

RESEARCH ARTICLE

Anxious attachment as an antecedent of people's aversion towards pattern deviancy

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The authors declare no conflicts of interest.

Ethical Statement

All the presented studies were conducted in accordance with ethical standards and were approved by the ethical review board of a northeastern university in the United States.

Transparency Statement

All data files and data analysis files can be found at https://osf.io/qy6rh/?view_only=8d27f0bdde1743a3a77a26ca62a14cfe

Abstract

Research suggests that people's aversion towards pattern deviancy—distortions of repeated forms or models—contributes to social phenomena, such as prejudice. Yet, the factors motivating pattern deviancy aversion remain unclear. Potentially, anxious attachment, as it entails hypervigilant detection of and reactivity to social inconsistency and unreliability, heightens pattern deviancy aversion. In Studies 1 ($N = 137$) and 2 ($N = 102$), anxious but not avoidant attachment predicted aversion towards broken patterns of geometric shapes. In Studies 3 ($N = 310$) and 4 ($N = 470$), experimentally inducing anxious versus avoidant and secure attachment (Study 3), and versus a neutral prime (Study 4), heightened pattern deviancy aversion. Controlling for participants' aversion towards unbroken patterns, novel objects, and negative stimuli did not change these results. Our findings demonstrate that anxious attachment is one antecedent of pattern deviancy aversion, and suggest that pattern deviancy aversion may underlie links between anxious attachment and certain social phenomena.

Keywords: pattern deviancy aversion, attachment style, anxious attachment, novelty aversion, pattern distortion, social cognition

A large number of psychological phenomena indirectly suggest that people feel negatively about pattern deviancy—the distortion of repeated forms or models. For instance, researchers have noted that people are resistant to change (Jost, 2015), dislike atypical stimuli (see Palmer, Schloss, & Sammartino, 2013), adhere to social norms (Sherif, 1936), are surprisingly conformist (Asch, 1952; Berg & Bass, 1961), prefer familiar stimuli (Zajonc, 1968), and are generally creatures of habit (e.g., James, 1890; Neal, Wood, & Quinn, 2006). Fore-shadowing much of this work, one of the creators of modern psychology, Lewin (1947), noted that cognitive and motivational systems pressure the individual and society towards regularities and consistencies.

People's aversion towards the distortion of patterns is also exemplified by people's prejudice against those who break societal patterns. People's prejudice and discrimination is commonly directed towards those who break societal regularities, ranging from deviancy in terms of group-identity (e.g., minorities in the United States), to character trait deviancy (e.g., social-norm breakers), and to physical deviancy (e.g., the physically handicapped; Goffman, 1963; Gollwitzer, Marshall, Wang, & Bargh, 2017; Gollwitzer & Marshall, 2019). Additionally, individuals at the forefront of new

cultural movements are often, at first, regarded with scorn and derision (e.g., Chesneau, 1874).

Researchers also have argued that people are motivated to see order, patterns, and consistencies in the world (Gilovich, 1991; Shermer, 2008). It is for this reason that people sometimes perceive patterns in meaningless noise, such as perceiving illusory patterns in the stock market (Whitson & Galinsky, 2008). In addition, research by Heintzelman, Trent, and King (2013) found that viewing reliable patterns as opposed to broken patterns (images of trees ordered in accordance with the seasons vs. unordered), and coherent as opposed to incoherent stimuli (sensical vs. nonsensical linguistic triads), induces comparatively higher reports of meaning in life.

The above research supports the possibility that humans hold a rudimentary aversion towards broken patterns. However, because this research is social in nature, it does not provide direct evidence of people's aversion towards broken patterns. For instance, people may adhere to social norms because breaking social norms provokes punishment (Fehr & Fischbacher, 2004), and not because breaking social norms distorts the societal pattern of behavior. Thus, to specifically document people's aversion towards pattern deviancy, one needs to boil such deviancy down to its basic

form. To do so, researchers have assessed people's evaluation of patterns comprised of non-social neutral stimuli that are explicitly distorted in some manner (e.g., a collection of shapes in which one shape is distorted in terms of type, size, or position).

Specifically, Gollwitzer et al. (2017) created such stimuli and documented people's aversion towards pattern deviancy. European American and East Asian adults, as well as children as young as three years old, exhibited an aversion towards non-social broken patterns of geometric shapes (compared to their unbroken counterparts). These findings, and a small collection of other studies that have examined attitudes towards non-social, broken patterns (e.g., geometric shapes, linguistic triads), support the claim that people respond negatively to pattern deviancy (e.g., Heintzelman et al., 2013; Kim & Markus, 1999; Okimoto & Gromet, 2016; Winkielman, Halberstadt, Fazendeiro, & Catty, 2006).

Despite this literature, however, it remains unclear what factors drive and modulate people's aversion towards broken patterns. Whereas ultimate evolutionary reasons, such as upholding social norms and group cohesion (Neuberg, Smith, & Asher, 2000; Schaller, Park, & Faulkner, 2003; Stangor & Crandall, 2000), may contribute to pattern deviancy aversion, here we focus on a more proximate (though still developmentally early-emerging) potential cause. Specifically, we hypothesize that *anxious attachment* qualifies as one factor motivating people's aversion towards pattern deviancy.

Attachment Style

Attachment theory was originally discussed by Bowlby (1973) in terms of the functional tendency of infants to remain close to caregivers and exhibit distress when separated from caregivers. Bowlby conceptualized caregivers as serving the dual purposes of safe havens for their infants in the face of danger, and secure bases when their infants explored the surrounding environment. Later, Ainsworth (1979) discussed three specific styles of attachment (internal working models of relationships; Bowlby, 1973): anxious, avoidant, and secure attachment style.

Anxious attachment, which arises from inconsistent care, involves expecting unreliable relationship partners and anxiously seeking out reliable attachment figures. This contrasts with avoidant attachment. Avoidant attachment, which presumably arises from consistent neglect, involves expecting that partners will not be responsive and distancing oneself from relationships (to avoid expected distress). Finally, secure attachment, which is said to arise from having received consistent care, involves expecting and seeking out reliable relationships when needed and, otherwise, confidently exploring one's environment (e.g., Ainsworth, 1979; Ainsworth, Blehar, Waters, & Wall, 1978; Bowlby, 1973; Hazan & Shaver, 1987).

Individual variations in these three differing attachment styles are assumed to be rooted in early experience and to persist and change in adulthood. That is, attachment styles are also manifested in adults. Adults possess distinct working models of the self and other, and these models guide social cognition, emotion, and behavior in myriad ways (Feeney, 1999; Hazan & Shaver, 1987; Shaver & Hazan, 1993; Mikulincer & Shaver, 2003; Mikulincer & Shaver, 2016).

Researchers examining attachment style in adults tend to conceptualize and assess attachment style in a two-dimensional framework. They posit that people vary both in the degree of their anxious attachment and in the degree of their avoidant attachment (secure attachment is classified as having both low anxious and low avoidant attachment; see Fraley, Waller, & Brennan, 2000).

Finally, researchers have documented that feelings of anxious and of avoidant attachment can be temporarily induced. Recalling a past or current relationship in which one felt or feels anxiously attached, for instance, activates the anxious attachment script, along with its desires of social reliability and worries of social unreliability (Mikulincer & Arad, 1999).

Anxious Attachment as an Antecedent of Pattern Deviancy Aversion

We hypothesize that anxious attachment may activate a domain-general response towards patterns in a person's environment, specifically, in the form of an *aversion* towards broken patterns. In other words, we propose that the fear of social unreliability and inconsistency entailed in anxious attachment (e.g., Bartz & Lydon, 2008) extends to a domain-general aversion towards inconsistencies. In support of this possibility, anxiously attached individuals lack a secure base from which to explore irregularities in their environment (Ainsworth et al., 1978; Bowlby, 1973). And further, some evidence suggests that anxiously attached individuals seek out consistency in their surroundings outside of the social domain. For instance, anxious attachment is related to engaging in compulsive rituals to reduce stress (American Psychiatric Association, 2000; Doron, Sar-El, Mikulincer, & Talmor, 2012).

In addition, shared correlates of anxious attachment and pattern deviancy aversion support our hypothesis. For instance, anxious attachment has been linked to heightened prejudice (e.g., Di Pentima & Toni, 2009; Mikulincer, 1997; Mikulincer & Shaver, 2001), and aversion towards pattern deviancy also relates to prejudice (Gollwitzer et al., 2017). Further, anxious attachment (compared to secure attachment) relates to increased seeking of meaning in life (Bodner, Bergman, & Cohen-Fridel, 2014), and Heintzelman et al. (2013) found participants to report a higher meaning in life after viewing patterned as opposed to random non-social stimuli. Researchers have also found participants from Asian cultures and with Asian

backgrounds to exhibit higher levels of anxious attachment than those from Western cultures (e.g., Wang & Mallinckrodt, 2006; Wei, Russell, Mallinckrodt, & Zakalik, 2004), and members of East Asian cultures exhibit a greater dislike of non-social pattern deviancy than do European Americans (Gollwitzer et al., 2017; Kim & Markus, 1999). Additionally, anxious attachment is associated with neuroticism (Shaver & Brennan, 1992), a construct that is related to pattern deviancy aversion as well (Gollwitzer et al., 2017). Finally, anxious attachment and aversion towards broken patterns both relate to heightened moral concern with regard to harm and purity violations (Gollwitzer, Martel, Bargh, & Chang, 2019; Koleva, Selterman, Iyer, Ditto, & Graham, 2014). Aside from these overlapping relationships, anxiously attached individuals fear inconsistencies and unreliability in the social domain, and these are exactly the qualities that pattern deviancy aversion captures more generally.

Whereas we expected anxious attachment to predict pattern deviancy aversion, we did not expect *avoidant* attachment to predict such aversion. Avoidant individuals have models of other people as unworthy of trust (Mikulincer & Shaver, 2003) and consistently act in accord with this conclusion—they simply avoid intimate social relationships (e.g., Beck & Clark, 2009). Unlike anxious attachment, avoidant attachment is neither associated with seeking reliability and consistency in close relationships, nor with fearing unreliability and inconsistency, and thus should not relate to pattern deviancy aversion.

A general aversion towards novel stimuli could potentially account for an effect of anxious attachment on pattern deviancy aversion. Bowlby (1973) theoretically conceptualized anxious people as averse to novel stimuli, and some researchers have linked anxious attachment to an aversion towards novel, unfamiliar stimuli (Ainsworth et al., 1978; Arend, Gove, & Sroufe, 1979). Importantly, however, novel stimuli do not always break the surrounding consistencies. For instance, when novel stimuli (e.g., exotic fruits) are categorized into their own category (e.g., the category, exotic fruit; Murphy, 2004), rather than compared to previous examples, they should not be evaluated as pattern deviant. To account for novelty aversion, we included a measure of aversion towards novel stimuli that are not necessarily pattern deviant in Studies 1 through 4.

Aside from novelty aversion, we also controlled for participants' aversion towards negative stimuli. We did so to control for the possibility that anxious attachment predicts pattern deviancy aversion simply because anxious attachment induces a general aversion towards negative stimuli (pattern deviant stimuli are generally evaluated negatively; Gollwitzer et al., 2017). Though we are unaware of any research linking anxious attachment to such negativity aversion, we wished to control for this possibility nonetheless. To do so, we included a measure of aversion towards negative but not necessarily pattern

deviant stimuli in Studies 3 and 4 (aversion towards bad weather).

The Current Research

In Studies 1 and 2, we examined whether participants' stable attachment style relates to their pattern deviancy aversion—assessed via aversion towards broken patterns of non-social stimuli (geometric shapes; see Gollwitzer et al., 2017). In these studies, we also controlled for aversion towards novelty in the form of aversion towards exotic fruits (over common fruits). In Study 2, we also assessed participants' socially desirable responding to ensure that social desirability bias does not account for our findings.

In Study 3, we temporarily induced attachment anxiety, avoidance, and security and thereafter assessed participants' pattern deviancy aversion. In this study, we also assessed and controlled for participants' novelty aversion (as in Studies 1 and 2), and their negativity aversion, in the form of aversion towards bad weather (over good weather).

In Study 4, we examined whether temporarily inducing anxious attachment compared to a neutral prime heightens pattern deviancy aversion. Conceptually extending Studies 1 through 3, we assessed pattern deviancy aversion in a non-visual, face-valid manner—aversion towards an explicit description of pattern deviancy (“I feel negative about things that break a pattern, are out of line, and are disordered”). Unlike Study 3, in Study 4, we assessed and controlled for novelty aversion in the form of novel Chinese ideographs and in the form of terms explicitly capturing novelty (e.g., I feel uncomfortable about “new” things). As in Study 3, we also controlled for participants' negativity aversion. Finally, in Study 4, we assessed participants' stable attachment style before the manipulation to examine whether stable attachment style moderates the potential effect of anxious attachment on pattern deviancy aversion.

Study 1

Method

Participants and design. We posit that a relationship between anxious attachment and pattern deviancy aversion should be considered psychologically and ecologically important if this relationship is of moderate or greater size. A power-analysis indicated that we needed approximately 110 participants to have a 90% ($1 - \beta$) likelihood of observing a moderate correlation ($r = .30$) at a .05 alpha level. To account for the potential exclusion of some participants' data (e.g., for failing attention checks), we aimed to recruit 140 participants. The final sample included 143 participants (74 female; age: $M = 34.77$, $SD = 11.97$)

recruited on Mechanical Turk (MTurk). Responses from six participants were excluded for failing the attention check item described in the materials.¹ All the presented studies were conducted in accordance with ethical standards and were approved by the ethical review board of a northeastern university in the United States. None of the reported data has been published elsewhere.

Pattern deviancy aversion. The pattern deviancy aversion measure was an adapted version of the validated pattern deviancy aversion measure introduced by Gollwitzer et al. (2017). The measure included eight images, each depicting a collection of geometric shapes. Four of these eight images depicted “broken” patterns (e.g., perfectly in-line shapes except for one shape which was shifted vertically out of line, a collection of identical shapes except for one different shape). The other four images depicted the identical scenes except that the patterns were unbroken (i.e., “perfect” patterns; see Figure 1 for the images used). Participants’ aversion in response to the images was assessed. Beneath each image there was a prompt that read “The above image makes me...” followed by three questions assessing participants’ discomfort, anxiety, and annoyance in response to the image (“feel uncomfortable”, “feel anxious”, and “feel annoyed”). Likert-scale: 1 = *Not at all agree* to 7 = *Strongly agree*. The images were presented individually and in random order.

This pattern aversion measure, as noted by Gollwitzer et al. (2017), aligns with conceptualizations of pattern-formation (based on repetition or rules) and pattern distortion (repetition or rule violation) in prior research on pattern-recognition (Näätänen, Paavilainen, Titinen, Jiang, & Alho, 1993; Posner, 1973). Further, similar measures depicting broken patterns of geometric shapes have been used by other researchers to assess people’s pattern deviancy aversion (e.g., Kim & Markus, 1999).

Attachment style. Participants’ attachment style was assessed via the Experiences in Close Relationships-Revised Questionnaire (ECR-R; Fraley et al., 2000). This questionnaire captures people’s attachment style in terms of two dimensions: anxious attachment and avoidant attachment (Fraley et al., 2000). Participants who score low on both dimensions are considered securely attached. Assessing individual differences in attachment style in a two-dimensional manner has been argued as being more robust and conceptually appropriate than a categorical manner (Fraley, Hudson, Heffernan, & Segal, 2015; Fraley & Spieker, 2003).

Participants first read the following prompt: “The following statements concern how you feel in emotionally intimate relationships (e.g., close friends, family, romantic partners). We are interested in how you generally experience relationships, not just in what is happening in a current relationship. Respond to each statement to indicate how much you agree or disagree with the statement. Again, the following items refer to close others in general.” Participants then responded to 36 items assessing their adult attachment style (presented in randomized order). These items were adapted from the original ECR-R in that the items referred to close others in general rather than specifically to one’s romantic partner (e.g., anxious attachment, “I’m afraid that I will lose others’ love”; avoidant attachment, “I get uncomfortable when others want to be very close”). Likert-scale: 1 = *Strongly disagree* to 7 = *Strongly agree*.

Novelty aversion. To assess aversion towards novel stimuli we included a measure assessing participants’ desire to try exotic fruits over common fruits. Participants were presented with five images each depicting a different exotic fruit, and five images each depicting a different common fruit. In response to each image, participants were asked: “Regarding each of the following fruits, would you want to try this fruit?” 1 = *I don’t want to try this fruit* to 7 = *I very much want to try this fruit* (see Supporting Information Figures S1 and S2 for all images).²

Attention check item. We indirectly assessed participants’ attention via the following item: “People vary in the amount they pay attention to these kinds of surveys. Some take them seriously and read each question, whereas others go very quickly and barely read the questions at all. If you have read this question carefully, please write the word yes in the blank box below labeled other. There is no need for you to respond to the scale below.” Participants were then presented with a Likert scale (1–7) and a text-box labeled “other”. Data from participants who failed to write “yes” in the text-box were excluded from the analyses.

Procedure. Participants completed the pattern deviancy aversion, attachment style, and novelty aversion measures in randomized order. They then completed the attention check item and demographics.

Results

Anxious attachment. To calculate pattern deviancy aversion, we averaged participants’ three responses to each broken pattern (inter-item reliability within each pattern, $\alpha = .96$), and then averaged

¹Measures that were included in Studies 1 through 3 but are not reported here—because they do not pertain to the specific hypotheses—are discussed in the Supporting Information.

²One may argue that this is an odd way to assess novelty aversion. To combat this concern, the measure was altered to assess discomfort towards exotic over normal fruits in Studies 2 and 3, and further, different measures of novelty aversion were included in Study 4.

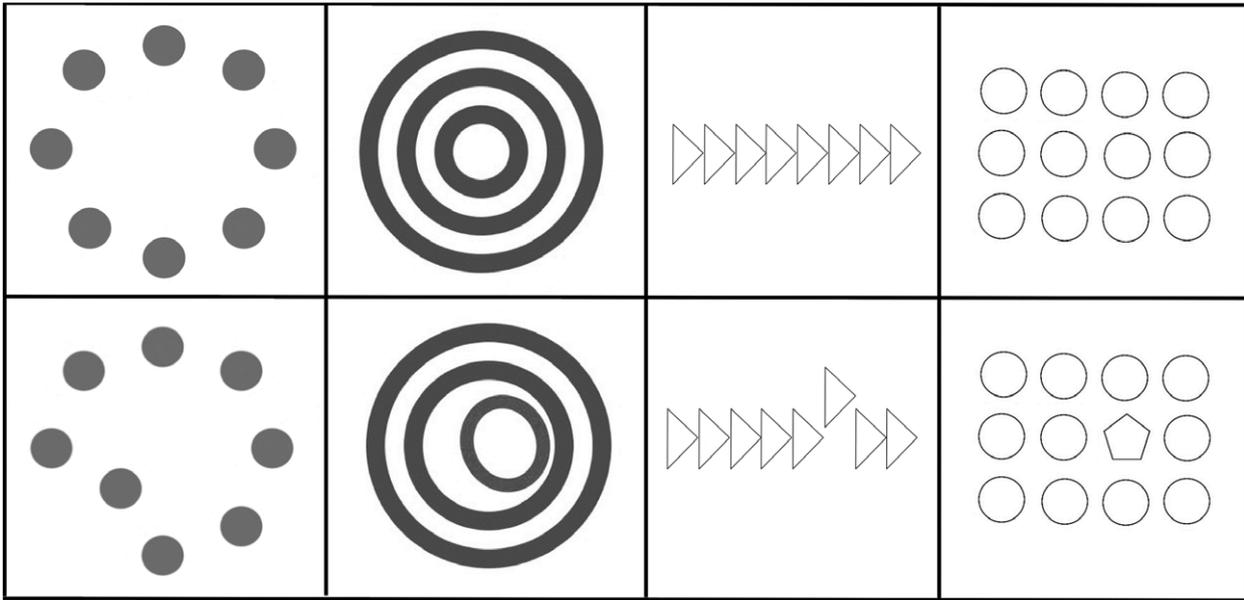


Fig. 1: The broken pattern images used to measure pattern deviancy aversion in Study 1, and their unbroken counterparts. Each image was presented individually

across these scores (Table 1). Supporting our main hypothesis, participants' anxious attachment related positively to their aversion towards broken patterns, $r(135) = .42$, $p < .001$ (Figure 2). This relationship remained when individually controlling for participants' (i) aversion towards the unbroken patterns (inter-item reliability within each pattern; $\alpha = .97$), $r(134) = .35$, $p < .001$, (ii) novelty aversion—calculated by subtracting participants' unwillingness to try common fruits from their unwillingness to try exotic fruits, $r(134) = .42$, $p < .001$, and (iii) avoidant attachment, $r(134) = .38$, $p < .001$. Further, when controlling for these three variables simultaneously, anxious attachment still predicted pattern deviancy aversion, $r(132) = .34$, $p < .001$. For descriptive statistics of the assessed variables see Table 1.

Avoidant attachment. In line with much prior research, anxious and avoidant attachment correlated positively, $r(135) = .36$, $p < .001$. Avoidant attachment related to pattern deviancy aversion, $r(135) = .18$, $p = .031$; however, this relationship was no longer significant when controlling for participants' aversion towards unbroken patterns, $r(134) = .11$, $p = .221$. This small, non-significant correlation disappeared completely when additionally controlling for anxious attachment, $r(133) = -.01$, $p = .889$. A Bayesian analysis we conducted using the JASP software (JASP Team, 2018) suggested that this observed relationship ($r = -.01$) indicates a 10.41 to 1 ratio in favor of the null hypothesis—this was categorized as a strong effect. That is, it is 10.41 times more likely that a null relationship exists between avoidant attachment and pattern deviancy aversion (when controlling for participants' aversion towards unbroken patterns and their anxious attachment) than that a relationship exists. The stretched beta prior width in the analysis

(1) was the default setting in the JASP software. The observed null finding indicates that specifically anxious attachment relates to pattern deviancy aversion.³

Novelty aversion. Surprisingly, anxious attachment did not relate to participants' novelty aversion, $r(135) = .04$, $p = .667$. We also did not observe a relationship between pattern deviancy aversion and novelty aversion, $r(135) = .04$, $p = .657$.

Discussion

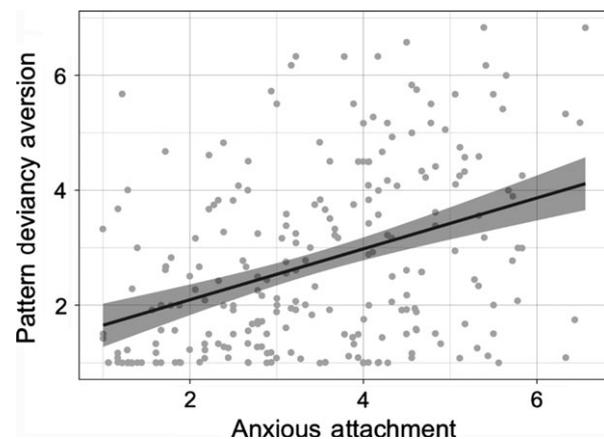
Study 1 established that anxious attachment is positively related to pattern deviancy aversion. The size of the observed relationship, $r = .42$, is striking considering that anxious attachment was measured with items such as "I'm afraid that I will lose others' love" and pattern deviancy aversion was assessed via participants' discomfort towards images depicting broken patterns of simple, non-social geometric shapes. Importantly, this relationship remained when controlling for participants' aversion towards unbroken patterns, novelty aversion, and avoidant attachment. In contrast to anxious attachment, avoidant attachment did not convincingly relate to pattern deviancy aversion—a strong null relationship was observed when controlling for participants' aversion towards unbroken patterns and anxious attachment. These results

³We did not directly calculate whether pattern deviancy aversion relates to secure attachment. The measure used to assess attachment style does not directly quantify secure attachment. Instead, secure attachment is considered to be having both low anxious and low avoidant attachment. An interaction between avoidant and anxious attachment predicting pattern deviancy aversion was *not* observed. This null finding suggests that specifically anxious attachment rather than secure attachment relates to pattern deviancy aversion.

Table 1. Descriptive statistics of studies 1 through 4

	Study 1 (<i>N</i> = 137) <i>M</i> , <i>SD</i>	Study 2 (<i>N</i> = 102) <i>M</i> , <i>SD</i>	Study 3 (<i>N</i> = 310) <i>M</i> , <i>SD</i>	Study 4 (<i>N</i> = 470) <i>M</i> , <i>SD</i>
Stable attachment style				
Anxious	3.42, 1.46, $\alpha = .96$	3.46, 1.26, $\alpha = .94$	–	3.50, 1.32, $\alpha = .95$
Avoidant	3.74, 1.18, $\alpha = .93$	3.94, 1.10, $\alpha = .93$	–	3.96, 1.22, $\alpha = .94$
Pattern deviancy aversion				
Stable or pre-manipulation pattern deviancy aversion				
Geometric shapes: Broken	2.81, 1.67, $\alpha = .93$	2.62, 1.42, $\alpha = .94$	4.15, 1.07, $\alpha = .89^a$	–
Geometric shapes: Unbroken	1.93, 1.10, $\alpha = .84$	1.69, 1.11, $\alpha = .93$	2.70, 0.79, $\alpha = .77^a$	–
Explicit terms	–	–	–	4.51, 1.31 ^b
Post-manipulation pattern deviancy aversion				
Geometric shapes: Broken	–	–	4.27, 1.16, $\alpha = .89^a$	–
Geometric shapes: Unbroken	–	–	2.86, 0.95, $\alpha = .77^a$	–
Explicit terms	–	–	–	4.45, 1.40 ^b
Novelty aversion				
Fruits: Exotic	3.96, 1.78, $\alpha = .90$	2.79, 1.62, $\alpha = .92$	2.15, 0.99, $\alpha = .90$	–
Fruits: Common	2.15, 1.07, $\alpha = .79$	1.83, 1.72, $\alpha = .99$	1.21, 0.53, $\alpha = .89$	–
Fruits: Difference score	1.81, 2.05	0.96, 1.99	0.94, 0.95	–
Chinese ideographs	–	–	–	1.62, 0.87, $\alpha = .97$
Novelty terms	–	–	–	2.60, 1.45, $\alpha = .85$
Negativity aversion				
Weather: Bad weather	–	–	1.79, 0.82, $\alpha = .85$	1.70, 0.78, $\alpha = .85$
Weather: Good weather	–	–	1.32, 0.66, $\alpha = .84$	1.35, 0.70, $\alpha = .85$
Weather: Difference score	–	–	0.47, 0.75	0.35, 0.69

Notes: ^aWhich patterns were presented pre- versus post-manipulation was randomized for each individual participant. Therefore, internal consistency for pre- and post-manipulation cannot be calculated. The internal consistency reported pertains to the measures collapsed across pre- and post-manipulation. ^bSee main text for a discussion of the internal consistency of the pattern deviancy aversion measure in Study 4.

**Fig. 2:** The relationship between anxious attachment and pattern deviancy aversion collapsed across Studies 1 and 2

suggest that specifically anxious attachment relates to people's aversion towards pattern deviancy.

Study 2

One aim of Study 2 was to replicate the findings of Study 1. We had two additional goals. First, given that novelty aversion in Study 1—measured by asking participants if they would like to try exotic fruits—correlated neither with anxious attachment (which fails to align with prior research; e.g., Ainsworth et al., 1978; Arend et al., 1979) nor with pattern deviancy aversion in Study 1, we altered the novelty aversion measure.

We assessed participants' aversion towards (rather than unwillingness to try) exotic fruits over normal fruits. Second, we controlled for the possibility that social desirability bias accounts for the findings of Study 1 (see Nederhof, 1985). Potentially, anxious attachment relates to socially desirable responding, and such desirable responding encourages participants to report an aversion towards broken patterns as such aversion is the “normative” response.

Method

Participants and design. A power-analysis based on the findings of Study 1, $r = .32$,⁴ indicated that we needed to recruit 121 participants to have a 95% power. We aimed to recruit 150 participants to account for participant exclusion. Our final sample consisted of 117 participants (60 female; age: $M = 34.79$, $SD = 10.72$) recruited on MTurk (see footnote for an explanation of the discrepancy in the number of intended vs. collected participants).⁵ Data from

⁴The power analysis of Study 2 was based on a different effect-size ($r = .32$) than the one reported in Study 1 ($r = .34$). This is because we had originally conducted difference score analyses in Study 1—rather than controlling for aversion towards unbroken patterns. As a result, the power-analysis of Study 2 was based on an underestimated effect-size (i.e., Study 2 actually had slightly greater power than reported).

⁵We obtained a lower number of participants than intended due to a software error. Nonetheless, we still had over 90% power to detect the predicted relationship based on the correlation observed in Study 1.

11 participants were excluded because the participants failed the attention check. Data from four additional participants were excluded because participants completed the study more than once (identified via IP address). In such cases, across the reported studies, participants' first responses were retained and their further responses were dropped.⁶

Materials. The materials were as in Study 1, except for the following changes. In an attempt to increase the reliability of the pattern deviancy aversion measure, we added two further images of broken patterns and their unbroken counterparts (four additional images in total). The novelty aversion measure was altered to assess participants discomfort towards exotic fruits (over common fruits): "How uncomfortable do the following fruits make you?" 1 = *Not at all uncomfortable* to 5 = *Extremely uncomfortable*. And finally, we added a validated measure of social desirability—participants' tendency to give socially desirable answers (Haghighat, 2007). Participants responded to four items (e.g., "Do you always practice what you preach to people?"). 1 = *No*, 2 = *Yes*.

Procedure. Participants completed the pattern deviancy aversion, attachment style, novelty aversion, and social desirability measures in randomized order. They then completed the attention check item and demographics.

Results

Anxious attachment. As in Study 1, to calculate pattern deviancy aversion, we averaged participants' three responses to each broken pattern (inter-item reliability within each pattern, $\alpha = .96$), and then averaged across these scores (see Table 1 for descriptives). Replicating Study 1, anxious attachment positively related to pattern deviancy aversion, $r(100) = .34$, $p = .001$ (Figure 2). This relationship remained when individually controlling for participants' (i) aversion towards unbroken patterns (inter-item reliability within each pattern, $\alpha = .99$), $r(99) = .29$, $p = .004$, (ii) novelty aversion, $r(99) = .34$, $p = .001$, (iii) avoidant attachment, $r(99) = .32$, $p = .001$, and (iv) social desirability, $r(99) = .34$, $p = .001$. The relationship also remained when simultaneously controlling for these four variables, $r(96) = .29$, $p = .004$. Finally, arguing against social desirability bias driving this relationship, an interaction between anxious attachment and social desirability predicting pattern deviancy aversion was not observed, $F(1, 97) = 0.07$, $p = .788$.

Avoidant attachment. As in Study 1, anxious and avoidant attachment correlated positively, $r(100) = .27$, $p = .006$. Importantly, further replicating Study 1, avoidant attachment did not relate to pattern deviancy aversion, $r(100) = .13$, $p = .203$. Again, this small non-significant correlation disappeared when controlling for participants' aversion towards unbroken patterns and their anxious attachment, $r(98) = -.03$, $p = .800$. Given this observed correlation was almost identical to the relationship observed in Study 1, the same Bayesian null analysis reported in Study 1 can be applied here.

Novelty aversion. As in Study 1, we did not find a relationship between participants' aversion towards novel stimuli (exotic fruits over common fruits) and their anxious attachment, $r(100) = -.04$, $p = .708$. Also as before, we did not find a relationship between novelty aversion and pattern deviancy aversion, $r(100) = -.02$, $p = .861$. We did, however, observe a relationship between novelty aversion and pattern deviancy aversion when controlling for participants' aversion towards unbroken patterns, $r(99) = .21$, $p = .031$.

Discussion

Study 2 replicated the results of Study 1. Anxious attachment related positively to pattern deviancy aversion. Further, as in Study 1, avoidant attachment was not associated with pattern deviancy aversion. And again, the relationship between anxious attachment and pattern deviancy aversion remained when controlling for participants' aversion towards unbroken patterns, avoidant attachment, and novelty aversion. Study 2 extended Study 1 by revising the novelty aversion measure; the novelty aversion measure in Study 2 assessed discomfort towards (rather than an unwillingness to try) exotic fruit over common fruits. Despite this change, participants' novelty aversion still did not relate to their anxious attachment. However, a small positive correlation between novelty aversion and pattern deviancy aversion was observed (albeit, only when controlling for participants' aversion towards unbroken patterns). This relationship very tentatively supports our claim that, though conceptually overlapping, a difference exists between people's aversion towards novel, unfamiliar stimuli and their aversion towards pattern deviancy—the violation of repeated forms and models.

Study 2 also extended the findings of Study 1 by assessing participants' social desirability. Decreasing the possibility that the observed findings occurred due to socially desirable responding, participants' social desirability did not play a role in the link between anxious attachment and pattern deviancy aversion. Overall, the results of Study 2 further support the conclusion that anxious attachment relates to an aversion towards pattern deviancy.

⁶If participants' responded multiple times and their responses overlapped in terms of time started and time stopped, all their responses were dropped.

Study 3

In Study 3, we examined whether experimentally priming anxious attachment causally heightens pattern deviancy aversion. Specifically, we investigated whether temporarily inducing anxious attachment, relative to avoidant and secure attachment, heightens people's aversion towards pattern deviancy. To account for potential third variables, we assessed participants' novelty aversion (as in Study 2) and their negativity aversion—their aversion towards negative but non-deviant stimuli (scenes of bad weather)—after the manipulation.

Method

Participants and design. A power-analysis indicated that we needed to recruit approximately 270 participants to have a 95% ($1 - \beta$) likelihood of observing a moderate effect ($f = .25$) at a .05 alpha level. We chose a moderate effect size because the correlations between pattern deviancy aversion and anxious attachment style in Studies 1 and 2 were of a moderate-to-large size. We examined the data after approximately half the data points had been collected (approximately 50 participants per condition).⁷ At this point, pattern deviancy aversion did not differ significantly between conditions ($p = .128$); however, the results were in the predicted direction. Given these non-significant results, we continued with data collection. Because we examined our data before completing data collection, we adjusted the p -value threshold when examining the effect of attachment condition on pattern deviancy aversion in the final sample, as recommended by Lakens (2014); adjusted threshold: $p = .025$).

We aimed to collect data from 330 participants based on the 270 participants recommended by the conducted power-analysis to account for participant exclusion. In total, we recruited 333 participants (180 female; age: $M = 34.89$, $SD = 11.35$) on MTurk.⁸ Eighteen participants were excluded for failing one of the attention check items (described in the materials). An additional two responses were excluded because participants completed the survey more than once. Data from three more participants were excluded from the analysis because the difference between their aversion towards broken patterns (over unbroken patterns) pre-manipulation to post-manipulation qualified as extreme (extreme outliers: $1.5 \times$ Inter-quartile-range). The design of the study was a mixed-model design

with attachment style manipulation as a three-level between-subjects variable (anxious, avoidant, secure) and pattern deviancy aversion as a within-subjects variable (pre- vs. post-manipulation pattern deviancy aversion). Novelty and negativity aversion served as control variables.

Attachment style induction. A number of studies have demonstrated that attachment styles can be temporarily induced (e.g., Beck & Clark, 2009; Mikulincer & Arad, 1999; Mikulincer & Shaver, 2001). Recalling a past or current relationship in which one felt or feels anxiously attached, for instance, activates the anxious attachment script, along with its desires of social reliability and worries of social unreliability (Mikulincer & Arad, 1999).

In our study, we used an attachment style manipulation validated by Beck and Clark (2009). Participants were randomly assigned to the anxious, avoidant, or secure attachment conditions. Participants in the anxious attachment condition read and responded to the following prompt: "Please think of a person who is reluctant to get as close to you as you would like. Describe a time in which you worried that this person did not care about you or want to spend time with you. In the text box below describe this time in detail (30 words or more). Really try to vividly think about this time and how you worried that this person did not care about you or want to spend time with you."

Participants in the avoidant attachment condition read and responded to the following prompt: "Please think of a person you are uncomfortable being close to. Describe a time in which you did not trust him or her, and did not allow yourself to depend on him or her. In the text box below describe this time in detail (30 words or more). Really try to vividly think about this time and how you did not trust this person and did not allow yourself to depend on him or her."

Participants in secure attachment condition read and responded to the following prompt: "Please think of a person you are comfortable being close to. Describe a time in which you felt comfortable depending on him or her, and/or having him or her depend on you. In the text box below describe this time in detail (30 words or more). Really try to vividly think about this time and how you felt comfortable depending on him or her, and/or having him or her depend on you."

Pattern deviancy aversion. The pattern deviancy aversion measure was an expanded version of the measure used in Studies 1 and 2. The measure assessed pattern deviancy aversion both pre-manipulation and post-manipulation. To do so, two new pairs of pattern images were added to the measure of Study 2 (see Supporting Information Figures S3 for all images). For each participant, the total eight pairs of unbroken and broken images were presented randomly with four random pairs (i.e., four broken patterns and their four unbroken counterparts) presented prior to the manipulation, and the four remaining

⁷We did so in order to have the possibility of saving resources.

⁸Some participants in the avoidant condition were run at a later date than those in the secure and anxious attachment conditions. This was due to experimenter error. However, given that the design of Study 3 was a within-subjects design (pattern deviancy aversion was measured pre- and post-manipulation) any potential variables related to running these participants at a later date should not have impacted the results.

pairs presented after the manipulation. Within each of these four pairs the images were presented individually and in random order.

We also altered the prompt participants read under each image. First, to keep the attachment style prime salient, we added the following text below the post-manipulation pattern images: "As you answer the following questions, please keep thinking about (*participant's response to the attachment manipulation was inserted here*)". Second, given the experimental nature of Study 3 we altered the items to assess "state" pattern deviancy aversion; the following phrase was added before each prompt "At the moment". Thus, the prompts read: "At the moment: The above image makes me..." Third, we altered one of the items assessing participants' aversion in response to each of the pattern images. The anxious item—"The above image makes me ... feel anxious" included in Studies 1 and 2 was altered in that the word "anxious" was replaced with the word "calm". We included this reverse-coded item in order to reduce potential participant response bias (e.g., yea- or nay-saying), and because the term "anxious" potentially triggers associations with anxious attachment.

Novelty aversion. Participants' novelty aversion was assessed as in Study 2, except that the prompts were altered to tap into participants "state" judgments: "At the moment, how uncomfortable do the following fruits make you?" To echo the pattern deviancy measure, participants were also reminded of their response to the attachment style prompt before responding to the fruit images.

Negativity aversion. To assess participants' aversion towards negative but not deviant stimuli we included a measure of participants' aversion towards bad weather over good weather (bad weather, though negative, is not particularly pattern deviant). Participants were presented with five images of bad weather and five images of good weather and asked to report their current discomfort in response to each of these scenes "At the moment, how uncomfortable do the following scenes make you?" 1 = *Not at all uncomfortable* to 5 = *Extremely uncomfortable* (see Supporting Information Figures S4 and S5 for all images). Again, participants were reminded of their response to the attachment style prompt before responding to the images.

Attachment style. Participants' state attachment style served as the manipulation check. As in Studies 1 and 2, attachment style was assessed via the ECR-R. To assess attachment style in a state manner, we added "At the moment" before each of the items. Participants also first read the following prompt: "Please respond to the following questions regarding how you feel right now, in this moment, or currently." Participants again were presented with their response to the attachment style induction before completing the questionnaire.

Attention check items. The study included two attention checks. The first was the attention check from Studies 1 and 2. The second asked participants to select the content of the manipulation prompt that they had read: "In the prompt in which you were asked to think of another person and write about a situation earlier in this survey, what was the topic of the prompt?" Participants selected one of the three following answers: 1 = *Think of a person you are uncomfortable being close to*, 2 = *Think of a person who is reluctant to get as close to you as you would like*, 3 = *Think of a person you are comfortable being close to*. Only participants who responded according to their condition were included in the analysis.

Procedure. Participants first completed the pre-manipulation pattern deviancy aversion measure. After completing the manipulation—the attachment style prime—participants completed the post-manipulation pattern deviancy aversion measure. Thereafter, they completed the novelty aversion and negativity aversion measures (in randomized order). They then completed the attachment style measure (the manipulation check). Finally, participants completed the attention check items and demographics.

Results

The attachment style manipulation successfully altered temporary attachment style (see Table 2).⁹ Participants induced to feel anxiously attached exhibited higher state anxious attachment compared to participants induced to feel securely attached, $t(205) = 3.84$, $p < .001$, 95% CI [0.37, 1.14], $d = 0.54$, and compared to participants induced to feel avoidantly attached, $t(203) = 2.01$, $p = .045$, 95% CI [0.01, 0.79], $d = 0.28$ (see Table 1 for descriptives depending on condition). Participants induced with avoidant attachment exhibited marginally higher anxious attachment than participants induced with secure attachment, $t(204) = 1.81$, $p = .071$, 95% CI [-0.03, 0.75], $d = 0.25$. This latter result aligns with anxious and avoidant attachment overlapping positively.

To examine the effect of attachment induction on pattern deviancy aversion, we conducted a repeated-measures GLM with Time (pre- vs. post-manipulation) and Pattern Type (broken vs. unbroken patterns) as within-participants variables. Attachment Style (anxious, avoidant, secure) functioned as a between-participants variable. Participants' aversion towards pattern deviancy functioned as the dependent variable. A three-way interaction between Time, Pattern Type, and Attachment Style was observed, $F(2, 307) = 4.93$, $p = .008$, $\eta^2 = .031$. This interaction-term passed the p -value threshold identified as appropriate given that

⁹One participant did not complete the attachment style manipulation check measure and was thus not included in this specific analysis.

Table 2. Effects of the attachment style manipulation on anxious attachment, novelty aversion, and negativity aversion in Study 3

	Anxious attachment	Avoidant attachment	Secure attachment	Significance test
	<i>n</i> = 104	<i>n</i> = 102	<i>n</i> = 104	
	<i>M</i> , <i>SD</i>	<i>M</i> , <i>SD</i>	<i>M</i> , <i>SD</i>	
Manipulation check				
Anxious attachment style	3.63, 1.52	3.24, 1.38	2.88, 1.34	$F(2, 306) = 7.38, p = .001, \eta^2 = .046$
Control variables				
Novelty aversion	2.25, 1.09	2.14, 0.89	2.04, 0.96	$F(2, 306) = 1.07, p = .344, \eta^2 = .007$
Negativity aversion	1.92, 0.92	1.86, 0.80	1.60, 0.69	$F(2, 306) = 4.80, p = .009, \eta^2 = .030$

Note: See in-text results section for the effects of the manipulation on pattern deviancy aversion.

we conducted a sequential analysis (i.e., examined our data before completing data collection; Lakens, 2014; $p = .025$). Pairwise comparisons revealed that participants in the anxious attachment condition responded differently depending on Time (pre- vs. post-manipulation) and Pattern Type (broken vs. unbroken patterns) than those in the avoidant, $F(1, 307) = 7.86, p = .005, \eta^2 = .025$, and secure attachment conditions, $F(1, 307) = 6.85, p = .009, \eta^2 = .022$. This interaction was not observed when comparing the avoidant and secure attachment conditions, $F(1, 307) = 0.04, p = .842, \eta^2 < .001$.

To further unpack the observed interactions, we examined participants' aversion pre- versus post-manipulation (Time) towards the broken versus unbroken patterns (Pattern Type) within each of the conditions. Within the anxious attachment condition, an interaction between Time and Pattern Type was observed, $F(1, 307) = 4.80, p = .029, \eta^2 = .015$. Participants' aversion towards specifically the broken patterns (inter-item reliability within each pattern, $\alpha = .60$) increased from pre- to post-manipulation, $F(1, 307) = 15.65, p < .001, \eta^2 = .049$, while their aversion towards the unbroken patterns (inter-item reliability within each pattern, $\alpha = .27$)¹⁰ did not change, $F(1, 307) = 1.38, p = .241, \eta^2 = .004$ (see Figure 3). In the avoidant condition, a marginal interaction between Time and Pattern Type was observed, $F(1, 307) = 3.00, p = .084, \eta^2 = .010$. Compared to participants' aversion towards broken patterns, which increased, $F(1, 307) = 8.29, p = .004, \eta^2 = .026$, participants' aversion towards unbroken patterns increased to a marginally greater extent from pre- to post-manipulation, $F(1, 307) = 21.82, p < .001, \eta^2 = .066$ (Figure 3). Finally, in the secure attachment condition, Time and Pattern Type did not interact, $F(1, 307) = 2.15, p = .144, \eta^2 = .007$. Participants' aversion towards broken and unbroken patterns largely stayed the same from pre- to post-

manipulation: Their aversion towards broken patterns decreased, $F(1, 307) = 4.92, p = .027, \eta^2 = .016$, and their aversion towards unbroken patterns did not change $F(1, 307) = 0.15, p = .702, \eta^2 < .001$ (Figure 3). All these results remained when controlling for participants' novelty and negativity aversion (see Supporting Information for analyses). See Table 3 for descriptive statistics. See Figure 3 for an illustration of these findings.

The attachment style manipulation did not affect novelty aversion, $p = .344$. However, an effect of attachment style induction on negativity aversion was observed, $p = .009$ (Table 2). Anxious attachment heightened negativity aversion compared to secure attachment, $t(206) = 2.98, p = .003, 95\% \text{ CI } [0.10, 0.48], d = 0.42$, and avoidant attachment heightened negativity aversion compared to secure attachment, $t(204) = 2.23, p = .026, 95\% \text{ CI } [0.03, 0.41], d = 0.31$. Anxious attachment and avoidant attachment did not differ in terms of negativity aversion, $t(204) = 0.71, p = .472, 95\% \text{ CI } [-0.12, 0.26], d = 0.10$. Finally, participants' aversion towards broken patterns (collapsed across conditions and pre- and post-manipulation) related to their novelty aversion, $r(307) = .29, p < .001$.

Discussion

The results of Study 3 suggest that anxious attachment—as compared to avoidant and secure attachment—causally heightens pattern deviancy aversion. Priming

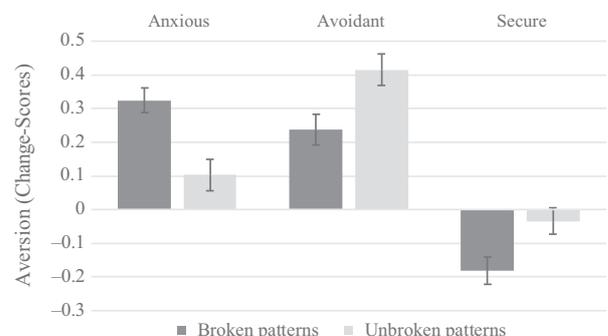


Fig. 3: The effect of attachment style prime on participants' aversion towards broken and unbroken patterns in Study 3. *y*-Axis represents aversion change scores from pre- to post-manipulation (scores above 0 indicate an increase in aversion from pre- to post-manipulation). Error bars: $\pm 1 \text{ SE}$

¹⁰The low inter-item reliabilities of the three items within each pattern for the broken and unbroken patterns was driven by the "calm" item we added in Study 3. When removing the calm item, the inter-item reliabilities were high, $\alpha = .90$ for the broken patterns, and $\alpha = .90$ for the unbroken patterns. We re-conducted the reported analyses separately when only including the negative items ("annoyed", "uncomfortable") and only including the positive item ("calm") and found largely consistent results (see Supporting Information).

Table 3. Means and SDs of participants' aversion towards broken and unbroken patterns depending on time (pre- vs. post-manipulation) and condition

	Pre-manipulation: Aversion towards broken patterns	Pre-manipulation: Aversion towards unbroken patterns	Post-manipulation: Aversion towards broken patterns	Post-manipulation: Aversion towards unbroken patterns
Condition				
Anxious attachment	$M = 4.15, SD = 1.10$	$M = 2.77, SD = 0.76$	$M = 4.48, SD = 1.21$	$M = 2.87, SD = 0.99$
Avoidant attachment	$M = 4.27, SD = 1.10$	$M = 2.57, SD = 0.80$	$M = 4.51, SD = 1.11$	$M = 2.99, SD = 0.93$
Secure attachment	$M = 4.03, SD = 1.03$	$M = 2.76, SD = 0.79$	$M = 3.85, SD = 1.06$	$M = 2.73, SD = 0.91$

anxious attachment heightened participants' aversion towards broken patterns but not unbroken patterns of geometric shapes. Priming avoidant attachment also heightened participants' aversion towards broken patterns, however, this dislike was accompanied by a contradictory, even greater increase in dislike of "perfect", unbroken patterns. That is, though inducing avoidant attachment influences people's pattern evaluation systems generally, it does not seem to heighten specifically aversion towards broken patterns.¹¹ Regarding secure attachment, priming secure attachment *reduced* participants' aversion towards broken patterns and did not alter their aversion towards unbroken patterns. Importantly, all these results remained when controlling for participants' negativity aversion and novelty aversion. Finally, in line with Studies 1 through 3, though novelty aversion and pattern deviancy aversion correlated positively, attachment style did not impact participants' novelty aversion.

Study 4

To conceptually replicate the results of Study 3, in Study 4 we examined whether priming anxious attachment (compared to a neutral control prime) causally heightens pattern deviancy aversion when assessing such aversion in an alternate manner. Specifically, unlike Studies 1 through 3, in Study 4, we assessed participants' pattern deviancy aversion via an explicit, verbal, face-valid measure of pattern deviancy—participants reported how negatively pattern deviancy aversion makes them feel: "I feel negatively about things that break a pattern, are out of line, and are disordered". Additionally, we examined whether the unexpected null findings of Studies 1 through 3—that attachment style does not induce novelty aversion—is limited to the specific way we measured novelty aversion in those studies (aversion towards exotic over common fruits). That is, in Study 4, we measured

novelty aversion via participants' discomfort towards Chinese ideographs (Chinese characters) as well as their explicit aversion towards the terms: "new things", "novel things", and "original things". We chose these measurements of novelty aversion because (i) ideographs have been used as novel stimuli in past research (i.e., mere exposure; Zajonc, 1968), and (ii) assessing participants' aversion towards explicit terms capturing novelty provides a highly face-valid measurement of novelty aversion. We also assessed participants' stable attachment style before the manipulation to exploratorily examine whether stable attachment style moderates the experimental effect of anxious attachment on pattern deviancy aversion.

Method

Participants and design. Study 4 was pre-registered: <https://aspredicted.org/5fv6a.pdf>. A power-analysis indicated that we needed to recruit 420 participants to have 85% power (based on the increase of pattern deviancy aversion pre- to post-manipulation within the anxious attachment condition in Study 3; $d = .21$).¹² We aimed to recruit 500 participants to account for participant exclusion. The final number of participants recruited was 501 (305 female; age: $M = 35.43, SD = 10.42$; MTurk). The data of 28 participants were excluded because these participants failed one of the attention check items. Three further responses were excluded because participants completed the survey more than once (identified via IP address). The design of the study was as in Study 3, except the manipulation involved a two-level between-participants factor (anxious attachment prime, neutral prime), and participants' stable attachment style was assessed prior to the manipulation.

Pre-manipulation stable attachment style. Participants' pre-manipulation stable attachment style was assessed as in Studies 1 and 2.

¹¹Notably, these findings may align with theorizing regarding avoidant attachment style. Avoidant attachment involves expecting and disliking social unreliability, and in turn avoiding social relationships. This avoidance of social relationships—and the consistencies these relationships can offer—may extend to casting away consistencies and regularities more generally, that is, consistencies in terms of non-social stimuli (i.e., patterned geometric shapes).

¹²The power analysis of Study 4 was based on a different effect-size ($d = .21$) than the one reported in Study 3 ($d = .43$). This is because we had originally conducted difference score analyses in Study 3—rather than repeated-measures analyses. As a result, the power-analysis of Study 4 was based on an underestimated effect-size (i.e., Study 4 actually had greater power than reported).

Attachment style induction. The anxious attachment induction was as in Study 3. The neutral control prime involved imagining a pencil and reporting on how this pencil looks and feels (see Supporting Information).

Pattern deviancy aversion.

Pre-manipulation pattern deviancy aversion. Two items assessed participants' pre-manipulation pattern deviancy aversion. Participants read "People feel differently about things that break a pattern, are out of line, and are disordered. How strongly do you agree with the following statements? I generally feel..." They then responded to two items: "negatively about things that break a pattern, are out of line, and are disordered" and "positively about things that break a pattern, are out of line, and are disordered" (reverse-coded). 1 = *Not at all agree* to 7 = *Strongly agree*. We decided not to assess participants' aversion towards unbroken patterns because anxious attachment did not heighten such aversion in Study 3.

Post-manipulation pattern deviancy aversion. The two-item pattern deviancy aversion measure was presented again except that we altered the prompt. Depending on condition, participants read: "How does thinking about... the person who is reluctant to get close to you and how you worried that this person does not care about you or want to spend time with you (anxious attachment condition) *the pencil that you imagined, and what this pencil looks like and feels like (neutral control condition)*... make you feel about things that break a pattern, are out of line, and are disordered? It makes me feel..." Participants then responded to the same two items that they responded to pre-manipulation (e.g., "...negatively [positively] about things that break a pattern...").

Novelty aversion. Novelty aversion was assessed in two ways. First, we assessed participants' discomfort towards novel Chinese ideographs. Such ideographs have been used in previous studies to measure people's evaluation of novel stimuli (e.g., Zajonc, 1968). The specific ideographs used were validated as neutral in valence by Weinreich and Gollwitzer (2016). The prompt and response-scale were identical to the novelty aversion measure in Study 3.

Second, we assessed participants' discomfort towards explicit terms capturing novelty. Participants read the following prompt: "People feel differently about things that are new, novel, and original. At the moment, how uncomfortable do the following things make you feel?" "New Things", "Novel Things", "Original Things", 1 = *Not at all uncomfortable* to 7 = *Extremely uncomfortable*. As was the case for the other dependent variable measures, participants were reminded of the attachment style or neutral prime prompt (depending on condition) before responding to these items.

Negativity aversion. The negativity aversion measure was as in Study 3.

Post-manipulation attachment style. The manipulation check was as in Study 3, except that we shortened the measure (six anxious attachment items; see Supporting Information).

Attention check items. The attention checks were as in Study 3. The attention check regarding the content of the manipulation prompt was altered appropriately.

Procedure. The procedure was as in Study 3, except that participants' pre-manipulation stable attachment style was assessed at the start of the study.

Results

The manipulation successfully altered participants' temporary post-manipulation anxious attachment ($\omega = .98$); participants in the anxious attachment condition exhibited higher anxious attachment compared to those in the neutral prime condition, $p < .001$ (Table 4).

Conceptually replicating Study 3, a univariate GLM revealed that participants induced with anxious attachment exhibited greater pattern deviancy aversion than those induced with a neutral prime, $p < .001$ (Figure 4). These results remained when controlling for participants' pre-manipulation pattern deviancy aversion, $p < .001$, as well as when additionally controlling for participants' novelty and negativity aversion, $p < .001$ (Table 4).¹³ Finally, replicating Study 3, participants' pattern deviancy aversion in the anxious attachment condition significantly increased from pre- to post-manipulation, $p = .001$ (Table 5).

We re-conducted each of the above analyses separately for the negative item and positive item of the pattern deviancy aversion measure. We did so because the two items only correlated moderately (after reverse-coding the positive item: pre-manipulation, $r[468] = .59$, $p < .001$, and post-manipulation, $r[468] = .37$, $p < .001$). All the results remained consistent.

Despite changing the novelty aversion measure from Study 3 to Study 4, as in Study 3, no effect of condition on novelty aversion was observed, Chinese characters, $p = .967$, and novelty terms, $p = .176$. Further, conceptually replicating Study 3, participants in the anxious attachment condition exhibited greater negativity aversion—discomfort towards bad over good weather—than those in the neutral prime condition, $p = .001$ (see Table 4).

¹³We controlled for participants' pre-manipulation pattern deviancy aversion rather than conducting a repeated measures analysis (as in Study 3) because in Study 4 pre-manipulation pattern deviancy aversion was assessed in terms of stable pattern deviancy aversion (e.g., "I generally feel...negatively about things that break a pattern..."). This analysis choice did not change the results.

Table 4. Effects of attachment style in Study 4

	Anxious attachment	Neutral prime	Significance test
	<i>n</i> = 224 <i>M</i> , <i>SD</i>	<i>n</i> = 246 <i>M</i> , <i>SD</i>	
Manipulation check			
Anxious attachment style	3.75, 1.75	2.87, 1.84	$F(1, 468) = 27.45, p < .001, \eta^2 = .055$
Control variables			
Novelty aversion: Ideographs	1.62, 0.88	1.62, 0.86	$F(1, 468) < 0.01, p = .967, \eta^2 < .001$
Novelty aversion: Explicit terms	2.70, 1.43	2.52, 1.47	$F(1, 468) = 1.84, p = .176, \eta^2 = .004$
Negativity aversion	1.81, 0.63	1.61, 0.63	$F(1, 467) = 11.20, p = .001, \eta^2 = .023$
Dependent variable			
Post-manipulation pattern deviancy aversion	4.86, 1.34	4.08, 1.36	$F(1, 468) = 39.46, p < .001, \eta^2 = .078$
Post-manipulation pattern deviancy aversion ^a	4.83, 1.14	4.11, 1.14	$F(1, 467) = 46.99, p < .001, \eta^2 = .091$
Post-manipulation pattern deviancy aversion ^b	4.81, 1.15	4.13, 1.14	$F(1, 464) = 40.97, p < .001, \eta^2 = .081$

Notes: ^aControlling for pre-manipulation pattern deviancy aversion. ^bControlling for pre-manipulation pattern deviancy aversion, novelty aversion, and negativity aversion.

We next explored whether participants' pre-manipulation stable attachment style moderates the effect of anxious attachment on pattern deviancy aversion. Participants' stable anxious attachment but not avoidant attachment moderated the effect of condition on pattern deviancy aversion, $p = .014$, and $p = .119$, respectively.¹⁴ Participants low (vs. high) in anxious attached exhibited a stronger effect of condition on pattern deviancy aversion (Table 6). This moderation remained when controlling for participants' pre-manipulation pattern deviancy aversion, negativity aversion, novelty aversion, and stable avoidant attachment, $p = .033$.

Discussion

In Study 4, priming anxious attachment versus a neutral prime heightened people's explicit aversion towards pattern deviancy (e.g., "I feel negatively about things that break a pattern"). These results conceptually replicate the findings of Study 3, in which anxious attachment heightened participants' aversion towards broken patterns of geometric shapes. Further, anxious attachment still did not heighten novelty aversion in Study 4, despite the fact that we assessed novelty aversion via two new, and arguably more valid, measures than in the previous studies. These results suggest that whereas anxious attachment heightens people's dislike of broken patterns, it does not heighten a dislike of novel stimuli *per se*. Finally, participants low (vs. high) in stable attachment anxiety exhibited a stronger effect of anxious attachment prime on pattern deviancy aversion. These findings may have arisen because people high in stable anxious attachment already have high levels of pattern deviancy aversion (as shown in

¹⁴A three-way interaction between stable anxious attachment, stable avoidant attachment, and condition on pattern deviancy aversion was not observed, $p = .844$ —stable secure attachment does not seem to moderate the effect of condition on pattern deviancy aversion.

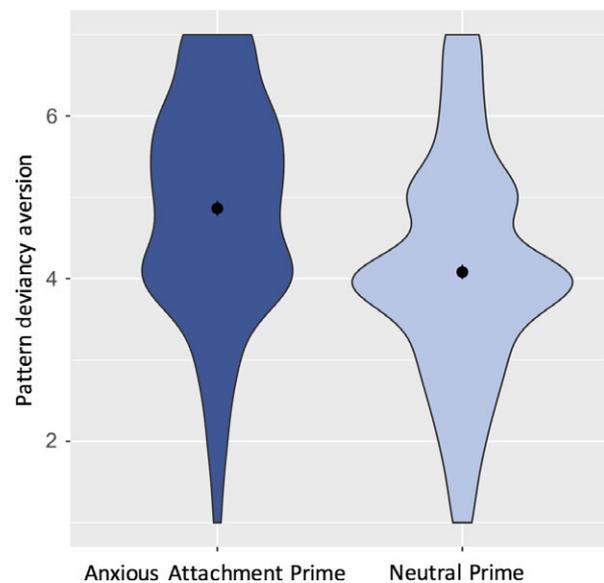


Fig. 4: The effect of the anxious attachment versus neutral prime condition on pattern deviancy aversion in Study 4. Error bars: $\pm 1 SE$

Studies 1 and 2). That is, it is more difficult to heighten pattern deviancy aversion in individuals whose pattern deviancy aversion is already at a high level.

General Discussion

In four studies, we found anxious attachment to relate and lead to an aversion towards pattern deviancy—the distortion of repeated forms or models. In Studies 1 and 2, participants' degree of anxious attachment but not avoidant attachment predicted their dislike of broken non-social patterns (e.g., distorted patterns of geometric shapes). Moreover, these results remained when controlling for participants' aversion towards novel stimuli and socially desirable responding. In Study 3, priming anxious attachment—as compared to avoidant and secure attachment—heightened participants' aversion towards broken patterns of

Table 5. Means and SDs of pre- and post-manipulation pattern deviancy aversion depending on condition in Study 4

	Pre-manipulation aversion towards broken patterns	Post-manipulation aversion towards broken patterns	Significance test
Condition			
Anxious attachment	$M = 4.56, SD = 1.30$	$M = 4.86, SD = 1.34$	$t(223) = 3.38, p = .001, d = 0.23$
Neutral prime	$M = 4.46, SD = 1.31$	$M = 4.08, SD = 1.36$	$t(245) = -4.74, p < .001, d = 0.30$

Table 6. The effect of condition on pattern deviancy aversion was moderated by stable anxious attachment (Study 4)

Stable anxious attachment	Anxious attachment condition M, SD	Neutral prime condition M, SD	Effect of condition on increasing pattern deviancy aversion (0 = Anxious attachment, 1 = Neutral prime)	Interaction term
High stable anxious attachment (+1 SD)	4.85, 1.93	4.37, 1.85	$F(1, 465) = 7.27, p = .007, \eta^2 = .015$	$F(1, 465) = 6.11, p = .014, \eta^2 = .013$
Low stable anxious attachment (-1 SD)	4.88, 1.98	3.79, 1.82	$F(1, 465) = 38.45, p < .001, \eta^2 = .076$	

Note: Descriptive statistics (M, SD) refer to pattern deviancy aversion.

geometric shapes. And in Study 4, priming anxious attachment compared to a neutral prime heightened participants' aversion towards explicit pattern deviancy ("I feel negative towards things that break a pattern"). Importantly, the results of Studies 3 and 4 remained when controlling for participants' aversion towards novel stimuli as well as when controlling for their aversion towards negative stimuli.

Taken together, our results indicate that anxious attachment elicits an aversion towards broken patterns. Thus, anxious attachment may contribute to numerous psychological phenomena that have indirectly and directly been linked to an aversion towards pattern deviancy, including, for instance, social norm following (Gollwitzer, Martel, & Bargh, 2018), prejudice (Gollwitzer et al., 2017), moral judgment (Gollwitzer et al., 2018), meaning in life (Heintzelman et al., 2013), and individualism versus collectivism (Kim & Markus, 1999).

Novelty Aversion

We observed no link between anxious attachment and disliking novel stimuli. In Studies 1 through 3, anxious attachment neither related to nor heightened participants' dislike of exotic over common fruits, and in Study 4, priming anxious attachment heightened neither participants' discomfort towards novel Chinese ideographs nor their discomfort towards explicit terms capturing novelty (e.g., "new things", "novel things"). At first glance, these findings conflict with past researchers' theorizing. Bowlby (1969/1982), for instance, argued that aversion towards exploring unknown environments is a key component of anxious attachment. Unknown environments are unappealing to non-securely attached individuals because they can be tiring and dangerous—especially for non-

securely attached individuals who have no safe-haven to retreat to (e.g., Hazan & Shaver, 1990).

Notably, though, unknown environments or stimuli may not *always* be tiring and dangerous. For instance, novel, unknown stimuli that are neither inconsistent nor unreliable may not be perceived as threatening—such stimuli are "different" rather than "deviant". In terms of our studies, we posit that, as intended, participants perceived the broken patterns of geometric shapes as inconsistent and unreliable, while they perceived the novel fruits, Chinese characters, and novelty terms as novel but not unreliable. As earlier noted, novel fruits and novel ideographs can be thought of as examples of their own categories (i.e., exotic fruits, foreign characters; Murphy, 2004) and thus do not necessarily break an instantiated pattern. If true, our findings suggest an important nuance regarding attachment theory: Individuals with anxious attachment are not necessarily averse to novelty, instead, they are averse to pattern deviancy, that is, the violation of repeated forms and models. Indeed, anxious attachment induces discomfort towards new information that heightens confusion and ambiguity, but not towards new information per se (Mikulincer, 1997).

Potential Mechanisms

A number of potential processes may underlie the effect of anxious attachment on people's pattern deviancy aversion. For instance, anxious attachment may heighten individuals' level of generalized anxiety—anxiety outside of the social domain—and such anxiety heightens pattern deviancy aversion. In the same vein, anxious attachment may heighten individuals' sensitivity towards threat (e.g., Ein-Dor, Mikulincer, & Shaver, 2011), and such threat sensitivity may be partially responsible for heightening pattern deviancy

aversion. Alternatively, or additionally, anxious attachment—as it induces fear of social unreliability—may induce individuals with feelings of losing control, and these feelings in turn increase people's aversion towards broken patterns. Supporting this possibility, Whitson and Galinsky (2008) found that people perceive illusory patterns, patterns that do not actually exist, when attempting to regain control after a perceived loss of control.

Functionality

Consider the functionality of anxious attachment heightening pattern deviancy aversion. Perhaps, anxious attachment heightens pattern deviancy aversion to help socially insecure individuals avoid unreliable others and approach reliable others. Indeed, increased pattern deviancy aversion has been linked to discomfort towards “unreliable” individuals—those who break physical patterns (e.g., people who are ill) and social patterns (e.g., social-norm breakers; Gollwitzer et al., 2017).

Pattern deviancy aversion may also help anxiously attached individuals find non-social substitutes for the reliability they crave (Ainsworth, 1979; Bowlby, 1973; Shaver & Hazan, 1993). For instance, disliking broken patterns may drive anxiously attached individuals to adopt repetitive, predictable lives and behaviors in order to cope with the social unreliability they perceive and fear. Indeed, past findings indicate that anxious attachment relates to compulsive, habitual behavior even in the non-social domain (American Psychiatric Association, 2000; Doron et al., 2012).

Implications and Future Research

Our results indicate that social experiences (of caretaking and social relationships) can impact one's attitude towards regularities in the environment, specifically, in terms of judging broken patterns as more or less negative. These findings may help explain the links between anxious attachment and certain social phenomena. For instance, both anxious attachment and pattern deviancy aversion have been associated with heightened prejudice (e.g., Di Pentima & Toni, 2009; Gollwitzer et al., 2017; Mikulincer, 1997; Mikulincer & Shaver, 2001), and a greater concern for moral violations (e.g., Gollwitzer et al., 2018; Koleva et al., 2014). Potentially, then, the links between anxious attachment and social phenomena such as prejudice and moral sensitivity may in part be driven by anxious attachment heightening people's pattern deviancy aversion.

The presented results also contribute to research on attachment styles. Research examining potential outcomes of attachment style has largely focused on the social outcomes of attachment styles (e.g., relationship conflict and quality; Li & Chan, 2012). Here we find anxious attachment to have outcomes beyond the social realm—anxious attachment heightens people's

dislike towards broken non-social patterns. In doing so, our results contribute to a nascent area of research that has observed non-social outcomes of attachment style (e.g., Ein-Dor et al., 2011; Mikulincer, 1997). For instance, securely and anxiously attached individuals are more curious than avoidantly attached individuals (Mikulincer, 1997), and anxious attachment style is associated with quicker threat responses (e.g., when a room is filling up with smoke; Ein-Dor et al., 2011).

Limitations and Concerns

Although we controlled for participants' aversion towards novel and negative stimuli, some other confounding variable may underlie the observed effects. For instance, one could argue that need for cognitive closure (Webster & Kruglanski, 1994) or disliking ambiguity (Budner, 1962) underlies the observed results. This is unlikely, however. Need for closure relates to both anxious and avoidant attachment (Mikulincer, 1997) and our effects apply solely to anxious attachment. Additionally, pattern deviancy aversion only correlates weakly (positively) with need for closure and disliking ambiguity (Gollwitzer et al., 2017).

In the same vein, one could argue that response bias plays a role in our findings. Arguing against this possibility, however, controlling for participants' (i) socially desirable responding (Study 2), (ii) aversion towards unbroken patterns (Studies 1 through 3), (iii) novelty aversion (Studies 1 through 4), and (iv) negativity aversion (Studies 3 and 4) did not alter the results.

The observed null relationship between anxious attachment and novelty aversion should be approached with some caution. For one, the external validity of the measure we used to assess novelty aversion in Studies 1 through 3—aversion towards exotic over common fruits—is unknown (we are the first to use such a measure). Notably, though, we did replicate the null relationship observed in Studies 1 through 3 when measuring novelty aversion via more valid measures in Study 4. Nonetheless, given that past research has documented a relationship between anxious attachment style and disliking novelty (e.g., Ainsworth et al., 1978; Arend et al., 1979), we conclude that further research should be conducted before any strong conclusions can be made about whether anxious attachment relates to or does not relate to disliking novelty.

Conclusion

Researchers have documented that most people hold an aversion towards broken patterns and that such pattern deviancy aversion relates to important social phenomena (e.g., prejudice, Gollwitzer et al., 2017; individualism versus collective; Kim & Markus, 1999). Yet, the antecedents of pattern deviancy aversion remain unknown. Here we identify one such antecedent: Anxious attachment heightens people's dislike of broken patterns.

Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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