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Seeing You Reminds Me of Things That Never Happened: Attachment Anxiety Predicts False Memories When People Can See the Communicator

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Previous research suggests that attachment avoidance is robustly linked to memory errors of omission—such as forgetting information or events that have occurred. Moreover, these avoidance-related errors of omission are the strongest for relational stimuli (e.g., avoidant people have trouble remembering relationship-related words, but not neutral ones). Conversely, an emerging body of studies has linked attachment anxiety to memory errors of commission—such as falsely remembering events that never actually happened. The present article describes three studies (*N*s = 204, 651, 547) that replicate the correlation between attachment anxiety and false memories. Moreover, the present studies experimentally explored the boundary conditions under which anxiety might predict false memories. Results indicated that attachment anxiety predicts false memories only when participants could see a video of another person conveying information—but not when reading a text transcript of the same information or when listening to the audio only. This is consistent with prior studies which suggest that highly attachment-anxious individuals are hypervigilant to others' emotional expressions and may use them to make incorrect inferences (which potentially become falsely encoded into memory).

Keywords: adult attachment, false memories, personality processes

In 1974, Elizabeth Loftus and John Palmer published their pioneering research demonstrating that—in addition to simply forgetting information about prior happenings—people can also experience memories that seem quite subjectively compelling to them, but are in fact, entirely false. Since that time, a large body of research has sought to understand the cognitive mechanisms that can produce false memories (for an overview, see Straube, 2012), as well as the individual differences that predict people's propensities to falsely remember events that never actually occurred (e.g., Zhu, Chen, Loftus, Lin, He, Chen, Li, Moyzis, et al., 2010; Zhu, Chen, Loftus, Lin, He, Chen, Li, Xue, et al., 2010).

A mere 5 years prior to Loftus and Palmer's (1974) research on false memories—beneath an entirely different umbrella of research topics—Bowlby (1969) published his seminal writings on attachment theory. Although Bowlby's original theory describes evolved psychological mechanisms that ensure children's survival by compelling them to maintain close bonds with caretakers, researchers quickly recognized the similarities between child–caretaker relationships and adult romantic relationships. As a result, attachment theory was extended to understand how adults form close relationships with one another (Hazan & Shaver, 1987). To that end, attachment theory has proven to be a particularly fruitful framework for understanding a multitude of adulthood phenomena—that sometimes even lie outside the purview of close relationships. For example, individual differences in people's attachment styles have been shown to predict a wide swath of adult outcomes, including relationship functioning (Simpson & Rholes, 2010), political preferences (Gillath & Hart, 2010), sexual fantasies (Birnbaum et al., 2011), attentional and perceptual abilities (e.g., Fraley et al., 2006; Collins & Feeney, 2000; Gillath et al., 2009), and even people's propensities to forget certain types of information (e.g., Edelstein, 2006; Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000; Miller & Noirot, 1999).

Although people's attachment styles have been shown to predict their propensities to fail to remember certain types of stimuli—memory *errors of omission*—very few studies have examined how attachment orientations might relate to memory errors of *commission*, including false memories (cf. Ein-Dor et al., 2011; Hudson & Fraley, 2018a). Therefore, the purpose of the present article was to explicitly unite these two disparate lines of research—adult attachment and false memories—and examine the extent to which people's attachment styles predict their susceptibility to "remember" events that never actually happened.

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These studies were not preregistered. These data have not been used for other publications. The authors did not receive funding to support this work. Data and Supplemental Materials can be found on Open Science Framework (https://osf.io/3xk4v/).

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Overview of Adult Attachment

Generally speaking, attachment theory describes both normative patterns and individual differences in how people form close relationships. In adulthood, individual differences in people's attachment styles vary along two continuous dimensions: attachment anxiety and avoidance (Bartholomew & Horowitz, 1991; Fraley et al., 2015; Fraley, Waller, et al., 2000; Mikulincer & Shaver, 2016). People with high levels of attachment anxiety tend to be preoccupied with the availability and accessibility of their caretakers and other close associates (Hazan & Shaver, 1987). Researchers have argued that this chronic relational worry produces a "hyperactivation" of the attachment system (Mikulincer & Shaver, 2016) in which highly anxious[1] individuals desire and seek higher-than-average levels of relational intimacy (e.g., Dewitte & De Houwer, 2008; Hudson & Fraley, 2017), experience difficulty feeling satisfied in close relationships (e.g., Birnbaum, 2007), and constantly monitor other people for signs of availability versus rejection (e.g., Fraley et al., 2006). In other words, attachment anxiety can be thought of as being associated with pseudo-obsessive cognitive qualities that can fundamentally affect how people perceive and construe the world around them (Fraley et al., 2006; Hazan & Shaver, 1987; Hudson & Fraley, 2017; Mikulincer & Shaver, 2016).

In contrast, people with high levels of attachment avoidance view close relationships as an ineffectual avenue for gaining emotional comfort and security (Bartholomew & Horowitz, 1991; Fraley & Shaver, 2000). Scholars have argued this produces a "deactivation" of the attachment system (Mikulincer & Shaver, 2016), in which highly avoidant individuals seek to minimize intimacy in their relationships (e.g., Dewitte & De Houwer, 2008). To this end, people with high avoidance appear to engage in defensive strategies designed to suppress thoughts and memories pertaining to relationships (Fraley & Shaver, 1997; Mikulincer & Orbach, 1995) and to "push" others away (Fraley & Marks, 2011; Mikulincer et al., 2010).

Prototypically "secure" individuals are low in both anxiety and avoidance. Importantly, although anxiety and avoidance may seem conceptually opposite to one another, empirically they are relatively orthogonal—if not positively correlated (Fraley, Waller, et al., 2000). Thus, it is possible for a single individual to be high in both anxiety and avoidance, manifesting as what has been described as "fearful avoidance"—in which a person simultaneously strongly wants but ironically also fears and avoids intimacy (e.g., Bartholomew & Horowitz, 1991; Hazan & Shaver, 1987).

Links Between Attachment and Memory Capacities

Errors of Omission

Largely motivated to understand the types of defensive strategies used by highly avoidant individuals, many different researchers have explored the links between people's attachment styles and memory capabilities. One of the most prevalent findings in the literature is that people with high levels of avoidance experience difficulty in remembering certain types of information. For example, as compared with their less-avoidant peers, individuals high in avoidance are slower and less able to recall attachment-related memories from their childhoods (Edelstein et al., 2005; Haggerty et al., 2010; Kohn et al., 2012; Mikulincer & Orbach, 1995). In laboratory settings, relative to less-avoidant people, highly avoidant people remember fewer correct details from stories containing relational themes (Fraley, Garner, et al., 2000; Fraley & Brumbaugh, 2007), interpersonal conversations (Miller, 2001), or even relationship-related word lists (Edelstein, 2006; Goodman et al., 2011; Zeijlmans van Emmichoven et al., 2003).

Importantly, these memory biases appear to be especially strong for stimuli that pertain to attachment or relational themes—as compared with neutral or nonrelational stimuli (e.g., Edelstein, 2006). Typically, these findings have been interpreted to collectively mean that—to minimize the psychological importance of close relationships—highly avoidant individuals direct their attention away from relationally relevant stimuli and fail to encode them into memory (e.g., Fraley & Brumbaugh, 2007). Moreover, people with high levels of avoidance may also suppress recalling whatever information manages to successfully eke past their defenses and into their memories (Fraley & Davis, 1997; Mikulincer & Orbach, 1995).

Errors of Commission

In addition to errors of omission, such as forgetting, there is reason to believe that attachment orientations might also predict errors of commission, such as falsely remembering events that never occurred. On a general level, the concepts that are strongly active in people's minds at the time that memories are initially *created* can be erroneously integrated into the memory being encoded (Brainerd & Reyna, 2002; Straube, 2012). This phenomenon is clearly evident in studies using the Deese–Roediger–McDermott paradigm. For example, the list of words, "bed, rest, awake, tired, dream, wake, snooze, blanket, doze, slumber, snore, nap, peace, yawn, drowsy" all relate to the theme of *sleep*, although the word "sleep" is inconspicuously absent from the list. Nevertheless, if participants are presented with those 15 words and asked to free recall the words they saw, about 60% will falsely remember that the word "sleep" was present (Stadler et al., 1999). This effect is thought to occur because the 15 words on the list semantically prime—or *activate*—the concept of sleep in participants' minds. Consequently, the strongly activated concept—"sleep"—is deeply integrated into participants' newly encoded memories for the words on the list—producing the subjectively compelling false memory that "sleep" was, in fact, on the list when it was not (Brainerd & Reyna, 2002).

Building upon this conceptual foundation, highly attachment-anxious individuals may be especially prone to experience false memories. Specifically, people with high levels of attachment anxiety are chronically *preoccupied* with relationships and rejection (Fraley & Shaver, 2000; Hazan & Shaver, 1987; Mikulincer & Shaver, 2016). Stated differently, themes pertaining to relationships and rejection are chronically and intensely *activated* in highly anxious people's minds. This has the potential to bias cognitive processes; for example, individuals with high levels of attachment anxiety tend to perceive social situations and their partners more negatively (e.g., Collins & Feeney, 2000; Pereg & Mikulincer, 2004), and they attend closely to cues that may indicate rejection—perhaps at the expense of absorbing other types of information (Fraley et al., 2006). Collectively, these processes might bias the types of information that highly anxious persons encode into memory. Moreover, the chronically and intensely activated themes

[1] Throughout this article, "anxiety" always refers specifically to *attachment anxiety*.

pertaining to rejection and relationships in their minds may be erroneously integrated into new memories. Additional evidence for this possibility comes from anxious individuals' higher likelihood of misremembering details and misapplying attributes from previous relationships to novel dating interactions (Brumbaugh & Fraley, 2006, 2007; Leahy & Chopik, 2021), as well as the fact that people with insecure attachment styles tend to remember prior interactions increasingly negatively as time passes (Feeney & Cassidy, 2003; Simpson et al., 2010).

In a similar vein, as a general principle, the concepts that are intensely active in people's minds at the time that memories are *retrieved* can influence errors of commission (Dell, 1986; Straube, 2012). Consequently, when trying to remember prior events, individuals with high levels of attachment anxiety may experience source memory confusion (Johnson et al., 1993) and be unsure whether themes pertaining to rejection and relationships are incidentally activated (due to high levels of attachment anxiety) or whether such themes are activated because they are directly relevant to the memory being retrieved (Straube, 2012).

In sum, people with high levels of attachment anxiety—who are preoccupied with ensuring that their attachment figures are available and responsive—are chronically and intensely concerned about relationships and rejection (Fraley et al., 2006; Mikulincer & Shaver, 2016), which may lead them to encode or reconstruct a greater number of false relationally relevant memories (e.g., Straube, 2012). However, despite the compelling nature of these ideas, to the best of our knowledge, only four peer-reviewed articles have directly addressed the associations between attachment and false memory susceptibility—and they have generally done so only tangentially in service of other research goals.

First, while studying people's threat-response strategies, across two studies, Ein-Dor et al. (2011) had participants watch a video of a confederate describing an incident where she encountered a threat and responded either (a) calmly; (b) with a hypervigilant "sentinel" strategy—monitoring the threat closely; or (c) with a fight-or-flight strategy. After the video, participants completed a surprise memory test and were asked to indicate whether several sentences were uttered in the video or not. Half of the sentences were actually said in the video, and the other half were not. Ein-Dor and colleagues found that people with high levels of attachment anxiety were more likely to falsely remember "sentinel" sentences, and avoidant individuals were more likely to remember false "fight-or-flight" sentences.

Second, Qin et al. (2008) were interested in whether the efficacy of a false memory implantation paradigm (Loftus & Pickrell, 1995) would be affected (a) if participants were warned that false memories can occur and (b) if participants increased the vividness of the false memory by visualizing it. Participants' parents provided three real stories from the participants' childhoods and confirmed that one of several false story options provided by the experimenter (e.g., a birthday party at McDonald's) never happened to the participant. In an interview session, half of the participants were warned that false memories can occur. All participants were subsequently presented with a basic prompt about the three real stories, as well as one confirmed false story. All participants rated their confidence as to whether each memory had actually occurred and orally recounted as much detail about each memory as possible. Collapsing across the warning and visualization conditions, Qin and colleagues found no links between participants' attachment styles and an aggregate measure of their reported confidence in the false memory and the number and clarity of details that they provided about it during the interview.

Third, McWilliams et al. (2014) were interested in the role of false rehearsal on memory recall. Participants read a fictitious account of childhood sexual abuse and either (a) correctly rehearsed the story, (b) rehearsed the story with instructions to hide the fact that abuse had occurred, or (c) did not rehearse the story. In a subsequent session, participants were asked several cued recall questions. Collapsing across conditions, both highly anxious and highly avoidant individuals provided fewer correct answers than their relatively secure peers. However, highly anxious individuals also provided greater *incorrect* answers for nonabuse-related information. Although this finding was not a direct test of the link between anxiety and false recall (and the authors did not interpret it as such), it may imply that anxious individuals are likely to remember false relationally relevant information.

Finally, Hudson and Fraley (2018a) ran a series of five studies linking attachment anxiety to false memories. In their studies, participants watched a 20-min video of a woman describing a breakup. They subsequently completed a recognition memory test in which half of the items were true and half were false. In all five studies, participants with higher levels of attachment anxiety—but not avoidance—were more likely to experience false memories. Moreover, three of the studies experimentally manipulated participants' state levels of attachment anxiety. They found evidence that high-state level attachment anxiety at the time that memories are *encoded*—but not necessarily during storage or retrieval—can cause people to experience subsequent false memories during retrieval.

Thus, collectively, the existing literature seems to suggest that attachment anxiety causes false memories in relational contexts (Ein-Dor et al., 2011; Hudson & Fraley, 2018a; McWilliams et al., 2014)—but some studies have not replicated this finding (Qin et al., 2008). Moreover, no studies have explored whether—similar to avoidance (Edelstein, 2006)—anxiety predicts memory processes *only for relational events* as opposed to whether it might also correlate with false memories for *general information*. The present studies were designed to fill this gap in the empirical literature.

Overview of the Present Studies

The present studies were designed to more thoroughly test the links between attachment orientations and false memories using a recognition paradigm. In particular, we wanted to (a) replicate the links between attachment anxiety and false memories, and (b) test the boundary conditions of the phenomenon—in terms of whether anxiety predicts false memories *only for relational stimuli*, or whether anxiety might predict false memories for general information, as well.

In these studies, we used a modified version of Hudson and Fraley's (2018a) paradigm. Namely, in our studies, participants watched a 20-min video of a woman describing a breakup or other topics (such as a shopping trip or the ecology of Californian wetlands). Subsequently, participants were presented with a surprise memory test containing roughly equal numbers of events that occurred versus did not occur in the story. We were primarily interested in correlating participants' attachment styles with *false alarms* on the memory test—the extent to which participants believed that false items had actually occurred.

We also examined several boundary conditions that might moderate the associations between attachment styles and false memories. In Study 1, we examined whether attachment anxiety differentially predicted false memories for a woman telling a story of a breakup versus another personal, albeit nonrelational story (i.e., talking about a recent shopping trip). Moreover, there are attachment-related differences in how people perceive communication via different media (e.g., oral, text)—and thus memory processes might also differ by mode of information presentation (Rockwell & Singleton, 2007; Sundar, 2000; Wardecker et al., 2016). Accordingly, in Studies 2–3, we tested whether anxiety predicted false memories for general factual information (a lecture on wetlands) and whether anxiety predicted false memories across various modes of communication (video, audio only, text). Collectively, these studies will elucidate the links between attachment anxiety and false memories and further our understanding of the contexts in which anxiety is likely to spur false memories.

Open Science

None of the reported studies were preregistered. These studies were approved by the institutional review boards at Southern Methodist University (H17-110-HUDN) and Michigan State University (16-1003). Abridged data sets for all studies, as well as supplemental analyses and materials, can be found on Open Science Framework (OSF; https://osf.io/3xk4v/). We ran a total of four studies for this article and report the results of three. The fourth study (a tangentially related exploratory study in which all participants saw a video describing a breakup—for which we manipulated surface-level aspects of the video stimuli) and its results are described in further detail on OSF; it produced null results for all effects (including main effects), suggesting that the "real" observed power of our studies to reliably detect the correlation between attachment anxiety and false memories was approximately 75%.[2]

Study 1

Prior research has found that attachment anxiety predicts people's propensities to experience false memories—at least for stimuli deeply permeated with attachment themes (Hudson & Fraley, 2018a). Previous research examining the links between *avoidance* and *errors of omission* (e.g., not remembering) has found that avoidance-related errors tend to be especially prevalent when the memory stimuli pertain to attachment themes (e.g., Edelstein, 2006). Theoretically, this domain-specific effect occurs because avoidant people wish to minimize the importance of relationships, and to this end, they defensively direct their attention away from attachment-related stimuli (Edelstein, 2006; Fraley & Brumbaugh, 2007) or actively suppress thoughts and memories pertaining to close relationships (e.g., Pereg & Mikulincer, 2004).

Following similar logic, it is possible that attachment anxiety might promote false memories, especially for—or perhaps solely for—stimuli permeated with attachment-relevant themes. Theoretically, this might occur because highly anxious people's chronically and intensely activated relational concerns more easily erroneously "bleed" into memories that already contain some attachment-relevant themes (e.g., Brainerd & Reyna, 2002; Straube, 2012). Stated differently, the fact that the source stimuli already contain relational themes may make it easier for highly anxious individuals to experience a sort of source monitoring confusion (Johnson et al., 1993) and erroneously associate their chronically activated relational concerns with the memory in question.

To explore the possibility that attachment anxiety predicts false memories only when the source stimuli pertain to attachment-relevant themes, Study 1 was a two-group randomized experiment. One group of participants experienced procedures identical to Hudson and Fraley's (2018a) studies—they viewed the breakup video and took a surprise memory test. In contrast, the second group of participants viewed a video by the same woman containing a description of a story with no attachment themes (a shopping trip) and completed a subsequent surprise memory test.

What should we expect to find? In the breakup video condition, we expected to directly replicate Hudson and Fraley's (2018a) studies: Attachment anxiety should positively predict false alarms (i.e., incorrectly indicating they had previously seen new content) but be unrelated to hit rates (i.e., the rate of correctly identifying content that had been presented). We had less-clear expectations regarding the shopping video condition. To the extent that attachment-driven false memories occur only when the source stimuli pertain to attachment themes, we might expect to observe no links between attachment anxiety and false memories in the shopping video condition. If, however, attachment anxiety is related to false memories more generally, we might expect to also observe a correlation between attachment anxiety and false memories in the shopping video condition.

Method

Participants

Participants were recruited through the psychology subject pools at various American Universities and completed Study 1 in exchange for course credit. Participants were prescreened to have normal or corrected-to-normal hearing and fluency in English, to ensure that they could adequately hear and understand the memory stimuli. A total of 204 participants were recruited for Study 1, enabling approximately 86% power to detect average-sized zero-order effects ($r \sim .21$; Richard et al., 2003). The sample was predominantly (75%) female, and the racial composition was approximately 48% White, 35% Asian, 11% Black, and 9% Hispanic. Using checkboxes that permitted participants to check all applicable options, 52% of participants indicated that they were single; the remaining participants were in a casual (4%) or committed nonmarriage (46%) relationship.

Measures

Attachment Orientations. Participants' attachment styles were assessed via the nine-item partner-specific subscale from the Experiences in Close Relationships—Relationship Structures questionnaire (ECR-RS; Fraley et al., 2011). Previous research suggests that general romantic (ECR-R) and partner-specific (ECR-RS) attachment orientations are very highly correlated for

[2] Hudson and Fraley (2018a) reported five studies linking anxiety to false memories. Given the four additional studies presented or noted here using approximately the same paradigm, nine total studies on the phenomenon have been conducted, eight of which have found a correlation between anxiety and false memories—and one of which did not.

young, college-aged adults (see Hudson et al., 2015). Therefore, to decrease the length of the study, we used the relatively short, nine-item ECR-RS partner-specific scale instead of the 36-item ECR-R scale.

The ECR-RS partner-specific subscale measures participants' attachment styles specifically with respect to their current (or, if single, most recent) romantic partner. This measure contains subscales for attachment anxiety (three items; e.g., "I often worry that my romantic partner doesn't really care for me") and attachment avoidance (six items; e.g., "I prefer not to show my romantic partner how I feel deep down"). All items were rated using a Likert scale running from *strongly disagree* (1) to *strongly agree* (5). Items were averaged to form composites for partner-specific attachment anxiety ($\alpha = .85$) and avoidance ($\alpha = .83$).

Emotional Stability. For use in exploratory analyses, participants' big five personality trait of *emotional stability* was measured using the two-item subscale from the Ten Item Personality Inventory (Gosling et al., 2003). Items (e.g., "I see myself as calm, emotionally stable") were rated on a scale from *strongly disagree* (1) to *strongly agree* (5) and were averaged to form a composite ($\alpha = .65$).

Procedure

Participants were presented with a cover story that the study was designed to examine whether people can accurately rate someone else's personality just by watching them tell a story. Participants first completed the attachment measure. Subsequently, participants were randomly assigned by the study computer program into one of two groups. Participants in the *breakup video* group viewed the same video that was used in Hudson and Fraley's (2018a) studies. Specifically, they watched an approximately 20-min video in which a woman, Victoria, described a true story of a tumultuous relationship and resultant breakup with a man pseudonymed "James." The specific video used was chosen because it was engaging and contained detailed descriptions of several episodes in Victoria and James's relationship from which memory test questions could be generated. Furthermore, the video was deeply permeated with themes relevant to attachment anxiety (e.g., difficulty letting ex-partners go), avoidance (e.g., James behaving in ways to minimize closeness and maximize distance), and security (e.g., after breaking up with James, Victoria enters a new relationship with a responsive, caring man). These participants were subsequently presented with the 54-item surprise memory quiz used in Hudson and Fraley's (2018a) latter three experiments (with 26 true items and 28 false items). For each item, participants responded, *yes, this DID occur* (1) or *no, this did NOT occur* (0). The full text of this memory measure can be found in Hudson and Fraley (2018a).

Participants assigned to the *shopping video* experimental condition viewed a 20-min video of the same woman, Victoria, describing a true story of a recent shopping spree during which she visited several different stores and purchased many different makeup, clothing, and accessory items. Throughout the video, Victoria describes these different items and also provides general commentary on her fashion and shopping preferences. This particular video was chosen because it (a) contained the same woman as the breakup video, (b) was the same length as the breakup video, (c) was similar in style and format to the breakup video (i.e., Victoria talking into a camera), and (d) did not contain attachment themes. Immediately after viewing the shopping video, participants completed a surprise 54-item memory test containing 26 true items (e.g., "Victoria said that she wears lip stain, lip liner, and lip stick") and 28 false items (e.g., "Victoria said that cross-patterns are her favorite pattern"). The true and false items were written to be roughly balanced in terms of difficulty and specificity as each other.

Results and Discussion

Descriptive statistics and correlations for all study variables can be found in Table 1.

Analysis Strategy

We used multilevel logistic models (MLLMs) to analyze our data. In these MLLMs, participants' logtransformed odds of endorsing individual items on the memory test *as having occurred* were modeled as a function of (a) the item's veracity (dummy coded: 0 = false, 1 = true), (b) participants' standardized partner-specific attachment anxiety, (c) the Item Veracity × Anxiety Interaction, (d) the experimental condition (dummy coded: 0 = breakup video, 1 = shopping video), (e) the Condition × Anxiety Interaction, (f) the Item Veracity × Condition Interaction, (g) the Item Veracity × Condition × Anxiety Interaction, and (h) a random intercept to model within-person dependencies in the data. Specifically, the model used was:

$$\begin{aligned}\ln\left(\frac{\pi}{1-\pi}\right) = {} & b_0 + b_1(\text{true})_{ij} + b_2(\text{anxiety})_j + b_3(\text{true})_{ij}(\text{anxiety})_j \\ & + b_4(\text{shopping})_j + b_5(\text{shopping})_j(\text{true})_{ij} \\ & + b_6(\text{shopping})_j(\text{anxiety})_j \\ & + b_7(\text{shopping})_j(\text{true})_{ij}(\text{anxiety})_j + U_j.\end{aligned}$$

In this model, the b_1(true) coefficient provides an estimate of participants' relative odds of endorsing *true* items as opposed to *false* ones *in the breakup video condition*. A positive b_1 parameter would indicate that participants who viewed the breakup video were more likely to endorse true items than false ones. The b_1 parameter is directly analogous to the d' accuracy coefficient frequently used in memory research (as it captures the difference between hit rates and false alarm rates). The b_2(anxiety) parameter provides an estimate of the extent to which attachment anxiety predicts *false alarm rates* (i.e., endorsement of *false* items) in the breakup video condition.

Table 1
Study 1 Descriptive Statistics and Correlations

Variable	*M*	*SD*	Correlations 1	2	3	4	5
1. Anxiety	2.48	1.03	—				
2. Avoidance	1.94	0.60	**.41**	—			
3. Stability	3.45	0.86	**−.31**	−.02	—		
4. Hit rate	0.79	0.12	−.02	−.09	.03	—	
5. False alarm rate	0.20	0.13	**.17**	**.17**	−.10	−.09	—

Note. The 95% confidence intervals for correlations in boldface do not contain zero.

This is the case because the *true* variable is dummy coded with false items as the reference group (i.e., 0 = false, 1 = true) and the interaction between attachment anxiety and item veracity is included in the model.

The b_3 interaction term estimates the extent to which attachment anxiety has a *different* association with hit rates, *relative* to its association with false alarms, in the breakup video condition. As a consequence, the simple association between attachment anxiety and *hit rates* is simply $b_2 + b_3$. As a concrete, hypothetical example, if $b_2 = 0.20$ and $b_3 = -0.20$, this pattern of results would indicate that attachment anxiety predicts false alarm rates ($b_2 = 0.20$, odds ratio [*OR*] $= e^{0.20} = 1.22$) but is unrelated to hit rates ($b_2 + b_3 = 0.20—0.20 = 0.00$, $OR = e^{0.00} = 1.00$). Thus, collectively, the b_1 through b_3 parameters provide a direct replication of Hudson and Fraley's (2018a) findings: They capture the correlations between attachment anxiety and hits and false alarms *in the breakup video condition*. Importantly, the b_3 interaction term also provides a direct test of the extent to which attachment anxiety is associated with *memory accuracy* (i.e., hit rate minus false alarm rate; similar to the association between anxiety and d').

Finally, due to the way the model is specified (i.e., using dummy codes), the b_4–b_7 coefficients provide an estimate of the extent to which these associations are *different* in the shopping video condition, *relative* to the breakup video condition.

One critically important feature of this MLLM is that it models *both* hit rates *and* false alarm rates simultaneously. Doing so affords insight into the processes underlying the generation of false memories (Dobbins et al., 2000). For example, if higher levels of attachment anxiety were associated with greater false alarm rates *and* hit rates, such a finding would indicate that attachment anxiety *biases* individuals toward endorsing *any* item on the memory quiz—whether true or false. Thus, the manifest false memories would be attributable to more general processes whereby highly anxious individuals are likely to believe that essentially any relationally relevant stimulus is, in fact, remembered.

Alternatively, if higher levels of attachment anxiety predicted *lower* hit rates and *higher* false alarms, such a finding would indicate that anxiety *desensitizes* people's memories—essentially pressing both hit rates and false alarm rates toward the guessing rate. This would suggest that highly anxious individuals' memories are simply poorer for relational information, inflating their false alarm rates, and deflating their hit rates.

Finally, if anxiety were positively correlated with false alarm rates and *uncorrelated* with hit rates, such a pattern of findings would indicate that attachment anxiety *both* biases *and* desensitizes people's memories. Specifically, although bias and insensitivity *both* inflate false alarm rates, the effect of bias is to inflate hit rates, whereas the effect of insensitivity is to deflate hit rates. Therefore, it is possible for these processes to mutually cancel each other out, creating a situation in which attachment anxiety appears to be unrelated to hit rates.

Associations Between Attachment Anxiety and Memory Test Performance

The parameter estimates from our MLLM are presented in Table 2. As can be seen by examining the *Anxiety* and *Item True* × *Anxiety* coefficients, we directly replicated Hudson and Fraley's (2018a) prior findings. Specifically, as depicted in the left-hand panels of Figure 1, in the *breakup video* condition, there was an interaction between item veracity and attachment anxiety (simple $OR_{\text{True} \times \text{Anxiety}} = 0.85$, 95% CI [0.74, 0.98]), such that higher levels of attachment anxiety were associated with greater false alarm rates (simple $OR_{\text{anxiety}} = 1.17$, 95% CI [1.03, 1.33]) but were unrelated to hit rates (simple $OR_{\text{anxiety}} = 1.00$, 95% CI [0.89, 1.14]). In terms of model-predicted probabilities, in the breakup video condition, false alarm rates were 17% and 22% for persons low (1 *SD* below the mean) and high (1 *SD* above the mean) in attachment anxiety, respectively.

Table 2
Study 1 MLLM Predicting Odds of Endorsing True and False Items on the Memory Quiz as a Function of Attachment Anxiety and Experimental Condition

Predictor	*b*	Odds ratio	95% CI LB	95% CI UB
Intercept	**−1.43**	—	—	—
Item true	**2.81**	**16.59**	14.51	18.97
Anxiety[a]	**0.16**	**1.17**	1.03	1.33
Item True × Anxiety	**−0.16**	**0.85**	0.74	0.98
Shopping	0.03	1.03	0.87	1.22
Shopping × Item True	0.06	1.06	0.64	1.74
Shopping × Anxiety	−0.04	0.96	0.81	1.13
Shopping × Item True × Anxiety	0.00	1.00	0.83	1.20

Note. MLLM = multilevel logistic model; CI = confidence interval; LB = lower-bound; UB = upper-bound. 95% CIs for parameters in boldface do not include 1.00.
[a] Because the "item true" variable was dummy coded (0 = false, 1 = true) and the experimental condition was dummy coded with the breakup video as the reference group (0 = breakup video, 1 = shopping video), this is the simple effect of anxiety on *false* items in the *breakup video* condition.

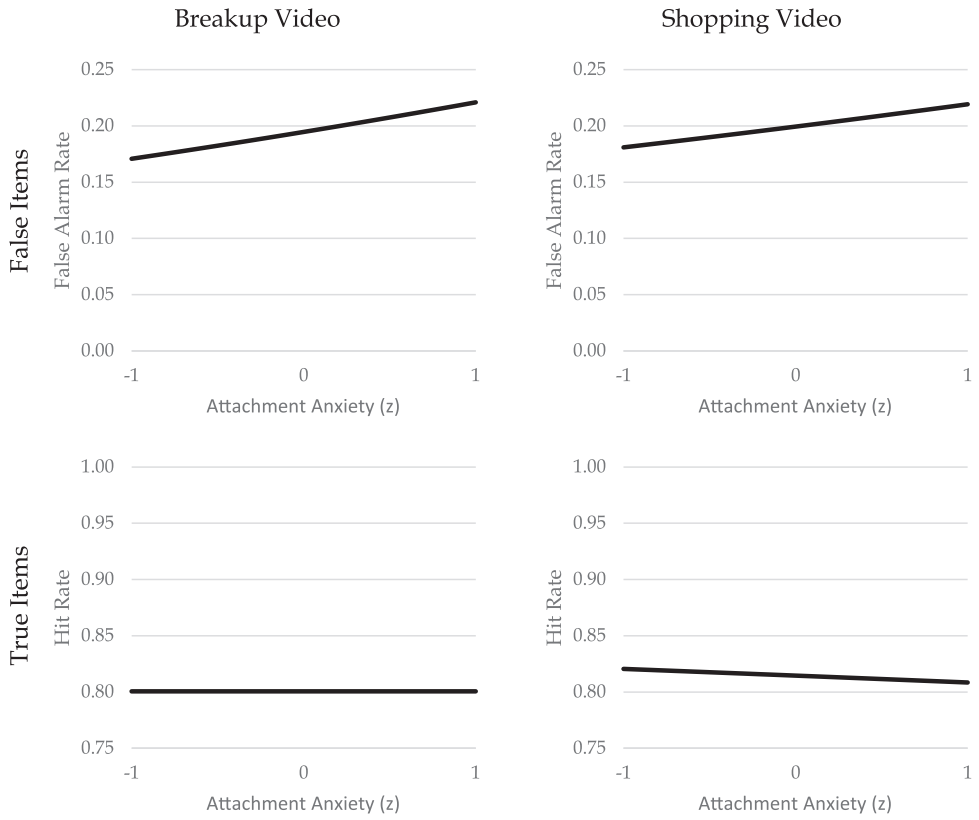
Finally, as depicted in the right-hand panels of Figure 1, these effects were nearly identical in the *shopping video* condition. Specifically, the experimental condition did not moderate the two-way interaction between item veracity and attachment anxiety, $OR_{\text{True} \times \text{Shopping} \times \text{Anxiety}} = 1.00$, 95% CI [0.83, 1.20]. Consequently, similar to the breakup video condition, in the shopping video condition, there was a simple two-way interaction between item veracity and anxiety (simple $OR_{\text{True} \times \text{Anxiety}} = 0.86$, 95% CI [0.75, 0.97]) such that anxiety was related to false alarm rates (simple $OR_{\text{anxiety}} = 1.12$, 95% CI [1.002, 1.26]) but not hit rates (simple $OR_{\text{anxiety}} = 0.96$, 95% CI [0.86, 1.08]). Taken together, these findings suggest that attachment anxiety predicted false memories even when the source stimuli did not directly pertain to attachment-related themes.

Exploratory Supplemental Analyses

As a series of exploratory analyses, we examined the extent to which (a) attachment anxiety predicted false memories above and beyond attachment avoidance and the big five trait of emotional stability, as well as the extent to which false memories could be predicted from (b) avoidance and (c) emotional stability. As can be seen in the Supplemental Analyses (https://osf.io/3xk4v/) Table S1, our general pattern of results for attachment anxiety remained nearly identical while statistically controlling both avoidance and emotional stability. Thus, the fact that attachment anxiety predicts false memories is not attributable to overlap with avoidance or general negative affectivity (i.e., low emotional stability).

Figure 1

Study 1 Model-Predicted Probabilities of Endorsing True and False Items on a Memory Test as a Function of Attachment Anxiety in the Breakup Video and Shopping Video Experimental Conditions



As seen in Supplemental Table S2, attachment avoidance had similar—albeit not statistically significant—effects to attachment anxiety. This is a divergence from previous research. For example, using a nearly identical paradigm, Hudson and Fraley (2018a) found that avoidance was almost completely unrelated to memory ability (i.e., the odds ratios were very close to 1.00) across three separate studies. In contrast, in the present article, attachment avoidance had a similar pattern of coefficients to attachment anxiety across this first study, as well as the two forthcoming studies—which may suggest that both attachment-related traits predict memory phenomena in a similar way. However, given that the coefficients for avoidance generally did not meet the threshold for statistical significance in our studies, this interpretation should be approached with caution.

Conversely, as seen in Supplemental Table S3, emotional stability was not a statistically significant predictor of true or false memories. Indeed, across all studies reported in the present article—the present one and the two forthcoming ones—emotional stability never predicted true or false memories. This suggests that the attachment-related memory phenomena reported in the present studies do not merely reflect processes related to generalized negative affectivity (i.e., neuroticism; the opposite of emotional stability).

Study 2

In Study 1, we found that attachment anxiety predicted false memories *both* for participants who viewed the breakup video and also for participants who viewed the shopping video. These findings may suggest that attachment anxiety generally predicts false memories and that this association is not necessarily constrained to attachment-related memory stimuli. However, one major limitation of Study 1 is that—although the shopping video did not contain attachment themes—it is possible that participants nevertheless construed it as fundamentally interpersonal in nature. Specifically, the shopping video depicted a person describing her prior experiences, as well as her stylistic preferences, tastes, likes, and dislikes. Even though Victoria did not discuss relationships or other attachment themes in the shopping video, watching the video mirrored the social experience of listening to a friend describe their experiences and interests. Likewise, particular aspects of the shopping video (i.e., shopping for makeup, clothing, accessories) might also take on relationship-related themes (e.g., doing so to appear attractive to others). Thus, even though the video lacked attachment themes, watching it may have mimicked the types of experiences that typically occur within the context of close interpersonal relationships.

Therefore, one potential explanation for the findings in Study 1 is that attachment anxiety predicted false memories across both conditions because both videos contained at least some *interpersonal information* (e.g., someone describing their past actions and preferences) transmitted via *interpersonal means* (i.e., a human storyteller). Thus, it may be the case that attachment anxiety predicts false memories for any type of *interpersonal* information (even if that

information does not pertain directly to attachment themes of close relationships, support, security, intimacy, and/or loss).

To address these issues, Study 2 was a 2 × 2 randomized factorial experiment designed to test whether the association between anxiety and false memories is moderated by two different aspects in which information can be "interpersonal." With respect to the first factor, similar to Study 1, we manipulated the content of the video. Some participants were randomly assigned to view the breakup video from Study 1. The remaining participants saw a video in which Victoria lectured on an unequivocally noninterpersonal topic: wetlands. Fully crossed with this breakup versus wetland topic manipulation, participants either saw a "slideshow video" of Victoria discussing the topic, or were presented with a plaintext, verbatim transcript of the words contained within the video (without any sort of audio). Using this design, we were able to isolate the effects of the stimuli containing interpersonal themes (a breakup vs. wetlands) and the effects of the stimuli being transmitted via interpersonal means (a human storyteller vs. text).

What should we expect to find? We had only one strong a priori expectation: We expected to directly replicate Study 1 and observe a correlation between anxiety and false memories in the breakup/human condition. Beyond this, we had less-clear a priori expectations. Specifically, four possibilities seemed equally reasonable. First, to the extent that attachment anxiety predicts only false memories pertaining to interpersonal stimuli, we might expect to observe a correlation between anxiety and false alarms in the breakup/human and breakup/text conditions, but not in the two wetlands conditions. Second, if attachment anxiety predicts false memories only for information transmitted via interpersonal media, we might expect correlations between anxiety and false alarms in the breakup/human and wetlands/human conditions, but not in the two text conditions. Third, if attachment anxiety predicts false memories if either the information or transmission medium is interpersonal in some regard, we might expect a correlation between attachment anxiety and false memories across every condition *except* the wetlands/text condition. Finally, if attachment anxiety predicts false memories in general, and this effect is not limited to interpersonal contexts, we should observe a correlation between attachment and false memories in all four conditions.

Method

Participants

Recruitment procedures were identical to Study 1. A total of 651 participants completed Study 2. The sample was predominantly (62%) female, and ages ranged from 18 to 31 (M = 19.34, SD = 1.49). The racial composition of the sample was approximately 51% White, 30% Asian, 11% Hispanic, 7% Black, and 5% Middle Eastern. Sixty-five percent of the sample indicated that they were currently single; the remaining participants were in a casual (6%) or committed nonmarriage relationship (31%).

Measures

Attachment Orientations. As in Study 1, participants' partner-specific attachment anxiety and avoidance were measured using the ECR-RS.

Emotional Stability. Participants' emotional stability was measured using the eight-item subscale from the Big Five Inventory (BFI; John & Srivastava, 1999). Items (e.g., "I see myself as someone who remains calm in tense situations") were rated on a scale from *strongly disagree* (1) to *strongly agree* (5) and were averaged to form a composite (α = .84).

Procedure

Upon arriving to the lab, participants were given a slightly different cover story than in Study 1 in order to accommodate the text conditions. Specifically, participants were told that the purpose of the study was to understand how their personalities relate to the types of details they want to know when they encounter new information—and that after learning some new information, we would ask them which types of included details they liked or disliked and also which types of details they wish would have been included but were not.

Participants first completed the attachment measure and were then randomly assigned by the study computer program into one of four conditions. In one group, participants saw an edited version of the breakup video from Study 1. The audio was identical to that in Study 1. However, the video was broken up into 4–8 s still-frame images of Victoria. The result was a "slideshow" effect, similar to that frequently used in some types of low-budget cartoons, anime, or antique educational films.

Participants in a second group saw an identical series of slides of Victoria; however, these slides were overlaid with audio from a lecture on wetlands. The lecture was edited to be approximately 20 min in length, flow coherently, and read like an article when transcribed into text. Furthermore, any references the speaker made to herself or the audience were removed. The final effect gave a quite compelling impression that Victoria was an amateur wetlands enthusiast who had perhaps created a video blog describing the *status quo* of Californian and—more broadly—American wetlands. As a brief overview, the wetlands transcript: (a) defined wetlands, (b) described functions of wetlands (e.g., providing fish and animal habitats; water purification), (c) enumerated several threats to wetlands (e.g., dredging to eliminate mosquito populations), (d) explained how mapping wetlands can aid efforts to restore them, and (e) detailed how the San Gabriel wetlands ecosystem in California has changed over time.

Participants in the two remaining groups were presented with a verbatim, plaintext transcript of either the breakup or wetlands audio. To clarify, these participants only saw plain text—to avoid any sort of human transmission medium, the text was neither narrated nor accompanied by any other audio. The text was presented in large (28 point) font with approximately 1.50 line spacing. The text automatically scrolled up the screen, such that the entire transcript was presented in precisely the same amount of time as the respective videos. Thus, participants reading the text transcripts were presented with the exact same information, at precisely the same rate—and identical to participants viewing the videos, they were unable to "scroll back" to review previous material. The experience of reading the breakup text felt similar to reading a transcript of a spoken interview. The wetlands audio was edited such that, when transcribed into text, it read very similarly to an article that might appear in a course textbook. The text transcripts were approximately 2,500 words each. At approximately 20 min each, the

text transcripts were presented at approximately 125 words per minute—approximately half the reading speed of the average adult (Brysbaert, 2019).

To summarize, participants either (a) saw a slideshow video of Victoria accompanied by spoken audio, or (b) read a plaintext transcript without any sort of audio accompaniment. Fully crossed with the human versus text manipulation, the content was either (a) Victoria's breakup story used in Study 1, or (b) the wetlands lecture.

Immediately after viewing a video or reading a transcript, participants were presented with a 54-item memory test. The memory test for the breakup conditions was identical to that used in Study 1. A new memory test was created for the wetlands material, containing 26 true items (e.g., "According to the transcript, drainage ditches are classified as wetlands") and 28 false ones (e.g., "According to the transcript, humans are the number one reason for wetlands changing over time") which were written to be roughly balanced in terms of difficulty and specificity.

Results and Discussion

Descriptive statistics and correlations for all study variables can be found in Table 3. We analyzed our data using an MLLM that estimated participants' odds of endorsing individual items on the memory test as a function of (a) the item's veracity (dummy coded: 0 = false, 1 = true), (b) the participant's standardized partner-specific attachment anxiety, (c) the topic of the stimuli (dummy coded: 0 = breakup, 1 = wetlands), (d) the transmission medium (dummy coded: 0 = human, 1 = text), (e) all 2-, 3-, and 4-way interactions between the aforementioned variables, and (f) a random intercept to model within-person dependencies in the data. All terms included in the MLLM are enumerated in the "Predictor" column of Table 4 (the models also included a random intercept to model and control within-person dependencies in the data).

As in Study 1, because the model was specified using dummy codes, the *Anxiety* and *True* × *Anxiety* parameter estimates in Table 4 represent the *simple associations* between anxiety and endorsement of false/true items *in the breakup/human condition*. Thus, these coefficients are identical in interpretation to the parameter estimates in Study 1. All interactions including either the *wetlands* or *text* variables provide estimates of the extent to which the anxiety-endorsement associations are *different* in the wetlands or text conditions, *relative* to the breakup/human condition.

Table 3
Study 2 Descriptive Statistics and Correlations

Variable	*M*	*SD*	Correlations 1	2	3	4	5
1. Anxiety	2.86	0.70	—				
2. Avoidance	2.24	0.69	.07	—			
3. Stability	3.01	0.72	**−.42**	−.03	—		
4. Hit rate	0.72	0.14	.01	.03	.04	—	
5. False alarm rate	0.34	0.21	.05	.05	−.02	**−.34**	—

Note. The 95% confidence intervals for correlations in boldface do not contain zero.

Table 4
Study 2 MLLM Predicting Odds of Endorsing True and False Items on the Memory Quiz as a Function of Attachment Anxiety and Experimental Condition

Predictor	*b*	Odds ratio	95% CI LB	95% CI UB
Intercept	**−1.31**	—	—	—
Item true	**2.64**	**13.96**	12.40	15.72
Anxiety[a]	**0.11**	**1.12**	1.003	1.24
Item True × Anxiety	**−0.12**	**0.89**	0.79	0.99
Wetlands	**1.37**	**3.95**	3.40	4.59
Wetlands × Item True	**−2.23**	**0.11**	0.09	0.13
Wetlands × Anxiety	0.00	1.00	0.32	1.16
Wetlands × Item True × Anxiety	0.02	1.02	0.88	1.19
Text	**−0.26**	**0.77**	0.66	0.90
Text × Item True	**0.26**	**1.30**	1.09	1.54
Text × Anxiety	−0.12	0.89	0.76	1.05
Text × Item True × Anxiety	0.10	1.10	0.92	1.31
Wetlands × Text	−0.15	0.86	0.70	1.07
Wetlands × Text × Item True	**0.38**	**1.47**	1.17	1.83
Wetlands × Text × Anxiety	0.01	1.01	0.82	1.26
Wetlands × Text × Item True × Anxiety	0.00	1.12	0.80	1.25

Note. MLLM = multilevel logistic model; CI = confidence interval; LB = lower-bound; UB = upper-bound. 95% CIs for parameters in boldface do not include 1.00.
[a] Because the "item true" variable was dummy coded (0 = false, 1 = true) and the experimental conditions were dummy coded with the breakup video group as the reference group (wetlands: 0 = breakup, 1 = wetlands; text: 0 = video, 1 = text), this is the simple effect of anxiety on *false* items in the *breakup video* condition.

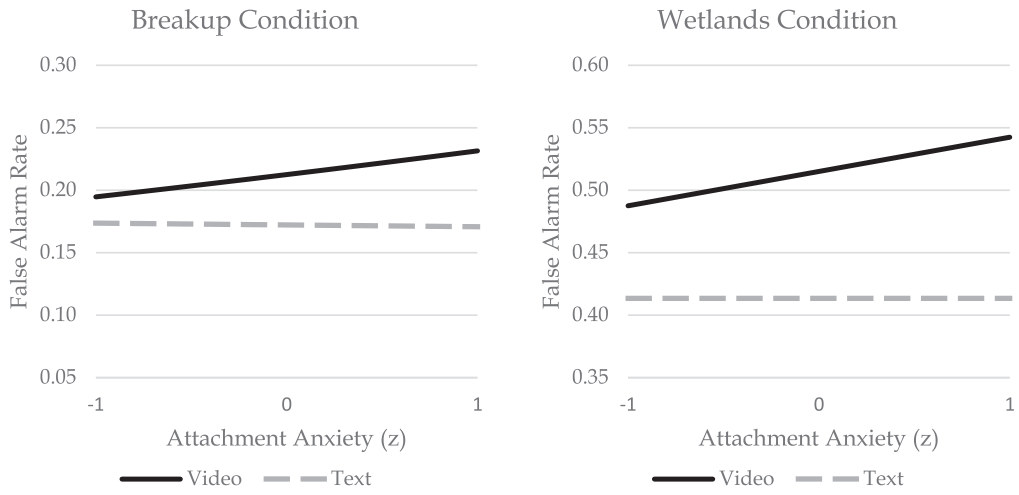
As can be seen in Table 4, replicating Study 1 and previous research, attachment anxiety predicted false alarms (simple $OR_{\text{anxiety}} = 1.12$, 95% CI [1.003, 1.24])—but not true memories (simple $OR_{\text{anxiety}} = 0.98$ 95% CI [0.88, 1.10])—in the breakup video condition (simple $OR_{\text{True} \times \text{Anxiety}} = 0.89$, 95% CI [0.79, 0.99]). Thus, participants tended to experience more numerous false memories—but not true ones—when listening to Victoria describe her breakup.

In contrast, as seen in Table 4, none of the conditions significantly moderated the effects of attachment anxiety. Thus, one might be tempted to conclude that attachment anxiety predicted false memories in all four experimental conditions. However, this is not the case. Indeed, simple slope analyses revealed that attachment anxiety predicted false memories in the breakup video (simple $OR_{\text{anxiety}} = 1.12$, 95% CI [1.003, 1.24]) and wetlands video (simple $OR_{\text{anxiety}} = 1.12$, 95% CI [1.02, 1.24]) conditions, but not in the breakup transcript (simple $OR_{\text{anxiety}} = 0.99$, 95% CI [0.88, 1.13]) or wetlands transcript (simple $OR_{\text{anxiety}} = 0.99$, 95% CI [0.92, 1.12]) conditions (see Figure 2).

Thus, we reran our analyses collapsing across the topic (breakup vs. wetlands) and only examining the effects of medium (video vs. transcript).[3] All parameters in these revised analyses can be seen in Table 5. In contrast to our prior model (see Table 4), which compared the *breakup video* condition to each of the four other conditions separately, the present analyses compared *both video* conditions

[3] We also sought to conceptually replicate this effect in Study 3 given these exploratory follow-up analyses.

Figure 2
Study 2 Model-Predicted False Alarm Rates as a Function of Attachment Anxiety in Each of the Four Experimental Conditions



to *both transcript* conditions. This increases the statistical power to detect the effects of the material being presented via video or text.

As seen in Table 5 and Figure 3, in the *main effects model* that collapsed across the breakup and wetlands topics, there was a 3-way interaction between anxiety, item veracity, and medium condition (*OR* = 1.11, 95% CI [1.01, 1.22]). Decomposing this interaction, for *videos*, there was a significant interaction between anxiety and item veracity ($OR_{\text{True} \times \text{Anxiety}}$ = 0.91, 95% CI [0.85, 0.97]), such that anxiety predicted more numerous false alarms (simple OR_{anxiety} = 1.11, 95% CI [1.05, 1.18]) but not hits (simple OR_{anxiety} = 1.01, 95% CI [0.95, 1.09]). Model-predicted false alarm rates for people low and high in attachment anxiety were 35% and 40%, respectively. In contrast, for *text*, there was no interaction between anxiety and item veracity ($OR_{\text{True} \times \text{Anxiety}}$ = 1.01, 95% CI [0.94, 1.08]), and anxiety was completely unrelated to memory performance—it predicted neither false alarms (simple OR_{anxiety} = 0.99, 95% CI [0.93, 1.06]) nor hits (simple OR_{anxiety} = 1.00, 95% CI [0.93, 1.07]).

Thus, to summarize, Study 2 found that attachment anxiety predicted more numerous false memories for *any* material that was presented via video—whether a woman describing her recent breakup, or a woman giving a lecture on wetlands. In contrast, attachment anxiety was unrelated to false memories for information—even relational information—presented via text. This suggests that something about *human interaction* (e.g., receiving information from another person, regardless of content communicated) might spur false memories for highly anxious individuals.

Table 5
Study 2 MLLM Examining Main Effects of Text Versus Video, Collapsing Across Topics

Predictor	*b*	Odds ratio	95% CI LB	95% CI UB
Intercept	−0.53	—	—	—
Item true	**1.43**	**4.17**	3.91	4.44
Anxiety[a]	**0.11**	**1.11**	1.05	1.18
Item True × Anxiety	**−0.10**	**0.91**	0.85	0.97
Text	**−0.30**	**0.74**	0.68	0.81
Text × Item True	**0.40**	**1.49**	1.36	1.63
Text × Anxiety	**−0.12**	**0.89**	0.81	0.97
Text × Item True × Anxiety	**0.10**	**1.11**	1.01	1.22

Note. MLLM = multilevel logistic model; CI = confidence interval; LB = lower-bound; UB = upper-bound. 95% CIs for parameters in boldface do not include 1.00.
[a] Because the "item true" variable was dummy coded (0 = false, 1 = true) and the experimental conditions were dummy coded with the breakup/human group as the reference group (audio: 0 = video, 1 = audio), this is the simple effect of anxiety on *false* items in the *video* conditions.

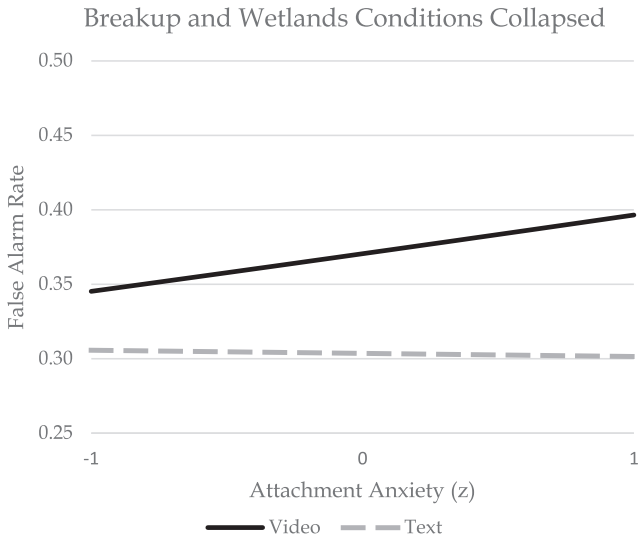
Exploratory Supplemental Analyses

As can be seen in Supplemental Analyses (https://osf.io/3xk4v/) Tables S4–S6, as in Study 1: (a) our pattern of results for attachment anxiety was not affected by statistically controlling for attachment avoidance and emotional stability; (b) the pattern of results for attachment avoidance was similar to that for attachment anxiety—albeit not consistently statistically significant; and (c) emotional stability did not predict true or false memories. This reaffirms, as in Study 1, that any attachment-related memory dynamics are not attributable to general emotional stability—and that neuroticism per se does not predict memory ability.

Study 3

Study 3 was designed to conceptually replicate and extend Study 2. Study 2 found that highly anxious individuals were likely to experience false memories when viewing a video of a person speaking—but not when reading a text transcript of the same material. One potential explanation for this phenomenon is that highly anxious individuals may use visual cues—such as facial expressions—to jump to potentially incorrect conclusions about what others are attempting to communicate (e.g., Fraley et al., 2006). For example, highly anxious participants might attempt to

Figure 3
Study 2 Model-Predicted False Alarm Rates as a Function of Attachment Anxiety for Video Versus Text Conditions



infer how Victoria felt about the topics she discussed, leading to the formation of inaccurate memory traces and subsequent false memories.

To test this idea, Study 3 was a relatively close replication of Study 2 with one exception—instead of reading a text transcript in two conditions, participants were presented with audio (sans video) in two conditions. Thus, Study 3 was a 2 × 2 randomized factorial experiment with four conditions: (a) breakup video, (b) wetlands video, (c) breakup audio, and (d) wetlands audio. An additional strength of Study 3 is that reading ability may have affected the results of Study 2; however, this is not possible in Study 3, given that all information was presented via audio (whether alone or accompanied by a "slideshow" video).

Method

Participants

Recruitment procedures were identical to Studies 1 and 2. A total of 547 participants completed Study 3. The sample was predominantly (76%) female, and ages ranged from 18 to 42 (M = 19.85, SD = 1.84). The racial composition of the sample was approximately 83% White, 11% Black, 4% Asian, 3% Hispanic, 2% Middle Eastern, 2% Native American, and 1% Pacific Islander. Fifty-seven percent of the sample indicated that they were currently single; the remaining participants were in a casual (5%) or committed nonmarriage relationship (39%).

Measures

Attachment Orientations. As in Studies 1 and 2, participants' partner-specific attachment anxiety and avoidance were measured using the ECR-RS.

Emotional Stability. Participants' emotional stability was measured using the 12-item subscale from the BFI2 (Soto & John, 2017). Items (e.g., "I see myself as someone who stays optimistic after experiencing a setback") were rated on a scale from *strongly disagree* (1) to *strongly agree* (5) and were averaged to form a composite (α = .89).

Procedure

The procedure was identical to Study 2 with the exception that, instead of reading a text transcript, half of the participants listened to the audio recordings sans video. Thus, there were a total of four conditions in Study 3: participants who (a) saw a video of Victoria describing her breakup, (b) saw a video of Victoria giving a lecture on wetlands, (c) heard the audio from Victoria's breakup video without any sort of video, or (d) heard the audio from the wetlands lecture without any sort of video. For the audio conditions, the screen was simply black for the entirety of the audio.

Results

Descriptive statistics and correlations for all study variables can be found in Table 6. As in Study 2, we first examined a model that compared the *breakup video* condition to each of the three other conditions separately (i.e., not collapsing across breakup/wetland content; see Figure 4). However, as in Study 2, none of the conditions moderated the effects of attachment anxiety on memory relative to the breakup video condition. Thus, as in Study 2, we collapsed across topics (breakup vs. wetlands) to examine the *main effects* of the video versus audio-only manipulation.

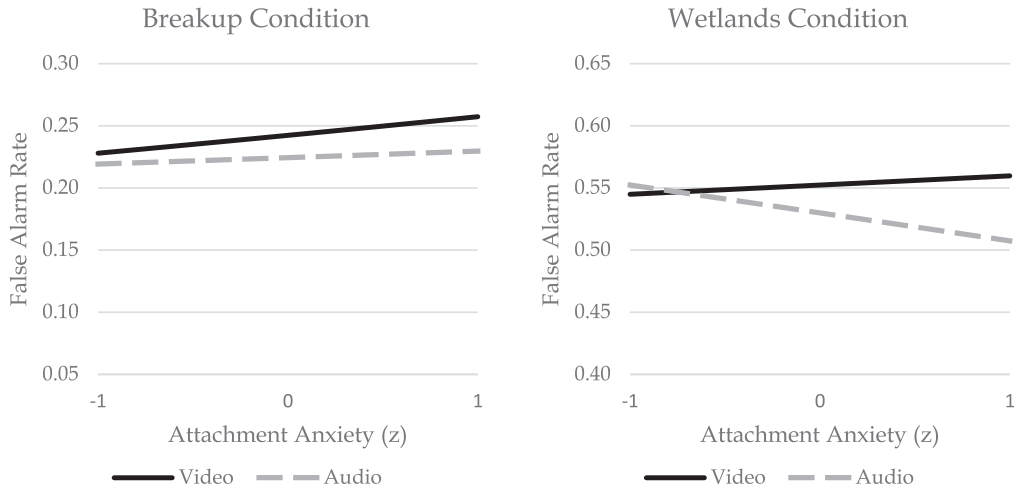
As can be seen in Table 7 and Figure 5, there was a statistically significant three-way interaction ($OR_{\text{Audio} \times \text{True} \times \text{Anxiety}}$ = 1.41, 95% CI [1.28, 1.56]). Decomposing the interaction, in the video conditions, there was a simple interaction between attachment anxiety and item veracity (simple $OR_{\text{True} \times \text{Anxiety}}$ = 0.88, 95% CI [0.82, 0.94]), such that anxiety was related to more numerous false alarms (simple OR_{anxiety} = 1.12, 95% CI [1.04, 1.19]), but it was unrelated to hits (simple OR_{anxiety} = 0.93, 95% CI [0.91, 1.05]). Thus, persons with low attachment anxiety (1 *SD* below the mean) were predicted to endorse 37% of the false items—whereas highly anxious individuals (1 *SD* above the mean) were predicted to have a 42% false alarm rate. In contrast, hit rates were relatively constant—73%—irrespective of individual differences in attachment anxiety. In sum, in the video conditions and consistent with Studies 1 and 2, as compared with their more secure peers, highly anxious individuals experienced more numerous false memories but not more numerous correct, true memories.

Table 6
Study 3 Descriptive Statistics and Correlations

			Correlations				
Variable	*M*	SD	1	2	3	4	5
1. Anxiety	2.51	1.01	—				
2. Avoidance	2.04	0.69	**.46**	—			
3. Stability	3.20	0.71	**−.43**	**−.15**	—		
4. Hit rate	0.72	0.14	.06	.04	−.05	—	
5. False alarm rate	0.39	0.22	.01	.05	.04	**−.31**	—

Note. The 95% confidence intervals for correlations in boldface do not contain zero.

Figure 4
Study 3 Model-Predicted False Alarm Rates as a Function of Attachment Anxiety in Each of the Four Experimental Conditions



In contrast, in the audio conditions, the simple interaction between attachment anxiety and item veracity was in the *opposite* direction, as compared with the video conditions (simple $OR_{\text{True} \times \text{Anxiety}} = 1.24$, 95% CI [1.15, 1.33]). And in fact, directly opposite the video conditions, in the audio conditions, anxiety was *negatively* related to false alarms (simple $OR_{\text{anxiety}} = 0.90$, 95% CI [0.84, 0.97]), and it was *positively* related to hits (simple $OR_{\text{anxiety}} = 1.11$, 95% CI [1.03, 1.20]). In short, high levels of attachment anxiety were associated with universally *better* memory performance in the audio conditions.

Thus, Study 3 collectively conceptually replicates Study 2 and suggests that anxiety predicts more numerous false memories *only for video stimuli* where participants can see another person speaking—and not for text or audio stimuli (and anxious individuals had *better* memory performance for audio stimuli).

Table 7
Study 3 MLLM Examining Main Effects of Audio Versus Video, Collapsing Across Topics

Predictor	*b*	Odds ratio	95% CI LB	95% CI UB
Intercept	−0.42	—	—	—
Item true	**1.43**	**4.16**	3.88	4.46
Anxiety[a]	**0.11**	**1.12**	1.04	1.19
Item True × Anxiety	**−0.13**	**0.88**	0.82	0.94
Audio	−0.08	0.92	0.83	1.01
Audio × Item True	0.07	1.07	0.97	1.19
Audio × Anxiety	**−0.22**	**0.81**	0.73	0.89
Audio × Item True × Anxiety	**0.35**	**1.41**	1.28	1.56

Note. MLLM = multilevel logistic model; CI = confidence interval; LB = lower-bound; UB = upper-bound. 95% CIs for parameters in boldface do not include 1.00.
[a] Because the "item true" variable was dummy coded (0 = false, 1 = true) and the experimental conditions were dummy coded with the breakup/human group as the reference group (audio: 0 = video, 1 = audio), this is the simple effect of anxiety on *false* items in the *video* conditions.

Exploratory Supplemental Analyses

As can be seen in Supplemental Analyses (https://osf.io/3xk4v/) Tables S7–S9, as in Studies 1–2: (a) our pattern of results for attachment anxiety was not affected by statistically controlling for attachment avoidance and emotional stability; (b) the pattern of results for attachment avoidance was similar to that for attachment anxiety—but unlike Studies 1–2, all primary coefficients of interest for avoidance were statistically significant; and (c) emotional stability did not predict true or false memories. Thus, all three studies collectively found that anxiety and avoidance had similar associations with memory ability (cf. Hudson & Fraley, 2018a)—although the associations were only statistically significant for avoidance in one of three studies (and thus should be approached with caution). In contrast, emotional stability did not predict true or false memories in any of our studies.

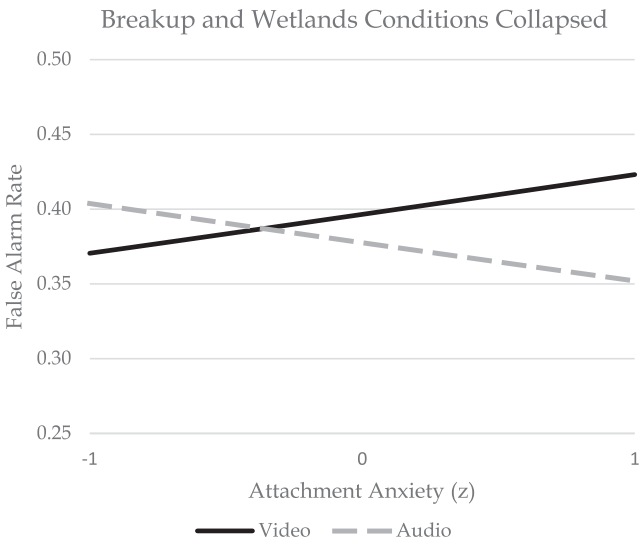
General Discussion

Previous research has found that people's attachment styles predict their propensities to experience *errors of omission* (e.g., forgetting), such that people with high levels of attachment avoidance are less likely to remember relationally relevant memory stimuli (e.g., Edelstein, 2006; Fraley & Brumbaugh, 2007; Mikulincer & Orbach, 1995). In the present studies, we explored whether people's attachment orientations might also predict their susceptibility to *errors of commission* (e.g., false memories). Specifically, we hypothesized that people with high levels of attachment anxiety would be likely to experience more numerous false memories, as compared with their less-anxious peers.

Replicating previous research (Ein-Dor et al., 2011; Hudson & Fraley, 2018a), in all three of our studies, participants with higher levels of attachment anxiety experienced more numerous false memories when watching a video of a woman describing a recent breakup. This is consistent with the idea that people with high levels of attachment anxiety chronically and intensely ruminate about their relationships and interpersonal interactions (Hazan & Shaver, 1987;

Figure 5

Study 3 Model-Predicted False Alarm Rates as a Function of Attachment Anxiety for Video Versus Audio Conditions



Mikulincer & Shaver, 2016)—and these ruminations can filter participants' perceptions of reality as well as become "confused" with actual memories, leading to the production of false memories (Hudson & Fraley, 2018a; Straube, 2012).

Moreover, the present research explored the boundary conditions surrounding this phenomenon. In particular, we found that attachment anxiety predicted false memories for *any* sort of content—relationship or general (e.g., a lecture on wetlands)—but only if participants could visually see the speaker's face. In contrast, anxiety did *not* predict false memories for any sort of content that was presented via text or audio only (with the exception that anxiety was negatively related to false memories for information relayed via audio in one study). These findings are consistent with the idea that attachment is a fundamentally relational phenomenon (Bowlby, 1969; Hazan & Shaver, 1987; Mikulincer & Shaver, 2016). More specifically, individuals high in attachment anxiety tend to be preoccupied with relationships, in addition to hypervigilant in monitoring others' emotions—which can oftentimes lead them to draw incorrect inferences about what other people are thinking or feeling (e.g., Fraley et al., 2006).

Thus, when highly anxious individuals were able to see Victoria's face, they may have drawn incorrect inferences about what she was thinking or feeling about the topics she was discussing (Fraley et al., 2006). Her emotional expressions may have been erroneously encoded alongside their memories for the content of the video, leading to false memories upon recall (Hudson & Fraley, 2018a; Loftus & Palmer, 1974; Loftus & Pickrell, 1995; Straube, 2012). Indeed, prior research shows that attachment anxiety exerts its influence on memory *at the time of encoding*—and not during later memory processes such as maintenance or retrieval (Hudson & Fraley, 2018a). As a nonmutually exclusive possibility, anxious individuals may have been distracted and/or had their attention divided between monitoring Victoria's emotions and paying attention to her words. This divided attention may have led anxious individuals to attend to the most emotionally salient or extreme elements of the video stimuli (e.g., strong vocal inflections and embellishments or particularly emotional facial expressions). Altogether, these attentional differences may have led to less reliable memory traces overall (e.g., Middlebrooks et al., 2017).

Other features may have also contributed to our findings. For example, the emotional salience of the material may have been the strongest in the video conditions and less prominent when reading the content of the video or merely hearing the audio—a possibility we did not test in the current studies. Ultimately, this could be why the video conditions yielded the strongest effects. Differences between modalities observed in our studies might be more directly attributable to the characteristics and settings those modalities provide. Specifically, videos provide visual information about emotional expressions (which anxious individuals hypervigilantly monitor); audio communicates information more directly with some, albeit diminished emotional cues; and text largely only communicates information. Future research should more directly evaluate the impact of modality on anxious individuals' propensity to generate false memories and also more directly test which particular elements of the stimuli used in the current studies facilitate false memory generation.

Nevertheless, our findings collectively point to an important distinction between the cognitive processes whereby attachment anxiety and avoidance bias memory. Namely, many previous studies show that attachment avoidance predicts forgetting relational stimuli, irrespective of the medium via which it is presented (Edelstein, 2006; Edelstein et al., 2005; Fraley & Brumbaugh, 2007; Fraley, Garner, et al., 2000; Fraley & Shaver, 1997). This phenomenon is thought to occur because avoidant individuals find relationship-related themes to be painful, and thus avoid paying attention to, thinking about, or remembering relational stimuli. In contrast, our studies point to a different process for attachment anxiety and how it affects memory. Highly anxious individuals experience false memories for information that is *communicated by a person who can be seen*—irrespective of the exact topic or content of the video. Thus, it seems that, in contrast to avoidance, which affects memory processes via cognitive means, it appears that attachment anxiety may be linked to false memories through *interpersonal and perceptual processes*. In other words, the mere act of interacting with another person and receiving information from them has the potential to produce false memories for highly anxious individuals. These effects might be attributable to anxious individuals' hypervigilance in monitoring other people and their emotional states (Fraley et al., 2006). In contrast, anxious individuals do not appear to generate false memories for information they receive via text or audio—even if that information is deeply relational in nature (such as a breakup story). Indeed, presenting information in a more detached, impersonal way reduced the likelihood of experiencing false memories for highly anxious individuals.

Our findings may have implications for understanding the personality processes that link adult attachment styles to memory processes. Moreover, our findings may also hold practical applications for how people process information more broadly, particularly with how that information is presented. For example, highly anxious students may have trouble correctly remembering information from in-person or video lectures. Such students may benefit from reading the textbook and listening to audio recordings of lectures, in addition to attending in-person classes. Naturally, given that the exact

processes linking anxiety to false memories in the video conditions remain poorly understood (e.g., facial expressions, distraction, emotional salience), future research should continue to investigate the precise mechanisms that link attachment anxiety to false memories.

Attachment Avoidance and Emotional Stability

In a series of exploratory analyses, we examined whether attachment avoidance and emotional stability might also predict false memories. In contrast to previous research, which has found that avoidance is not linked to false memories (Hudson & Fraley, 2018a)—and that it is usually linked to forgetting relational information (e.g., Edelstein, 2006)—our studies found similar patterns of effects for both anxiety and avoidance. That said, in two of our three studies, the effects for avoidance were just outside the threshold for statistical significance. Naturally, given that these findings were not consistently statistically significant, they should be approached with caution. Nevertheless, to the extent that they represent real effects that our studies were underpowered to detect, it may be the case that highly avoidant individuals divert their attention away from relational stimuli, producing fuzzier memory traces (e.g., Edelstein, 2006). To the extent that they later attempt to recall a memory with poor-quality traces, they may confabulate false details upon recall (Brainerd & Reyna, 2002; Straube, 2012).

In contrast, in our studies, emotional stability consistently predicted *neither* true *nor* false memories. This finding reinforces the notion that attachment anxiety is a unique construct above and beyond general anxiety or neuroticism (Bowlby, 1969; Hazan & Shaver, 1987; Mikulincer & Shaver, 2016). Moreover, the fact that neuroticism (i.e., the opposite of emotional stability) did not predict false memories indicates that it is something specifically about *attachment anxiety per se*—fear of rejection, close monitoring of others for signs of responsiveness, intense desires for intimacy—that predicts false memories and not mere negative affectivity in general.

Implications, Strengths, Limitations, and Future Directions

The single biggest implication of our study is that highly anxious individuals tend to experience false memories for information—including general information, such as a lecture on wetlands—that is conveyed by a human speaker that they can see. This has implications for understanding the interpersonal processes that link attachment anxiety to false memories, and may have real-world applications, such as understanding when anxious individuals are most likely to experience false memories (e.g., while watching live news anchors, listening to in-person lectures, video chat). Moreover, our studies employed highly powered experimental designs. Thus, we can be relatively confident that the medium via which information is conveyed (i.e., text, audio, video) causes anxious individuals to experience false memories.

That said, several limitations of our studies are worth considering. For one, we did not explore the mechanisms that cause people to experience false memories when they can see the speaker. This would give deeper insights into exactly what is causing false memories among anxiously attached people and the exact ways false memories manifest. Previous research suggests that highly anxious individuals are hypervigilant in monitoring others' facial expressions (Fraley et al., 2006)—and thus highly anxious individuals may make incorrect inferences about what a speaker is thinking or feeling (which get incorrectly mixed into their memories for the content; Straube, 2012), or they may simply be distracted due to divided attention (leading to less reliable memories; Middlebrooks et al., 2017). Future research should further explore and disentangle these possibilities. For example, future studies could test the extent to which anxious individuals' incorrect inferences (based on facial expressions) get falsely integrated into their memories or the extent to which anxious individuals' attention is divided in the presence of other people. To this end, future research should continue to explore why visual—but not audio—cues seem to elicit false memories for those with high levels of attachment anxiety.

Additionally, our studies relied exclusively upon largely female college samples. Thus, future research should explore whether our findings replicate with more diverse samples—such as older adults, those who are less educated, and individuals from other cultures. Indeed, personality processes often differ across the life span (e.g., Wrzus et al., 2021) or in different cultures (e.g., Schimmack et al., 2002), suggesting that the degree to which attachment anxiety is associated with false memories might be moderated by these—and other factors—too. To this end, research has found systematic differences in how attachment differs across the life span (e.g., Chopik et al., 2013), socioeconomic context and diverse life experiences (Mickelson et al., 1997), and culture (e.g., individualistic and collectivistic cultures may view attachment-related constructs differently; Rothbaum et al., 2000; Schmitt et al., 2004). Thus, future research should examine the extent to which attachment and memory processes function similarly and/or differently across a variety of moderators—including age, socioeconomic status, and culture. In the same vein, future studies might explore whether similar phenomena occur in real-world settings beyond the specific context studied here. For example, it may be the case that highly anxious employees experience false memories for information ascertained during live meetings but might have more reliable memories for information presented via email or audibly.

Another limitation of our studies is that experimental demand or acquiescence may have played some role in our pattern of results. Although (a) our research questions and findings were quite complex and obtuse (e.g., attachment anxiety predicts specifically false memories under only certain experimental conditions and not others), (b) participants were provided with a compelling cover story, and (c) we did not even have strong a priori hypotheses ourselves (so it is unlikely that participants could guess them), it nevertheless remains possible that participants were able to divine our research questions and knowingly endorsed false items in only certain experimental conditions—as a function of their attachment anxiety—in order to acquiesce to perceived experimental demand (see Smeets et al., 2009).

Moving forward, one final implication of our studies regards changes in attachment styles (Fraley, 2007). Namely, most people want to change their attachment anxiety, and interventions may be able to help them do so (Gillath et al., 2008; Hudson et al., 2020; Hudson & Fraley, 2018b). Previous research suggests that changes in attachment styles can lead to improved well-being (Hudson et al., 2016). Some literature also suggests that how relational memories (of relationships, individuals, situations, etc.) are structured or made accessible can have implications for the stability and expression of

attachment styles over time (Fraley, 2007). Thus, the selective memory biases of anxious and avoidant individuals may have implications for understanding the malleability or reification/stability of attachment styles (e.g., do anxious individuals' false memories reinforce their understanding about the world?). However, there is also a possibility that state- or trait-level changes in attachment styles might also affect the experience of false memories (Hudson & Fraley, 2018a). Our study contributes to the possibility that moving toward a more secure attachment style may also have implications for cognitive processes—such as memory. Future studies should explore this possibility.

Conclusion

Previous research has found that highly avoidant individuals frequently fail to remember stimuli that are related to interpersonal topics. The present experiments demonstrate that highly anxious individuals experience more false memories for information that is presented by a speaker that they can see (but not for the content they only read or hear). These studies underscore the importance of attachment styles in predicting a huge gamut of consequential outcomes and augment our knowledge of how attachment styles relate to memory processes. We hope that future research will continue to investigate these topics.

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