the number of wins. The results of this study indicated that higher attachment anxiety was predictive of better ability to cheat without getting caught and better ability to detect cheating, even after controlling for familiarity with the game. Attachment anxiety, however, was only marginally associated with greater number of wins in the game.

Although this study is informative in that it provides support for Social Defense Theory, it does not take into account participant "inaccuracies" or misses (i.e., not calling BS when an unfair card was played). This is a limitation because previous work has omitted any consideration of the relative frequency of false-negatives (i.e., misses) to measure how biased

participants are to respond "no". This is particularly important because anxious individuals may demonstrate a *lie* bias, which would be inconsistent with the assumptions of Social Defense Theory. That is, individuals with high attachment anxiety may adopt a liberal strategy whereby they have a lower criterion for judging that deceit is present. Put another way, always saying "lie" would lead to more hits because all the lies would be detected (even if there are numerous false alarms).

To the best of my knowledge, there are only two other studies that examine the association between attachment style and lie detection, and neither provide support for Social Defense Theory In fact, the findings contradict the theory. In a study of 121 Israeli adolescents, participants were administered a Hebrew version of the Experiences in Close Relationships (ECR) questionnaire to assess attachment style. Participants were also asked to complete the Lies and Truth Related Abilities Questionnaire (Elaad, 2009) in which they self-assessed their own lie-telling, lie-detecting, truth detecting, and truth-telling abilities relative to other people's abilities, on a scale ranging from 0 (much worse than others) to 100 (much better than others), with 50 (as good as others) serving as the middle point. Elaad et al. (2012) found that attachment anxiety predicted poor subjective ability to detect lies. Although they did not directly test this, the authors suggest that their results could be due to anxious individuals' tendency towards a negative self-perception and low self-esteem. These results also correspond with previous findings that imply lower relationship-related skills of anxious individuals (see Mikulincer & Shaver, 2007 for a review).

Work by Wu, Cai, Zhang, Liu, and Jin (2018) examined the association between adult attachment anxiety and deception judgment, specifically whether motivation moderates the association. One hundred and seventy-three Chinese students were asked to listen to ten audio

clips (without obvious cues to distinguish lies from truth). In each of these audio clips, a person narrated a traveling experience. Half of these people narrated a real experience of traveling to a city, while the other half narrated a fabricated experience of traveling to a city. The authors manipulated participants' motivation, operationally defined as whether participants' monetary rewards (high vs. low) were associated with their accuracy of deception judgment. Adult attachment was assessed using the Experiences in Close Relationships Questionnaire (Brennan et al., 1998) modified by Li and Kato (2006). The results indicated that, compared with people who had low attachment anxiety, those with high attachment anxiety tended to have higher truth biases in the low-motive condition and lower accuracy in the high-motive condition. Overall, the findings cast doubt on Social Defense Theory given the negative correlation observed between attachment anxiety and accuracy, such that participants with higher attachment anxiety exhibited lower detection accuracy. This negative correlation was opposite to the aforementioned results of studies conducted by Ein-Dor et al. (2013, 2017) who found a positive correlation between attachment anxiety and detection accuracy. Given such contradictory findings[2], future work is needed to determine whether attachment anxiety reflects an actual ability to detect lies.

1.6 Base Rates and Lie-Truth Judgments

As mentioned previously, anxious people may be found to have numerous false alarms which would possibly undermine the purported adaptiveness explanation of Social Defense Theory. It is important to note that this is conditional on the base rate of lies. If the base rate of lies is high, then it is incomprehensible to imagine a situation in which there are evolutionary pressures to detect lies. If a person adopts a liberal threshold and sees many lies, ability is not needed. Put simply, a liberal threshold ensures detection without discrimination.

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[2] Quantitative effect size estimation was used to assess the degree of heterogeneity, or variation in outcomes between studies. See Appendix A and Figure 2 for the forest and funnel plots.

With respect to lie detection research, there is some evidence of sensitivity to base rate information. For instance, a study by Levine et al. (1999) manipulated the actual base rate of truths, although participants were not told anything about the likelihood of deception. They found that the truth bias remained constant regardless of the base rate. It is unclear whether this suggests that participants did not pick up on the true base rate, meaning it could not be used in their judgments or whether they did discover it, but that base rate information is not used when making lie–truth judgments. Similarly, in a set of experiments by Bond, Howard, Hutchison, and Masip (2013), raters' accuracy was near perfect when raters were only given information about speakers' incentives for lying or telling the truth. That is, base rates were perfectly defined by the incentives, and raters made use of that information when forming their judgments. However, when raters were able to observe the speakers' statements in addition to the incentive information, accuracy dropped markedly (Bond et al., 2013, Study 3). In fact, these judgments suggest that raters ignored the base rate information when the speakers' behavior was available.

Other research has found that perceivers also forego information about the frequency of lying. Schul, Mayo, Burnstein, and Yahalom (2007) had people judge a series of deceptive and truthful events. Prior to encountering the events, judges were informed that no more than one third of the events would be deceptive and received evidence of the validity of this information. Then these individuals rendered judgments of the deceptiveness of each event. Although judges could have achieved at least 67% accuracy by stating that every event was truthful, they did not use this strategy. Ignoring the base rate information, they judged many of the events to be deceptive and achieved less than 60% accuracy.

Given these considerations, the base rate of lies will not be assessed in the present work. Although this could be seen as a possible limitation, it is worthwhile to consider that base rate

neglect may be a result of how information is framed. Reframing the information so that it is informative and relevant reduces the neglect (as cited in Street & Richardson, 2015). That is, raters ignore the base rate when the experiment is designed so that base rates are not informative or relevant.

1.7 Overview of the Present Study

Past research on attachment and lie detection (e.g., Ein-Dor et al., 2010) demonstrates that people who are insecure-anxious in their attachment styles are better able to detect lies than others. What is unknown, however, is whether that finding reflects differences in anxious people's ability to discriminate lies from non-lies or whether they have more liberal thresholds for classifying a statement as a lie. These alternative accounts have vastly different implications for understanding insecure[3] attachment. Should the results provide further support for Social Defense Theory, greater focus should be made to studying the adaptive functions of insecure attachment patterns in adulthood. On the other hand, if the findings are at odds with Social Defense Theory, attachment scholars should abandon the evolutionary[4] approach advanced by Ein-Dor and his colleagues. The purpose of this dissertation is to first replicate previous work by Ein-Dor et al. (2013) and then extend that work using tools from signal detection theory to test alternative explanations for the phenomenon. Two research questions will guide this work: (RQ1) Do anxious people show a greater ability to discriminate lies from non-lies, and (RQ2) Do

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[3] Although attachment avoidance is not the primary interest of this work, it was assessed in an exploratory analysis (see Table 7). A person who is relatively avoidant with respect to attachment may rely on their self-protective fight-or-flight reactions in times of threat. This defensive pattern may be advantageous given that avoidant people may be more distrusting of others, thereby exercising their model of quick self-protection (Ein-Dor et al., 2010). Alternatively, avoidance might be unrelated to lie detection since avoidant people are known to engage in deactivating strategies which may involve deemphasizing the threat.

[4] It should be noted that the evolutionary arguments put forth by Ein-Dor et al. (2010) are not fundamental to the present goals. Past work by Ein-Dor and colleagues examines the detection of interpersonal deceit and it can be argued that social-oriented threat does not constitute "imminent" danger. With this, we recognize that the *context* of lies may matter for the broader theoretical idea that failing to detect deceit could have implications for one's reproductive fitness.

they have more liberal thresholds for classifying a statement as a lie, compared to their less-anxious counterparts? It is my hope that this research will provide us with a more comprehensive test of Social Defense Theory, so that we can better understand lie detection in anxious versus non-anxious adults.

CHAPTER 2: METHOD

2.1 Sample

Two hundred and fifty-four participants, aged 23-71 years ($M = 37.51$, $SD = 10.25$) from Amazon's Mechanical Turk workforce were invited to take part in a study on the detection of lies. Participants were paid $2.00 per hour for completing the study which consisted of self-report measures and a lie detection task involving a series of short videos. The videos were obtained by RAs who received the same set of instructions that would have been distributed to subject pool participants. That is, they were told not to state their name or the name of other people in the recordings.

2.2 Procedure

The data were collected using Qualtrics software. Upon reading the online consent form and agreeing to take part in the study, participants completed self-report questionnaires of attachment style and state/trait anxiety. The order of the questionnaires was randomized for each participant. After completing these self-report measures, participants were shown twenty video clips[5] in which people told 1-minute stories. The video clips were embedded in Qualtrics. Participants were told that they were completing a detective task in which they must identify whether the person in the video clip was being deceitful or honest. Following the lie detection task, participants completed basic demographic questions, received a score indicating their lie detection accuracy (i.e., how many videos they got correct out of 20), and were compensated for their time.

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[5] The video clips were taken from unique people. The order of the stimuli was randomized.

2.3 Measures

Demographics. Basic demographic information on participants' age, gender, ethnicity, race, and relationship status were collected at the end of the study. This information was aggregated across participants. Age and sex were included as covariates in an auxiliary analysis, given that previous research suggests they play a role in the ability to detect deception. Specifically, college students have been found to be better detectors than older adults, with older adult males being the hardest to detect (Sweeney & Ceci, 2014). Further demographic information can be found in Table 1.

Attachment. Individual differences in attachment[6] were assessed in terms of attachment anxiety and attachment avoidance using the ECR-RS (Fraley et al., 2011). Importantly, the ECR-RS can be used to assess people's attachment orientations with regard to close relationships in general or with regard to specific relationships (e.g., mother, father, romantic partner). The general version of the ECR-RS was administered in the present study insofar as the present work focuses on how people's general approach to close relationships may be associated with lie detection. The ECR-RS consists of 9 items (avoidance: $\alpha = .60$, anxiety: $\alpha = .91$) that are rated on a scale from 1 = *strongly disagree* to 7 = *strongly agree*. Mean scores were calculated for each subscale (i.e., attachment anxiety and avoidance) on the general ECR-RS and used in present analyses.

State and Trait Anxiety. Similar to previous research by Ein-Dor and colleagues (e.g., Ein-Dor & Perry, 2013) that includes this measure, I assessed trait ($\alpha = .91$) and state ($\alpha = .89$)

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[6] By conceptualizing attachment along dimensions, researchers can capture variation that corresponds to meaningful differences in how people think, feel, and behave in their close relationships. The individual who scores low on both of these dimensions is secure–someone who is not anxious about rejection, who is comfortable with intimacy, and who seeks closeness to and support from relationship partners. Attachment anxiety refers to the amount of fear a person feels about rejection and abandonment within close relationships. Attachment avoidance captures the extent to which a person is uncomfortable with emotional intimacy and dependence on others.

anxiety with the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, &

Jacobs, 1983) and included it as a covariate in secondary analyses. Participants rated the extent

to which they were feeling anxious at the present moment (i.e., state anxiety) on a 4-point scale

ranging from 1 = *not at all* to 4 = *very much so*, and the extent to which they feel anxious in

general (i.e., trait anxiety) on a 4-point scale ranging from 1 = *almost never* to 4 = *almost always*.

Summed scores were calculated for each participant[7].

Descriptive Statistics. I ran a series of descriptive statistics on the data, including: (a)

mean and range of participants' ages; (b) percentage of participants who identify as women,

men, or other; (c) percentage of racial or ethnic groups with which participants identify; (d)

percentage of participants who ascribe to each of the attachment styles; (e) means, standard

deviations, and correlations between all measures (i.e., ECR-RS, STAI, and lie detection). See

Table 1.

2.4 Data Analysis

Classic signal detection measures (e.g., Macmillan & Creelman, 2004) are often used in

psychology to describe the association in a 2 x 2 cross-tabulation, whereby the trial and response

are sorted into one of four categories: Hit, Miss, Correct Rejection, and False Alarm. The

traditional method within signal detection involves calculating a value of the association for each

individual and then running analyses on these aggregate values. An alternative approach,

comprised of multilevel logistic models (MLLMs), allows the analysis to be conducted in a

single step. This ultimately provides a simple way to estimate signal detection parameters

(DeCarlo, 1998). In addition to its simplicity, the MLLM approach offers two practical

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[7] Please note that state and trait anxiety were measured, but there was no intention of using it in my primary
analyses. It may be the case that reviewers request this data, given that Ein-Dor has occasionally used the STAI as a
covariate.

advantages. First and foremost, possible dependencies among responses can be addressed within a multilevel framework, opposed to the signal detection method which assumes independent responses. This is important because the data collected involve repeated responses/trials from participants, so their responses might be correlated. Second, employing MLLMs allows for the inclusion of covariates that are continuous (Wright, Horry, & Skagerberg, 2009).

2.5 Power

Although approaches to determining power for two-level models exist (e.g., Mathieu, Aguinis, Culpepper, & Chen, 2012), most of these methods are limited to specific two-level models or specific types of effects. Recently, SIMR has been put forward as a power estimation method based on Monte Carlo simulation for two-level models with different types of outcomes (Arend & Schäfer, 2019). However, precise power estimation requires the appropriate specification of input parameters, such as the size of the proportion of the L2 variance in the total variance (i.e., the ICC). As there was no basis for estimating these priors *a priori*, we based our power analyses (associated R code is provided as supplemental material) to ensure at least 80% power to detect all main and interaction effects of interest.

CHAPTER 3: RESULTS

The R script and basic analytic plan was pre-registered on the Open Science Foundation (OSF) project page (https://osf.io/cf5tp). All data analysis was conducted in R (version 4.0.9; R Core Team, 2020) and the associated R code is included as supplemental material. Descriptive statistics (means, standard deviations, and correlations) are reported in Table 2.

3.1 Overview

The analyses consisted of multilevel logistic models (MLLMs) given that participants responded in a binary fashion (0 = deceit absent, 1 = deceit present). In the present study, trials (level 1) are nested within persons (level 2), allowing us to take both within-stimuli and between-participant variations into account (Judd, Westfall & Kenny, 2012). The purpose of the MLLMs were to assess associations between individual differences in attachment and lie detection. Specifically, the MLLMs were used to examine which of the possibilities is best accounted for by the data (i.e., bias only, discrimination only, bias and discrimination). Please refer to Figures 2-4 in Appendix B. Plotting the model-predicted probabilities of detecting deceit as a function of standardized attachment anxiety will help us better understand bias and discrimination in lie detection.

In the MLLM analyses, I modeled the log-odds of a person, j, identifying a deceitful trial, i, as a function of trial accuracy, attachment anxiety, and the interaction between trial accuracy and attachment anxiety. A random intercept (Uj) was also added to the model. This effectively resolves the non-independence that stems from having multiple responses by the same participant, allowing us to assume an intercept that is different for each person.

The basic linear-mixed model is defined below, whereby "log [p/(1-p)]" represents the log-odds[8] of judging deceit as having occurred; "deceit" represents whether a trial was deceitful (yes= 1 or no = -1); "anxiety" represents individuals' standardized attachment anxiety scores; the "anxiety × deceit" interaction term represents the extent to which trial type (deceitful vs. non-deceitful) moderates the association between attachment anxiety and trial endorsement; and "Uj" represents a random intercept for participants.

$$\text{Log } [P(\text{oddsdeceit }_{ij} =1)] = \gamma 00 + \gamma 01(\text{anxiety }_j) + \gamma 10 \text{ (deceit }_i) + \gamma 11 \text{ (anxiety }_j)(\text{deceit }_i) + U_j$$

In this equation, anxiety is standardized and deceit is effects coded such that 1 represents deceit trials and -1 represents non-deceit trials. The intercept ($\gamma 00$) indicates the average person's tendency to claim that trials contained lies (i.e., across all trial types). This tendency is modified by attachment anxiety via the $\gamma 01$ term. The $\gamma 01$ term, therefore, represents the extent to which attachment anxiety is associated with a tendency to detect lies regardless of trial type (i.e., it is a measure of bias). The $\gamma 10$ term represents the extent to which people detect deceitful trials as lies at a greater frequency than non-deceitful trials (i.e., it is a measure of the average person's discrimination). The deceit × anxiety interaction term ($\gamma 11$) indicates the extent to which discrimination is moderated by people's attachment anxiety. In short, the $\gamma 01$ term reflects the extent to which attachment anxiety is associated with bias and the $\gamma 11$ term reflects the extent to which anxiety is associated with discrimination.

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[8] The GLM in R contains a logit link function. Instead of using Y itself, we're using the logit of Y (log[p/(1-p)]) as the response. Once we fit this model, we can then back-transform the estimated regression coefficients off of a log scale. That is, these log-odds can be converted to odds by taking the exponent of the log-odds: exp(log-odds). The log-odds can be translated into more easily interpretable model-predicted probabilities by the following transformation: exp(log-odds) / (1+exp(log-odds)).

3.2 Preliminary Analysis

Before the primary analysis was conducted, I performed a between-person's linear regression analysis predicting participants' accuracy scores on the lie detection task. Accuracy was defined as the total number of trials that were judged correctly (i.e., deceit trials were judged as lies and non-deceit trials were judged as truths). There were no significant associations between individual differences in attachment and accuracy. The mean number of videos that participants correctly identified, holding the attachment variables constant, was approximately 10--half of the trials (see Table 3).

3.3 Primary Analysis

A multi-level logistic model was conducted to determine whether the log-odds of a person judging a trial as a lie varies as a function of whether the trial was deceitful, attachment anxiety, and the interaction between deceit and attachment anxiety. Specifically, this model was run with predictors at level 1 (i.e., trial deceit) and level 2 (i.e., attachment anxiety and the interaction term). The results are summarized in Table 4 and illustrated in Figure 1.

Attachment anxiety was positively associated with a tendency to detect lies regardless of trial type, indicating that highly anxious participants were more biased to detect deceit ($\beta = 0.13$ $SE = 0.04$, $p < 0.001$). This finding implies that for every one unit increase in attachment anxiety, the odds of a participant identifying a deceitful trial increased by a factor of 1.14, 95% CI [1.05, 1.24]. Put simply, highly anxious people were more likely to judge a trial as a lie, suggesting that they had a lower threshold for judging deceit. This implies that anxious people will have a high hits rate for detecting lies (i.e., correctly identifying lies as lies), but will also have a higher false alarm rate than others (i.e., incorrectly identifying non-lies as lies).

There was no evidence that the average person was able to discriminate deceitful trials from non-deceitful trials (β = -0.02, SE = 0.03, p = 0.53). Moreover, the deceit × anxiety interaction term was not significant, indicating that discrimination did not vary as a function of attachment anxiety (β = 0.03, SE = 0.03, p = 0.39). Put simply, we did not replicate Ein-Dor et al.'s (2010, 2013, 2017) finding that anxious people demonstrate superior discrimination compared to their less anxious counterparts.

3.4 Secondary Analyses

The multi-level logistic model outlined above was re-run with the inclusion of age and gender as covariates. The pattern of associations between the predictor variables and outcome remained the same as in the primary analysis. That is, the attachment anxiety effect remained significant (see Table 5). This suggests that anxious people were more likely to detect lies regardless of trial type, β = 0.11, SE = 0.04, p < 0.01. Specifically, the odds of an anxious person identifying a deceitful trial increased by a factor of 1.12, 95% CI [1.03, 1.22].

A third multi-level logistic model was run with the inclusion of state and trait anxiety as covariates. Once again, when controlling for these predictors, the attachment anxiety effect remained significant, β = 0.12, SE = 0.05, p < 0.05 (see Table 6). The log-odds of a person identifying a deceitful trial did not vary as a function of trial accuracy (β = -0.02, SE = 0.03, p = 0.53) nor the interaction between trial accuracy and attachment anxiety (β = 0.02, SE = 0.03, p = 0.45).

CHAPTER 4: DISCUSSION

The primary goal of the present study was to shed light on the association between attachment and lie detection. Specifically, I sought to evaluate whether people who are highly anxious are, in fact, better lie detectors than others. According to Social Defense Theory (Ein-Dor et al., 2010), people who are high in attachment anxiety exhibit superior lie detection performance compared to their less anxious counterparts to the extent that they can separate lies from non-lies (Ein-Dor & Perry, 2013; Ein-Dor et al., 2017). However, previous research has not been positioned to tell us whether anxious people possess a *true* ability to discriminate lies from non-lies. Thus, the present research was an attempt to provide a more comprehensive test of Social Defense Theory in an effort to better understand lie detection in anxious versus non-anxious adults.

Social Defense Theory holds that anxious people have high discrimination abilities and not merely liberal thresholds, yet it is possible that their lie detection is simply a result of adopting more liberal thresholds for classifying a statement as a lie. This would lead them to be able to detect lies when lies are present--something compatible with Social Defense Theory. At the same time, it would imply that anxious people construe others as lying even in situations where people are being truthful. To test these alternative explanations for the phenomenon (i.e., discrimination and bias), 254 adults completed self-reports of attachment and a lie detection task. The overall accuracy rating for detecting deceit on the task was approximately 50% (i.e., 10 trials), which is in line with previous work suggesting that people are no better than chance at differentiating truth from lies (Bond & DePaulo, 2006).

The first research question was whether anxious people show a greater ability to discriminate lies from non-lies. The present analyses revealed that discrimination did not vary as

a function of attachment anxiety. In other words, highly anxious people were not better able to separate lies from non-lies, compared to their less anxious counterparts. Such a finding is at odds with the claim made by Ein-Dor and colleagues (2013, 2017) that people who are high in attachment anxiety can more accurately detect deceit.

The second research question concerned whether attachment anxiety reflects the use of a more liberal threshold for detecting lies. The results indicated that highly anxious people were more likely to judge a trial as a lie, implying that they had a lower threshold for judging deceit. Consequently, anxious people were found to have high hits rate for detecting lies (i.e., correctly identifying lies as lies), but also have a higher false alarm rate than others (i.e., incorrectly identifying non-lies as lies). The model-predicted false alarm rate for people low in attachment anxiety (1 *SD* below the mean) was 59% (95% CI [56%, 62%]). In contrast, the model-predicted false alarm rate for people high in attachment anxiety (1 *SD* above the mean) was 65% (95% CI [62%, 68%]).

The two primary research questions were re-examined with age, gender, and state/trait anxiety as control variables. The pattern of associations found between attachment and lie detection performance remained the same after accounting for these variables. That is, anxious people were more likely to detect lies regardless of trial type (indicative of a liberal bias).

Taken together, the present results are inconsistent with the predictions of Social Defense Theory. Anxious people were not found to be better lie detectors than others. This would seem to refute the assumption that anxious people possess a 'sentinel' schema which allows them to detect deceit more accurately than less anxious people. However, the finding that anxious people have a liberal bias for judging events as lies suggests that they may be vigilant to cues of dishonesty even if they are not better than others at separating lies from non-lies.

4.1 Implications for Attachment Theory and Research

The present investigation makes a unique contribution to the literature on attachment and lie detection for two primary reasons. First, the method allows for rigorous, empirical testing of Social Defense Theory. Unlike previous work, the current study is appropriately powered and designed to determine whether there is evidence for the phenomenon. Second, in addition to replication efforts, this research seeks to disentangle two processes--discrimination and bias--that might underlie any association between anxious attachment and lie detection. This is foundational to understanding whether anxious people are better able to discriminate lies from non-lies (representing a true ability), or whether they possess lower thresholds for judging deceit (meaning they are biased toward seeing lies where lies do not exist). These processes have vastly different implications for understanding insecure attachment. That is, evidence for discrimination (increased "hits") would provide further support for Social Defense Theory. On the other hand, evidence for a more liberal threshold (increased "hits" but also increased false alarms) would undermine the adaptiveness explanation of Social Defense Theory.

The pattern of results I observed do *not* provide support for Social Defense Theory. In fact, they challenge the idea that anxious peoples' hypervigilance may be beneficial with respect to lie detection. Specifically, it was found that highly anxious people had a lower threshold for judging deceit. In other words, attachment anxiety was positively associated with a tendency to detect lies regardless of trial type (indicating the presence of bias). This suggests that anxiety appears to be suboptimal, rather than optimal, with respect to deception judgements. Such findings are consistent with previous work on attachment anxiety and detection accuracy (Elaad, 2009; Wu et al., 2018). Given the nature of these contradictory results, attachment scholars

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should consider abandoning the evolutionary perspective advanced by Ein-Dor and his colleagues, or revising it at the very least.

4.2 Revising or Abandoning Social Defense Theory

Social Defense Theory posits that groups may benefit from having anxious "sentinels" present – for instance, they are the first to pick up on signs of danger and alert others to its presence. Despite the claim that anxious peoples' hypervigilance may be beneficial, the present results suggest otherwise. In actuality, anxious peoples' hypervigilance appears to be detrimental in a lie detection task such as ours. Not only are anxious people more biased to see lies (which goes against peoples' natural "truth bias," e.g., Peace & Sinclair, 2012), but they cannot properly separate lies from non-lies. This undermines the purported adaptiveness explanation of Social Defense Theory.

It is important to note, however, that the adaptiveness of high anxiety is conditional on the base rate of lies. If the base rate of lies is low, there is no adaptive advantage of attachment anxiety. If deceit is rare, yet anxious people still "see" lies and falsely alert others, their signals may no longer be attended to. That is, seeing deceit where there is none is costly; people will not benefit from the anxious *sentinel's* presence in the event of real deception because they will assume it's another false alarm (i.e., their defenses are unnecessarily elicited). If the base rate of lies is high, there is no adaptive advantage of attachment anxiety. If a person adopts a liberal threshold and sees many lies, a true ability to separate truths from non-truths is not needed. Put simply, when the base rate of lies is high, a liberal threshold ensures detection without the need for actual discrimination. Taken together, this implies that the adaptation argument put forth by Social Defense Theory is only valid under the following circumstances: (1) anxious people can

discriminate under high and low base rate conditions, or (2) anxious people lack discrimination, but exhibit bias when the base rate of lies are high.

Although the evolutionary arguments put forth by Ein-Dor and his team (2010) are not fundamental to the present goals, it is worth noting that anxious participants' adoption of a liberal threshold can be understood as an adaptation produced by evolution. From the perspective of Error Management Theory (EMT; Haselton & Buss, 2000, Haselton & Nettle, 2006), a false negative (missing deceit when it is, in fact, deceit) is more costly than a false positive (seeing deceit where deceit does not exist). In this sense, it may be best to err on the side of caution. Error Management Theory proposes that when the costs of false-positives and false-negatives were asymmetrical over evolutionary history, natural selection designed social judgment adaptations biased in the direction of the less costly error. Because our ancestors may have suffered considerable costs when deceived, natural selection might have favored a bias that leads to the overestimation of lies.

Consequently, if it is the case that anxious people are exposed to deception at a higher rate than less anxious people, it is possible that the development of liberal thresholds for lie detection would be more beneficial for them than the development of the ability to discriminate lies from truths. When reproductive costs are involved, missed detections of deception can be highly costly. Take, for instance, reproductive costs for women. Failing to perceive real deception from one's partner (false negative) would be associated with a much higher cost than falsely perceiving partner deception when deception does not exist (false positive). Taken together, where the cost of a miss is much greater than the cost of a false alarm, it can be worthwhile to bias the decision-making system towards reducing those errors.

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4.3 Limitations and Future Directions

Despite the contributions of the present work, there are some limitations. First and foremost, the current study did not manipulate the actual base rate of lies. Previous work lacks consensus whether people pick up on the base rate and use it in their judgments, or whether they ignore this information (for more information, refer to Section 1.6). As mentioned previously, base rate neglect may be a result of how information is framed. Participants in the present study were not told how many trials were lies. Thus, the base rate was not made informative or relevant to them. Future work should seek to vary the base rate[9] given that it can influence bias (Green & Swets, 1966; Macmillan & Creelman, 1991). Infrequent deceit trials and costly false alarms promote a conservative bias (i.e., a higher threshold for judging that deceit is present), whereas frequent deceit trials and costly misses promote a liberal threshold for judging that deceit is present. Future work should address whether the effect of bias will remain significant when manipulating the base rate. There are two possibilities. Anxious people may continue to adopt a liberal threshold when the base rate of non-deceitful trials exceeds deceitful ones. Alternatively, it may be the case that anxious people do *not* show a liberal threshold as the number of non-deceitful trials increase. Taken together, it is our ultimate hope that scholars will seek to model the parameters that underlie bias in an effort to predict the optimal criterion (one that maximizes utility) across various base rates. In doing so, signal detection serve can serve as a model of optimal decision making (Lynn, & Barrett, 2014) going beyond its common use as an analytic method. Perhaps future research could involve a training study where people are given feedback on their decisions with the purpose of seeing who can improve over repeated trials.

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[9] This can be done by assigning people to three levels of base rates, for example (10% lies, 50% lies, 90% lies). Another option is to vary it more naturalistically, such that each person is randomly assigned a base rate that follows a uniform distribution or a normal one with a mode.

This may prove to be a viable avenue, given that a meta-analysis on 30 studies shows a small to medium training effect for improving detection accuracy[10] (Hauch, Sporer, Michael, & Meissner, 2016).

Second, it's possible that the nature of the task (i.e., making a yes/no decision) is not the most natural way to examine deception judgements. How do people make decisions when they are uncertain? In a real-world setting, there is often a vast amount of information available to guide the decision, including an understanding of the social situation, prior beliefs/experience, and cues available in the present environment. Yet research such as ours has examined the process using only brief (i.e., 1-minute or less) information made available to participants. Future work should consider continuous measures of performance such as response/decision time and confidence ratings, in addition to the binary choice variable of the decision-maker. Pleskac and Busemeyer (2010) propose a two-stage dynamic signal detection (2DSD) model that accounts for all three indices. After making a choice, judges continue to accumulate evidence in support of the two alternatives. They then use the complete set of evidence to estimate their confidence in their choice. In keeping with dual process theories applied to the detection of bullshit (e.g., Petrocelli, 2020), it's possible that poor performance stems from an error-prone processing route, but the use of a more effortful and analytical processing route may overcome it.

4.4 Conclusion

People high in attachment anxiety are not better skilled at lie detection than those who are less anxious. Despite previous research suggesting that anxious people are superior lie detectors, the present investigation found that anxious people were *not* better able to discriminate lies from non-lies, compared to others. Rather, anxious participants showed a liberal threshold for judging

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[10] Unfortunately, it was not possible to test for response bias shifts in this meta-analysis due to missing information (about the truth-lie judgments regardless of accuracy) in most studies.

deceit. Taken together, attachment anxiety may not have a positive impact on the detection of threat-related information as previously assumed. These findings underscore the importance of revising or abandoning Social Defense Theory, as it does not afford an adaptiveness explanation with respect to deception judgments.

CHAPTER 5: TABLES/FIGURE

Table 1
Demographic Characteristics

Characteristic	Percentage (Frequency)
Gender	
Male	63.40% (161)
Female	35.80% (91)
Binary	0.00% (0)
Non-binary	0.40% (1)
Other	0.00% (0)
Prefer not to disclose	0.40% (1)
Race/Ethnicity	
Black	19.70% (50)
Asian/Pacific Islander	3.10% (8)
White	66.90% (170)
Hispanic	3.10% (8)
Native American	3.90% (10)
Other	0.00% (0)
More than one race	2.90% (7)
Prefer not to disclose	0.40% (1)
Relationship Status	
Single	18.00% (46)
Dating	2.40% (6)
In a Relationship	9.10% (23)
Engaged	2.00% (5)
Married	68.50% (174)
Other	0.00% (0)

Note. Percentages are rounded to two decimal places and calculated based on total sample size (N = 254).

Table 2

Means, standard deviations, and correlations with confidence intervals

Variable	*M*	*SD*	1	2	3	4	5
1. Anxiety	3.89	1.86					
2. Avoidance	3.33	0.96	.30* [.28, .33]				
3. Deceit	0.00	1.00	.00 [-.03, .03]	.00 [-.03, .03]			
4. Y	0.50	0.50	.01 [-.02, .04]	.03* [.00, .06]	.22* [.19, .24]		
5. Lie	0.61	0.49	-.00 [-.03, .03]	-.01 [-.03, .02]	-.01 [-.04, .02]	.00 [-.03, .03]	
6. Score	9.91	2.12	.01 [-.02, .03]	-.00 [-.03, .03]	.00 [-.03, .03]	.21* [.19, .24]	.01 [-.02, .03]

Note. Means and SDs presented for raw attachment Avoidance and Anxiety scores, prior to mean centering. Deceit = type of trial (truth = -1, lie = 1); Y = whether the participant responded correctly or not (0 = no, 1 = yes); Lie = actual participant response (0 = truth, 1 = lie); Score = total number of videos correct out of 20. Values in square brackets indicate the 95% confidence interval for each correlation. The confidence interval is a plausible range of population correlations that could have caused the sample correlation (Cumming, 2014). * indicates $p < .05$.

Table 3

Regression Model: Accuracy Score on Lie Detection Task

Predictor	β	SE	R^2
Intercept	**9.91***	**0.13**	0.00
Anxiety	0.13	0.14	
Avoidance	-0.04	0.14	

Note. * indicates $p < .05$; Accuracy reflects the total number of trials that were judged correctly (i.e., deceit trials were judged as lies and non-deceit trials were judged as truths)

Table 4

Parameter Estimates for Primary Multilevel Model

Predictor	β log-odds	exp(β) OR [95% CI]	(exp)β/(1+expβ) probability
Intercept	**0.47***	—	—
Anxiety	**0.13***	**1.14 [1.05, 1.24]**	**0.53**
Deceit	-0.02	0.98 [0.93, 1.04]	0.50
Anxiety × Deceit	0.03	1.03 [0.97, 1.09]	0.51

Note. * indicates $p < .05$; "Anxiety" represents the extent to which attachment anxiety is associated with a tendency to detect lies regardless of trial type (i.e., it is a measure of bias). "Deceit" represents the extent to which people detect deceitful trials as lies at a greater frequency than non-deceitful trials (i.e., it is a measure of the average person's discrimination). The "anxiety × deceit" interaction indicates the extent to which discrimination is moderated by attachment anxiety (i.e., it reflects the extent to which anxiety is associated with discrimination).

Table 5

Parameter Estimates for Multilevel Model Controlling for Age and Gender

Predictor	β log-odds	$exp(\beta)$ OR [95% CI]	$(exp)\beta/(1+exp\beta)$ probability
Intercept	**0.84***	—	—
Anxiety	**0.11***	**1.12 [1.03, 1.22]**	**0.53**
Deceit	-0.02	0.98 [0.93, 1.04]	0.50
Age	-0.01	0.99 [0.98, 1.00]	0.50
Gender	-0.06	0.94 [0.82, 1.08]	0.49
Anxiety × Deceit	0.03	1.03 [0.97, 1.09]	0.51

Note. * indicates $p < .05$; "Anxiety" represents the extent to which attachment anxiety is associated with a tendency to detect lies regardless of trial type (i.e., it is a measure of bias). "Deceit" represents the extent to which people detect deceitful trials as lies at a greater frequency than non-deceitful trials (i.e., it is a measure of the average person's discrimination). The "anxiety × deceit" interaction indicates the extent to which discrimination is moderated by attachment anxiety (i.e., it reflects the extent to which anxiety is associated with discrimination).

Table 6

Parameter Estimates for Multilevel Model Controlling for State and Trait Anxiety

Predictor	β log-odds	$exp(\beta)$ OR [95% CI]	$(exp)\beta/(1+exp\beta)$ probability
Intercept	**0.47***	—	—
Anxiety	**0.12**	**1.12 [1.03, 1.23]**	**0.53**
Deceit	-0.02	0.98 [0.93, 1.04]	0.50
Trait Anxiety	-0.02	0.98 [0.92, 1.05]	0.50
State Anxiety	0.06	1.06 [0.99, 1.13]	0.51
Anxiety × Deceit	0.02	1.02 [0.96, 1.08]	0.51

Note. * indicates $p < .05$; "Anxiety" represents the extent to which attachment anxiety is associated with a tendency to detect lies regardless of trial type (i.e., it is a measure of bias). "Deceit" represents the extent to which people detect deceitful trials as lies at a greater frequency than non-deceitful trials (i.e., it is a measure of the average person's discrimination). The "anxiety × deceit" interaction indicates the extent to which discrimination is moderated by attachment anxiety (i.e., it reflects the extent to which anxiety is associated with discrimination). "Trait Anxiety" and "State Anxiety" represent the composites from the State and Trait Anxiety Inventory (STAI).

Table 7

Parameter Estimates for Multilevel Model with Attachment Avoidance (Exploratory Analysis)

Predictor	β log-odds	$exp(\beta)$ OR [95% CI]	$(exp)\beta/(1+exp\beta)$ probability
Intercept	**0.47***	—	—
Avoidance	-0.07	0.93 [0.86, 1.01]	0.48
Deceit	-0.02	0.98 [0.93, 1.04]	0.50
Avoidance × Deceit	0.00	1.00 [0.94, 1.06]	0.50

Note. * indicates $p < .05$; "Avoidance" represents the extent to which attachment avoidance is associated with a tendency to detect lies regardless of trial type (i.e., it is a measure of bias). "Deceit" represents the extent to which people detect deceitful trials as lies at a greater frequency than non-deceitful trials (i.e., it is a measure of the average person's discrimination). The "avoidance × deceit" interaction indicates the extent to which discrimination is moderated by attachment avoidance (i.e., it reflects the extent to which avoidance is associated with discrimination).
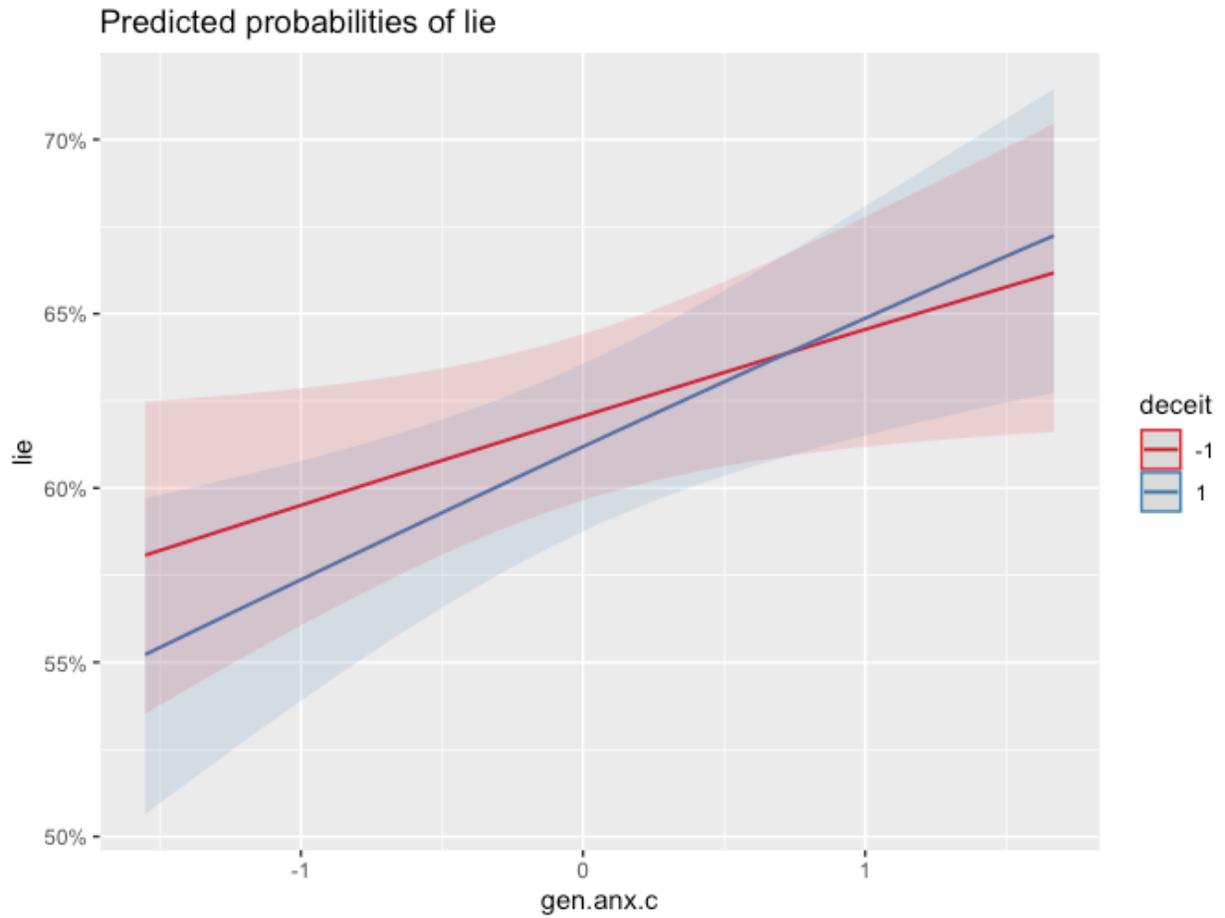
Figure 1. Attachment anxiety is associated with bias, not discrimination. Low attachment anxiety (-1 SD); high attachment anxiety (+1 SD). Trial type: deceit (1); non-deceit (-1).

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APPENDIX A: SUPPLEMENTARY ANALYSIS

Given the contradictory findings of work on attachment and lie detection (as outlined in Section 1.5), quantitative effect size estimation was used to assess the degree of heterogeneity, or variation in outcomes between studies. The I^2 statistic describes the percentage of variation across studies that is due to heterogeneity rather than chance (Higgins et al., 2003). In the present analysis, there was substantial heterogeneity, $I^2 = 82.89\%$, 95% CIs [49.74, 98.04]. See Figure 2 (below) for the forest and funnel plots. The R code for this estimation is provided as supplemental material.
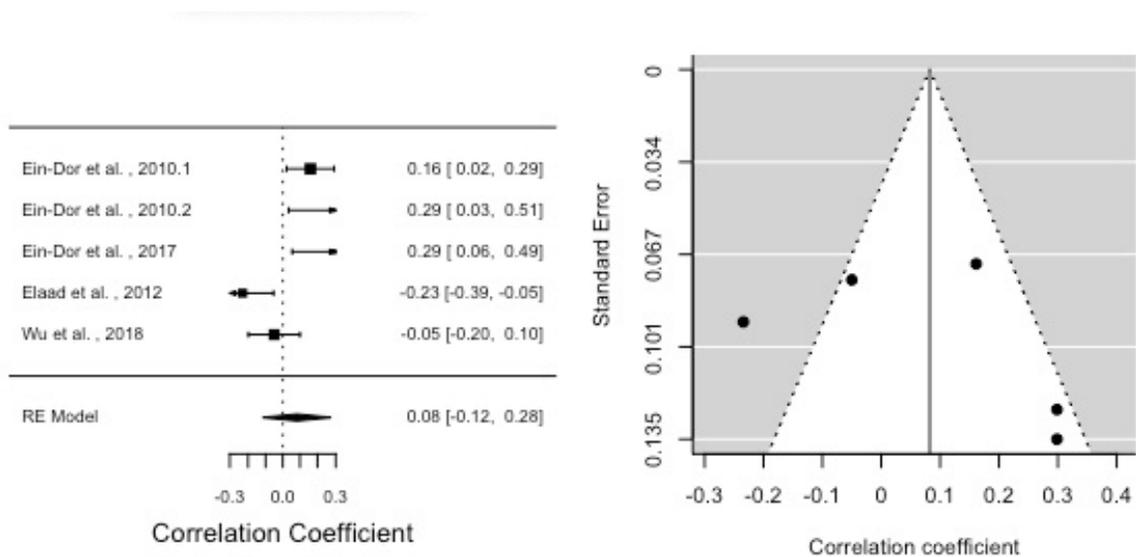

Figure 2. Forest and funnel plots of quantitative effect size estimation.
Note: The included studies do not share a common effect size, Q ($df = 4$) = 21.11, $p = 0.0003$.

APPENDIX B: CALCULATIONS FOR SECTION 2.4

The following material illustrates the ideas discussed in section 2.4. Here, I've plotted three hypothetical patterns of results where varying coefficients indicate the presence of bias effects, discrimination effects, or both. The R code for the present calculations is provided as supplemental material. Figure 3 depicts a situation in which anxiety is associated with bias, not discrimination. The interaction term ($\gamma11$) equals zero, indicating that anxiety has the *same association* with judging that a trial was a lie on deceitful and non-deceitful trials. That is, people with high levels of attachment anxiety are more likely to judge a trial as a lie because they have a lower threshold for judging deceit. This means that they judge as lies both deceitful and non-deceitful trials at a greater rate compared to their less-anxious counterparts.

Figure 4 illustrates a case in which anxiety is associated with discrimination, not bias. The deceit term ($\gamma10$) and interaction term ($\gamma11$) both equal one. The anxiety term ($\gamma01$) equals zero. This positive interaction would suggest that anxiety has *opposite associations* with judging that a trial was a lie on deceitful and non-deceitful trials. The higher anxiety is, the more likely it is that people will judge as deceitful an actual deceit trial vs. a non-deceit trial. Unlike those low in attachment anxiety, people with high levels of attachment anxiety are more likely to show an increase in hit rates and decrease in false alarm rates. Put simply, highly anxious people are better able to discriminate lies from non-lies.

Figure 5 illustrates a case in which anxiety is associated with both bias and discrimination. Here, the anxiety term ($\gamma01$), deceit term ($\gamma10$), and the interaction term ($\gamma11$) each equal one. There is a main effect of anxiety and a positive interaction term indicating that anxiety has *no simple association* with judging that a trial was a lie on non-deceitful trials. This

finding suggests that high levels of attachment anxiety are associated with increased

discrimination, but also more false alarms, which is indicative of bias.
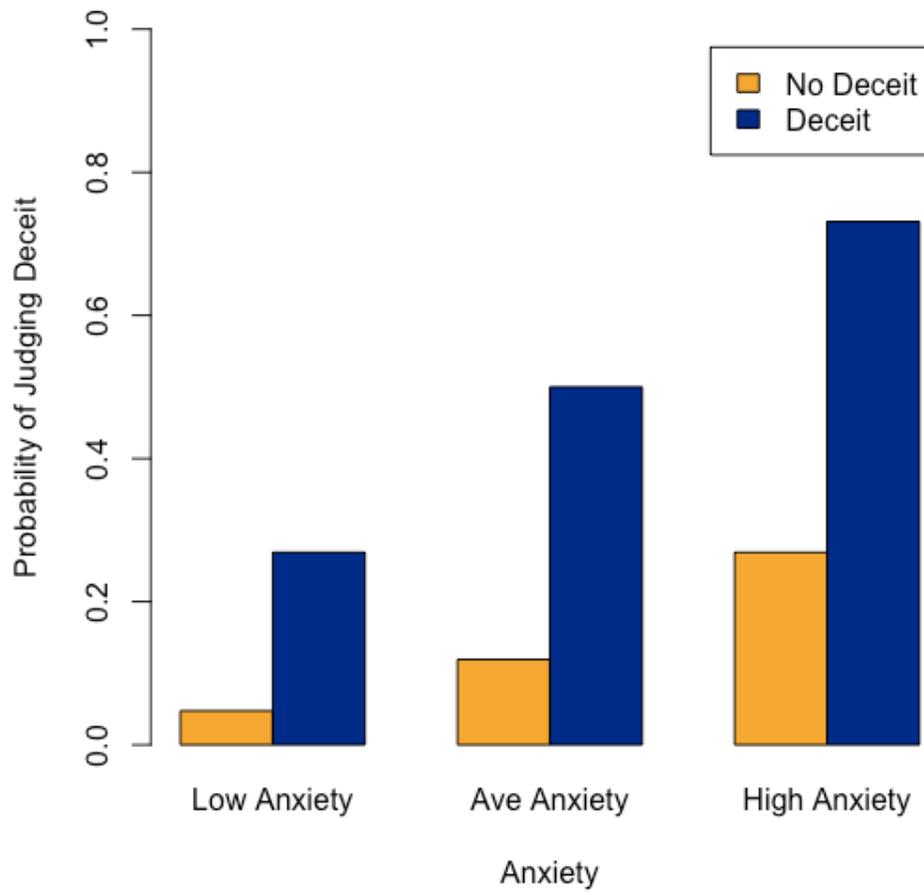
Figure 3. Anxiety is associated with bias, not discrimination. The coefficients for this model are as follows: $\gamma 00 = -1$, $\gamma 01$ (anxiety) $= 1$, $\gamma 10$ (deceit) $= 1$, and $\gamma 11$ (deceit $\times$ anxiety) $= 0$.
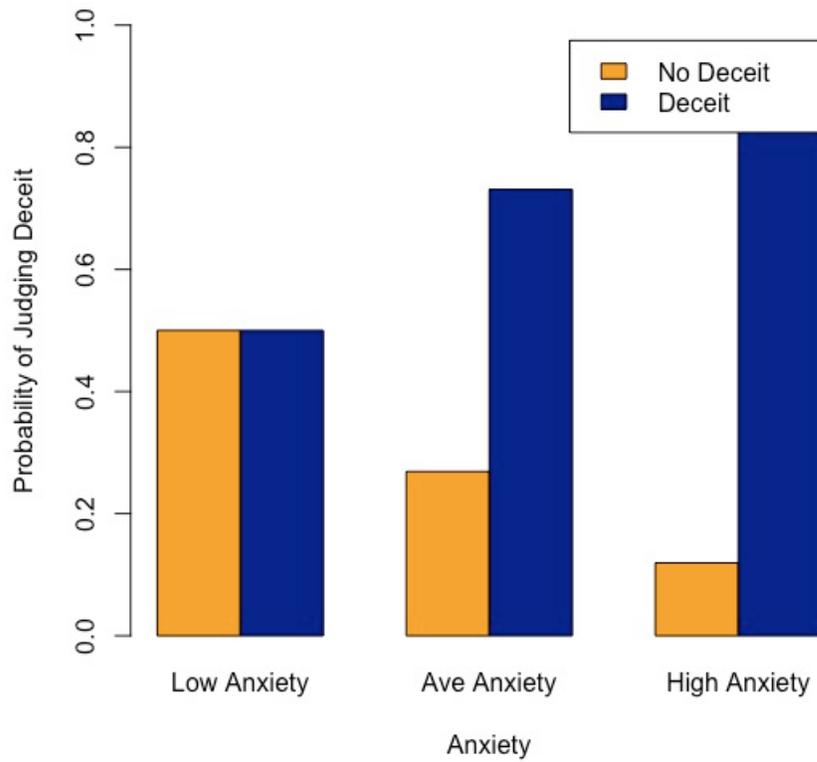
Figure 4. Anxiety is associated with discrimination, not bias. The coefficients for this model are as follows: $\gamma00 = 0$ (Please note that this coefficient was minimized to prevent squashing), $\gamma01$ (anxiety) = 0 , $\gamma10$ (deceit) = 1, and $\gamma11$ (deceit × anxiety) = 1.
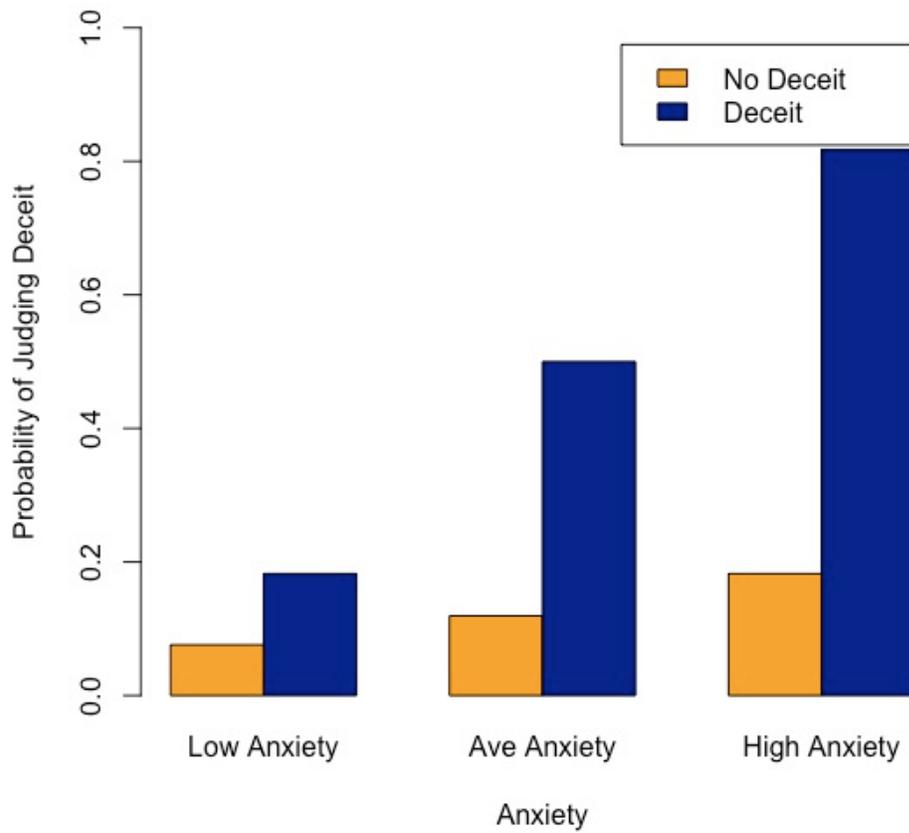
Figure 5. Anxiety is associated with bias and discrimination. The coefficients for this model are as follows: $\gamma 00 = -1$, $\gamma 01$ (anxiety) = 1, $\gamma 10$ (deceit) = 1, and $\gamma 11$ (deceit × anxiety) = 1.

Demographics

How old are you (in years)? _____

What gender do you most identify with?
❍ Male
❍ Female
❍ Binary
❍ Non-binary
❍ Other (please specify)
❍ Prefer not to disclose

What is your ethnic/racial identity? Select all that apply.
❍ Black
❍ Asian/Pacific Islander
❍ White
❍ Hispanic
❍ Native American
❍ Other (please specify)
❍ Prefer not to disclose

What is your current relationship status? Please select only one.
❍ Single
❍ Dating
❍ In a Relationship
❍ Engaged
❍ Married
❍ Other (please specify)

*The following two questions are to be answered by people who are in a romantic relationship

How long have you and your partner been in a relationship? _____ years, ___months

Experiences in Close Relationships – Relationships Structures Questionnaire (ECR-RS; Fraley, Heffernan, Vicary, & Brumbaugh, 2011)

Instructions: Please read each of the following statements and rate the extent to which you believe each statement best describes your feelings about <u>close relationships in general.</u>

(1 = Strongly Disagree, 7 = Strongly Agree)

1. It helps to turn to people in times of need.
2. I usually discuss my problems and concerns with others.
3. I talk things over with people.
4. I find it easy to depend on others.
5. I don't feel comfortable opening up to others.
6. I prefer not to show others how I feel deep down.
7. I often worry that other people do not really care for me.
8. I'm afraid that other people may abandon me.
9. I worry that others won't care about me as much as I care about them.

State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1970)

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then indicate <u>how you feel right now, that is, at this moment.</u> There is no right or wrong answer. Do not spend too much time on any one statement but give the answer which seems to describe your feelings best.

(1 = Not at all, 2 = Somewhat, 3 = Moderately so, 4 = Very much so)

1. I feel calm
2. I feel secure
3. I am tense
4. I feel strained
5. I feel at ease
6. I feel upset
7. I am presently worrying about possible misfortunes
8. I feel satisfied
9. I feel frightened
10. I feel comfortable
11. I feel self-confident
12. I feel nervous
13. I am jittery
14. I feel indecisive
15. I am relaxed
16. I feel content
17. I am worried
18. I feel confused
19. I feel steady
20. I feel pleasant

Instructions: A number of statements which people have used to describe themselves are given below. Read each statement and then indicate <u>how you generally feel</u>. There is no right or wrong answer. Do not spend too much time on any one statement but give the answer which seems to describe your feelings best.

(1= Almost Never, 2 = Sometimes, 3 = Often, 4 = Almost Always)

1. I feel pleasant
2. I feel nervous and restless
3. I feel satisfied with myself
4. I wish I could be as happy as others seem to be
5. I feel like a failure
6. I feel rested
7. I am "calm, cool, and collected"
8. I feel that difficulties are piling up so that I cannot overcome them
9. I worry too much over something that really doesn't matter
10. I am happy
11. I have disturbing thoughts
12. I lack self-confidence
13. I feel secure
14. I make decisions easily
15. I feel inadequate
16. I am content
17. Some unimportant thought runs through my mind and bothers me
18. I take disappointments so keenly that I can't put them out of my mind
19. I am a steady person
20. I get in a state of tension or turmoil as I think over my recent concerns and interests

APPENDIX D: IRB APPROVAL LETTERS

Approval for removing pilot study through Psychology Subject Pool due to HSC concerns:

UNIVERSITY OF ILLINOIS
URBANA-CHAMPAIGN

Office of the Vice Chancellor for Research & Innovation
Office for the Protection of Research Subjects
805 W. Pennsylvania Ave., MC-095
Urbana, IL 61801-4822

Notice of Approval: Amendment #01

April 7, 2021

Principal Investigator	R Chris Fraley
CC	Elizabeth Lozano
Protocol Title	*Anxious to Detect Deceit?: An Empirical Investigation of Social Defense Theory*
Protocol Number	21708
Funding Source	Unfunded
Review Type	Expedited 7
Amendment Requested	Removing pilot study with Psychology Subject Pool
Status	Active
Risk Determination	No more than minimal risk
Approval Date	April 7, 2021 (amendment approval date)
Closure Date	March 18, 2026

This letter authorizes the use of human subjects in the above protocol. The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) has reviewed and approved the research study as described.

The Principal Investigator of this study is responsible for:
- Conducting research in a manner consistent with the requirements of the University and federal regulations found at 45 CFR 46.
- Using the approved consent documents, with the footer, from this approved package.
- Requesting approval from the IRB prior to implementing modifications.
- Notifying OPRS of any problems involving human subjects, including unanticipated events, participant complaints, or protocol deviations.
- Notifying OPRS of the completion of the study.

UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN
IORG0000014 · FWA #00008584
217.333.2670 · irb@illinois.edu · oprs.research.illinois.edu

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Approval for recruiting participants through Amazon Mechanical Turk (MTurk):

ILLINOIS

OFFICE OF THE VICE CHANCELLOR
FOR RESEARCH & INNOVATION

Office for the Protection of Research Subjects
805 W. Pennsylvania Ave., MC-095
Urbana, IL 61801-4822

Notice of Approval: New Submission

March 19, 2021

Principal Investigator	R. Chris Fraley
CC	Elizabeth Lozano
Protocol Title	*Anxious to Detect Deceit?: An Empirical Investigation of Social Defense Theory*
Protocol Number	21708
Funding Source	Unfunded
Review Type	Expedited 6, 7
Status	Active
Risk Determination	No more than minimal risk
Approval Date	March 19, 2021
Closure Date	March 18, 2026

This letter authorizes the use of human subjects in the above protocol. The University of Illinois at Urbana-Champaign Institutional Review Board (IRB) has reviewed and approved the research study as described.

The Principal Investigator of this study is responsible for:
- Conducting research in a manner consistent with the requirements of the University and federal regulations found at 45 CFR 46.
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- Requesting approval from the IRB prior to implementing modifications.
- Notifying OPRS of any problems involving human subjects, including unanticipated events, participant complaints, or protocol deviations.
- Notifying OPRS of the completion of the study.

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APPENDIX E: SUPPLEMENTARY FILES

The zip file contains several supplementary files. The file called 'Section 1.5' contains the R script for the quantitative effect size estimation referred to in Appendix A. The file called 'Section 2.4' contains the hypothetical patterns of results referred to in Appendix B. The file called 'Power Analysis' contains the R script used to conduct a power analysis for the present work. The folder called 'Data Analysis' contains the dataset and R script used for data preparation and analysis.