

FROM MOTHER TO MOTHER NATURE:  
THE ROLE OF INTERPERSONAL ATTACHMENT IN HUMAN–NATURE RELATIONS

by

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### **Abstract**

Over the past two decades, environmental psychologists have become increasingly interested in the concept of nature connectedness: the degree to which people feel connected to the natural world. Nature connectedness has been shown to predict a variety of important individual differences, including stronger proenvironmental attitudes and behaviours, and greater well-being. Despite the increased attention that this topic has recently received, there is a dearth of research that has comprehensively examined how people’s relationship to nature might be related to and influenced by social relationships and contexts. In this dissertation, I consider and test the applicability of attachment theory to human–nature relations. Across two studies, I examined whether interpersonal attachment orientations (i.e., attachment anxiety and attachment avoidance) are associated with nature connectedness at the trait-level. I also investigated whether momentary activation of specific attachment-related schemas influence people’s motivation to connect with nature, and whether dispositional attachment orientations and nature connectedness moderate the impact of these temporarily activated schemas on motivation to connect with nature. Evidence for relationships between interpersonal attachment orientations and nature connectedness at the trait-level were weak and inconsistent across the two studies. Motivation to connect with nature did not differ across experimental conditions in either study, but some evidence was found for interpersonal attachment orientations moderating the effect of some of the experimental conditions. In general, the current research did not provide clear and consistent evidence for a link between how people relate to close others and how they relate to nature, or for attachment-related contexts impacting people’s motivation to connect with nature. Based on these results, one could conclude that attachment theory appears to have limited relevance for understanding human–nature relations. Limitations and future research directions are discussed.

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**Table of Contents**

Abstract .....	ii
Acknowledgements .....	iii
Table of Contents .....	iv
List of Tables .....	vii
List of Figures .....	xi
List of Appendices .....	xiii
Introduction .....	1
Attachment Theory .....	4
Theoretical and Empirical Foundations .....	4
Attachment in Adulthood .....	9
Attachment Processes in the Moment .....	11
Human–Nature Relations .....	18
Nature as a Relational Partner .....	20
Developing a Connection to Nature .....	27
Integrating Attachment Theory and Human–Nature Research .....	32
Behavioural Systems .....	33
Nonhuman Attachments and the Correspondence/Compensation Hypotheses .....	39
Indirect Support for the Correspondence Hypothesis .....	45
Personality .....	45
Well-Being .....	49
Values .....	54
Indirect Support for the Compensation Hypothesis .....	55

Meaning Maintenance Model .....	56
Ostracism .....	58
Anthropomorphization .....	63
Preliminary Investigation of the Link Between Attachment and Nature Connectedness .....	68
Reanalysis of Zelenski and Nisbet (2014) .....	69
Study 1 .....	75
Research Questions .....	75
Method .....	78
Materials .....	78
Procedure .....	84
Results .....	87
Background & Data Quality .....	87
Exclusions and Sample Demographics .....	87
Trait-Level Associations Between Interpersonal Attachment and Nature Connectedness ...	90
Manipulation Checks .....	91
Experimental Manipulation, Trait Attachment, Trait Nature Connectedness, and Motivation to Connect with Nature .....	117
Discussion .....	128
Correlational Findings .....	128
Experimental Findings .....	132
Study 2 .....	136
Research Questions .....	137
Method .....	138

Materials .....	138
Procedure .....	142
Results .....	145
Exclusions and Sample Demographics .....	146
Trait-Level Associations Between Interpersonal Attachment and Nature Connectedness ..	148
Manipulation Checks .....	150
Experimental Manipulation, Trait Attachment, Trait Nature Connectedness, and Motivation to Connect with Nature.....	177
Discussion.....	192
Correlational Findings .....	192
Experimental Findings.....	196
General Discussion .....	203
References .....	210

### List of Tables

Table 1 <i>Measures of Human–Nature Relationships</i> .....	21
Table 2 <i>Reanalyzing the Correlations Between Nature Connectedness and Trait Attachment from Study 2 of Zelenski and Nisbet (2014)</i> .....	70
Table 3 <i>Correlations Between Trait Nature Connectedness and Trait Attachment in Study 1</i> .....	91
Table 4 <i>Multiple Regression Analyses with Big Five Personality and Trait Attachment Avoidance as Predictors of Indexes of Trait Nature Connectedness in Study 1</i> .....	92
Table 5 <i>Multiple Regression Analyses with Big Five Personality and Trait Attachment Anxiety as Predictors of Indexes of Trait Nature Connectedness in Study 1</i> .....	94
Table 6 <i>Effects of Experimental Manipulation on State Attachment and Affect (Strict Exclusions) in Study 1</i> .....	97
Table 7 <i>Effects of Experimental Manipulation on State Attachment and Affect (Lenient Exclusions) in Study 1</i> .....	99
Table 8 <i>Dummy Coding for Multiple Regression Analyses in Study 1</i> .....	103
Table 9 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on State Attachment and Affect in Study 1</i> .....	104
Table 10 <i>Investigating Conditional Effects of Trait Attachment Avoidance on State Attachment Security and Negative Affect in Attachment Conditions vs. Control Condition in Study 1</i> .....	109
Table 11 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on State Attachment and Affect in Study 1</i> .....	113
Table 12 <i>Investigating Conditional Effects of Trait Attachment Anxiety on State Attachment Security in Secure Attachment Condition vs. Control Condition in Study 1</i> .....	118
Table 13 <i>Effects of Experimental Manipulation on Motivation to Connect with Nature in Study 1</i>	

.....	119
Table 14 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on Motivation to Connect with Nature in Study 1</i>	.....
.....	120
Table 15 <i>Investigating Conditional Effects of Trait Attachment Avoidance on Motivation to Connect with Nature in Secure Attachment Condition vs. Control Condition in Study 1</i>	.....
.....	124
Table 16 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on Motivation to Connect with Nature in Study 1</i>	.....
.....	125
Table 17 <i>Investigating Conditional Effects of Trait Attachment Anxiety on Motivation to Connect with Nature in Insecure Attachment Condition vs. Control Condition in Study 1</i>	.....
.....	128
Table 18 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Nature Connectedness on Motivation to Connect with Nature in Study 1</i>	.....
.....	129
Table 19 <i>Correlations Between Trait Nature Connectedness and Trait Attachment in Study 2</i>	149
Table 20 <i>Multiple Regression Analyses with Big Five Personality and Trait Attachment Avoidance as Predictors of Indexes of Trait Nature Connectedness in Study 2</i>	.....
.....	151
Table 21 <i>Multiple Regression Analyses with Big Five Personality and Trait Attachment Anxiety as Predictors of Indexes of Trait Nature Connectedness in Study 2</i>	.....
.....	153
Table 22 <i>Effects of Experimental Manipulation on State Attachment and Affect (Strict Exclusions) in Study 2</i>	.....
.....	155
Table 23 <i>Effects of Experimental Manipulation on State Attachment and Affect (Lenient Exclusions) in Study 2</i>	.....
.....	157

Table 24 <i>Effect Sizes for Pairwise Comparisons with State Attachment and Affect as Outcomes in Study 2</i> .....	159
Table 25 <i>Dummy Coding for Multiple Regression Analyses in Study 2</i> .....	163
Table 26 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on State Attachment and Affect in Study 2</i> .....	164
Table 27 <i>Investigating Conditional Effects of Trait Attachment Avoidance on State Attachment Avoidance/Security and Negative Affect in Attachment Conditions vs. Control Condition in Study 2</i> .....	166
Table 28 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on State Attachment and Affect in Study 2</i> .....	173
Table 29 <i>Investigating Conditional Effects of Trait Attachment Anxiety on Positive and Negative Affect in Attachment Conditions vs. Control Condition in Study 2</i> .....	176
Table 30 <i>Effects of Type of Space and Experimental Condition on Interest in Visiting in Study 2</i> .....	180
Table 31 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on Interest in Visiting Natural Over Built Spaces in Study 2</i> .....	183
Table 32 <i>Investigating Conditional Effects of Trait Attachment Avoidance on Interest in Visiting Natural Over Built Spaces in Anxious Attachment Condition vs. Control Condition in Study 2</i> .....	186
Table 33 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on Interest in Visiting Natural Over Built Spaces in Study 2</i> .....	187
Table 34 <i>Investigating Conditional Effects of Trait Attachment Anxiety on Interest in Visiting</i>	

<i>Natural Over Built Spaces in Anxious Attachment Condition vs. Control Condition in Study 2</i>	189
Table 35 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Overall Scores on the Nature Relatedness Scale on Interest in Visiting Natural Over Built Spaces in Study 2</i> .....	190
Table 36 <i>Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Overall Scores on the Connectedness to Nature Scale on Interest in Visiting Natural Over Built Spaces in Study 2</i> .....	191
Table 37 <i>Investigating Conditional Effects of Trait Connectedness to Nature on Interest in Visiting Natural Over Built Spaces in Avoidant Attachment Condition vs. Control Condition in Study 2</i> .....	194
Table A1 <i>Reasons for Coding Writing Task as Incorrectly Completed in Each Experimental Condition in Study 1</i> .....	283
Table A2 <i>Reasons Why Participants Indicated that Their Data Should Be Excluded in Study 1</i> .....	285
Table A3 <i>Reasons for Coding Writing Task as Incorrectly Completed in Each Experimental Condition in Study 2</i> .....	312
Table A4 <i>Reasons Why Participants Indicated that Their Data Should Be Excluded in Study 2</i> .....	314
Table A5 <i>Exclusion-Worthy Idiosyncratic Events in Study 2</i> .....	317
Table A6 <i>Correlations Between State Attachment and Motivation to Connect with Nature Measures in Study 1 and Study 2</i> .....	319

### List of Figures

<i>Figure 1.</i> A proposed model for how interactions with an attachment figure and interactions with nature may influence one another .....	38
<i>Figure 2.</i> Conditional effect of secure attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 1 .....	108
<i>Figure 3.</i> Conditional effect of insecure attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 1 .....	110
<i>Figure 4.</i> Conditional effect of insecure attachment condition (compared to control condition) on negative affect as a function of trait attachment avoidance in Study 1.....	112
<i>Figure 5.</i> Conditional effect of secure attachment condition (compared to control condition) on state attachment security as a function of trait attachment anxiety in Study 1.....	116
<i>Figure 6.</i> Conditional effect of secure attachment condition (compared to control condition) on the adapted Connectedness to Nature Scale (CNS) as a function of trait attachment avoidance in Study 1.....	122
<i>Figure 7.</i> Conditional effect of secure attachment condition (compared to control condition) on the adapted Preferences for Nature Questionnaire (PNQ) as a function of trait attachment avoidance in Study 1 .....	123
<i>Figure 8.</i> Conditional effect of insecure attachment condition (compared to control condition) on the adapted Connectedness to Nature Scale (CNS) as a function of trait attachment anxiety in Study 1.....	126
<i>Figure 9.</i> Conditional effect of secure attachment condition (compared to control condition) on state attachment avoidance as a function of trait attachment avoidance in Study 2.....	165
<i>Figure 10.</i> Conditional effect of anxious attachment condition (compared to control condition)	

on state attachment security as a function of trait attachment avoidance in Study 2.....	168
<i>Figure 11.</i> Conditional effect of avoidant attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 2.....	170
<i>Figure 12.</i> Conditional effect of avoidant attachment condition (compared to control condition) on state negative affect as a function of trait attachment avoidance in Study 2.....	172
<i>Figure 13.</i> Conditional effect of secure attachment condition (compared to control condition) on positive affect as a function of trait attachment anxiety in Study 2.....	175
<i>Figure 14.</i> Conditional effect of avoidant attachment condition (compared to control condition) on state negative affect as a function of trait attachment anxiety in Study 2.....	178
<i>Figure 15.</i> Effects of experimental condition and type of space on interest in visiting (natural vs. built) spaces in Study 2.....	181
<i>Figure 16.</i> Conditional effect of anxious attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait attachment avoidance in Study 2.....	184
<i>Figure 17.</i> Conditional effect of anxious attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait attachment anxiety in Study 2 .....	188
<i>Figure 18.</i> Conditional effect of avoidant attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait connectedness to nature in Study 2.....	193

**List of Appendices**

Appendix A: Rescoring the Trait Attachment Measure in Zelenski and Nisbet (2014).....	257
Appendix B: Experimental Manipulation (Study 1).....	259
Appendix C: State Adult Attachment Measure (Study 1 & 2).....	261
Appendix D: Positive and Negative Affect Schedule (Study 1 & 2).....	262
Appendix E: Adapted Connectedness to Nature Scale (Study 1).....	263
Appendix F: Adapted Preferences for Nature Questionnaire (Study 1) .....	264
Appendix G: Experiences in Close Relationships Scale (Study 1 & 2).....	265
Appendix H: Nature Relatedness Scale (Study 1 & 2) .....	267
Appendix I: IPIP-NEO-120 (Study 1).....	268
Appendix J: SONA Recruitment Notice (Study 1).....	271
Appendix K: Informed Consent Form (Study 1) .....	272
Appendix L: Demographics Questionnaire (Study 1 & 2).....	274
Appendix M: Data Quality Questionnaire (Study 1) .....	275
Appendix N: Mood Booster (Study 1 & 2) .....	276
Appendix O: A Priori Power Analyses (Study 1).....	277
Appendix P: Detailed Data Quality Information (Study 1).....	282
Appendix Q: Experimental Manipulation (Study 2).....	289
Appendix R: Motivation to Connect with Nature (Study 2) .....	293
Appendix S: Connectedness to Nature Scale (Study 2) .....	295
Appendix T: 100-item IPIP Representation of NEO-PI-R Domains (Study 2) .....	296
Appendix U: SONA Recruitment Notice (Study 2) .....	299
Appendix V: Informed Consent Form (Study 2).....	300

Appendix W: Data Quality Questionnaire (Study 2) .....302

Appendix X: A Priori Power Analyses (Study 2).....303

Appendix Y: Detailed Data Quality Information (Study 2) .....311

## Introduction

As scientific evidence concerning the major environmental issues facing humanity in the twenty-first century accumulates, the need for wide-spread behavioural change at the individual and societal level has become increasingly apparent and pressing. Despite the growing scientific consensus, not all individuals are concerned about and willing to address or even acknowledge these problems. Numerous personal and social factors have been linked to environmental attitudes and actions, from knowledge about environmental issues to personality traits such as openness to experience (see review by Gifford & Nilsson, 2014). One psychological characteristic that has been shown to consistently predict proenvironmental attitudes and behaviours is nature connectedness—the degree to which an individual identifies with and feels subjectively connected to the natural world (e.g., Tam, 2013a).<sup>1</sup> People who report a stronger connection with nature are more likely to express concern about environmental issues, support environmental causes and organizations, call themselves an environmentalist, and engage in sustainable behaviours like recycling (e.g., Mayer & Frantz, 2004; Nisbet, Zelenski, & Murphy, 2009; Tam, 2013a; also see recent meta-analyses by Mackay & Schmitt, 2019 and Whitburn, Linklater, & Abrahamse, 2019). Beyond implications that nature connectedness might have for the well-being of the natural environment, it has also been implicated in the well-being of

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<sup>1</sup> I broadly use the terms ‘nature’, ‘natural world’, and ‘natural environment’ throughout this document in a manner that is consistent with how they are commonly construed and operationalized in environmental psychology research. The following explanation offered by Kaplan and Kaplan (1989) in their seminal book titled “The Experience of Nature: A Psychological Perspective” accurately captures my focus as well:

*Nature* connotes many settings ... [T]he word *nature* is intended to be broad and inclusive (although, for the most part, the discussion excludes fauna). This discussion of nature here is not limited to those faraway, vast, and pristine places where there has been little intervention ... Nature includes parks and open spaces, meadows and abandoned fields, street trees and backyard gardens. We are referring to places near and far, common and usual, managed and unkempt, big, small, and in-between, where plants grow by human design or even despite it. We are referring to areas that would often be described as green, but they are also natural when the green is replaced by white or brown or red and yellow. Nature includes plants and various forms of vegetation. It also includes settings or landscapes or places with plants. (p. 2)

individuals: those who are higher in nature connectedness tend to report higher hedonic and eudaimonic well-being compared to others with a weaker connection to nature (see meta-analyses by Capaldi, Dopko, & Zelenski, 2014 and Pritchard, Richardson, Sheffield, & McEwan, 2019).

Given these associations with environmental and individual well-being, a crucial question arises of why some people feel more connected to nature than others. Research to date has revealed that contact with natural environments in one's distant and recent past is likely an important factor for the development and maintenance of a strong psychological connection to nature (e.g., Cleary, Fielding, Murray, & Roiko, 2018; Kals, Schumacher, & Montada, 1999; Tam, 2013a). Similar to other aspects of identity formation (Wortham, 2006), one's social context appears to be important as well (Olivos & Clayton, 2017). Having close others who encourage spending time in nature, and exhibit an appreciative, loving, and caring orientation toward nature can foster the same in those around them (e.g., Windhorst & Williams, 2015). This foundational work provides some initial insight into possible antecedents of nature connectedness, but there still remains ample room for alternative, perhaps complementary, explanations that are informed by a broader theory of human nature.

Here, I consider whether attachment theory can help shed light on some of the psychosocial conditions that impede and promote nature connectedness. Although initial theoretical and empirical work on attachment theory focused on parent-child interactions (e.g., Ainsworth, Blehar, Waters, & Wall, 1978), it has since been extended and shown to be a useful framework for understanding close human relationships in adolescence and adulthood (e.g., Bowlby, 1988; Hazan & Shaver, 1987; Howe, 2011), as well as the bonds people form with nonhuman targets (e.g., God, pets, places; Keefer, Landau, & Sullivan, 2014). Applying

attachment theory to this area may help decipher how human–nature relationships are different from and similar to interpersonal relationships, and increase understanding of how social functioning might positively or negatively impact people’s connection to the natural world.

The current line of research tests two competing hypotheses of how interpersonal attachment might be related to nature connectedness. The first hypothesis is that there is a correspondence between people’s relationship with nature and their relationship with others. From this perspective, individuals who are more secure in their interpersonal relationships will also be more secure in their relationship with nature compared to those who tend to relate to others in a more avoidant or anxious manner. Moreover, based on this perspective, feeling a sense of attachment security in the moment should lead people to feel more connected to nature and be more interested in connecting with nature. However, an opposing hypothesis is that insecurity in interpersonal relationships is associated with a stronger relationship with nature. A strong connection to nature may be a way that people compensate for weak or labile social connections. If this second hypothesis is correct, feeling a sense of attachment security in the moment should decrease people’s connection to nature or their desire to connect with nature, while attachment insecurity should increase it.

To provide background information on attachment theory and nature connectedness, this dissertation begins with brief reviews of each body of knowledge. Underlying theoretical similarities and overlaps between the literature on interpersonal attachment and human–nature relationships are described, along with preliminary findings from previous research that provides some initial clues to how interpersonal attachment might relate to and influence nature connectedness. A reanalysis of data from the only published study to simultaneously assess interpersonal attachment and nature connectedness is presented, and then two novel studies are

reported. Study 1 attempted to experimentally manipulate attachment security and attachment insecurity to examine the impact of these psychosocial contexts on motivation to connect with nature, which was measured by two self-report questionnaires. Study 2 attempted to experimentally manipulate more specific attachment-related states of mind (i.e., attachment anxiety and attachment avoidance, as well as attachment security) and assessed motivation to connect with nature by having participants report their interest in visiting numerous photographed spaces. Trait attachment and trait nature connectedness were also measured in both Study 1 and Study 2 in order to examine their relationship and to investigate whether they might moderate the effect of the attachment primes on motivation to connect with nature.

By investigating the link between interpersonal attachment and nature connectedness at both the trait level and state level in Study 1 and Study 2, I was able to examine not only who might be more/less likely to have a strong connection to nature (Research Question #1), but also the psychosocial contexts in which people might be more/less likely to seek out a connection with nature (Research Question #2). Moreover, how individual differences interact with these psychosocial contexts in shaping people's desires to connect with nature could also be assessed (Research Question #3). Thus, the current line of research attempted to serve as a novel attempt at understanding the correlates and antecedents of human–nature relationships by integrating two literatures that have remained largely isolated up to this point in time. I begin by reviewing the body of work that is based on attachment theory.

### **Attachment Theory**

#### **Theoretical and Empirical Foundations**

According to attachment theorists, behaviours that draw an individual closer to an attachment figure under certain circumstances are driven by a behavioural system—“a species-

universal, biologically evolved neural program that organizes behavior in ways that increase the chances of an individual's survival and reproduction" (Mikulincer & Shaver, 2007, p. 10)—that is dedicated to attachment. Behavioural systems are thought to be activated in response to specific triggers internal or external to the individual that then guides thoughts, emotions, and behaviours toward a particular goal. The attachment behavioural system is thought to become activated when a threat is perceived, which motivates efforts to achieve proximity to an attachment figure (Bowlby, 1969/1982). This is evolutionarily adaptive as it promotes the avoidance of potential dangers and propels the individual to the safety of a 'stronger and wiser' attachment figure; those who did not exhibit this response would have been more likely to fall victim to dangers in the environment, and be less likely to survive and pass on this behavioural tendency to future generations (Bowlby, 1969/1982). The attachment behavioural system is thought to be deactivated when the attachment figure is sensitive and responsive to proximity seeking efforts, and feelings of threat are replaced with feelings of security (Mikulincer & Shaver, 2007). In this way, one of the functions of an attachment figure is to act as a safe haven.

Complementing the attachment behavioural system of the individual seeking support is the caregiving behavioural system of the attachment figure. While the goals of the attachment behavioural system are to obtain protection and security, some of the main functions of the caregiving behavioural system is to provide protection and reduce suffering (Collins, Ford, Guichard, Kane, & Feeney, 2010; Mikulincer & Shaver, 2011; Mikulincer, Shaver, & Gillath, 2008). The caregiving behavioural system is thought to be activated when the attached individual is perceived to be under threat and/or experiencing distress (George & Solomon, 2008). Activation motivates behaviours to protect the attached individual by actively obtaining and maintaining proximity, and providing protection, reassurance, and comfort. In turn, the

caregiving behavioural system is thought to be deactivated when proximity has been achieved and the attached individual is perceived to be content (George & Solomon, 2008). These reactions by a caregiver would have been evolutionarily adaptive as they encourage the protection of offspring from danger and maximizes their chances of survival, increasing the likelihood of reproduction and transmission of shared genes to future offspring.

Another important function of the caregiving behavioural system is to not only protect the well-being of the attached individual, but to encourage their development as well. According to attachment theorists, the caregiving behavioural system can also be activated when opportunities for learning, exploration, or mastery are available to the attached individual, and the caregiver perceives that the attached individual needs their instrumental or emotional support (Collins, Guichard, Ford, & Feeney, 2006; Mikulincer & Shaver, 2016). Thus, along with offering a safe haven under times of threat, the second function of an attachment figure is to serve as a secure base “from which the individual can work out gradually, forming new skills and interests” (Ainsworth, 1940, p. 45).

Initial support for these theoretical propositions come from Mary Ainsworth’s research with mothers and young children (Ainsworth & Bell, 1970; Ainsworth et al., 1978; Ainsworth & Wittig, 1969) that found that children generally tended to explore the surrounding environment more when their mother was present (presumably providing a secure base) and tended to become distressed when they were separated from their mother when she left the room (presumably activating the attachment behavioural system and motivating attempts to regain proximity). Upon the mother’s return, children were more likely to seek proximity and maintain contact with her, as predicted by attachment theory. Despite these general patterns, not all children responded in the same way. A subset of children did not pay much attention to their mother, exhibited little

concern when their mother left the room, and did not seek proximity or contact with their mother when she returned (Ainsworth et al., 1978). This pattern of behaviour is commonly considered to be indicative of an insecure attachment style that is characterized by avoidance (Mikulincer & Shaver, 2016). In contrast, another subset of children was hypervigilant regarding their mother's presence and (un)availability, became extremely distressed when they were separated from their mother, and were harder to console upon the mother's return (Ainsworth et al., 1978). This pattern of behaviour is considered to be indicative of an insecure attachment style that is characterized by anxiety. Finally, children who become upset following episodes of separation but seek out the mother on her return and are easily consoled are thought to have a secure attachment style.

The goal-corrected and context-sensitive nature of behavioural systems can account for these individual differences in attachment styles. Instead of rigidly pursuing the goal of security with the same behavioural strategy regardless of its effectiveness in the context that one finds oneself in, Bowlby (1969/1982) reasoned that attachment figure availability and their responsiveness to one's attempts to garner their support in times of need is continually monitored and evaluated. When these attempts are not successful or unreliable in the responses that they elicit from the caregiver, secondary strategies can be adopted so that unresolved attachment system activation can be more effectively managed (Main, 1990). If caregivers are inconsistent in their response and proximity seeking efforts are intermittently successful at eliciting support, hyperactivation of the attachment behavioural system may be favoured. Under this type of secondary strategy, efforts to gain attention and support from the caregiver are intensified, distress and helplessness are exaggerated, demands become more pressing, and protesting persists until the individual's needs are sufficiently addressed by the caregiver (Cassidy, 1994).

In contrast, if caregivers are consistently dismissive and rejecting of proximity seeking efforts, a deactivating attachment strategy may be favoured where expressions of vulnerability and need are minimized, and the self is exclusively relied upon to placate the caregiver (Cassidy & Kobak, 1988). Indeed, Ainsworth et al. (1978) observed that children classified as having an avoidant attachment style tended to have mothers who were emotionally unavailable and rejecting of proximity seeking efforts, while mothers of anxiously attached children tended to be inconsistent in their availability and responses to proximity seeking efforts.<sup>2</sup>

According to attachment theory, individuals develop working cognitive models concerning what to expect and how to behave in close relationships when a threat is perceived based on the outcomes of early interactions with primary attachment figures (Bowlby, 1969/1982). These working models include beliefs about whether specific close others and people in general are trustworthy, reliable, and physically and emotionally available in times of need (Main, Kaplan, & Cassidy, 1985). They also inform one's beliefs about the self, such as whether one is capable, weak, or worthy when dealing with threats and seeking support.

Although working models can be updated based on subsequent social experiences and life events

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<sup>2</sup> Seemingly suboptimal parenting and insecure attachment styles can be understood from an evolutionary perspective as well. While seeking protection and support from caregivers is of the utmost importance for the child and in the biological parent's genetic interest, caregivers can also allocate limited resources to other offspring or future potential mating opportunities to increase their reproductive success, which may conflict with the self-interests of the child (Trivers, 1974). Investments into quantity vs. quality of offspring and mating vs. parenting represent different life history strategies that can be more or less adaptive depending on the environmental and temporal context (e.g., a stable vs. unstable environment; Del Giudice, Gangestad, & Kaplan, 2015). Given that individuals would have had to occasionally deal with caregivers who pursued life history strategies that valued and devoted resources to other goals besides the child's development, insecure attachments may have evolved as a response to elicit greater investment from the caregiver (i.e., an anxious attachment style) or to prepare the individual to be relatively self-sufficient in a social environment where support is lacking (i.e., an avoidant attachment style; Belsky, Steinberg, & Draper, 1991; Simpson & Belsky, 2008).

(e.g., Waters, Merrick, Treboux, Crowell, & Albersheim, 2000), and can differ depending on specific relational partners (e.g., Baldwin, Keelan, Fehr, Enns, & Koh-Rangarajoo, 1996; La Guardia, Ryan, Couchman, & Deci, 2000; Overall, Fletcher, & Frieson, 2003), attachment theorists generally consider early experiences with primary caregivers to be particularly influential in the development of working models, forming a prototype that continues to have an impact on subsequent close interpersonal relationships (e.g., Bowlby, 1979; Hazan & Shaver, 1987; Owens et al., 1995). Importantly, longitudinal research appears to support these theoretical assumptions (see meta-analyses by Fraley, 2002 and Pinqart, Feußner, & Ahnert, 2013).

### **Attachment in Adulthood**

In adults, individual differences in interpersonal attachment orientations are typically conceptualized and assessed across two dimensions: attachment avoidance and attachment anxiety (Brennan, Clark, & Haver, 1998; Collins & Read, 1990; Simpson, 1990). Discomfort with closeness/disclosure, avoidance of intimacy, defensiveness, distrust, and self-reliance are key aspects of attachment avoidance. In contrast, jealousy, preoccupation, fear of rejection/abandonment, worrying, and anxiety are key aspects of attachment anxiety. These two dimensions of attachment in adults have been shown to be significantly related to past and current experiences in close interpersonal relationships. Individuals higher in attachment anxiety and individuals higher in attachment avoidance are more likely to recollect negative experiences involving their caregivers when asked to list memories from their childhood (Haggerty, Siefert, & Weinberger, 2010), and they are more likely to perceive their primary childhood caregiver as being low in warmth (Collins & Read, 1990). Those higher in attachment anxiety and/or attachment avoidance tend to experience fewer positive emotions and more negative emotions in their romantic relationships (Simpson, 1990), and report lower relationship satisfaction (e.g.,

Nofle & Shaver, 2006) and commitment (see Table 10.3 in Mikulincer & Shaver, 2016).

Furthermore, attachment avoidance predicts a more independent self-concept that excludes close others (Aron, Melinat, Aron, Vallone, & Bator, 1997; Rholes et al., 2011), while attachment anxiety predicts greater unmet desires for interdependence and closeness (Cozzarelli, Hoekstra, & Bylsma, 2000). Given the above interpersonal issues faced by those high in attachment avoidance and/or attachment anxiety, it is not surprising that feelings of loneliness are positively associated with these two dimensions as well (see Table 9.6 in Mikulincer & Shaver, 2016).

Attachment researchers have also investigated the role of interpersonal attachment orientations in thoughts, emotions, and actions related caregiving. Individuals high in attachment avoidance tend to be less likely to help, have empathic concern, take the perspective, and share the emotional experience of someone who is in need compared to those who are low in attachment avoidance (e.g., Corcoran & Mallinckrodt, 2000; Joireman, Needham, & Cummings, 2002; Kogut & Kogut, 2013; Trusty, Ng, & Watts, 2005; Wayment, 2006). Attachment anxiety, in contrast, has been found to be associated with greater distress in response to suffering, and higher concern for others that is based more on personal insecurities and a compulsive need to care for others (e.g., Bassett & Aubé, 2013; Britton & Fuendeling, 2005; Joireman et al., 2002; Monin, Schulz, Feeney, & Cook, 2010; Shavit & Tolmacz, 2014).

As I discuss in subsequent sections, individual differences in interpersonal attachment have also been linked to the values that people hold (Mikulincer et al., 2003), various aspects of well-being (e.g., Lavy & Littman-Ovadia, 2011; Wei, Liao, Ku, & Shaffer, 2011), the reactions people have to being excluded (e.g., Besser & Priel, 2009; Yaakobi & Williams, 2016), broad personality characteristics (e.g., Donnellan, Burt, Levensky, & Klump, 2008), and the bonds people form with nonhuman targets (e.g., Beck & McDonald, 2004). Overall, research on

attachment orientations provides a useful framework for understanding a wide range of psychological functioning in adulthood.

### **Attachment Processes in the Moment**

Beyond attachment orientations at the trait level, researchers have also examined how momentary feelings of attachment (in)security can impact a variety of intrapersonal and interpersonal processes (Gillath & Karantzas, 2019; Mikulincer & Shaver, 2016). This has enabled researchers to test causal claims underlying attachment theory, including the presumed functioning and interaction of different behavioural systems. One simple and apparently effective way of experimentally manipulating attachment security, commonly referred to as security priming, is to ask individuals to think and/or write about a real or hypothetical close interpersonal relationship or situation that is characterized by aspects of attachment security (e.g., responsiveness, sensitivity, care, comfort, closeness, acceptance, supportiveness; Carnelley & Rowe, 2007; Luke, Sedikides, & Carnelley, 2012; Mikulincer & Shaver, 2001; Rowe & Carnelley, 2003). Underlying this approach is the theoretical proposition that as individuals mature and become less reliant on others for their own survival, physical proximity to an attachment figure for protection in times of need can be supplemented with psychological (or symbolic) proximity via salient mental representations of supportive others to provide one with a sense of security (Mikulincer & Shaver, 2016).

Indeed, several studies show that the aforementioned experimental manipulations are able to effectively increase feelings of security (Luke et al., 2012; Rowe, Shepstone, Carnelley, Cavanagh, & Millings, 2016; Otway, Carnelley, & Rowe, 2014; Rowe et al., 2012), and analyses of the writing produced by participants suggests that these tasks promote thoughts related to security, such as acceptance and safety, as well as thoughts related to positive emotions and

belonging, while discouraging thoughts about negative emotions (Carnelley & Rowe, 2010). Security priming also appears to improve the encoding and recall of positive attachment information, and leads to more positive interpersonal expectations (i.e., more optimistic and favourable views of trust, dependence, and closeness in interpersonal relationships; Carnelley & Rowe, 2007; Rowe & Carnelley, 2003). In addition, individuals exposed to a stressor (e.g., recalling a distressing personal experience) recover from the resultant negative emotions more rapidly if they visualize the presence of a supportive close other shortly thereafter (e.g., their mother; Selcuk, Zayas, Günaydin, Hazan, & Kross, 2012). These results hint that symbolic proximity to a responsive and sensitive attachment figure can deactivate the attachment behavioural system in a similar manner as physical proximity. Moreover, viewing images of warm, comforting, and caring interactions between individuals—another way that researchers have attempted to experimentally manipulate attachment security—has been shown to attenuate amygdala activation in response to threatening stimuli (Norman, Lawrence, Iles, Benattayallah, & Karl, 2015). As the amygdala is involved in processing threat (e.g., Mattavelli et al., 2014), this research provides evidence for how “reminders of secure attachment relationships act as safety cues which modulate threat appraisals and down-regulate neural responses to potential threats” (Norman et al., 2015, p. 837). In this way, feelings of security can help individuals adapt to and overcome possible stressors, returning one back to baseline and allowing one to move on more quickly. Finally, researchers have also shown how security primes can serve a secure base function: visualizing and writing about a close interpersonal relationship or situation characterized by aspects of security leads to more positive views about the self (Carnelley & Rowe, 2007), greater cognitive openness (Mikulincer & Arad, 1999), and greater willingness to explore novel environments (Luke et al., 2012) and help others (Mikulincer, Shaver, Gillath, &

Nitzberg, 2005). These are just a few examples of findings that empirically corroborate Bowlby's (1969/1982) argument concerning the interaction between different behavioural systems, and how deactivation of the attachment system once security is obtained allows for the activation and optimal functioning of other behavioural systems responsible nonattachment-related goals, such as exploration and caregiving (Mikulincer & Shaver, 2016).

Of the over 90 studies that have employed a wide range of security priming techniques, Gillath, Karantzas, and Karantzas (2016) found that, on average, they have a moderately sized impact on outcomes of interest (as cited in Gillath, Karantzas, & Fraley, 2016). Thus, it appears that momentary attachment security can be effectively induced in the lab, and successfully used to investigate safe haven and secure base processes associated with attachment security, although it should be noted that the sample size of studies in this area of research tend to be fairly small and the aforementioned meta-analysis did not appear to directly assess or correct for publication bias (Gillath et al., 2016; Gillath & Karantzas, 2019). While older literature reviews concluded that research does not frequently find that the effectiveness of security priming varies for individuals depending on how anxiously or avoidantly attached they are dispositionally (Gillath et al., 2016; Gillath, Selcuk, & Shaver, 2008), a recent systematic review of security priming research published from 2016-2018 came to a slightly different conclusion (Gillath & Karantzas, 2019). In five out of the nine reviewed studies that tested for interactions, people who were higher in trait attachment anxiety appeared to benefit more from security priming (Bryant & Chan, 2017; Dutton, Lane, Koren, & Bartholomew, 2016; Gillath, Karantzas, & Selcuk, 2017; Tang, Chen, Hu, & Liu, 2017). Moreover, two studies found the effect of security priming to be moderated by trait attachment avoidance (Bryant & Chan, 2017; Gillath et al., 2017). Given that attachment orientations are sometimes shown to interact with experimental manipulations and

that null moderation findings might be attributed, at least in part, to the small sample sizes employed in this area, it seems wise for researchers to include trait measures of attachment when investigating attachment processes at the state level, while also ensuring that studies have adequate statistical power to detect moderation effects if they exist.

Just as momentary feelings of attachment security can be induced in the lab, so too can attachment insecurity. This can be accomplished by having individuals imagine/recall and write about being separated from a close other (e.g., a romantic relationship breakup; Gillath, Hart, Noffle, & Stockdale, 2009), or by having individuals imagine/recall and write about a personal relationship that is characterized by aspects of insecurity (e.g., inconsistency, unreliability, lack of support, insensitivity to needs; Gillath & Shaver, 2007; Yaakobi & Williams, 2016). Beyond attempts to induce a general sense of attachment insecurity, researchers have also employed more targeted methods to make specific insecure states of mind salient. For instance, to bring working models associated with attachment avoidance into consciousness, individuals may be asked to think and/or write about a relationship that is characterized by aspects of attachment avoidance (e.g., discomfort with closeness and dependence, lack of trust; Baldwin et al., 1996; Collins & Gillath, 2012; Mikulincer & Arad, 1999; Rowe & Carnelley, 2003). In contrast, individuals may be asked to think and/or write about a relationship characterized by aspects of attachment anxiety to bring relevant working models associated with attachment anxiety to mind (e.g., strong desires for greater intimacy, fear of rejection, questioning affection; Baldwin et al., 1996; Collins & Gillath, 2012; Mikulincer & Arad, 1999; Rowe & Carnelley, 2003; Rowe et al., 2012). Although people are more likely to have close relationships that match their general attachment orientation, the vast majority of individuals are able to recall a relationship that they have experienced where features of attachment security, anxiety, or avoidance are dominant

(Baldwin et al., 1996). Furthermore, bringing to mind relationships with these different attachment dynamics does not appear to be overly difficult according to self-reported ratings of ease of recall; on a 7-point scale ranging from -3 (*very difficult*) to 3 (*very easy*), mean ratings of ease for those who classified themselves as having a secure, anxious, or avoidant attachment style were above the scale midpoint when recalling all three types of relationships (Baldwin et al., 1996).

Compared to security priming or nonattachment-related control conditions, priming insecurity tends to lead to reductions in feelings of security (Luke et al., 2012; Rowe et al., 2012), and lower positive expectations for interpersonal relationships (Rowe & Carnelley, 2003). People are also more likely to favour insecure behavioural responses to potentially threatening interpersonal situations (e.g., noticing a romantic partner glancing at an attractive person while at a restaurant) when they are asked to imagine having an unsupportive (vs. supportive) relational partner (Gillath & Shaver, 2007). Investigating the writing produced by individuals randomly assigned to insecurity priming conditions suggests that thoughts related to negative emotions and negative care (e.g., rejection, overprotection) are more prevalent, while thoughts related to positive emotions, security, and nostalgia are less prevalent, compared to those writing about a secure relationship (Carnelley & Rowe, 2010). Echoing these findings, priming attachment avoidance or attachment anxiety often leads to a worsened mood, including higher levels of negative affect in general and anxiety in particular, and lower levels of positive affect, when compared to security primes that make salient a relationship that provides a safe haven for comfort and support in times of need (e.g., Carnelley, Otway, & Rowe, 2016; Gillath et al., 2009; Rowe & Carnelley, 2003; Rowe et al., 2012). Potentially reflecting the hypersensitivity to rejection and the typical protest response to perceptions of attachment figure unavailability that

attachment anxiety promotes, individuals report greater emotionality and feelings of depression when asked to think and write about an anxious relationship vs. a secure or avoidant one (Carnelley et al., 2016; Rowe & Carnelley, 2003). Moreover, the encoding and recall of positive attachment information is at its lowest when individuals reflect upon an avoidant relationship (Rowe & Carnelley, 2003), which supports the presumed deactivation of the attachment behavioural system that underlies attachment avoidance.

Finally, there is some evidence that insecurity priming can interrupt the functioning of other behavioural systems. Green and Campbell (2000), for instance, experimentally primed different attachment styles by having participants read and attempt to memorize a series of sentences that described either interpersonal interactions containing themes of either attachment security (e.g., “John and Betty trust each other completely”), attachment anxiety (e.g., “Ellen is constantly worried that her boyfriend will leave her”), or attachment avoidance (e.g., “Tom does not want to become too dependent on his girlfriend”). Participants who were exposed to the attachment anxiety or attachment avoidance primes expressed lower overall interest in exploration and lower preference for novel stimuli compared to those who were exposed to the security prime (Green & Campbell, 2000), suggesting that activation and functioning of the exploratory behavioural system may be impaired when cues are present that indicate that a secure base may be currently unavailable. Support for the detrimental effect of attachment insecurity on another behavioural system that is dedicated to caregiving comes from Mikulincer et al. (2001), where they asked individuals to remember and visualize an interaction with their parents that contained elements of security, anxiety, or avoidance, and then visualize a person who had been in a severe accident and indicate the degree to which they felt a number of emotions related to empathy. Participants who were randomly assigned to recall an interpersonal

experience involving aspects of avoidance or anxiety reported lower empathic feelings compared to those who recalled a situation involving aspects of security. This is consistent with the idea that when feelings of security are not present and the attachment behavioral system remains active, behavioral systems dedicated to other functions like caregiving will operate less effectively. Overall, these results suggest that momentary feelings of attachment insecurity, and specific working models associated with attachment anxiety and attachment avoidance, can be effectively induced in the lab and can impact psychological processes in ways that are consistent with theoretical predictions.

Similar to findings involving security priming, there is somewhat mixed evidence on the moderating role of dispositional attachment orientations on the effect of experimentally induced insecurity. As an example, some studies have not found that trait attachment anxiety and attachment avoidance impact the effect of anxiety or avoidance primes on interpersonal expectations, general positive/negative affect, or specific feelings of empathy, depression, or anxiety, although main effects of trait attachment are still frequently found (Mikulincer et al., 2001; Rowe & Carenelley, 2003; Rowe et al., 2012). Mikulincer et al. (2001), however, observed that trait attachment avoidance predicted greater personal distress in response to a person in need after being primed with attachment anxiety, but not after being primed with attachment security. Additionally, the attachment primes in Green and Campbell (2000) were shown to have a stronger impact on exploratory interest among those high in attachment avoidance. The potential for dispositional attachment orientations to occasionally interact with experimental manipulations of insecurity reinforces the decision to include trait measures of attachment when looking at attachment processes in the current research.

In sum, attachment theory offers a rich framework for understanding interpersonal

relationships and broader psychological functioning throughout the lifespan. I will now turn to another important relationship that has traditionally received less attention than those within the interpersonal domain—namely, the relationship between individuals and the natural world.

### **Human–Nature Relations**

The natural environment has been the setting that humans have lived in for the vast majority of our evolutionary history; it is only recently that we have lived in cities and largely divorced ourselves from many of the common evolutionary pressures that faced our ancestors (Cronk, 1999; Diamond, 2012; Kelly, 1995). As Frumkin (2001) notes, “we have broken with long-established patterns of living rather late in our life as a species” (p. 235). Given this extensive evolutionary history, human psychology has likely been shaped by our interactions with the natural world and it is likely that humans have evolved psychological tendencies that would have increased our chances of survival in nature (Ulrich, 1983; Ulrich et al., 1991). Indeed, decades of research shows that fearful (biophobic) responses to common evolutionarily threats like snakes are developed relatively easily, while extinguishing these fearful responses is relatively difficult (see Öhman, 2009). Animal phobias and natural environment phobias are, in fact, two of the most common types of specific phobias that people suffer from (LeBeau et al., 2010).<sup>3</sup> Along with biologically prepared fear responses to threatening aspects of nature (Seligman, 1970, 1971), there is also suggestive evidence that people are predisposed to have pleasant (biophilic) reactions to natural stimuli that is nonthreatening and even conducive to survival. Research from environmental psychology consistently shows that people prefer scenes of nature over urban environments (Joye, 2007; Ulrich, 1993), especially when the natural

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<sup>3</sup> Consistent with predictions from attachment theory, when individuals are (subliminally) exposed to biophobic stimuli (e.g., an image of a snake), they are quick to seek out security in others who appear to be responsive and supportive (Beckes, Simpson, & Erickson, 2010).

environment has water present (e.g., Kaplan & Kaplan, 1989; Ulrich, 1981). Moreover, spending time in nature or simply viewing scenes of natural landscapes has been shown to boost positive emotions (McMahan & Estes, 2015), and promote physiological and psychological recovery from stressors (Berto, 2014). From a psycho-evolutionary perspective, biophobic responses help us avoid potential dangers in the natural environment, while biophilic responses encourage restoration and motivate approach behaviours that lead to further exploration of the environment (Ulrich et al., 1991). The biophilic aspect of human–nature interactions is alluded to in Wilson’s (1984) biophilia hypothesis, which argues that humans have an “innate tendency to focus on life and life-like processes” (p. 1), and Kaplan’s (1995) attention restoration theory, which views natural settings as particularly effective restorative environments due, in part, to their capacity to rather effortlessly engage our attention.

In contrast to this evolutionary history embedded within natural environments, modern lifestyles leave many of us physically separated from nature. More than half of the human population lives in cities where opportunities for nature contact are more limited (United Nations Department of Economic and Social Affairs, 2019), and more of our time that might have been spent outdoors in the past is being spent in front of the screens of our smartphones, tablets, computers, and televisions (e.g., Meeker, 2019). Indirect exposure to nature via these technologies is possible but increasingly rare as references to and portrayals of nature in cultural products like fictional books, song lyrics, and films have been on the decline since the mid-twentieth century (Kesebir & Kesebir, 2017; Prévot-Julliard, Julliard, & Clayton, 2014; Williams, Podeschi, Palmer, Schwadel, & Meyler, 2012). These trends, along with numerous others, are suggestive of an increasing physical disconnection between humans and nature, which has led some to argue that we are undergoing an ‘extinction of experience’ of nature (e.g., Miller,

2005; Pyle, 1993; Soga & Gaston, 2016). Beyond missing out on the multitude of physical and psychological benefits that nature contact can provide, this physical disconnection may be accompanied by a psychological disconnection from nature as well, which may make further deterioration of the health of our planet even more likely (e.g., Bragg, 1996; Howard, 1997; Louv, 2012; Naess, 1973; Roszak, 1992; Schultz, Shriver, Tabanico, & Khazian, 2004).

Despite this overall shift away from nature, the natural world remains an important part of many people's identity and lifestyle. There are clear, observable differences in how individuals relate to and interact with the natural world; some people have a stronger sense of connection to nature than others.

### **Nature as a Relational Partner**

Researchers have developed numerous scales to measure individual differences in people's relationship to nature. Table 1 briefly describes the most notable scales in this area, along with how some of the constructs were directly inspired by previous work on interpersonal relations. As one can discern from this table, many social psychological characteristics, processes, and experiences that arise in interpersonal relationships are also relevant to how people relate to and interact with nature. For instance, similar to how other individuals and social groups can contribute to our self-concept, so too can our relationship with nature be an important part of our identity (Clayton, 2003; Leary, Tipsord, & Tate, 2008; Nisbet et al., 2009; Schultz, 2001). Interestingly, people who include others in their self-concept to a greater degree are more likely to include aspects of nature in their self-concept as well (Leary et al., 2008; but see Moreton, Arena, & Tiliopoulos, 2019 and Zelenski & Nisbet, 2014 for more mixed findings). When someone or something is more central to our sense of self, outcomes that happen to the

Table 1

*Measures of Human–Nature Relationships*

Measure	Description	Link to Interpersonal Relations
Emotional Affinity Toward Nature (Kals et al., 1999)	16 items assessing feelings of freedom and safety in nature, feelings of oneness with nature, and love of nature.	Not explicitly based on previous constructs from interpersonal relationship research.
Inclusion of Nature in Self (Schultz, 2001)	One graphical item showing seven increasingly overlapping pairs of circles labelled “self” and “nature”. Respondents select pair of circles that best represents their relationship with natural environment.	Adaptation of Inclusion of Other in Self Scale that originally used circles labeled “self” and “other” (Aron, Aron, & Smollan, 1992). Greater inclusion of relational partner in one’s own identity reflects greater perceived closeness, intimacy, and interconnectedness in relationship.
Environmental Identity (Clayton, 2003)	24 items assessing 5 components of environmental identity: (1) identity salience (i.e., degree to which individual interacts with nature and personal importance of interactions), (2) self-identification (i.e., degree to which nature is incorporated into individual’s collective identity), (3) ideology (i.e., degree to which individual endorses proenvironmental viewpoint), (4) positive emotions derived from collective identity (i.e., degree of satisfaction and appreciation individual experiences when interacting with nature), and (5) autobiographical (i.e., degree to which individual has memories of experiences in nature).	Clayton (2003) views environmental identity as similar to other collective identities (e.g., ethnic group) that can provide “a sense of connection, of being part of a larger whole, and with a recognition of similarity between ourselves and others” (p. 46). Four of five components of environmental identity based on previous work on collective social identities.
Connectedness to Nature (Mayer & Frantz, 2004)	14 items assessing perceptions of belonging to and feeling kinship with natural world, viewing self as egalitarian member of nature, and thinking personal well-being is dependent on well-being of environment.	Mayer and Frantz (2004) explicitly mention relevance of social psychological research on self-expansion, interpersonal closeness, and empathy, but base scale more directly on literature from ecopsychology.
Connectivity with Nature	One graphical item similar to Inclusion of Nature in Self Scale and six items that contain statements	Dutcher et al. (2007) adopted a more sociological approach and construed connectivity with nature as

(Dutcher, Finley, Luloff, & Johnson, 2007)	about one's connectivity with nature (e.g., "I feel a sense of oneness with nature").	recognition that humans and nature are part of one community, which arises from an intuitive sense of sameness with natural world.
Allo-Inclusive Identity – Natural World (Leary et al., 2008)	Uses similar graphical presentation of overlapping circles as Inclusion of Nature in Self Scale, but asks degree to which eight animate and inanimate aspects of nature are included in self-identity instead.	Leary et al. (2008) view allo-inclusive identity as fourth aspect of identity that is not completely captured by individual, relational, or collective aspects of identity.
Commitment to Nature (Davis, Green, & Reed, 2009)	11 items assessing (1) psychological attachment to nature (e.g., "I feel strongly linked to the environment") and (2) long-term orientation toward natural world (e.g., "I am interested in strengthening my connection to the environment in the future").	Two components of commitment to nature based on previous work on commitment in interpersonal relationships (Rusbult, Olson, Davis, & Hannon, 2001). Influenced by interdependence theory (Van Lange & Rusbult, 2012).
Nature Relatedness (Nisbet et al., 2009)	21 items assessing identification with natural world (e.g., "My relationship to nature is an important part of who I am"), nature-oriented worldview (e.g., "The state of nonhuman species is an indicator of the future for humans"), and familiarity with and appreciation of being in nature (e.g., "My ideal vacation spot would be a remote, wilderness area").	Not explicitly based on previous constructs from interpersonal relationship research; more informed by writings of those primarily interested in human–nature relationships (e.g., Naess, 1973; Roszak, 1992).
Love and Care for Nature (Perkins, 2010)	15 items assessing (1) feelings of interest, wonder, and awe in nature (e.g., "I enjoy learning about nature"), (2) feelings of interconnectedness, emotional closeness, and love with nature (e.g., "I feel a deep love for nature"), and (3) feelings of responsibility, care, and commitment to protect nature (e.g., "I often feel a strong sense of care towards the natural environment").	Largely based on work in environmental ethics. Nevertheless, some of the work Perkins (2010) draws upon mentions importance of viewing nature as community which one belongs to for fostering proenvironmental orientation (i.e., Leopold, 1949/1987).
Connection to Nature Index (Cheng & Monroe, 2012)	16 items assessing (1) enjoyment of nature (e.g., "Being in the natural environment makes me feel peaceful"), (2) empathy for creatures (e.g., "I feel sad when wild animals are hurt"), (3) sense of oneness (e.g., "Humans are part of the natural	This index was developed to measure children's affective attitude toward nature. Cheng and Monroe (2012) based their index on existing adult measures of nature connectedness (e.g., Clayton, 2003; Kals et al., 1999; Mayer & Frantz, 2004) and

	world”, and (4) sense of responsibility (e.g., “My actions will make the natural world different”).	they explicitly discuss the importance of empathy, sympathy, emotional affinity, commitment, inclusion, and sense of community in human–nature relationships.
Dispositional Empathy with Nature (Tam, 2013b)	10 items assessing tendency to understand and share emotional experience of natural world (e.g., “I imagine how I would feel if I were the suffering animals and plants”).	Adaptation of Interpersonal Reactivity Index (Davis, 1983), one of the most popular measures of interpersonal empathy.

other entity are more likely to be seen as personally relevant and experienced as though it happened to ourselves (e.g., McFarland, Buehler, & MacKay, 2001). This has important implications for environmental sustainability: incorporating nature into one’s self-concept may be associated with greater concerns about environmental degradation as it not only harms the environment but threatens a significant aspect of the self as well (e.g., Leary et al., 2008; Martin & Czellar, 2016; Olivos & Aragonés, 2011; Schultz, 2001).

Beyond the influence that others can have in shaping our self-concept, we also rely on those around us for a sense of belongingness and community. Feeling like we fit in and are a part of a social group is a fundamental human need according to some (e.g., Baumeister & Leary, 1995; Maslow, 1943; Ryan & Deci, 2000). Several of the measures reviewed in Table 1 reveal that feelings of belongingness and community are an important aspect of the human–nature relationship as well (e.g., Dutcher et al., 2007; Mayer & Frantz, 2004). Indeed, the role of feeling a sense of belongingness to the wider natural community in fostering environmental concern and care is a long-standing idea among environmental thinkers. Leopold (1949/1987), for instance, wrote: “We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect” (p. viii). Empirical research backs up this intuition: measures that include items that assess feelings of

belongingness and a sense of community with nature predict more proenvironmental attitudes and behaviours (e.g., Mayer & Frantz, 2004).

Just as people can feel committed to their romantic relationship partners, Davis et al. (2009) argue that people can also be committed to nature. Regardless of the whether one is discussing commitment to nature or commitment to a romantic partner, both involve feeling psychologically attached/connected/linked to the relational partner, and having a long-term orientation where one envisions the relationship into the foreseeable future and considers how actions in the present might impact the relationship in the future (Davis et al., 2009; Rusbult et al., 2001). Both types of commitment are based on interdependence theory (Van Lange & Rusbult, 2012), which posits that commitment arises via increasing interdependence between relational partners where the well-being of each is dependent on the other. Within human–nature relationships, this interdependence can manifest in the physical and mental health benefits that individuals receive from nature (Capaldi, Passmore, Nisbet, Zelenski, & Dopko, 2015; Frumkin, 2001; Millennium Ecosystem Assessment, 2005), and the impact that individuals have on the natural world that can either promote its protection or degradation. Causal support for interdependence theory in the context of human–nature relationships comes from Davis et al. (2009), who showed that priming thoughts about the interdependence of human–nature interactions increases commitment to nature, as well as proenvironmental intentions and behaviours.

Empathy—taking the perspective of another person and experiencing their emotions as our own—is seen by many as having an important role in interpersonal relations and prosocial behaviours in particular (e.g., Baron-Cohen, 2011; Batson & Shaw, 1991; Hume, 1777/1966; Rifkin, 2009; but see Bloom, 2016 for the downsides of empathy). Some environmental scholars

have similarly argued for the crucial role of empathy in promoting proenvironmental concern and behaviours. Sobel (1999), for instance, stated that “we must begin in empathy, by becoming the animals before we can save them” (Para. 27). Supporting this contention, experimental research that asks participants to take the perspective of a harmed animal or forest has been shown to increase empathic feelings, moral reasoning, proenvironmental concern, and behavioural intentions to help the harmed entity and nature more generally (Berenguer, 2007, 2010; Schultz, 2000; Shelton & Rogers, 1981). Furthermore, some research has found that perspective taking and empathic concern are positively correlated with proenvironmental values, intentions, and behaviours (Schultz, 2001; Pfattheicher, Sassenrath, & Schindler, 2016; but see McIntyre, 2012 for more mixed findings), and a representative survey of almost 27,000 children found a positive association between empathy and nature connectedness (Whitten et al., 2018). Similar to how some people are more empathetic than others, there also appears to be individual differences in “the tendency to spontaneously take the perspective of certain natural entities in distress” and “share the distress of certain natural entities and experience compassionate feelings toward them” (Tam, 2013b, p. 95). Complementing the experimental findings discussed above, those higher in dispositional empathy with nature tend to have more proenvironmental attitudes, concerns, and behaviours (Tam, 2013b). Overall, these findings suggest that empathy is not restricted to human targets, but can be applied to, and have important consequences for, human relations with the natural world as well.

Finally, feelings of love in interpersonal relationships are highly valued (Buss et al., 1990), strongly associated with higher relationship satisfaction (Graham, 2011), and one of the best predictors of whether a couple will remain together or break up (Le, Dove, Agnew, Korn, & Mutso, 2010). Feelings of affection are not only displayed in interpersonal contexts, but can also

be experienced in relation to nature; a couple of the measures reviewed in Table 1 emphasize love as a key aspect of the human–nature relationship (Perkins, 2010; Kals et al., 1999). The importance of affection in human–nature interactions is even found in the word ‘biophilia’ itself, with its literal meaning of ‘life loving’ (Fromm, 1973). Not surprisingly, those who report feeling more love for nature tend to be the ones who are more willing to protect it (Kals et al., 1999; Müller, Kals, & Pansa, 2009; Tam, 2013a). Just as love can form the foundation of a caring and flourishing relationship with close others, so too can it inform our place in, and responsibility to, the wider natural environment that we find ourselves in.

Despite the differing backgrounds and conceptualizations of the measures listed in Table 1, many of the scales contain similar items and tend to be highly correlated with one another. The most comprehensive comparison of these measures was conducted by Tam (2013a), who had respondents simultaneously complete 9 out of the 11 questionnaires from Table 1 (the Connection to Nature Index and Dispositional Empathy with Nature Scale were not included). Exploratory factor analyses revealed that a common factor was able to explain most of the variance in these measures (i.e., 68-74%). Moreover, when controlling for this common factor, the individual measures had little to no incremental validity in predicting a variety of other constructs. Based on these results, Tam (2013a) concluded that the various measures “can be considered as markers of the same underlying construct” (p. 74). Taking this into account, I use the term ‘nature connectedness’ to inclusively refer to these overlapping constructs that all examine the strength of a person’s relationship to the natural world.

In summary, previous research suggests that there might be more similarities between interpersonal and human–nature interactions and relationships than one might initially assume. Given that nature can be experienced as a relational partner in many ways, it is plausible that

attachment orientations and processes might also play a role in how people relate to nature. Before I discuss this more in depth, it is important to consider why some people are more connected to nature than others.

### **Developing a Connection to Nature**

Direct experiences with the natural world and support from close others, especially during childhood, are commonly thought to play critical roles in the development of a proenvironmental orientation (e.g., Gifford, 2014; Kellert, 2002; Orr, 2004). Some support for this assertion comes from retrospective accounts in adulthood (see review by Chawla, 1998). For instance, when Tanner (1980) asked individuals working at environmental organizations like the Sierra Club what led them to dedicate their careers to conservation, almost three-quarters of them mentioned experiences interacting with natural spaces. Parents were also mentioned by around half of the respondents. Similar patterns have been found in subsequent research that asked environmental professionals to either describe the factors that influenced their attitudes about nature or their career choice (Chawla, 1999; Gunderson, 1989; James, 1993; Peterson, 1982; Palmer, 1993; Palmer et al., 1998; Sward, 1999). Outdoor experiences were noted by most environmental professionals, while close family members like parents were mentioned by a considerable portion as having a significant influence as well. Windhorst and Williams' (2015) interviews with undergraduate students about their childhood experiences in nature also revealed that those highly connected to nature were more likely than students who were relatively low in nature connectedness to report growing up near expansive natural places, and having families who encouraged nature contact and appreciation of the natural world. Broom (2017) similarly found that almost all the undergraduate students in her sample who indicated that they loved nature reported frequent positive experiences playing outside in nature during their childhood,

while those who had a more neutral view of nature revealed that they did not play in nature often during their childhood. Nature-based activities and close others (e.g., parents) were the two most commonly mentioned influences in Voloaca and Huta's (2016) interviews with highly nature connected undergraduate students too.

Along with these qualitative studies, quantitative research has also linked past and present nature contact with people's current commitment and connection to nature. Kals et al. (1999) showed that adults who reported spending a higher frequency of time in nature in the present and during their childhood tended to report greater emotional affinity toward nature, as well as greater interest in nature, compared to those who reported spending less time in nature (also see Cleary et al., 2018; Rosa, Profice, & Collado, 2018). Self-reported frequency of contact with nature during childhood and adulthood have been shown to be associated (Rosa et al., 2018; Thompson, Aspinall, & Montarzino, 2008); nevertheless, both remained significant predictors of emotional affinity toward nature even after Kals et al. (1999) statistically controlled for each. Thus, a personal history of time in nature in the distant and recent past appears to be important in the development and maintenance of a strong connection to nature. Tam (2013a) extended some of the findings from Kals et al. (1999) by showing that self-reported contact with nature in the present and during childhood were positively correlated with not just emotional affinity toward nature, but a wide range of measures that are all aimed at assessing people's connection with nature. Moreover, an even stronger relationship emerged between nature connectedness and recalled nature contact during childhood when Windhorst and Williams (2015) specifically asked young adults about positive childhood experiences in nature.

Analyses from Kals et al. (1999) also complement the qualitative research highlighting the role of close others in encouraging nature connectedness. Although past and present nature

contact were the strongest predictors, meaningful accompaniment by family members during experiences in nature in childhood and by partners, friends, or family members during experiences in nature in adulthood also significantly predicted a stronger emotional affinity and interest toward nature. Similarly, Cheng and Monroe (2012) found that children’s previous experience in nature and the perception of their family valuing nature were both correlated with a stronger connection to nature (also see Fränkel, Sellmann-Risse, & Basten, 2019 for additional correlational evidence that nature contact and nature connectedness is associated in children). These results suggest that human–nature relations do not exist in isolation, but occur within a broader social context that promotes or impedes a connection to nature. Relational partners that encourage, model, and reinforce appreciation for nature and experiences therein appear to be an important factor in understanding why some people are more connected to nature than others. Given the important role of close others, it seems reasonable to presume that the quality of these relationships and the interpersonal orientations of those within them might also have an influence on people’s experience of and connection to nature. In line with this, when extracting common themes underlying environmental activists’ stories concerning the role of close adults in encouraging a connection to nature, Chawla (2006) observes “that the quality of the relationship that they shared with this adult as a child was as important as the quality of the relationship with nature that child and adult shared together” (p. 74). A (perceived) lack of support from one’s relational partner or an uneasiness with their presence and encouragement in general or while in natural spaces in particular may inhibit one’s “freedom to move about and engage autonomously with natural areas” (Chawla, 2006, p. 71), and interrupt the psychological processes that lead people to feel more connected to nature. The transference of nature-oriented social norms and values may be a less effective route to greater nature connectedness when a close other is

(perceived to be) absent, inconsistent, restrictive, or unwelcome. Indeed, Whitten et al. (2018) found that children with fewer social supports at home, at school, and in their community tend to report being less connected to nature than children who have more social supports. Moreover, Musitu-Ferrer, León-Moreno, Callejas-Jerónimo, Esteban-Ibáñez, and Musitu-Ochoa (2019) found that adolescents who perceived their parents as having neglectful or authoritarian parenting styles were less connected to nature than adolescents who perceived their parents as having indulgent or authoritative (i.e., more accepting and involved) parenting styles.

Much of the research discussed above is limited in that it is cross-sectional and/or relies on retrospective accounts from adults, which may be inaccurate and biased (Raphael, 1987). Providing more convincing longitudinal evidence however, Evans, Otto, and Kaiser (2018) assessed the same individuals at age 6 and 18, and found that more time spent outside when six years old was associated with more proenvironmental behaviour when 18 years old. Moreover, proenvironmental attitudes and behaviours of participants' mothers (assessed when participants were six years old) was also associated with participants' proenvironmental behaviour when 18 years old. Although similar longitudinal studies with nature connectedness as the outcome of interest have not been published, there are other lines of research that offer additional evidence beyond just self-report measures of nature contact. For instance, Shanahan et al. (2017) found that aspects of nature connectedness are higher among people who live in areas with greater tree cover. Of course, people who have a stronger connection to nature may seek out areas to live in that provide greater opportunities for nature contact; in reality, the link between nature connectedness and nature contact is likely bidirectional and self-reinforcing. Nevertheless, nature connectedness among children, who presumably do not have much of a say in where they live, has been found to be higher when natural spaces are closer to their home (Cheng, 2008; Cheng &

Monroe, 2012; Stuart-Currier, 2016).

The aforementioned studies tend to conceptualize nature connectedness as fairly stable and trait-like; the measures listed in Table 1 are typically employed to assess between-person differences in nature-related thoughts, feelings, and actions. However, nature connectedness can also be construed as being more like a state, with feelings of connectedness varying within-person in different physical and temporal contexts.<sup>4</sup> Instead of asking about how people relate to nature in general, researchers have adapted some of the measures in Table 1 to assess how people currently relate to nature. Several experimental and large-scale intervention studies show that nature experiences can lead to increased momentary feelings of connectedness with nature. Mayer, Frantz, Bruehlman-Senecal, and Dolliver (2009) found that spending 10-15 minutes walking in a nature preserve and even just watching a video of that same walk caused undergraduate participants to report higher present feelings of nature connectedness compared to other students who either walked downtown or viewed a video of a busy urban area. Viewing a six-minute slideshow of photographs of the countryside was shown to boost feelings of nature connectedness among university students in Richardson and Sheffield (2015), while Soliman, Peetz, and Davydenko (2017) similarly found that viewing a four-minute video of natural landscapes on a computer screen or through a head-mounted display led to higher state nature connectedness than viewing a video of built environments. The positive effect of nature contact on nature connectedness has been observed in children as well: Dopko, Capaldi, and Zelenski (2019) found that elementary school children reported a closer connection to nature and a greater willingness to engage in proenvironmental actions after a four-hour field trip to a forest school

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<sup>4</sup> Nevertheless, consistent with the density distribution model of personality (Fleeson, 2001; Fleeson & Gallagher, 2009; Fleeson, Malanos, & Achille, 2002), those who are higher in trait nature connectedness tend to report higher levels of state nature connectedness as well (e.g., Mayer et al., 2009).

vs. a field trip to an aviation museum.

Beyond isolated experiences of nature, frequent exposure to nature appears to have a similar effect on trait levels of nature connectedness. A two-week intervention study by Passmore and Holder (2017) found that undergraduate students who were randomly assigned to pay attention to and photograph natural settings and elements in their everyday life reported greater connectedness with others and nature compared to students in the control conditions. Similar increases in nature connectedness have been observed in the context of interventions with community members who sign up to participate in month-long challenges to spend more time engaged in nature-based activities (e.g., the 30x30 Challenge by the David Suzuki Foundation; Nisbet, 2013, 2014, 2015; Richardson, Cormack, McRobert, & Underhill, 2016). Overall, these findings suggest that nature contact is a viable and important route to developing a strong connection to nature. That social relationships can be important as well further highlights the potential relevance of attachment theory when attempting to understand human–nature relationships.

### **Integrating Attachment Theory and Human–Nature Research**

The two literatures reviewed above on attachment theory and human–nature relations come from largely distinct areas of psychology and, with a few notable exceptions, have had a limited influence on each other up to this point in time. Nevertheless, this separation does not appear to be due to any irreconcilable differences in underlying theoretical perspectives or propositions; in fact, the surrounding environment is an important, yet often overlooked, feature in attachment theory, and both literatures take an evolutionary approach to explain the development and maintenance of their respective psychological orientations and processes. Thus, as Wilson (1999) has argued about the modern state of research more generally, “the ongoing

fragmentation of knowledge” in these areas are likely “not reflections of the real world but artifacts of scholarship” (p. 8). Along with the narrower goal of trying to understand some of the psychosocial antecedents of nature connectedness, this dissertation, more broadly, is an attempt to apply what Cosmides, Tooby, and Barkow (1992) refer to as conceptual integration (i.e., the principle that diverse areas of knowledge should be compatible with another) or what Wilson (1999) refers to as consilience (i.e., the idea that knowledge can be unified “by the linking of facts and fact-based theory ... to create a common groundwork of explanation”, p. 8) to these previously disconnected lines of inquiry.

### **Behavioural Systems**

At its broadest level, attachment theory not only describes the causes and consequences of how we relate to others, but also how we relate to ourselves and the world around us. Along with the aforementioned attachment and caregiving behavioural systems, Bowlby (1969/1982) posited that there were several other systems dedicated to other functional behaviours like affiliation, sexual mating, and exploration. The exploratory behavioural system is relevant to human–nature relations as it is conceptualized as “an innate system aimed at investigating, manipulating, and mastering the environment” (Mikulincer & Shaver, 2016, p. 230), which happens to overlap with some of the basic ways listed by Kellert (1997) that humans value and relate to nature. A naturalistic way of relating to nature that involves the direct experience and exploration of nature, an ecologicistic-scientific way of relating to nature that involves knowledge and understanding of the natural world through systematic exploration and study, and even a utilitarian way of relating to nature that involves the utilization of natural resources for physical sustenance and security (along with several other ways that one can relate to nature; e.g., aesthetic) are all described by Kellert as reflecting “a range of physical, emotional, and

intellectual expressions of the biophilic tendency to associate with nature” (p. 26) that served adaptive functions throughout our evolutionary history. Nevertheless, Kellert also recognized that “their full expression ... depend on repeated exposure and social reinforcement before emerging as meaningful dimensions of human emotional and intellectual life” (Kellert, 1997, p. 26), echoing the findings reviewed earlier that support the important roles of nature contact and close others in the development of a strong connection to nature.

Although attachment researchers have operationalized exploration quite broadly and have attempted to apply it to a variety of contexts (e.g., work; Hazan & Shaver, 1990), there is a dearth of attachment research that has investigated exploration in the context of the natural environment. This is surprising given that Bowlby (1969/1982) emphasized that behavioural systems were selected for in response to pressures that would have been present in the environment of evolutionary adaptedness, which would have included challenges and opportunities associated with our ancestors being physically immersed in nature. From this perspective, behavioural systems dedicated to interpersonal attachment and exploration of the environment would have developed alongside one another, and the functioning of one system has likely evolved to be at least partially dependent on the other. A key proposition of attachment theory, in fact, is that behavioural systems do not operate in complete isolation from one another; as numerous studies that were discussed in the review of attachment theory illustrate, the (mal)functioning of one behavioural system can impact another. This is especially true of the attachment behavioural system as survival of the individual when faced with real or perceived danger needs to take precedence over less immediate goals like exploration (Mikulincer & Shaver, 2007; cf. Maslow, 1943). Thus, activation of the attachment behavioural system is thought to lead to the inhibition of other behavioural systems, while the successful deactivation

of the attachment behavioural system allows other behavioural systems to become active and function optimally.

Indeed, Bowlby (1969/1982, 1973) acknowledged the importance of the natural world in attachment theory by describing how it shaped and can still motivate security-seeking behaviours via biophobic responses that encourage avoidance of potentially dangerous aspects of nature. Specifically, he posited that common triggers that can activate the attachment behavioural system include environmental threats (e.g., predators) and natural cues of potential danger (e.g., loud noises), along with attachment-related threats (e.g., separation from an attachment figure). The probability of experiencing harm from some of these nonattachment-related threats are relatively low in the modern context, but they persist as potential triggers as they would have been especially relevant to survival in the context that humankind spent most of its evolutionary history in (i.e., as hunter-gatherers living off the land; Cronk, 1999; Diamond, 2012; Kelly, 1995). Within the human–nature literature, Kellert (1997) also describes these negativistic (biophobic) reactions as another basic way in which people relate to nature, and similarly argues that their adaptive function is to increase the security and safety of the individual. Without an attachment figure (or a highly accessible internalized working model) that provides a safe haven and sense of security when one is exposed to unpleasant aspects of nature however, the attachment behavioural system remains activated, and biophobic reactions may be prolonged and exaggerated in relation to the actual risk of harm. These unpleasant experiences could generalize to a more negative view and greater avoidance of nature overall, resulting in a greater physical and psychological disconnection from nature among those who are more insecurely attached in general or in the moment.

Being connected to nature does not require one to completely ignore or avoid the

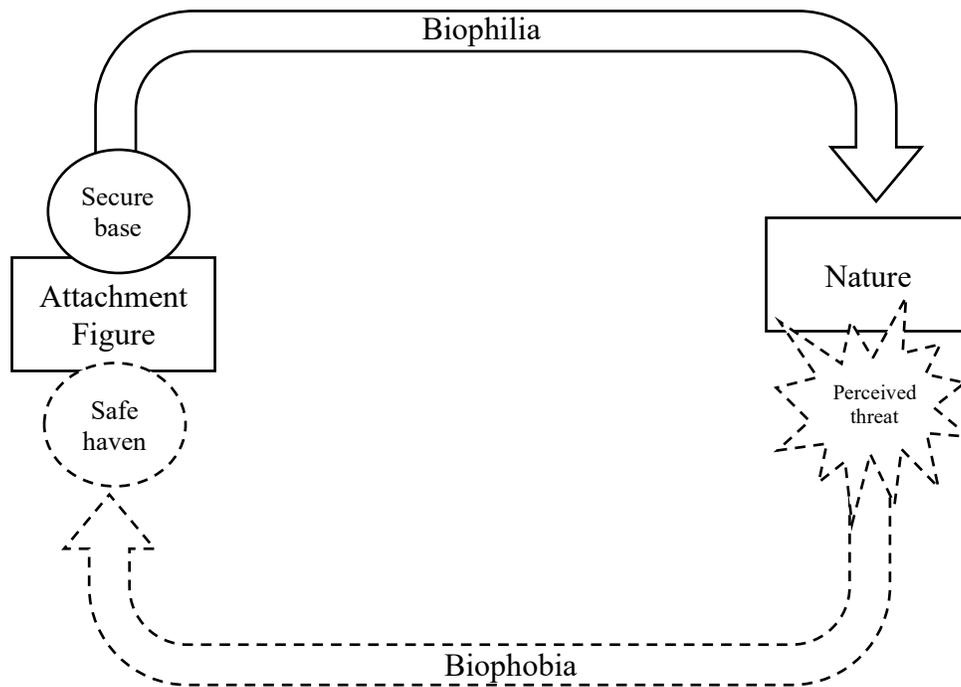
unpleasant aspects of nature; as Nisbet et al. (2009) explain, nature connectedness “is not simply a love of nature or enjoyment of only the superficially pleasing facets of nature” but “is also an understanding of the importance of all aspects of nature, even those that are not aesthetically appealing to humans (e.g., spiders and snakes)” (p. 718). Similarly, Kellert (1997) speculates that when negativistic reactions are not excessive or irrational (cf. phobias; LeBeau et al., 2010), they may also encourage a sense of deference and awe toward nature (see Joye & Bolderdijk, 2015 for evidence that fear and awe can be experienced simultaneously in response to certain types of nature). This nuanced view and response to the unpleasant aspects of nature might be more likely to materialize when people have a sense of security and a safe haven that they can rely upon.

Beyond the psychological processes that might push people away from nature, opposing forces that pull people toward the natural world can also be understood from an attachment perspective that is informed by the literature on human–nature relations. Along with providing a safe haven in times of need, attachment figures can also provide a secure base from which people can confidently explore the surrounding environment knowing that they will be supported and protected if they encounter challenges or potential dangers (e.g., Hazan & Shaver, 1994). In contrast, if the attachment behavioural system remains active because its set-goal of security has not been realized, the exploratory behavioural system is less likely to become activated and exploratory behaviours will be impaired (e.g., Ainsworth et al., 1978). As Hazan and Shaver (1990) explain, “attachment needs are primary; they must be met before exploration can proceed normally” (p. 271). This may explain why supportive close others have been found to be an important predictor of a connection to nature (see previous section on developing a connection to nature), and why perceptions of safety in natural environments are boosted when people imagine being accompanied by family members or friends vs. being alone (Staats & Hartig, 2004).

Moreover, concerns about safety and a lack of social support have been identified as two major barriers preventing individuals from spending more time in nature (e.g., Kellert et al., 2017). These findings hint that attachment processes may have a role in the development and maintenance of human–nature relationships.

The exploratory behavioural system is described by Bowlby (1969/1982) as being typically activated by novel and/or complex stimuli. As discussed in attention restoration research, natural settings often contain rich and fascinating features that are effective at capturing people’s attention in a way that is rather effortless, and experiences in nature are frequently accompanied by a sense of being away (Kaplan, 1995). As natural spaces were the predominant physical environment for the exploratory behavioural system to act upon for most of our evolutionary history and exploration of natural environments would have been essential for survival (e.g., scavenging and tracking animals for sustenance), it makes sense that natural environments and features would be particularly adept at capturing our interest and encouraging exploration. According to attachment theory, exploration of the natural environment should be even more likely when one feels a sense of security and has a secure base that they can expand from.

Figure 1 illustrates the attachment and exploration processes outlined above, revealing how interactions with attachment figures and nature might influence one another based on a behavioural systems approach. The two circles on the left side of Figure 1 indicate the two main functions of an attachment figure: (1) to provide a safe haven in times of need and (2) to provide a secure base from which to expand from. The two arrows indicate how biologically prepared responses to nature can either draw us closer to nature (i.e., biophilia) or push us away from nature when a threat is perceived (i.e., biophobia). Biophilia is theorized to activate the



*Figure 1.* A proposed model for how interactions with an attachment figure and interactions with nature may influence one another. The perceived threat and biophobia pathway are illustrated with dashed lines as they were not directly investigated in the current research.

exploratory behavioural system, while biophobia is theorized to deactivate the exploratory behavioural system and activate the attachment behavioural system instead. The biophilia arrow extending from the secure base represents the idea that attachment security needs to be achieved before exploration of the natural environment and the expression of biophilic tendencies can be prioritized and fully acted upon, while the biophobia arrow extending to the safe haven reflects the idea that responsive attachment figures (or a highly accessible secure working model) can comfort the individual if/when they experience unpleasant feelings or events in nature. The feedback loop that is incorporated into this figure suggests that attachment insecurity that leaves

one without a viable safe haven or secure base can interrupt and stall healthy interactions with the natural world. Thus, a behavioural systems approach leads to the prediction that attachment security should promote and be related to a stronger connection to nature, while attachment insecurity should hinder nature connectedness.

### **Nonhuman Attachments and the Correspondence/Compensation Hypotheses**

While the previous section focused on the exploratory behavioural system as the driver of human–nature interactions, it is possible that the attachment behavioural system might play a direct and vital role in shaping people’s relationship to the natural world as well. Just as individuals develop bonds to other people, individuals can also develop a cognitive and emotional connection to nature (see earlier section on nature as a relational partner). As previously discussed, many characteristics, processes, and experiences that manifest in interpersonal relationships have been successfully applied to understand people’s relationship with nature. If nature can be construed and experienced as a relational partner in some ways, it seems reasonable to presume that attachment orientations and processes might extend to human–nature relations. For instance, the working models that are most accessible in people’s minds in general or in particular circumstances might influence their thoughts, feelings, and actions toward others and toward nature in a similar manner (e.g., individuals who are uncomfortable with closeness and interdependence in their close interpersonal relationships might also be reluctant to feel close and interdependent with nature).

Although attachment theory has largely been ignored within the literature on human–nature relations, it has been used to understand other relationships that people regularly have with nonhuman targets (Keefer et al., 2014). Applications of attachment theory to religion and people’s relationship to a higher power, for instance, have shown that the nonreligious tend to

score higher on attachment avoidance compared to those who identify as religious (see Granqvist & Kirkpatrick, 2008). Among the religious, those higher in interpersonal attachment avoidance also tend to be more avoidantly attached to God (i.e., they are less comfortable depending on and being emotionally intimate with God; Beck & McDonald, 2004). Moreover, some research extending attachment theory to human–pet relationships has found that those who are more avoidantly attached tend to have more insecure relationships with their pets (Brown & Symons, 2016; Konok et al., 2015; Zilcha-Mano, Mikulincer, & Shaver, 2011, 2012; but see Beck & Madresh, 2008; Smolkovic, Fajfar, & Mlinaric, 2012; Quinn, 2005). Chronic deactivation of the attachment system might not only impair the formation and maintenance of close relationships with other people, but also make it more difficult to form and maintain a hardy connection with other external targets, including the natural world. This general pattern of results is consistent with what researchers in this area refer to as the correspondence or matching hypothesis, where people’s nonhuman attachment styles are congruent with their attachment orientation in interpersonal relationships (Granqvist, Mikulincer, & Shaver, 2010; Zilcha-Mano et al., 2011). This hypothesis predicts that individuals whose interpersonal relationships are characterized by insecurity (i.e., high avoidance and/or anxiety) will also be insecure in other types of relationships, while those who are secure in their relationships with other people will also report low levels of avoidance and/or anxiety in their nonhuman relationships (e.g., with God; Kirkpatrick, 2005). In this way, dominant internal working models are applied across different domains, as posited in the previous paragraph.

Researchers have also investigated how attachment anxiety might influence nonhuman relationships. Attachment anxiety has been linked with stronger attachments to objects like mobile phones (Hooley & Wilson-Murphy, 2012; Keefer, Landau, Rothschild, & Sullivan, 2012;

Konok, Gigler, Bereczky, & Miklósi, 2016),<sup>5</sup> while increased feelings of security has been shown to reduce the value people place on their possessions (Clark et al., 2011). Individuals who are more anxiously attached are also more likely to form and rely upon one-sided, parasocial relationships with figures in the media like fictional television characters (Cole & Leets, 1999; Greenwood, Pietromonaco, & Long, 2008). Thus, having a hyperactive attachment system might motivate individuals to not only obstinately pursue closeness and intimacy with other people in their life, but with other targets as well. At an initial glance these results may be seen as being consistent with the compensation hypothesis, which predicts that nonhuman relationships will be relied upon for security when it is not being obtained interpersonally (Granqvist et al., 2010; Zilcha-Mano et al., 2011). However, despite attempts to achieve interdependence and security from other sources, the nonhuman relationships of those high in attachment anxiety still tend to be characterized by anxiety. Interpersonal attachment anxiety has been found to be significantly associated with being more anxiously attached to one's pet (i.e., worrying excessively about being separated from the pet and needing constant reassurance of the pet's love; Beck & Madresh, 2008; Brown & Symons, 2016; Zilcha-Mano et al., 2011, 2012) and, among the religious, being more anxiously attached to God (i.e., worrying about being abandoned or unloved by God, and being jealous of other people's relationship with God; Beck & McDonald, 2004). Furthermore, in the context of separation in parasocial relationships, individuals who are anxiously attached anticipate having a more intense negative reaction to their favourite character no longer being on television compared to those who are securely or avoidantly attached (Cohen, 2004). Thus, similar to findings involving attachment avoidance, the correspondence hypothesis seems to most accurately describe the experience of nonhuman relationships among the

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<sup>5</sup> In contrast, nature connectedness has been found to be negatively correlated with time spent on phone and problematic smartphone use (Richardson, Hussain, & Griffiths, 2018).

anxiously attached.

Perhaps most relevant to the current research is a related area of environmental psychology that is also focused on human–environment relations: place attachment (Altman & Low, 1992). Along with developing strong emotional bonds with family, friends, romantic partners, pets, media figures, and personal belongings, people also frequently become attached to meaningful locations (Keefer et al., 2014; Lewicka, 2011). The places that people become attached to can vary in scale, from a specific room, building, or park to a neighbourhood, city, or country (e.g., Cuba & Hummon, 1993; Laczko, 2005; Tuan, 1975). Like attachment figures, places that one is attached to can serve as safe havens in times of need and as secure bases that one can explore from (see Scannell & Gifford, 2014). Moreover, attachment to a specific place can generalize to other places of a similar type and become incorporated into one’s identity over time (Scannell & Gifford, 2010). Feldman (1990), in her work attempting to understand why some people prefer living in suburban vs. urban areas, referred to this as a ‘settlement identity’, while ‘generic place dependence’ was used by Stokols and Shumaker (1981) to label a similar construct. This generalization process might aid in understanding how a broad and inclusive connection with nature is developed. Just as early interactions with caregivers inform one’s expectations for subsequent close interpersonal relationships, initial interactions and possible emotional attachment to particular natural spaces might inform one’s working model of the self in relation to nature, and be extended to other natural spaces. This may explain why contact with natural environments consistently predicts higher levels of nature connectedness.

Despite similar terminology used to describe the connections people form with others and the connections people form with places, the interpersonal attachment and place attachment literatures developed separately from one another, and it is only recently that researchers have

begun to theoretically integrate and empirically investigate their potential linkages (Scannell & Gifford, 2014). The couple of studies that have been conducted on the topic thus far have generally found support for the correspondence hypothesis. McBain (2010), for instance, found that those who are insecurely attached in their close social relationships also tend to be insecurely attached to the place they consider their home. Scannell (2013) similarly found that those who are more anxious about their interpersonal relationship also tend to be more anxious about the place they are attached to (e.g., worrying about losing and not being supported by the place), while interpersonal attachment avoidance was positively related to place attachment avoidance (e.g., finding it difficult to be close to and depend on the place). Scannell also asked participants about the functions that place attachments might serve. Beyond those directly related to a safe haven (e.g., providing physical and psychological comfort) or secure base (e.g., supporting self-growth), another common reason people gave for seeking proximity to their attached place was to connect with nature. Interestingly, those classified as having a secure interpersonal attachment style were the most likely to mention connection to nature as one of the benefits of spending time in their attached place. This seems to hint that nature connectedness will be lower in those who are higher in attachment anxiety and/or attachment avoidance. Moreover, if attached places can serve as a safe haven and secure base, and if nature connectedness reflects a generalized attachment to natural environments, this suggests that people's motivation to connect with nature in times of security and insecurity may depend on how connected to nature they are in general. For this reason, the current research tested whether trait nature connectedness might play a moderating role.

One attempt to theoretically integrate the interpersonal attachment and place attachment literatures come from Morgan (2010), who proposed a model that is quite similar to the one

presented in Figure 1. Morgan's model, however, is narrower in scope in that it focuses solely on the functioning of behavioural systems in childhood, and attempts to explain how attachment to individual places are formed rather than how a connection to nature in general is developed. As such, the concepts of biophilia and biophobia are not explicitly accounted for in Morgan's model. Despite these differences, Morgan also sees the functioning of the exploratory behavioural system and the attachment behavioural system as interdependent as Bowlby (1969/1982) originally posited, with the exploratory behavioural system motivating individuals to explore and play in a physical environment, and the attachment behavioural system drawing individuals back to their attachment figure when unpleasant feelings or events are experienced in a physical environment. Through repeated positively valenced interactions with a place, Morgan posits that children form an internal working model of their relationship with the specific place and become attached to it. Like what is outlined in Figure 1, having a supportive and responsive attachment figure is expected by Morgan to encourage place attachment via the safe haven and secure base functions that they can provide. Although not mentioned by Morgan, nature connectedness could be considered a settlement identity, generic place dependence, or general working model of the individual in relation to nature that stems from a person's attachment to a specific natural place. Thus, Morgan's model and Figure 1 are overlapping, and consistent in their theoretical underpinnings and predictions concerning the interaction between interpersonal and human–nature relations.

Regardless of whether one primarily draws upon the writings of Bowlby or turns to contemporary research on nonhuman attachments, the above integration of the two literatures on interpersonal attachment and human–nature relations suggests that the correspondence hypothesis may be the most likely. Nevertheless, there are other important theoretical

perspectives and lines of research that might provide hints and converging/diverging predictions of how nature connectedness and interpersonal attachment might be related. Therefore, in the following sections, I discuss indirect evidence for the correspondence and compensation hypotheses that are not directly inspired by attachment theory and research.

### **Indirect Support for the Correspondence Hypothesis**

The correspondence hypothesis argues that security in interpersonal attachment will extend to other relationships. If this hypothesis is valid at the trait level, nature connectedness should be positively associated with attachment security (i.e., low attachment anxiety and low attachment avoidance). If the correspondence hypothesis is valid at the state level, motivations to connect with nature should be highest when people feel like they have a secure base to operate from. Research on personality, values, and well-being are discussed in this section as they provide initial evidence that indirectly suggests a potential concordance between interpersonal relationships and human–nature relationships.

#### **Personality**

Although a comprehensive investigation of the potential association between interpersonal attachment and nature connectedness is wanting, the existing research on the similar relationships these constructs share with broad personality traits (i.e., agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) offers some initial clues to how they might relate to one another.

Out of all the big five personality dimensions, neuroticism's relationship to interpersonal attachment has been investigated the most. Of the nearly 100 studies that have been conducted, the majority find that neuroticism is positively associated with attachment anxiety and attachment avoidance, although the association is more consistently found with attachment

anxiety than attachment avoidance (see Table 13.1 in Mikulincer & Shaver, 2016).

Agreeableness and extraversion—the two personality dimensions that are the most explicitly interpersonal in focus—are found to be negatively correlated with attachment anxiety and attachment avoidance in the majority of studies, although this pattern is more consistently observed for attachment avoidance than attachment anxiety (see Table 9.1 in Mikulincer & Shaver, 2016). Evidence for the association between interpersonal attachment orientations and the remaining two broad personality dimensions is less consistent however (see Table 8.2 in Mikulincer & Shaver, 2016). Around half of the studies that have measured conscientiousness and attachment orientations have found a significant negative relationship between this personality dimension and attachment insecurity, while the rest report null results. Moreover, although some studies have reported that openness to experience has a significant negative relationship with attachment anxiety and attachment avoidance, most have not found support for these associations. Nevertheless, looking beyond the broad dimension of openness to experience and examining narrower aspects of openness that are the more directly related to exploration appears to produce results that are more theoretically consistent (i.e., feeling like one has a secure base to explore from should lead people to be more open to experiences and ideas), particularly when it comes to associations with attachment avoidance. Individuals with a more avoidant attachment orientation tend to be less curious, more closed off to new ideas and perspectives, and lower in novelty seeking compared to those who are less avoidantly attached (Bourne, Berry, & Jones; 2014; Carnelley & Ruscher, 2000; Chotai, Jonasson, Hagglof, & Adolfsson, 2005; Lattifian & Delvarpour, 2012; Mikulincer, 1997). Further supporting theoretical predictions, the avoidantly attached generally report lower interest and willingness to engage in activities that involve exploration in one form or another (Green & Campbell, 2000;

Reich & Siegel, 2002; Wu & Yang, 2012). Attachment anxiety has also been found to predict reduced exploratory interests, albeit not within the social domain (Green & Campbell, 2000; Wu & Yang, 2012). Overall, attachment orientations and many personality traits appear to relate to one another in significant and meaningful ways.

Compared to the above research on attachment and personality, relatively less attention has been given to the personality correlates of nature connectedness. Nonetheless, the studies that have examined this topic suggest that nature connectedness and attachment security share similarities in their associations with some of the big five personality dimensions. In general, they have found that those who report a stronger connection to nature are more agreeable, conscientious, extraverted, and open to experience (Nisbet et al., 2009; Tam, 2013a; Zhang, Howell, & Iyer, 2014; Zhang, Piff, Iyer, Koleva, & Keltner, 2014). Nature connectedness' relationships with agreeableness and openness to experience tend to be moderate in magnitude, while its relationships with conscientiousness and extraversion tend to be small. In terms of the last major personality dimension, these studies either find no association between nature connectedness and neuroticism, or—when sample sizes are especially large—a negative correlation that is statistically significant but trivial in magnitude.

The similar patterns of relations that attachment security and nature connectedness have with some of the big five personality dimensions (i.e., agreeableness, extraversion, and certain aspects of openness to experience) argue in favour of the correspondence hypothesis, particularly at the trait level. Simultaneously, the similarities in some underlying personality traits highlight a potential issue for the proposed theoretical interactions between attachment (in)security and human–nature relations. That is, nature connectedness may not be associated with attachment orientations because of the interplay between behavioural systems or the application of relational

working models to one's relationship with the natural world, but simply due to shared personality characteristics that underlie both orientations. In other words, personality might be a third confounding variable that explains the associations of interest. For this reason, it is important to assess personality traits, alongside interpersonal attachment orientations and nature connectedness, to account for shared variance and determine whether relationships between the constructs of interest are still present when personality is controlled for. By doing this, one can have more confidence that personality is not able to completely explain the association between these constructs (but see Westfall & Yarkoni, 2016 for limitations with this statistical approach). This is in line with recommendations from Donnellan et al. (2008) after they found evidence for the shared genetic influences that partly explain some of the association between attachment orientations and the big five personality dimensions. These researchers emphasize the “need to exercise great care when interpreting associations between dimensions of adult attachment and psychosocial outcomes in the absence of controls for adult temperament or the Big Five” and that “routinely including personality variables in adult attachment research ... will help clarify the relations among attachment, personality traits, and important outcomes” (Donnellan et al., 2008, p. 13).

It is important to mention, however, that when the big five personality dimensions are assessed and controlled for in studies, interpersonal attachment orientations still tend to predict relevant constructs in a theoretically consistent manner (Mikulincer & Shaver, 2007). For instance, attachment anxiety and attachment avoidance emerge as the strongest predictors of relationship quality when the two interpersonal attachment orientations and the big five personality dimensions are concurrently entered as predictors in multiple regression analyses (Nofle & Shaver, 2006). This supports the unique and important contribution that an attachment

perspective can provide in understanding interpersonal relations and human functioning more broadly. Although they are related, attachment orientations are not redundant or completely captured by the big five personality factors. Thus, it is not unrealistic to expect that attachment orientations might predict nature connectedness and desires to connect with nature, over and above the five broad personality dimensions.

### **Well-Being**

Another aspect of human functioning that has been investigated by attachment researchers and environmental psychologists alike is well-being. Various definitions and operationalizations of well-being abound (Huta & Waterman, 2014), but one of the most common and influential approaches focuses on the concept of subjective well-being, which typically includes life satisfaction, positive affect, and negative affect (Diener, 2009).

Meta-analyses by Capaldi et al. (2014) and Pritchard et al. (2019) both found that individuals who have a stronger connection to nature tend to report higher positive affect, life satisfaction, and vitality compared to those who are less connected to nature. Nature connectedness' association with negative affect was not tested in these meta-analyses, but many of the studies that have investigated overall levels of negative affect and individual differences in nature connectedness do not find support for a relationship in either direction (Aitken, 2013a, 2013b; Capaldi et al., 2017; Mayer et al., 2009; Nisbet et al., 2011; Okvat, 2011; Zelenski & Nisbet, 2014; but see Wolsko & Lindberg, 2013 for evidence of a significant negative association). However, evidence of an association with nature connectedness appears to emerge when narrower negative emotional constructs are considered. Martyn and Brymer (2016) reported that nature connectedness tends to be negatively associated with anxiety at both the trait and state level. The nature connected were also found to have lower anxiety in Lawton, Brymer,

Clough, and Denovan (2017), as well as lower anxiety and anger, and fewer depressive symptoms in Ginting, Näring, Kwakkenbos, and Becker (2015; but see Dean et al., 2018 for less supportive evidence). Another meta-analysis by McMahan and Estes (2015) examined the emotional impact of brief nature contact and found that spending time in natural environments or simply viewing virtual representations of nature (e.g., photographs of natural landscapes) leads to higher positive affect and lower negative affect. Similarly, MacKerron and Mourato's (2013) experience sampling study showed that people tend to be happier when they are in natural (vs. urban) environments, while White, Alcock, Wheeler, and Depledge (2013) found that people are more satisfied with life when they live in greener areas. In general, these findings suggest that physical and psychological closeness with nature are conducive to subjective well-being.

In the attachment literature, attachment security has been found to be significantly correlated with positive affect (Deniz & Işık, 2010; Wearden, Lambertson, Crook, & Walsh, 2005); attachment anxiety and attachment avoidance predict lower levels of positive emotions (Landen & Wang, 2010; Palmer & Gentzler, 2018; Wei et al., 2011). Moreover, both interpersonal attachment orientations show negative associations with life satisfaction (Deniz & Işık, 2010; Landen & Wang, 2010; Lavy & Littman-Ovadia, 2011; Wei et al., 2011). The fact that nature connected and securely attached individuals are happier in general hints that there might be correspondence between these constructs at the trait level. One reason why the insecurely attached are lower in subjective well-being might be due to how they tend to respond to positive events and emotions. In particular, people who are higher in attachment anxiety and attachment avoidance are less likely to savour positive experiences, and are more likely to minimize positive events and dampen/underestimate the resultant positive emotions (Gentzler & Kerns, 2006; Gentzler, Kerns, & Keener, 2010; Goodall, 2015; Palmer & Gentzler, 2018). This

could have implications for human–nature relations and interactions if the positive emotions that are typically elicited during nature contact experiences are down-regulated in the moment and recalled less favourably by those who are more insecurely attached. These circumstances could lead to decreased interest and willingness to spend time connecting with nature given that experiences in nature may be (perceived as) less emotionally rewarding, which would also hint that the correspondence hypothesis may be valid.

In addition to positive affect and life satisfaction, over eighty studies have assessed interpersonal attachment dimensions and negative affect. Attachment anxiety is almost always found to have a positive correlation with indexes of negative affect (see Table 13.2 in Mikulincer & Shaver, 2016), while attachment avoidance is found to predict greater emotional distress in around two-thirds of the studies. Similar patterns are observed when the relations of these attachment orientations are examined with regards to anxiety and depression (see Tables 13.3 and 13.4 in Mikulincer & Shaver, 2016). At the state level, threats to attachment security and interpersonal threats more generally lead to higher negative affect, including greater feelings of anxiety (e.g., Carnelley et al., 2016; Gerber & Wheeler, 2009). This effect appears to be especially pronounced for those who are high in attachment anxiety or attachment avoidance (Dewitte, De Houwer, Goubert, & Buysse, 2010). That attachment insecurity is linked to worse affective functioning, while interactions with nature (and nature connectedness) are linked to improved affective functioning, seems to be at odds with the compensation hypothesis and more in line with the correspondence hypothesis.

The lower levels of positive affect and the higher levels of negative affect associated with attachment insecurity might actually reduce willingness to spend time in nature, and the ability and likelihood of developing a connection to nature. Some emotion researchers emphasize the

role of positive emotions in motivating approach behaviours and negative emotions in motivating avoidance behaviours (e.g., Cacioppo & Berntson, 1999; Watson, Wiese, Vaidya, & Tellegen, 1999). When positive affect is experienced, individuals are more willing and likely to engage with their environment, while experiencing negative emotions inhibits this engagement (e.g., Carver & White, 1994; Cunningham, 1988; Gnoth, Zins, Lengmueller, & Boshoff, 2000; Kahn & Isen, 1993; Reschly, Huebner, Appleton, & Antaramian, 2008; Roseman, 2008; Whelan & Zelenski, 2012). Thus, for those high in attachment anxiety and/or attachment avoidance, or when attachment insecurity is salient, increased negative affect and decreased positive affect might discourage exploration of the natural world and reduce interest in connecting with nature. Similarly, the broaden-and-build theory (Fredrickson, 2001) argues that positive emotions broaden the way people think and act, while negative emotions narrow them. For instance, positive affect has been shown to promote more inclusive and holistic cognitive processes (Fredrickson & Branigan, 2005; Isen & Daubman, 1984), such as a sense of self that is more likely to include others (Waugh & Fredrickson, 2006). This broader sense of self in response to positive affect may also involve greater inclusion of the natural world into one's identity. Moreover, the ability of positive affect to promote holistic thinking may lead to greater recognition and appreciation of the interconnectedness of humans with the wider natural world. As Leong, Fischer, and McClure (2014) explain, holistic thinking emphasizes “the interconnectedness of interactions between objects/people and their surroundings”, while analytic thinking emphasizes “linear analysis of an object which is in isolation from any related factors” (p. 58). When researchers examined the cognitive styles of the nature connected, they found that nature connectedness was associated with more holistic (vs. analytic) thought patterns (Leong et al., 2014).

Along with subjective well-being, some researchers also include functioning well in the social domain as another key aspect of well-being (e.g., Keyes, 1998; Ryff, 1989; World Health Organization, 2006). Keyes (1998) argues that social well-being is made up of five dimensions: social acceptance (i.e., believing that others are good and trustworthy), social actualization (i.e., believing in the progress of society), social coherence (i.e., feeling like one understands the social world), social contribution (i.e., feeling like one is a contributing member of society), and social integration (i.e., feeling part of society). Attachment anxiety and attachment avoidance have been linked to impairments across all five dimensions of social well-being (e.g., Akirmak, 2014; Bauminger, Finzi-Dottan, Chason, & Har-Even, 2008; Chisholm, 1999; Collins & Read, 1990; Feeney & Collins, 2001; Givertz, Woszidlo, Segrin, & Knutson, 2013; Karantzas, Feeney, Goncalves, & McCabe, 2014; Mikulincer & Shaver, 2016; Molinari, Speltini, Passini, & Carelli, 2016; Raque-Bogdan, Ericson, Jackson, Martin, & Bryan, 2011; Rood, 2000; Temple, 2013). This contrasts with the pattern of associations found between broad measures of social well-being and nature connectedness. In particular, several studies have shown that people who have a stronger connection to nature tend to report higher social well-being than those who are not as connected to nature (Capaldi et al., 2017; Howell, Dopko, Passmore, & Buro, 2011; Howell, Passmore, & Buro, 2013; but see Nisbet et al., 2011 and Windhorst & Williams, 2015 for nonsignificant findings). Moreover, the meta-analysis by Pritchard et al. (2019) found evidence for a positive association between nature connectedness and positive relations with others. Given the detrimental impact of attachment insecurity on social functioning and subjective well-being, these findings suggest that a positive relationship between nature connectedness and attachment anxiety/avoidance may be unlikely.

## Values

The well-established literature on human values allows for additional speculation on the potential links between orientations toward others and nature. The degree to which people value unity with and protection of nature is included in one of Schwartz' (1992, 1994) ten basic values, namely, universalism. This basic value not only includes prioritization of the welfare of nature, but also includes concerns about the welfare of all people (i.e., social justice, equality, and world peace). Benevolence, another basic value that more narrowly focuses on the well-being of one's ingroup, is related to universalism as they are both other-oriented and emphasize self-transcendence over self-enhancement (cf. values of achievement and power; Schwartz, 1992, 1994, 2005; Schwartz & Boehnke, 2004). This research tells us that people who place greater importance on nature also prioritize the well-being of other people close to them and in general, which could be considered indicators of a well-functioning caregiving behavioural system supported by a secure interpersonal attachment. Not surprisingly, measures of nature connectedness have been found to strongly correlate with universalism (Clayton, 2003) and with self-transcendent values in general (Tam, 2013a).

More direct evidence of the impact of interpersonal attachment on prosocial and pro-nature values comes from Mikulincer et al. (2003). Across three studies, higher attachment avoidance predicted lower endorsement of universalism and benevolence values; attachment anxiety, in contrast, was not a significant predictor of either value. Mikulincer et al. explain these diverging findings by noting that the (negative) working model of others reflected in attachment avoidance may be more relevant for these other-oriented values than the (negative) working model of the self that underlies attachment anxiety. Along with examining how chronic interpersonal attachment orientations relate to universalism and benevolence values, the three

studies also investigated how feeling secure in the moment can influence self-transcendent concerns. Mikulincer et al. experimentally manipulated attachment security by having participants think about a time when they received support from others or by having them view a picture that showed a person comforting someone in distress. Compared to participants in the neutral and general positive affect conditions, individuals who were primed with a secure base placed greater importance on universalism and benevolence. These findings suggest that chronic and contextual activation of attachment security may play a role in promoting a connection to nature. This still remains largely speculative, however, as specific values related to nature were not analyzed separately from the broader value of universalism. It is possible that the social concerns of universalism may completely account for the observed effects, although one could argue that this is unlikely given the high congruence these concerns have with concerns about nature. An additional note of caution stems from the low-powered designs used in Mikulincer et al. with experimental conditions only including 20 to 24 participants. In sum, the discussed research on values and attachment offer some preliminary hints for how interpersonal attachment orientations and processes might impact people's relation to nature, but further studies are needed to more directly and definitively test these links.

### **Indirect Support for the Compensation Hypothesis**

The compensation hypothesis posits that people will pursue stronger relationships with other targets when interpersonal attachment is insecure. Thus, if this hypothesis is valid at the trait level, nature connectedness should have a positive relationship with attachment insecurity (i.e., attachment anxiety and attachment avoidance). If the compensation hypothesis is valid at the state level, momentary threats to attachment security and attachment figure unavailability should increase people's willingness to connect with nature. The meaning maintenance model,

and research on ostracism and anthropomorphization are discussed below as they offer similar theoretical predictions and preliminary evidence for these compensatory relationships and processes.

### **Meaning Maintenance Model**

One reason why one might predict an inverse relation between interpersonal attachment and nature connectedness comes from the meaning maintenance model (Heine, Proulx, & Vohs, 2006). Proponents of this theory argue that humans have a need for meaning—we readily search for, identify, and strive to maintain coherence, predictability, and significance with ourselves, the external environment, and ourselves in relation to the external environment. When our sense of meaning is threatened by incongruent information in one of these domains, people will attempt to restore meaning within the same domain or in another domain entirely—a process that Heine et al. (2006) refer to as fluid compensation. For instance, people who receive critical feedback about one aspect of their personality will rate themselves more favourably on other aspects of their personality (Baumeister & Jones, 1978), an example of an attempt to restore meaning within the same domain. Moreover, research from the terror management literature finds that people will more strongly defend their ingroup and cultural worldview when they are reminded of their own mortality (Greenberg & Kosloff, 2008), an example of an attempt to restore meaning across domains.<sup>6</sup>

Both interpersonal attachment and nature connectedness concern the relation of the self to the external world. In the case of interpersonal attachment, it is to the surrounding social environment; in the case of nature connectedness, it is to the surrounding physical environment.

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<sup>6</sup> Although a meta-analysis of almost 280 experiments from the terror management literature found a fairly large effect of mortality salience on a range of relevant outcomes (Burke, Martens, & Faucher, 2010), there are reasons to be cautious about the robustness of (at least some of) the research on terror management theory (Klein, 2017; Yen & Cheng, 2013) and the meaning maintenance model (Porter & Davis, 2016; Ratner, Burrow, & Thoemmes, 2016).

Consistent with the meaning maintenance model, both nature connectedness and interpersonal attachment orientations have been linked to meaning. Those who report greater connectedness to nature also tend to report greater meaning and purpose in life (see meta-analysis by Pritchard et al., 2019), and spending time in nature has been shown to increase meaning (Hamann & Ivztan, 2016; Passmore & Howell, 2014a). Similarly, attachment security tends to be positively associated with meaning in life (Bodner, Bergman, & Cohen-Fridel, 2014; Mikulincer & Shaver, 2005; Lopez, Ramos, Nisenbaum, Thind, & Ortiz-Rodriguez, 2015; Reizer, Dahan, & Shaver, 2013), and preliminary research suggests that meaning is boosted when feelings of attachment security are experimentally induced (Mikulincer & Shaver, 2005).

If attachment security is threatened either chronically or contextually, however, the meaning maintenance model would predict that people would be more likely to turn to nature, if it is available, to regain and maintain a sense of meaning and connection with the external world. In this way, connectedness to nature would fulfill the “desire to avoid feeling alienated from the outside world” (Heine et al., 2006, p. 91). Thus, at the state level, feeling insecurely attached should promote a stronger desire to connect with nature than feeling secure; if meaning cannot be derived from close others in a certain circumstance then people should be motivated to derive it from another source that is accessible in that moment, such as the natural world. This greater desire to connect with nature might lead individuals who are chronically higher in attachment insecurity to actually spend more time in nature and, in turn, feel more connected to nature in general (see previous section on developing a connection to nature). From this perspective, at the trait level, attachment avoidance and attachment anxiety should be positively correlated with nature connectedness.

## **Ostracism**

A narrower body of research that fits under the meaning maintenance model is the work on ostracism. As scholars have noted since Aristotle, human beings are social animals, and we depend on each other in order to survive and thrive. Because of this, some have described the need to feel like we belong as a fundamental human motivation (e.g., Baumeister & Leary, 1995; Maslow, 1943; Ryan & Deci, 2000). Supporting this contention is research showing the diverse array of negative consequences associated with not having this need met, from dysregulated immune system functioning (e.g., Jaremka et al., 2013) to suicidal ideation (e.g., Christensen, Batterham, Soubelet, & Mackinnon, 2013). Given the importance of feeling like one belongs, threats to belongingness due to social exclusion can elicit strong negative emotional reactions (e.g., Baumeister & Tice, 1990) and aggressive responses toward others (e.g., Twenge, Baumeister, Tice, & Stucke, 2001), as well as attempts to restore belongingness with novel individuals who may potentially provide social connection (e.g., Maner, DeWall, Baumeister, & Schaller, 2007).

When people are ostracized and a sense of belonging is not available in the immediate social environment, connecting with nature may be an attractive alternative. This hypothesis is supported by initial research by Poon, Teng, Chow, and Chen (2015). In two experimental studies, the researchers randomly assigned some participants to feel ostracized by having them imagine themselves being ostracized by others in a hypothetical scenario or asking them to recall a personal experience where they had been ostracized. In a seemingly unrelated part of the study, individuals were asked how likely they would be to engage in a number of nature-related activities (e.g., planting flowers) if the opportunity arose or how connected to nature they wanted to be by completing a modified version of the Connectedness to Nature Scale (Mayer & Frantz,

2004). Compared to individuals who imagined being accepted by others in a hypothetical scenario or recalled a nonsocial negative experience (i.e., a time when they experienced physical pain), those who felt ostracized reported a greater willingness to engage in nature-related activities and a stronger desire to connect with nature. A similar finding was reported in Lovell (2010), where individuals who were randomly assigned to write about a personal experience where they had been ostracized reported feeling a stronger connection to nature (as measured by a state version of the Connectedness to Nature Scale; Mayer & Frantz, 2004) compared to those who simply wrote about a time when they failed within the intellectual domain (e.g., did poorly on an exam). In interpreting these findings, Poon et al. reasoned that people may turn to nature to minimize feelings of isolation and to regain a sense of belonging when interpersonal avenues to satisfy these needs are not available.

There is some evidence nature contact may be effective at buffering some of the negative effects associated with ostracism. Across three studies, Poon, Teng, Wong, and Chen (2016) either measured general feelings of ostracism or experimentally induced feelings of ostracism among a portion of participants by having them imagine being ostracized. The researchers then exposed participants to a series of images of natural environments or urban environments. They subsequently assessed people's willingness to act aggressively by asking them how they would respond to various anger-provoking scenarios, having them determine how long another participant should hold their hand in cold water for and how cold the water should be, or having them decide much hot sauce should be given to another participant and how spicy the hot sauce should be. Consistent with previous research (e.g., Twenge et al., 2001), when individuals viewed images of urban environments, those who reported higher overall levels of ostracism or were made to feel ostracized during the studies were more willing to behave aggressively (e.g.,

assign spicier hot sauce to another participant) than those who reported lower overall levels of ostracism or were not made to feel ostracized. In contrast, ostracism did not seem to increase aggressive behaviour among those who viewed images of natural environments, suggesting that even indirect exposure to virtual representations of nature can ameliorate some of ostracism's negative interpersonal effects by providing something beyond the self to which one can connect to and feel a sense of belonging with.

These findings on ostracism and human–nature interactions have interesting implications for the potential link between interpersonal attachment and nature connectedness. One of the defining characteristics of attachment anxiety is a strong fear of rejection, and hypervigilance to potential signs of rejection and abandonment (Baldwin & Kay, 2003; Baldwin & Meunier, 1999; Downey & Feldman, 1996; Khoshkam, Bahrami, Ahmadi, Fatehizade, & Etemadi, 2012; Taubman-Ben-Ari, Findler, & Mikulincer, 2002; Weeks, 2011). Those high in attachment anxiety also tend to have stronger negative reactions to being rejected and to relational conflict more generally (Besser & Priel, 2009; Campbell, Simpson, Boldry, & Kashy, 2005; but see Yaakobi & Williams, 2016 for null findings). Given this greater propensity to feel ostracized and to respond more strongly to it, those high in attachment anxiety may be more likely to turn to the natural world in an attempt to restore feelings of belongings and to try to buffer some the negative effects that can arise from (perceived) social exclusion. The natural world may be seen by them as being a place where they might be able to feel more interconnected with something outside of themselves without risking further rejection. From this perspective, nature might not only be a place for exploration, but may also serve as a safe haven when one is not immediately present within the social domain. Thus, in line with the compensation hypothesis, this area of research seems to suggest that attachment anxiety should be positively associated with nature

connectedness and that threats to attachment security should lead to greater motivations to connect with nature.

Contrasting the hyperactive nature of attachment anxiety, attachment avoidance is characterized by deactivation of the attachment behavioural system (Mikulincer & Shaver, 2007), and the conscious and unconscious avoidance of attachment-related experiences (Fraley, Garner, & Shaver, 2000; Fraley & Brumbaugh, 2007). With their strong drive to be self-reliant and independent, individuals high in attachment avoidance should exhibit less concern about being socially excluded and should be less likely to seek out a sense of belonging in the face of ostracism. Yaakobi and Williams (2016) tested these predictions in both individualistic and collectivistic cultures by randomly assigning a portion of participants to experience ostracism by being ignored in a virtual ball-tossing game called Cyberball (Hartgerink, van Beest, Wicherts, & Williams, 2015). Yaakobi and Williams found that being ostracized had less of a negative impact on people's mood, self-esteem, and sense of belonging and meaning if they were high in attachment avoidance.<sup>7</sup> Thus, motivation to seek out alternative sources of connection (e.g., with others or with nature) after experiences of ostracism may be diminished for the highly avoidant as they appear to be less perturbed by exclusion; the potential compensatory route to nature connectedness may be less available to these individuals. Based on the ostracism literature, nature connectedness' association with attachment avoidance might actually differ in direction from its speculated association with attachment anxiety, with higher attachment avoidance predicting lower nature connectedness and higher attachment anxiety predicting higher nature connectedness. The diverging reactions to ostracism by those high in attachment avoidance vs.

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<sup>7</sup> It is important to note that although individuals high in attachment avoidance may be less affected by acute experiences of social exclusion, persistent neglect of their belongingness needs does appear to be detrimental in the long-term. Attachment avoidance has been shown to predict a host of ill-being outcomes (e.g., loneliness, depression, and shame; Wei, Shaffer, Young, & Zakalik, 2005).

those high in attachment anxiety also highlights the importance of taking these two chronic attachment orientations into account in experimental research examining how feeling insecurely attached in the moment may promote or impede a connection to nature. While feelings of insecurity may increase desires to connect to nature among the anxiously attached, they may have no (or the opposite) impact on those with a more avoidant attachment orientation.

Although the described research on ostracism is suggestive, a more direct link to interpersonal attachment orientations and processes is needed. The studies by Poon et al. (2015) and Lovell (2010) investigated social exclusion and rejection by others in general, but not necessarily by close others that one has formed an attachment to. Imagining being rejected by hypothetical others and recalling times when one was rejected by a nonattachment figure may be less threatening and have different psychological consequences compared to thinking about or experiencing rejection by a close other that one relies upon for a safe haven and secure base (Cleek, 2015; Leary, Springer, Negel, Ansell, & Evans, 1998; Sommer, Kirkland, Newman, Estrella, & Andreassi, 2009; cf. Nelson et al., 2013). As noted by Maxwell, Spielmann, Joel and MacDonald (2013), threats to belongingness via social exclusion should activate the attachment behavioural system and prompt proximity seeking efforts toward attachment figures, but research on ostracism has tended to ignore attachment theory and designed studies in a way that does not make the obtainment of felt security from an attachment figure a viable option. In this way, research on ostracism largely (and inadvertently) focuses on what happens when attachment insecurity is experienced and secondary attachment strategies must be relied upon. It is still unknown whether motivations to restore belongingness and security after social exclusion by an attachment figure is a more effective route to nature connectedness than feeling like one has a supportive, loving, and accepting attachment figure that can act as secure base. Moreover,

although there is initial evidence that threats to belongingness can motivate people to connect to nature and attachment orientations can moderate the effect of ostracism, no research has examined whether desires to connect to nature under conditions of insecurity might depend on attachment avoidance and anxiety, or trait nature connectedness.

I would also argue that the per-group sample sizes in previous studies investigating how human–nature relations intersect with experiences of ostracism should lead one to view these results with some caution. More specifically, the average of 33-39 participants per condition in Poon et al. (2015), Lovell (2010), and Poon et al. (2016) were likely underpowered study designs. Simmons, Nelson, and Simonsohn (2013) recommend that per-group sample sizes should probably consist of more than 50 individuals for most hypothesis testing in psychology as it takes a considerable number of participants to detect even seemingly obvious group differences. Moreover, to detect an average effect size in social psychology (i.e.,  $d = .43$ ; Richard, Bond, & Stokes-Zoota, 2003), per-group sample sizes of at least 86 are required to obtain statistical power of 80% (and this ignores the fact that some of the hypotheses in this area involve interactions, which tend to require even larger sample sizes for adequate statistical power; Maxwell & Delaney, 2004). Thus, along with more directly testing the potential link between attachment (in)security and nature connectedness, another goal of the current research was to do so by employing high-powered research designs so the obtained results can be interpreted with greater confidence.

### **Anthropomorphization**

As previously discussed, there are many ways in which nature can be construed as a relational partner. The capacity to form a meaningful connection with nature may be, in part, a reflection of a highly sensitive social cognitive system that causes us to readily attribute

intentionality and other human-like traits and behaviours to nonhuman targets (Barrett, 2004; Caporael & Heyes, 1997; Dennett, 1971; Gray & Wegner, 2010; Guthrie, 1997; Mithen, 1996; Urquiza-Haas & Kotrschal, 2015). Other animals are the most frequent nonhuman targets of anthropomorphization (Urquiza-Haas & Kotrschal, 2015), but people routinely anthropomorphize less animate natural objects (e.g., trees) and even broader aspects of nature as well (e.g., mountains, oceans, or the Earth; Tam, Lee, & Chao, 2013; Waytz, Cacioppo, & Epley, 2010). This is especially prevalent in many indigenous cultures, where the natural world tends to be viewed as animate, agentic, and intimately part of the social life of humans (e.g., Davis, 1993; Watts, 2013).

Although this capacity is theorized to have developed during our shared evolutionary history (e.g., Mithen, 1996; Gray & Wegner, 2010), individuals appear to differ in their willingness to attribute human characteristics and intentions to nonhuman targets (Waytz et al., 2010). This has important implications for sustainability as we are more likely to include entities within our circle of moral concern (Singer, 2011) when we perceive them as being capable of experiencing suffering and other phenomenological states (Gray, Gray, & Wegner, 2007). Individuals who are more willing to anthropomorphize nonhuman targets report greater concern for the environment, stronger intentions to engage in proenvironmental actions, and more frequent sustainable behaviours (Tam et al., 2013; Tam, 2014; Waytz et al., 2010). Moreover, environmental messaging that anthropomorphizes nature has been shown to increase feelings of connectedness with nature and proenvironmental intentions/attitudes (Tam, 2013b; Tam et al., 2013).

One of the main motivations that is thought to underlie anthropomorphization is the desire for social connection (Waytz et al., 2010). By anthropomorphizing nonhuman targets, it is

easier to view them as potential relational partners, and sources of social connection and support; those who are not obtaining these benefits from their relationships with others may be more likely to anthropomorphize nonhuman targets in order to satisfy their social needs. In support of this, individuals who are lonelier are more likely to ascribe human-like characteristics, such as consciousness and intentionality, to technological gadgets compared to those who are less lonely (Bartz, Tchalova, & Fenerci, 2016; Epley, Akalis, Waytz, & Cacioppo, 2008). Moreover, experimentally induced feelings of loneliness have been shown to lead to stronger beliefs in humanlike supernatural agents (e.g., ghosts and God) and a greater likelihood of describing a pet as possessing positive social characteristics (e.g., considerate; Epley et al., 2008). In contrast, priming thoughts about a supportive relationship partner appears to make people less likely to anthropomorphize technological products, suggesting that a relational orientation towards nonhuman targets is less attractive when one already feels socially connected with others (Bartz et al., 2016).

Given that the insecurely attached experience high levels of loneliness (see Table 9.6 in Mikulincer & Shaver, 2016) and are less satisfied in the relationships that they do have (e.g., Nettle & Shaver, 2006), one might expect attachment insecurity to predict an increased tendency to anthropomorphize, while greater attachment security should inhibit this tendency. Partial support has been found for these prediction in the few studies that have examined the link between interpersonal attachment and anthropomorphization. The aforementioned study by Bartz et al. (2016) that randomly primed half of their participants to think about a supportive relationship partner is directly based on an experimental manipulation used by attachment researchers to induce feelings of attachment security (Baldwin et al., 1996; Bartz & Lydon, 2004). This particular finding seems to argue in favour of the compensation hypothesis at the

state level in that people appear to be less motivated to construe nonhuman targets as viable relational partners when their social needs are already being met by close others.

Along with investigating momentary attachment processes, Bartz et al. (2016) also assessed interpersonal attachment orientations at the beginning of their study to see how chronic attachment patterns might be related to anthropomorphization tendencies. Attachment anxiety was found to predict greater anthropomorphization of technological gadgets and pets, while attachment avoidance was not a significant predictor. (Interpersonal attachment orientations did not moderate the effect of the attachment security prime on anthropomorphization, however.) Individuals who are anxious about their close relationships seem to be more prone to anthropomorphize nonhuman targets, perhaps in hopes of satiating their greater desire for intimacy and connection. As Bartz et al. (2016) speculate, the greater willingness to anthropomorphize could be explained by hyperactivation of the attachment behavioural system that characterizes attachment anxiety, and makes individuals high in this particular attachment orientation hypersensitive to social cues and opportunities for social connection. By perceiving nonhuman targets as possessing more humanlike capacities, the anxiously attached may be more motivated and likely to try to connect with nature as well. This is in line with the compensation hypothesis as these results suggest that greater insecurity in interpersonal relationships at the trait level, particularly in regards to attachment anxiety, might be related to a stronger connection to nature. Support for the compensation hypothesis is qualified, however, by the lack of association between attachment avoidance and willingness to anthropomorphize nonhuman targets. This finding suggests that the discomfort with closeness, prioritization of self-reliance, and overall deactivation of the attachment behavioural system that is characteristic of those high in attachment avoidance might disrupt processes that promote nonhuman relationships as well (i.e.,

anthropomorphization), unsatisfied social needs notwithstanding.

Findings from the second study in Tam (2015) largely complement the trait level results from Bartz et al. (2016). With the aim of investigating individual differences that might moderate the effectiveness of certain proenvironmental appeals, Tam assessed participants' interpersonal attachment orientations, and then had them view and evaluate environmental awareness posters that either did or did not anthropomorphize nature. Individuals high in attachment anxiety were especially receptive to the anthropomorphic message framing: they reported being more involved and persuaded, and liked the poster more when it anthropomorphized nature (e.g., a picture of the Earth with a frowning face saying "I am hot and hurt"). Individuals low in attachment anxiety, in contrast, had more positive impressions if they were randomly assigned to view a poster that did not anthropomorphize nature. These contrasting responses to the experimental manipulation were also observed in subsequent behavioural intentions, with individuals high in attachment anxiety reporting stronger intentions to engage in proenvironmental behaviours when they viewed posters that anthropomorphized nature. Similar to the findings from Bratz et al. (2016), attachment avoidance was not found to predict or moderate any of the outcomes of interest. Overall, the results from Tam arguably reinforce the notion that the anxiously attached are motivated to view nonhuman targets, including nature, as a social agent, which seems to lend credence to a potential compensatory role of nature connectedness among this group of insecurely attached individuals. The null findings involving attachment avoidance in the aforementioned studies, however, may hint that the same compensatory processes might not manifest for individuals who possess this type of attachment insecurity; a relatively weak or negative association between attachment avoidance and nature connectedness may be more likely according to anthropomorphization research. Thus, support for the compensatory

hypothesis vs. the correspondence hypothesis from this area of work can be considered mixed at the trait level.

### **Preliminary Investigation of the Link Between Attachment and Nature Connectedness**

The only previous instance I am aware of where researchers have simultaneously measured interpersonal attachment and nature connectedness is in Study 2 of Zelenski and Nisbet (2014). Interested in testing whether feeling connected in general accounts for the association between nature connectedness and happiness, the researchers recruited a sample of 204 Americans from Amazon’s Mechanical Turk to fill out an online survey containing a number of questionnaires, including an adapted version of the attachment questionnaire by Hazan and Shaver (1987) and the Nature Relatedness Scale by Nisbet et al. (2009). The results from Zelenski and Nisbet showed that individuals who had a more secure attachment style tended to have higher overall nature connectedness scores, but the zero-order correlation was trivial in magnitude and not statistically significant,  $r(196) = .07, p = .35$ .<sup>8</sup>

Nevertheless, there are a couple reasons why one should be cautious in inferring too much from this finding. One concern with the version of the questionnaire used by Zelenski and Nisbet (2014) is that it only allowed for one of two responses to each of the statements (i.e., *mostly true* or *mostly false*). This restriction in the variability of possible responses by participants could have reduced reliability and validity, and made it more difficult to detect a relationship between the constructs of interest (see Krosnick & Fabrigar, 1997). Including a wider range of response options, like more recent attachment questionnaires (e.g., Brennan et al.,

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<sup>8</sup> Although all 21 items of the Nature Relatedness Scale were assessed in Study 2 of Zelenski and Nisbet (2014), the researchers calculated overall nature connectedness scores by only averaging the six items included in the short-form version of the scale (i.e., the NRS-6; Nisbet & Zelenski, 2013). To make the findings from my reanalysis directly comparable to what was published, I mainly focus on the NRS-6 results when reporting/discussing how overall nature connectedness scores are correlated with attachment anxiety and attachment avoidance. Nevertheless, to be comprehensive, I also report on page 71 the correlations between the two attachment subscales and overall nature connectedness when all 21 items are used.

1998; Collins, 1996; Feeney, Noller, & Hanrahan, 1994; Fraley, Waller, & Brennan, 2000; Griffin & Bartholomew, 1994; Simpson, Rholes, & Phillips, 1996), would allow for more nuanced answers from participants and provide the opportunity for the continuous nature of attachment (Fraley & Spieker, 2003; Fraley & Waller, 1998) to be reflected in responses to each of the items. Another limitation is that the authors combined the three subscales of attachment anxiety, avoidance, and security into one overall score of healthy attachment. This could have obscured the true relationship as results from a variety of studies (e.g., factor analyses) tend to suggest that two dimensions—frequently labeled attachment anxiety and attachment avoidance—underlie attachment orientations, not one (e.g., Ainsworth et al., 1978; Brennan et al., 1998; Fraley et al., 2000; Sibley & Liu, 2004; Simpson, 1990).

#### **Reanalysis of Zelenski and Nisbet (2014)**

In an attempt to address this last potential shortcoming, I reanalyzed data from the second study of Zelenski and Nisbet (2014). Instead of averaging all the items into one general measure of healthy attachment, two subscales of attachment anxiety and attachment avoidance were calculated (see Appendix A for more details). As one would expect, the trait attachment avoidance and trait attachment anxiety subscales were negatively associated with the one-dimension measure of healthy attachment from Zelenski and Nisbet (2014),  $r(196) = -.87, p < .001$  and  $r(196) = -.57, p < .001$ , respectively. The two subscales also shared a small but statistically significant positive association with one another,  $r(202) = .17, p = .02$ , which is similar in magnitude to the association that is typically found between anxiety and avoidance in the attachment literature (Cameron, Finnegan, & Morry, 2012). Pearson correlation coefficients between nature connectedness and trait attachment are presented in Table 2 below. The first row of correlations are the results reported in Table 3 of Zelenski and Nisbet, while the second and

Table 2

*Reanalyzing the Correlations Between Nature Connectedness and Trait Attachment from Study 2 of Zelenski and Nisbet (2014)*

	NRS-Self	NRS-Perspective	NRS-Experience	NRS-6
One dimension (as previously reported)				
Attachment Security	.08	-.05	.03	.07
Two dimensions				
Attachment Avoidance	-.14 <sup>†</sup>	.04	-.13 <sup>†</sup>	-.15*
Attachment Anxiety	-.01	-.04	.11	.08

*Note.* NRS-Self: Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NR-Experience = Experience subscale of the Nature Relatedness Scale; NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (6 items).

<sup>†</sup>  $p < .10$ . \*  $p < .05$ .

third rows of correlations contain the novel results involving the two-factor scoring.

Trait attachment avoidance was significantly negatively correlated with overall levels of nature connectedness,  $r(202) = -.15, p = .035$ . In general, those higher in trait attachment avoidance were less connected to nature than those lower in trait attachment avoidance. In contrast, the association between trait attachment anxiety and overall nature connectedness was in the opposite direction but not significant,  $r(202) = .08, p = .267$ . The correlations involving overall nature connectedness and the two interpersonal attachment orientations were significantly different from one another,  $z = -2.51, p = .012$ . These diverging results highlight the importance and utility of taking into account the different ways that people can be insecurely attached;

conceptualizing attachment as unidimensional appeared to mask differences in nature connectedness among those with a more hyperactive vs. deactivated attachment behavioural system.

More fine-grained examinations involving the three subscales of the Nature Relatedness Scale might aid understanding of the broader associations between the two trait attachment dimensions and nature connectedness. The perspective subscale, which taps people's beliefs about the role humans have or should have in relation to the natural world, was more or less unrelated to trait attachment avoidance and anxiety,  $r(202) = .04$  and  $-.04$ ,  $p = .622$ ; these correlations did not significantly differ either,  $z = 0.77$ ,  $p = .442$ ). Items from this subscale are not included in overall scores on the NRS-6. Nisbet and Zelenski (2013) have speculated that the perspective subscale might be more of a measure of proenvironmental attitudes, which are strongly related to but arguably distinct from feeling and being connected with nature (e.g., Tam, 2013a). The lack of association between the perspective subscale and trait attachment might have somewhat attenuated nature connectedness' associations with trait attachment avoidance,  $r(202) = -.10$ ,  $p = .146$ , and trait attachment anxiety,  $r(202) = .02$ ,  $p = .783$ , when all 21 items were used to calculate overall nature connectedness scores instead of just six.<sup>9</sup>

The experience subscale, which assesses people's familiarity and comfort with being in nature, as well as their desire to spend time in nature, showed a similar diverging pattern with the two interpersonal attachment orientations as the results involving overall NRS-6 did.

Specifically, a negative (albeit only marginally significant) correlation was found for trait

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<sup>9</sup> Study 2 of Zelenski and Nisbet (2014) also included the one-item Inclusion of Nature in Self scale (INS; Schultz, 2001), which measures the degree to which nature is incorporated into one's self-identity. Interpretation of results was similar when INS was correlated with trait attachment avoidance,  $r(201) = -.08$ ,  $p = .234$ , and trait attachment anxiety,  $r(201) = .01$ ,  $p = .848$ , instead of the full 21-item measure of nature connectedness. This suggests that the inclusion of the perspective subscale items in overall nature connectedness scores from the 21-item measure may not fully account for the attenuated associations with attachment anxiety and avoidance.

attachment avoidance and the experience subscale,  $r(202) = -.13, p = .070$ . In contrast, a positive (but not significant) association was observed for trait attachment anxiety and the experience subscale,  $r(202) = .11, p = .133$ . The correlations involving the experience subscale and the two interpersonal attachment orientations were significantly different from one another,  $z = -2.57, p = .010$ .

Finally, the self subscale, which measures how embedded nature is in one's identity, had a negative (albeit only marginally significant) correlation with trait attachment avoidance,  $r(202) = -.14, p = .051$ , but was not associated with trait attachment anxiety,  $r(202) = -.01, p = .842$ . Despite the differences in statistical significance, the correlations involving the self subscale and the two attachment orientations were not significantly different from one another,  $z = -1.36, p = .174$ .

Although some psychometric issues that were previously mentioned still persist, this preliminary investigation provides some initial hints to how interpersonal attachment and nature connectedness might be related at the trait level. The findings involving attachment avoidance were somewhat consistent with the correspondence hypothesis and other research on human–nonhuman relations in that some evidence was found for those who were less comfortable with closeness and interdependence in their interpersonal relationships also being more disconnected in their relationship with a nonhuman target, in this case the natural world. In other words, the tendency to defensively distance oneself might apply to how avoidantly attached people relate to nature as well; attachment avoidance's negative relationship with the self subscale suggests psychological distancing from nature, while its negative association with the experience subscale suggests physical distancing (although both of these associations were admittedly only marginally significant so caution is warranted).

The lower levels of some aspects of nature connectedness among those who were more avoidantly attached can also be understood through a behavioural systems approach. As avoidant strategies attempt to deactivate the attachment behavioural system without achieving an actual sense of security, those high in trait attachment avoidance experience unresolved insecurity and lack a secure base from which they can confidently explore and engage with the surrounding environment (Bowlby, 1988; Feeney & Van Vleet, 2010). Supporting this is research showing that attachment avoidance is associated with lower curiosity, exploratory interest, and novelty seeking (Aspelmeier & Kerns, 2003; Carnelley & Ruscher, 2000; Chotai et al., 2005; Green & Campbell, 2000). This lower interest among the avoidantly attached not only applies to exploration of the social domain (e.g., talking to strangers), but to exploration of the physical environment as well (e.g., traveling to and spending time in an unfamiliar place; Green & Campbell, 2000). The lower desire, familiarity, and comfort with being in nature, and lower identification with the natural world that was partially found among the avoidantly attached in this preliminary investigation is in line with these previously published findings and the notion that exploratory behaviours are generally impaired by chronic and contextual attachment insecurity. Nevertheless, due to the correlational nature of the data that was analyzed (and the marginal significance of some of the associations), these causal claims should be taken with caution.

Although the associations between trait attachment anxiety and nature connectedness were not significant, that trait attachment anxiety's associations with the short-form version and the experience subscale of the Nature Relatedness Scale were in the opposing direction (i.e., positive) and significantly differed from the associations involving trait attachment avoidance is intriguing. These attachment anxiety results are more in line with the compensation hypothesis

than the correspondence hypothesis, and contrary to what one would predict when taking a behavioural systems approach. While the human–nonhuman attachment literature more clearly supports the correspondence hypothesis when it comes to attachment avoidance, the findings involving attachment anxiety are more nuanced in that the highly anxious appear to be more willing to develop bonds with some nonhuman targets but these relationships still tend to be characterized by anxiety (see section on nonhuman attachments). Individuals who are more anxiously attached might be motivated to spend more time in nature (as potentially suggested by the small positive correlation with the experience subscale), but the ambivalence and anxiety that characterizes their relational approach might interfere with the successful internalization of a nature-oriented identity (as potentially suggested by the essentially null correlation with the self subscale). Moreover, research by Carnelley and Ruscher (2000) finds that the regulation of negative affect stemming from interpersonal relationship problems is an important motivation for leisure activities among those high in attachment anxiety. Although this may motivate the highly anxious to spend time in nature, especially given the perceived and experienced ability of brief nature exposure to quell negative emotions (McMahan & Estes, 2015; Gifford, 2007) and aid in the reflection of personal problems (Mayer et al., 2009), it may not be a state of mind that is particularly conducive to connecting with nature cognitively.

Nevertheless, the above interpretations and speculations should, admittedly, be taken with considerable caution given that the results involving attachment anxiety were weak, nonsignificant, purely correlational, and based on a measure of attachment with limitations. The two novel studies that I conducted attempted to address these issues by employing larger sample sizes, more well-established measures of interpersonal attachment, and correlational and experimental designs to investigate the link between interpersonal attachment and human–nature

relations at both the state and trait levels.

### **Study 1**

There are numerous theoretical and empirical reasons why one might predict that interpersonal attachment orientations will be related to nature connectedness. There is also a foundation of research both outside and within the interpersonal attachment and human–nature relation literatures that suggest that attachment (in)security might have a causal role in (de)motivating people to connect with the natural world. This first study was designed to bridge these disconnected literatures to better understand the psychosocial correlates and antecedents of a strong connection to nature. To do so, Study 1 attempted to experimentally manipulate feelings of attachment security or insecurity (or exposed individuals to a neutral control condition), and assessed individuals' motivation to connect with nature using two different self-report questionnaires. Moreover, to examine whether interpersonal attachment orientations and nature connectedness are associated at the trait level, Study 1 also had participants complete well-established and widely used self-report measures that assess these constructs.

### **Research Questions**

Given the nascent nature of this line of research and the competing predictions that could be plausibly made based on the reviewed literatures, I present three primary research questions of interest instead of making firm directional hypotheses. Research Question #1 concerns whether individual differences in attachment anxiety and attachment avoidance are associated with nature connectedness. From a behavioural systems perspective, chronic hyperactivation or deactivation of the attachment behavioural system should be associated with an impaired exploratory behavioural system, which may prevent people from spending time in natural environments and developing/maintaining a strong connection to nature. Moreover, the influence

of close others in supporting and modeling nature-oriented feelings, thoughts, and behaviours may be less effective or available for those who are chronically insecure in their interpersonal relationships. Research comparing how people relate to others and how they relate to nonhuman targets also generally argues in favour of correspondence when it comes to interpersonal attachment and nature connectedness, as do the opposing associations that attachment anxiety/avoidance and nature connectedness have with some broad personality traits and aspects of well-being. In contrast, the meaning maintenance model appears to suggest compensation; individuals who are less successful at achieving meaning within the interpersonal domain may rely on other available sources instead, such as the natural world. Finally, the mixed findings from the values, ostracism, and anthropomorphization literatures, along with my reanalysis, suggest that associations with nature connectedness may differ for trait attachment avoidance and trait attachment anxiety. A related research question that is less primary but still of interest is whether associations between interpersonal attachment orientations and nature connectedness are present even after the big five personality traits are statistically controlled for (see earlier section on personality for rationale).

Research Question #2 concerns whether inducing attachment (in)security motivates or dissuades people from connecting with nature. According to attachment theorists, attachment security needs to be obtained before other behavioural systems can operate normally. From this perspective, motivations to explore and connect with the natural world should be lower when attachment insecurity is experienced. In contrast, when a sense of attachment security is attained and people feel like they have a secure base, exploratory behaviours should be more likely and people should express a greater interest in connecting with nature. The role of negative emotions in motivating avoidance behaviours and narrowing people's cognition also suggest that desires to

connect with nature will be lower when attachment insecurity is acutely experienced, while the increased importance placed on self-transcendent values when attachment security is primed suggests that there may be an increased desire to connect with nature in this condition. In contrast, the meaning maintenance model and the research on ostracism and anthropomorphization suggest that desires to connect with nature will be the greatest when people feel like they are isolated from others (i.e., the insecure attachment condition).

Research Question #3 asks whether the effect of attachment (in)security on the desire to connect with nature depends on trait interpersonal attachment or nature connectedness. This is important to test as the effects of some of the experimental manipulations might be more effective for some individuals given the differing availability and accessibility of working models (e.g., a person high in trait attachment anxiety may more easily remember a time when they were not supported by others). Moreover, the preferred secondary strategies relied upon by those high in trait attachment anxiety (i.e., hyperactivation) vs. those high in trait attachment avoidance (i.e., deactivation) may also moderate people's motivation to connect with nature in the face of attachment insecurity. Trait nature connectedness could play a role in how people react to attachment (in)security as well. For instance, individuals who have a stronger connection to nature might turn to nature as a safe haven when primed with attachment insecurity or may be interested in connecting with nature regardless of the psychosocial context.<sup>10</sup>

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<sup>10</sup> The importance of taking sex and gender into account in scientific research has been increasingly emphasized by researchers and funding agencies in Canada and elsewhere (e.g., Tannenbaum, Ellis, Eyssel, Zou, & Schiebinger, 2019). While acknowledging the potential relevance of sex/gender differences in interpersonal attachment and human–nature relations (e.g., Dean et al., 2018; Del Giudice, 2011), I decided to not examine how the results of Study 1 or Study 2 might differ by gender (or by sex, which was not asked about in the demographic questionnaire in either study). A priori power analyses were conducted to ensure that the chances of uncovering associations and effects of specific magnitudes were high in the overall sample (not when the sample was split by a certain demographic characteristic). Thus, gender-stratified analyses or examining interactions involving gender would likely be underpowered, especially considering the relatively low proportion of male participants in both samples.

## Method

### Materials

**Experimental manipulation.** Participants were randomly assigned to one of three experimental conditions (see Appendix B). In the secure attachment condition, participants were instructed to visualize a problematic situation that they could not solve by themselves, but were surrounded by others who were sensitive, responsive, and willing to help. Participants were then asked to write for eight minutes about a personal experience that was similar to this imagined scenario. Participants in the insecure attachment condition were also instructed to visualize a problematic situation that they could not solve by themselves, but they were asked to imagine that they were surrounded by others who were insensitive, unresponsive, and unwilling to help. Participants in the insecure attachment condition were then asked to write for eight minutes about a personal experience that was similar to this imagined scenario. Lastly, participants assigned to the control condition were asked to imagine that they were about to start an important piece of coursework and write for eight minutes about how they would complete it.

Although minor edits were made, the instructions for the secure attachment condition and control condition were taken largely verbatim from Carnelley and Rowe (2007), which found that repeated security primes led to more positive relationship expectations and views of the self, while no significant improvements were observed among those in the control condition. The coursework writing task used in the current study was employed as one of the three writing tasks in the control condition in Carnelley and Rowe (2007), while the secure writing task in the current study was used as one of the two methods of priming attachment security. The instructions for the insecure attachment condition were crafted for Study 1 to directly mirror the instructions in the secure attachment condition; they were also partially inspired by another

insecure attachment manipulation reported in Saleem (2011). While both attachment conditions made attachment-related experiences salient, those in the secure attachment condition were expected to feel the most secure (i.e., low state attachment avoidance and anxiety, and high state attachment security) as they thought and wrote about a time when proximity seeking efforts were successful, in that others were there for them in a time of need, providing them with a safe haven and secure base. In contrast, those in the insecure attachment condition were expected to feel the least secure (i.e., high state attachment avoidance and anxiety, and low state attachment security) as they thought and wrote about a time when proximity to others was not attained, and a safe haven and secure base were not established.

**State attachment.** To examine whether the experimental manipulation had its intended effect on attachment-related states of mind (i.e., a manipulation check), participants were asked to complete the 21-item State Adult Attachment Measure (Gillath et al., 2009; see Appendix C). The State Adult Attachment Measure consists of three 7-item subscales that assess current levels of attachment-related avoidance (e.g., “If someone tried to get close to me, I would try to keep my distance”;  $\alpha = .85$ ), anxiety (e.g., “I feel a strong need to be unconditionally loved right now”;  $\alpha = .85-.86$ ), and security (e.g., “I feel like I have someone to rely on”;  $\alpha = .92$ ).<sup>11</sup> Participants were asked to respond to each item using a 7-point Likert scale ranging from 1 (*disagree strongly*) to 7 (*agree strongly*). Overall scores on the three subscales were obtained by calculating the average of their respective items (after reverse scoring appropriate items). The State Adult Attachment Measure was chosen because it has been shown to be sensitive to some attachment priming manipulations in previous research (Gillath et al., 2009) and because of its

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<sup>11</sup> Throughout the “Materials” subsection of Study 1, the range of Cronbach’s alpha values are reported for when strict and lenient exclusions were applied, and (if applicable) when outliers were included and excluded (see the “Exclusions and Sample Demographics” subsection for more information on specific exclusion criteria).

multidimensional nature (cf. the Felt Security Scale, which only assesses state attachment along a single dimension of security-insecurity; Luke et al., 2012).

**Affect.** The 20-item Positive and Negative Affect Schedule (Watson, Clark, & Tellegen, 1988; see Appendix D) was included to examine whether the experimental manipulation also influenced the mood of participants and to check whether the effects of the experimental manipulation persisted after controlling for mood. Half of the items assessed positive affect (e.g., “interested”, “excited”, “proud”;  $\alpha_s = .91$ ), while the other half assessed negative affect (e.g., “distressed”, “hostile”, “afraid”;  $\alpha_s = .90$ ). Overall scores on positive affect and overall scores on negative affect were calculated by obtaining the average of their respective items.

**Motivation to connect with nature.** Two measures were used to assess participants’ current motivation to connect with nature. The first was an adapted version of the 14-item Connectedness to Nature Scale (Mayer & Frantz, 2004), which was developed by Poon et al. (2015) in their research on the effects of ostracism (see Appendix E). Items were rephrased by Poon et al. to assess desires, instead of general tendencies, to connect with nature (e.g., “I often feel a sense of oneness with the natural world around me” was changed to “I want to feel a sense of oneness with the natural environment around me”). This adapted version of the Connectedness to Nature Scale was shown to be sensitive to experimental manipulations and predicted self-reported willingness to engage in proenvironmental behaviours in Poon et al. (2015). Participants indicated the extent to which they (dis)agreed with each of the 14 statements using a 7-point Likert-scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Overall scores on the adapted Connectedness to Nature Scale ( $\alpha_s = .88$ ) were obtained by calculating the average of all the items (after reverse scoring appropriate items), with higher scores indicating a stronger motivation to connect with nature.

The second measure of motivation to connect with nature employed in Study 1 was an adapted version of the 10-item Preferences for Nature Questionnaire (McMahan & Josh, 2017; see Appendix F). The original Preferences for Nature Questionnaire assesses individual differences in preferences for natural vs. built environments, and initial research shows that it predicts more frequent visits to natural environments, more time spent and more enjoyment when visiting natural environments, and higher levels of trait nature connectedness (McMahan & Josh, 2017). A similar approach to the one taken by Poon et al. (2015) in adapting the Connectedness to Nature Scale was taken in Study 1 to adapt the Preferences for Nature Questionnaire. Specifically, the instructions and items were modified to assess current desires to spend time in natural (vs. built) environments, instead of a person's general preferences for natural (vs. built) environments (e.g., the item "I prefer outdoor leisure activities, like hiking and camping, over indoor leisure activities, like going to the movies or museums" was changed to "I want to engage in outdoor leisure activities, like hiking and camping, over indoor leisure activities, like going to the movies or museums"). Participants were asked to indicate their (dis)agreement with each of the 10 statements using a 7-point Likert-scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*). Overall scores on the adapted Preferences for Nature Questionnaire ( $\alpha = .91-.92$ ) were obtained by calculating the average of all the items (after reverse scoring appropriate items), with higher scores indicating a stronger motivation to connect with nature.

These two measures of motivation to connect with nature were included in Study 1 for a couple of reasons. First, the adapted Connectedness to Nature Scale is fairly abstract and focuses on desires to be psychologically connected with nature. The adapted Preferences for Nature Questionnaire, in contrast, is more concrete and largely focuses on desires to be physically connected with nature (i.e., to spend time in natural environments). Thus, the two measures were

thought to assess unique but related ways of connecting with nature (i.e., psychologically vs. physically).<sup>12</sup> The reanalysis of Zelenski and Nisbet (2014) hints that this distinction might be important to consider. Second, the adapted Preferences in Nature Questionnaire was included alongside the adapted Connectedness to Nature Scale as the former but not the latter measure can disentangle whether individuals are motivated to spend time in natural environments in particular or motivated to explore/connect with the physical world in general as the items in the Preferences for Nature Questionnaire explicitly compare natural to built environments. This also allowed for a closer conceptual replication attempt in Study 2, which also compared motivation to connect with natural (vs. built) environments as its main outcome variable.

**Trait attachment.** Individual differences in trait attachment were assessed using the Experiences in Close Relationships Scale (Brennan et al., 1998; see Appendix G). The version of the Experiences in Close Relationships Scale employed in the current study asked participants about their global attachment orientation (i.e., how they generally feel, think, and act in close interpersonal relationships), instead of their attachment to a specific individual or in a specific type of relationship. Global attachment orientation was thought to be the most relevant for understanding people’s relationship to nature and their motivation to connect with nature in times of insecurity vs. security as “global attachment representation acts as the default, or automatic representation, which individuals use most frequently in times of stress ... or with unknown or ambiguous relationship partners” (Overall et al., 2003, p. 1482). Participants were asked how much they (dis)agreed with 36 statements on a Likert-scale ranging from 1 (*disagree*

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<sup>12</sup> This assumption was supported by correlational analyses. The two measures of motivation to connect with nature were significantly positively associated ( $r_s = .44-.45, p_s < .001$ ), but the correlations were not large enough to suggest that they were measuring the exact same construct. Moreover, the self subscale of the Nature Relatedness Scale tended to be more strongly associated with the adapted Connectedness to Nature Scale ( $r_s = .71, p_s < .001$ ) than the adapted Preferences for Nature Questionnaire ( $r_s = .44-.46, p_s < .001$ ). In contrast, the experience subscale of the Nature Relatedness Scale tended to be more strongly associated with the Preferences for Nature Questionnaire ( $r_s = .67, p < .001$ ) than the adapted Connectedness to Nature Scale ( $r_s = .49-.50, p_s < .001$ ).

*strongly*) to 7 (*agree strongly*). Half of the items assessed trait attachment anxiety (e.g., “I worry about being rejected or abandoned”;  $\alpha_s = .91$ ), while the other half assessed trait attachment avoidance (e.g., “I prefer not to be close to others”;  $\alpha_s = .89$ ). Overall scores for trait attachment anxiety and overall scores for trait attachment avoidance were calculated by obtaining the average of their respective items (after reverse scoring relevant items). Trait attachment anxiety and trait attachment avoidance were significantly positively correlated ( $r_s = .26, p < .001$ ).

**Trait nature connectedness.** Individual differences in trait connection to nature were measured using the Nature Relatedness Scale (Nisbet et al., 2009; see Appendix H). The Nature Relatedness Scale was chosen because it is one of the more widely used measures of nature connectedness (e.g., Capaldi et al., 2014), and because it is multidimensional (i.e., it allows one to examine overall levels of nature connectedness, as well as more specific aspects of the human-nature relationship via its subscales). Participants were asked to rate their level of (dis)agreement to 21 statements on a 5-point Likert scale ranging from 1 (*disagree strongly*) to 5 (*agree strongly*). The Nature Relatedness Scale is composed of three subscales. The first subscale (i.e., NRS-Self) consists of eight items that assess how important nature is to one’s sense of identity (e.g., “My relationship to nature is an important part of who I am”;  $\alpha_s = .83$ ). The second subscale (i.e., NRS-Perspective) consists of seven items that assess beliefs about the role that humans have or should have in protecting to nature (e.g., “Conservation is unnecessary because nature is strong enough to recover from any human impact”;  $\alpha_s = .69-.70$ ). Finally, the third subscale (i.e., NRS-Experience) consists of six items that assess people’s familiarity, comfort, and desire to spend time in natural environments (e.g., “My ideal vacation spot would be a remote, wilderness area”;  $\alpha_s = .75$ ). Overall nature connectedness scores were calculated by obtaining the average of all 21 items (after reverse scoring relevant items;  $\alpha_s = .87$ ), and scores

on each of the subscales and on the short-form version of the Nature Relatedness Scale ( $\alpha$ s = .82-.83) were calculated by obtaining the average of their respective items (after reverse scoring relevant items).

**Big five personality factors.** The big five personality factors were measured by the 120-item version of the International Personality Item Pool (IPIP-NEO-120; Johnson, 2014; see Appendix I), which is based on the NEO Personality Inventory (NEO-PI-R; Costa & McCrae, 1992). Unlike the NEO-PI-R, the IPIP-NEO-120 is in the public domain and, thus, free for researchers to use. The IPIP-NEO-120 assessed each of the big five personality dimensions (i.e., agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) with 24 statements; participants rated how (in)accurate the statements were on a 5-point Likert-scale ranging from 1 (*very inaccurate*) to 5 (*very accurate*). The beginning of the IPIP-NEO-120 items were slightly modified to match the phrasing of the two other trait measures (e.g., “Have a vivid imagination” was changed to “I have a vivid imagination”). Overall scores for agreeableness ( $\alpha$ s = .85-.86), conscientiousness ( $\alpha$ s = .89-.90), extraversion ( $\alpha$ s = .85-.86), neuroticism ( $\alpha$ s = .89), and openness to experience ( $\alpha$ s = .77) were calculated by obtaining the average of their respective items (after reverse scoring relevant items).

### **Procedure**

A recruitment notice (see Appendix J) was posted on the experimental management system (SONA) of the Department of Psychology at Carleton University that called for individuals to participate in an online study for course credit. Potential participants were told that the study was investigating the links among visualization, autobiographical memories, motivation, affect, and personality. Individuals were ineligible to sign up for Study 1 if they had already signed up or participated in Study 2 or another research project led by an honours thesis

student that used some of the same measures.

A link to the online study, which was hosted on Qualtrics, was presented to individuals if they signed up to participate. After clicking the link and indicating that they agreed to participate at the bottom of an informed consent form (see Appendix K), individuals were randomly assigned to the secure attachment condition, the insecure attachment condition, or the control condition. Participants were given eight minutes for the writing task and then they were automatically forwarded to the next part of the study by Qualtrics where they were asked to complete the State Adult Attachment Measure, followed by the Positive and Negative Affect Schedule. The adapted Connectedness to Nature Scale and the adapted Preferences for Nature Questionnaire were then presented; the presentation order of these two measures of motivation to connect with nature was counterbalanced.

Participants were then presented with a brief message to help make it clear that the next part of the study contained questionnaires about how they are in general/overall, instead of questionnaires about their current thoughts/feelings/motivations. Following this message, participants were asked to complete the IPIP-NEO-120. This big five personality measure was presented across multiple pages and had two attention check items embedded within it. Specifically, two items asked participants to “Please select 4 as your response for this statement” and “Please select 2 as your response for this statement”. After the IPIP-NEO-120, participants were asked to complete the Nature Relatedness Scale and the Experiences of Close Relationships Scale to measure their trait nature connectedness and trait attachment; the presentation order of these two trait measures was counterbalanced as well.<sup>13</sup>

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<sup>13</sup> To check whether the experimental manipulation may have unintentionally influenced participant responses on the Experiences in Close Relationships Scale, separate one-way between-subjects ANOVAs were conducted with experimental condition (control vs. secure attachment vs. insecure attachment) as the independent variable and trait attachment avoidance or anxiety as the outcome variable. There was not a significant effect of condition on trait

The final part of the study asked participants to complete a demographics questionnaire (see Appendix L), which asked about their age, gender, and the type of area they grew up in (from 1 = “*very rural*” to 5 = “*very urban*”),<sup>14</sup> followed by a data quality questionnaire (see Appendix M). The data quality questionnaire asked participants in the attachment conditions if they were able to think a personal experience for the writing task and to indicate how easy it was to think of a personal experience to write about (from 1 = “*very difficult*” to 7 = “*very easy*”).<sup>15</sup> Participants in all three conditions were also asked if they spent the eight minutes thinking/writing about the topic they were assigned and whether there was any reason why their data should not be included in analyses. To counteract any lingering negative feelings and thoughts that might have been caused by some of the experimental manipulations, a mood booster was included where participants were asked to briefly imagine themselves in two positive scenarios (see Appendix N). Finally, a debriefing form was presented to participants, which explained the purpose of the study, provided links to background research, and listed contact information in case they had questions, ethical concerns, or were emotionally upset.

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attachment avoidance when strict exclusions were applied,  $F(2, 460) = 0.10, p = .91, \eta_p^2 < .001$ , or when lenient exclusions were applied,  $F(2, 508) = 0.11, p = .90, \eta_p^2 < .001$ . Similarly, there was not a significant effect of condition on trait attachment anxiety when strict exclusions were applied,  $F(2, 459) = 1.52, p = .22, \eta_p^2 = .007$ , or when lenient exclusions were applied,  $F(2, 507) = 0.71, p = .49, \eta_p^2 = .003$ .

<sup>14</sup> Consistent with previous research that suggests that childhood experiences in natural environments foster a connection with nature, growing up in a more urban (vs. rural) area was associated with lower overall trait nature connectedness scores ( $r_{\text{strict}} = -.19, p < .001$ ;  $r_{\text{lenient}} = -.18, p < .001$ ) and lower motivation to connect with nature as assessed by the adapted Connectedness to Nature Scale ( $r_{\text{strict}} = -.11, p = .019$ ;  $r_{\text{lenient}} = -.09, p = .038$ ) and the adapted Preferences for Nature Questionnaire Scale ( $r_{\text{strict}} = -.29, p < .001$ ;  $r_{\text{lenient}} = -.29, p < .001$ ). The interpretation of results was similar when the outlier on overall trait nature connectedness was excluded from analyses in the lenient condition. Interpretation of results also tended to be similar when Spearman correlation coefficients were obtained (due to the urban vs. rural variable being slightly skewed), with the only exception being the association between the rural vs. urban variable and the adapted Connectedness to Nature Scale changing from significant to marginally significant when lenient exclusions were applied.

<sup>15</sup> Those higher in trait attachment anxiety tended to rate the secure attachment condition as more difficult ( $r = -.22, p = .009$  when strict exclusions were applied;  $r = -.21, p = .008$  when lenient exclusions were applied;  $r = -.12, p = .081$  when only those who did not finish the study were excluded) and the insecure attachment condition as easier ( $r_s = .24, p_s \leq .005$ ). In contrast, trait attachment avoidance was not significantly associated with difficulty ratings in either attachment condition ( $r_s$  ranged from  $-.09$  to  $.08, p_s \geq .240$ ).

## Results

### Background & Data Quality

Data for Study 1 was collected online from February 26, 2018 to February 28, 2019. A total of 749 individuals consented to participate in the study and 648 of those who consented finished the study (86.52%).<sup>16</sup> A sample size of 550 participants was planned based on a priori power analyses (see Appendix O for more information), but data from more participants were collected to try to achieve this target sample size after excluding participants who dropped out of the study and who needed to be excluded for other reasons.<sup>17</sup> The percentage of those who finished the study after consenting ranged from 85.54% to 87.60% across the three experimental conditions; the likelihood of not finishing the study after consenting to participate did not significantly differ across conditions,  $\chi^2(2, N = 749) = 0.46, p = .796$ . Of those who did not finish the study, the vast majority appeared to drop out shortly after consenting as they had nothing written for the writing task and/or they did not respond to any of the questionnaires ( $n = 94$ ). A detailed discussion of other data quality indicators in Study 1 is presented in Appendix P.

### Exclusions and Sample Demographics

Two versions of exclusions were adopted in the current study. The first version was stricter as it excluded participants for all the reasons listed in Table A1, while the second version was more lenient as it only excluded participants for some of the reasons listed in Table A1. By conducting analyses using both versions of exclusions, the robustness of results can be examined

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<sup>16</sup> The raw data set downloaded from Qualtrics contained 864 rows. The ID numbers in some of the rows could not be linked to specific individuals who signed up for the study on SONA. In other cases, the same ID number was associated with more than one row, indicating that the same individual accessed the survey more than once. There were also three individuals who indicated that they did not want to participate after reading the informed consent form. The data set was cleaned of cases that could not be linked to specific individuals on SONA, repeat responses, and non-consenters, which left a sample of 749 individuals.

<sup>17</sup> The decision to collect data from around 200 more participants than planned was informed by the rate of exclusions observed in preliminary data quality checks. These preliminary checks examined data quality indicator variables, internal reliability and convergent/discriminant validity of measures, and manipulation checks.

across different exclusion criteria.

**Strict exclusions.** For the strict version of exclusions, individuals were excluded if (1) they did not finish the study, (2) they were coded as not completing the writing task correctly (see Table A1), (3) they indicated that their data should not be used and gave an exclusion-worthy reason (see Table A2) or did not offer an explanation, (4) they did not answer the question about whether their data should be included or not, (5) they indicated that their data should be included but they wrote about an exclusion-worthy reason in the follow-up open-ended question, (6) they failed both attention checks, or (7) they took less than half (15 minutes) or more than double (120 minutes) the expected time to complete the study.

Applying the strict exclusions left a sample of 465 participants ( $n_{\text{control}} = 179$ ;  $n_{\text{security}} = 147$ ;  $n_{\text{insecurity}} = 139$ ).<sup>18</sup> In terms of gender, 351 participants were female (75.48%), 110 participants were male (23.66%), and 4 participants identified as “other” (0.86%). The age of participants ranged from 16 to 53 years old ( $M = 20.05$ ,  $SD = 4.10$ ), although most of the participants ( $n = 419$ ; 90.11%) were between the ages of 18 and 23 years old.

To check if the likelihood of being excluded varied by condition when the strict exclusion criteria was applied, a chi-square analysis was conducted for all those who finished the study. The results from this test suggested that the likelihood of being excluded was not the same across conditions,  $\chi^2(2, N = 648) = 17.40$ ,  $p < .001$ . This was likely due to the control condition having almost less than half the rate of exclusions (18.26%) compared to the secure attachment condition (30.99%) and the insecure attachment condition (35.65%); the rates of exclusions did

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<sup>18</sup> Although the sample size of 465 participants when strict exclusions were applied was smaller than the planned sample size of 550 participants, this sample size still gave fairly adequate statistical power to observe the estimated effect sizes in the a priori power analyses (see Appendix O). Specifically, the statistical power associated with a sample size of 465 was 73.93% for Research Question #1, 80.34% for the conservative estimate for Research Question #2, and 72.29% for Research Question #3.

not differ significantly between the attachment conditions,  $\chi^2(1, N = 429) = 1.05, p = .306$ .

**Lenient exclusions.** For the lenient version of exclusions, all the same exclusion criteria mentioned above were used except a more lenient approach to coding the writing task was adopted. Specifically, participants were only excluded for their performance on the writing task if (1) they did not write anything, (2) they explicitly wrote that they could not think of an experience that matched the scenario, (3) they wrote that they were not comfortable sharing their experience, or (4) they wrote about something unrelated or about the current study.

Applying the lenient exclusions left a sample of 513 participant ( $n_{\text{control}} = 179; n_{\text{security}} = 168; n_{\text{insecurity}} = 166$ ).<sup>19</sup> In terms of gender, 386 participants were female (75.24%), 123 participants were male (23.98%), and 4 participants identified as “other” (0.78%). The age of participants ranged from 16 to 53 years old ( $M = 20.14, SD = 4.11$ ), although most of the participants ( $n = 457; 89.08\%$ ) were between the ages of 18 and 23 years old.

To check if the likelihood of being excluded varied by condition when the lenient exclusion criteria was applied, a chi-square analysis was conducted for all those who finished the study. The results from this test suggested that the likelihood of being excluded did not significantly differ across conditions,  $\chi^2(2, N = 648) = 1.59, p = .452$ . The rates of exclusion in the secure attachment condition (21.13%) and the insecure attachment condition (23.15%) became more similar to the lower rate of exclusion in the control condition (18.26%) when a more lenient approach to coding the writing task was taken.

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<sup>19</sup> Although the sample size of 513 participants when lenient exclusions were applied was slightly smaller than the planned sample size of 550 participants, this sample size still gave fairly adequate statistical power to observe the estimated effect sizes in the a priori power analyses (see Appendix O). Specifically, the statistical power associated with a sample size of 513 was 78.01% for Research Question #1, 84.30% for the conservative estimate for Research Question #2, and 76.93% for Research Question #3.

**Trait-Level Associations Between Interpersonal Attachment and Nature Connectedness**

To investigate Research Question #1, associations between trait attachment and nature connectedness were obtained (see Table 3). Regardless of the exclusion criteria and whether outliers were included or excluded,<sup>20</sup> trait attachment anxiety was not significantly associated with any index of trait nature connectedness ( $-.05 \leq r_s \leq .01$ ). In contrast, trait attachment avoidance was significantly negatively correlated with overall scores on the Nature Relatedness Scale, and the perspective and experience subscales, when lenient exclusions were applied ( $-.11 \leq r_s \leq -.09$ ); the associations between trait attachment avoidance and these nature connectedness (sub)scales were only marginally significant when strict exclusions were applied however ( $-.09 \leq r_s \leq -.08$ ; the exclusion/inclusion of outliers did not change the interpretation of results). These significant and marginally significant associations tended to hover around the typical minimum cut-off for correlations that are considered to be small in magnitude (Cohen, 1998; Funder & Ozer, 2019). Trait attachment avoidance was not significantly associated with the short-form version of the Nature Relatedness Scale or the self subscale (i.e., measuring how important one's relationship with nature is to one's identity;  $-.05 \leq r_s \leq -.03$ ).

To investigate whether the small associations found between trait attachment avoidance and (some aspects of) trait nature connectedness may be due to shared personality characteristics underlying both traits, multiple regression analyses were conducted that included the big five personality dimensions (i.e., agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience) and trait attachment avoidance as predictors of each index of trait nature connectedness (see Table 4). When the big five personality dimensions were controlled for, trait attachment avoidance did not significantly predict any index of trait nature connectedness

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<sup>20</sup> Outliers were identified as scores that were more than three standard deviations from the mean.

Table 3

*Correlations Between Trait Nature Connectedness and Trait Attachment in Study 1*

	Strict Exclusions		Lenient Exclusions	
	Trait Attachment Avoidance	Trait Attachment Anxiety	Trait Attachment Avoidance	Trait Attachment Anxiety
NRS-Overall	-.08 <sup>+</sup>	-.03	-	-
With outliers	-	-	-.10*	-.02
No outliers	-	-	-.09*	-.02
NRS-6	-.03	-.02	-.05	-.01
NRS-Self	-.03	-.02	-.05	-.01
NRS-Perspective				
With outliers	-.09 <sup>+</sup>	.01	-.11*	.01
No outliers	-.08 <sup>+</sup>	.01	-.10*	.01
NRS-Experience	-.09 <sup>+</sup>	-.05	-.10*	-.05

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale. The degrees of freedom ranged from 458 to 460 when strict exclusions were applied and from 506 to 508 when lenient exclusions were applied.

<sup>+</sup>  $p < .10$ . \*  $p < .05$ .

(regardless of which exclusion criteria was used and whether outliers were included or excluded). The same result was found when trait attachment anxiety (instead of avoidance) was included as a predictor alongside the big five personality dimensions (see Table 5).

### Manipulation Checks

Before Research Questions #2 and #3 were investigated, manipulation checks were

Table 4

*Multiple Regression Analyses with Big Five Personality and Trait Attachment Avoidance as Predictors of Indexes of Trait Nature Connectedness in Study 1*

Outcome		Strict Exclusions					Lenient Exclusions						
		Predictors					Predictors						
		Agree	Consc	Extra	Neur	Open	Trait Attach Avoid	Agree	Consc	Extra	Neur	Open	Trait Attach Avoid
NRS-Overall	Step 1	$\beta = .25$ $p < .001$	$\beta = -.02$ $p = .683$	$\beta = .11$ $p = .026$	$\beta = .05$ $p = .333$	$\beta = .35$ $p < .001$		$\beta = .26$ $p < .001$	$\beta = -.03$ $p = .581$	$\beta = .09^e$ $p = .046$	$\beta = .03$ $p = .591$	$\beta = .33$ $p < .001$	
	Step 2	$\beta = .26$ $p < .001$	$\beta = -.02$ $p = .674$	$\beta = .13$ $p = .014$	$\beta = .04$ $p = .405$	$\beta = .35$ $p < .001$	$\beta = .05$ $p = .292$	$\beta = .27$ $p < .001$	$\beta = -.03$ $p = .570$	$\beta = .11$ $p = .035$	$\beta = .02$ $p = .659$	$\beta = .33$ $p < .001$	$\beta = .03$ $p = .502$
NRS-6	Step 1	$\beta = .13$ $p = .01$	$\beta = -.09$ $p = .097$	$\beta = .07$ $p = .190$	$\beta = -.02$ $p = .741$	$\beta = .28$ $p < .001$		$\beta = .16$ $p < .001$	$\beta = -.10^g$ $p = .042$	$\beta = .05$ $p = .333$	$\beta = -.05$ $p = .366$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .15$ $p = .005$	$\beta = -.09$ $p = .094$	$\beta = .10^a$ $p = .094$	$\beta = -.03$ $p = .634$	$\beta = .27$ $p < .001$	$\beta = .06$ $p = .226$	$\beta = .17$ $p = .001$	$\beta = -.10^g$ $p = .040$	$\beta = .07$ $p = .220$	$\beta = -.06$ $p = .308$	$\beta = .26$ $p < .001$	$\beta = .05$ $p = .364$
NRS-Self	Step 1	$\beta = .14$ $p = .006$	$\beta = -.06$ $p = .272$	$\beta = .09^a$ $p = .081$	$\beta = .01$ $p = .881$	$\beta = .31$ $p < .001$		$\beta = .17$ $p = .001$	$\beta = -.07$ $p = .148$	$\beta = .07$ $p = .163$	$\beta = -.01$ $p = .784$	$\beta = .30$ $p < .001$	
	Step 2	$\beta = .16$ $p = .002$	$\beta = -.06$ $p = .264$	$\beta = .12$ $p = .027$	$\beta < -.01$ $p = .967$	$\beta = .31$ $p < .001$	$\beta = .08$ $p = .121$	$\beta = .18$ $p < .001$	$\beta = -.07$ $p = .140$	$\beta = .09^a$ $p = .085$	$\beta = -.02$ $p = .665$	$\beta = .29$ $p < .001$	$\beta = .06$ $p = .237$
NRS-Perspective	Step 1	$\beta = .39$ $p < .001$	$\beta = .10$ $p = .026$	$\beta = .06$ $p = .200$	$\beta = .16$ $p = .001$	$\beta = .27$ $p < .001$		$\beta = .38$ $p < .001$	$\beta = .11$ $p = .013$	$\beta = .05$ $p = .295$	$\beta = .15$ $p = .002$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .39$ $p < .001$	$\beta = .10$ $p = .026$	$\beta = .07^b$ $p = .153$	$\beta = .15$ $p = .002$	$\beta = .27$ $p < .001$	$\beta = .03$ $p = .520$	$\beta = .38$ $p < .001$	$\beta = .11$ $p = .014$	$\beta = .05$ $p = .302$	$\beta = .15$ $p = .002$	$\beta = .26$ $p < .001$	$\beta = .01$ $p = .880$

NRS- Experience	Step 1	<b><math>\beta = .10^e</math></b> <b><math>p = .045</math></b>	$\beta = -.08^d$ $p = .142$	<b><math>\beta = .11^e</math></b> <b><math>p = .035</math></b>	$\beta = -.03$ $p = .576$	<b><math>\beta = .26</math></b> <b><math>p &lt; .001</math></b>		<b><math>\beta = .12</math></b> <b><math>p = .013</math></b>	$\beta = -.08$ $p = .105$	<b><math>\beta = .11^e</math></b> <b><math>p = .027</math></b>	$\beta = -.05$ $p = .318$	<b><math>\beta = .25</math></b> <b><math>p &lt; .001</math></b>	
	Step 2	<b><math>\beta = .10^e</math></b> <b><math>p = .049</math></b>	$\beta = -.08^d$ $p = .142$	<b><math>\beta = .11^f</math></b> <b><math>p = .048</math></b>	$\beta = -.03$ $p = .571$	<b><math>\beta = .26</math></b> <b><math>p &lt; .001</math></b>	$\beta = .01$ $p = .923$		<b><math>\beta = .12^e</math></b> <b><math>p = .017</math></b>	$\beta = -.08$ $p = .105$	<b><math>\beta = .11^e</math></b> <b><math>p = .038</math></b>	$\beta = -.05$ $p = .320$	<b><math>\beta = .25</math></b> <b><math>p &lt; .001</math></b>

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale; Agree = Agreeableness; Consc = Conscientiousness; Extra = Extraversion; Neur = Neuroticism; Open = Openness to Experience; Attach Avoid = Attachment Avoidance. Significant and marginally significant predictors for each outcome are highlighted in bold. The results reported in this table did not exclude any outliers; a superscript (next to relevant coefficients) and an explanation (at the bottom of this note) is provided when the interpretation of results differed when outliers were excluded. The degrees of freedom for the error terms in Step 2 ranged from 450 to 455 when strict exclusions were applied and from 497 to 503 when lenient exclusions were applied. Step 1 results in this table and Table 5 differed slightly as one participant with missing data for trait attachment anxiety subscale was included in this table but not in Table 5. Variance inflation factors were all  $\leq 1.70$ .

<sup>a</sup> Extraversion changed from a marginally significant to non-significant predictor when outliers were excluded.

<sup>b</sup> Extraversion changed from a non-significant to marginally significant predictor when outliers were excluded.

<sup>c</sup> Agreeableness changed from a significant to marginally significant predictor when were excluded.

<sup>d</sup> Conscientiousness changed from a non-significant to marginally significant predictor when outliers were excluded.

<sup>e</sup> Extraversion changed from a significant to marginally significant predictor when outliers were excluded.

<sup>f</sup> Extraversion changed from a significant to non-significant predictor when outliers were excluded.

<sup>g</sup> Conscientiousness changed from a significant to marginally significant predictor when outliers were excluded.

Table 5

*Multiple Regression Analyses with Big Five Personality and Trait Attachment Anxiety as Predictors of Indexes of Trait Nature Connectedness in Study 1*

		Strict Exclusions					Lenient Exclusions						
		Predictors					Predictors						
Outcome		Agree	Consc	Extra	Neur	Open	Trait Attach Anx	Agree	Consc	Extra	Neur	Open	Trait Attach Anx
NRS-Overall	Step 1	$\beta = .25$ $p < .001$	$\beta = -.02$ $p = .621$	$\beta = .11$ $p = .033$	$\beta = .04$ $p = .415$	$\beta = .35$ $p < .001$		$\beta = .27$ $p < .001$	$\beta = -.03$ $p = .523$	$\beta = .09$ $p = .057$	$\beta = .02$ $p = .699$	$\beta = .34$ $p < .001$	
	Step 2	$\beta = .25$ $p < .001$	$\beta = -.02$ $p = .632$	$\beta = .10$ $p = .036$	$\beta = .03$ $p = .661$	$\beta = .35$ $p < .001$	$\beta = .02$ $p = .688$	$\beta = .26$ $p < .001$	$\beta = -.03$ $p = .556$	$\beta = .09$ $p = .068$	$\beta = -.01$ $p = .875$	$\beta = .34$ $p < .001$	$\beta = .04$ $p = .400$
NRS-6	Step 1	$\beta = .13$ $p = .010$	$\beta = -.09$ $p = .081$	$\beta = .07$ $p = .224$	$\beta = -.03$ $p = .635$	$\beta = .28$ $p < .001$		$\beta = .16$ $p = .001$	$\beta = -.11$ $p = .035$	$\beta = .04$ $p = .382$	$\beta = -.06$ $p = .296$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .13$ $p = .010$	$\beta = -.09$ $p = .085$	$\beta = .06$ $p = .243$	$\beta = -.05$ $p = .483$	$\beta = .28$ $p < .001$	$\beta = .03$ $p = .585$	$\beta = .16$ $p = .001$	$\beta = -.10^f$ $p = .041$	$\beta = .04$ $p = .442$	$\beta = -.10$ $p = .121$	$\beta = .27$ $p < .001$	$\beta = .07$ $p = .224$
NRS-Self	Step 1	$\beta = .14$ $p = .006$	$\beta = -.06$ $p = .243$	$\beta = .09^a$ $p = .097$	$\beta < .01$ $p = .981$	$\beta = .31$ $p < .001$		$\beta = .17$ $p = .001$	$\beta = -.07$ $p = .129$	$\beta = .07$ $p = .190$	$\beta = -.02$ $p = .691$	$\beta = .30$ $p < .001$	
	Step 2	$\beta = .14$ $p = .006$	$\beta = -.06$ $p = .250$	$\beta = .09$ $p = .105$	$\beta = -.02$ $p = .829$	$\beta = .32$ $p < .001$	$\beta = .02$ $p = .680$	$\beta = .16$ $p = .001$	$\beta = -.07$ $p = .144$	$\beta = .06$ $p = .220$	$\beta = -.06$ $p = .390$	$\beta = .30$ $p < .001$	$\beta = .05$ $p = .348$
NRS-Perspective	Step 1	$\beta = .39$ $p < .001$	$\beta = .10$ $p = .027$	$\beta = .06$ $p = .209$	$\beta = .16$ $p = .002$	$\beta = .27$ $p < .001$		$\beta = .38$ $p < .001$	$\beta = .11$ $p = .014$	$\beta = .05$ $p = .306$	$\beta = .15$ $p = .002$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .39$ $p < .001$	$\beta = .10$ $p = .027$	$\beta = .06$ $p = .222$	$\beta = .14$ $p = .018$	$\beta = .27$ $p < .001$	$\beta = .02$ $p = .705$	$\beta = .38$ $p < .001$	$\beta = .11$ $p = .014$	$\beta = .05$ $p = .320$	$\beta = .14$ $p = .019$	$\beta = .26$ $p < .001$	$\beta = .01$ $p = .775$

NRS- Experience	Step 1	<b><math>\beta = .10^b</math></b> <b><math>p = .043</math></b>	$\beta = -.08^c$ $p = .117$	<b><math>\beta = .11^d</math></b> <b><math>p = .046</math></b>	$\beta = -.04$ $p = .465$	<b><math>\beta = .26</math></b> <b><math>p &lt; .001</math></b>		<b><math>\beta = .12</math></b> <b><math>p = .013</math></b>	<b><math>\beta = -.09</math></b> <b><math>p = .085</math></b>	<b><math>\beta = .11^d</math></b> <b><math>p = .036</math></b>	$\beta = -.06$ $p = .245$	<b><math>\beta = .25</math></b> <b><math>p &lt; .001</math></b>	
	Step 2	<b><math>\beta = .10^b</math></b> <b><math>p = .044</math></b>	$\beta = -.08^c$ $p = .119$	<b><math>\beta = .11^e</math></b> <b><math>p = .049</math></b>	$\beta = -.05$ $p = .496$	<b><math>\beta = .26</math></b> <b><math>p &lt; .001</math></b>	$\beta = .01$ $p = .886$		<b><math>\beta = .12</math></b> <b><math>p = .013</math></b>	<b><math>\beta = -.08</math></b> <b><math>p = .093</math></b>	<b><math>\beta = .10^d</math></b> <b><math>p = .042</math></b>	$\beta = -.09$ $p = .189$	<b><math>\beta = .25</math></b> <b><math>p &lt; .001</math></b>

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale; Agree = Agreeableness; Consc = Conscientiousness; Extra = Extraversion; Neur = Neuroticism; Open = Openness to Experience; Attach Anx = Attachment Anxiety. Significant and marginally significant predictors for each outcome are highlighted in bold. The results reported in this table did not exclude any outliers; a superscript (next to relevant coefficients) and an explanation (at the bottom of this note) is provided when the interpretation of results differed when outliers were excluded. The degrees of freedom for the error term in Step 2 ranged from 449 to 454 when strict exclusions were applied and from 496 to 502 when lenient exclusions were applied. Step 1 results in this table and Table 4 differed slightly as one participant with missing data for trait attachment anxiety subscale was excluded in this table but was included in Table 4. Variance inflation factors were all  $\leq 2.42$ .

<sup>a</sup> Extraversion changed from a marginally significant to non-significant predictor when outliers were excluded.

<sup>b</sup> Agreeableness changed from a significant to marginally significant predictor when were excluded.

<sup>c</sup> Conscientiousness changed from a non-significant to marginally significant predictor when outliers were excluded.

<sup>d</sup> Extraversion changed from a significant to marginally significant predictor when outliers were excluded.

<sup>e</sup> Extraversion changed from a significant to non-significant predictor when outliers were excluded.

<sup>f</sup> Conscientiousness changed from a significant to marginally significant predictor when outliers were excluded.

conducted to investigate whether the experimental manipulation had its intended impact on state attachment (and whether trait attachment might have moderated the effect of the attachment conditions on state attachment). As previous research has found changes in affect after attachment priming (e.g., Carnelley et al., 2016; Gillath et al., 2009; Rowe & Carnelley, 2003; Rowe et al., 2012), the effect of the experimental manipulation on positive and negative affect (and the potential moderating role of trait attachment) was also examined.

**State attachment.** Separate one-way between-subjects ANOVAs were run with experimental condition (control vs. secure attachment vs. insecure attachment) as the independent variable and each of the subscales of the SAAM as dependent variables (see Tables 6 and 7 for results when strict and lenient exclusions were applied, respectively). Interpretation of the results was identical when outliers were excluded/included, when the different exclusion criteria were applied, and when non-parametric tests were conducted.

The effect of experimental condition on state attachment avoidance was not statistically significant. Average levels of state attachment avoidance were very similar across all three conditions ( $-.05 \leq ds \leq -.01$ ). Similarly, although state attachment security was slightly higher in the secure attachment condition than the control condition ( $.11 \leq ds \leq .14$ ) and the insecure attachment condition ( $.05 \leq ds \leq .19$ ), these differences were not statistically significant and the overall effect of experimental condition on state attachment security was not statistically significant either.

The effect of experimental condition on state attachment anxiety, however, was statistically significant. As expected, state attachment anxiety was significantly higher in the insecure attachment condition than the control condition ( $d_{\text{strict}} = .28$ ;  $d_{\text{lenient}} = .22$ ).

Unexpectedly, state attachment anxiety was also significantly higher in the secure attachment

Table 6

*Effects of Experimental Manipulation on State Attachment and Affect (Strict Exclusions) in Study 1*

	Control Condition	Secure Attachment Condition	Insecure Attachment Condition								
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>F</i>	<i>p</i>	$\eta_p^2$	<i>d</i> S - C	<i>d</i> I - C	<i>d</i> S - I	Kruskall- Wallis	
SAAM											
Avoidance	3.14 <sup>a</sup> (1.30)	3.09 <sup>a</sup> (1.23)	3.12 <sup>a</sup> (1.28)	0.06	.942	< .001	-.04	-.02	-.02	H = 0.02 <i>p</i> = .991	
Anxiety	4.38 <sup>a</sup> (1.22)	4.70 <sup>b</sup> (1.14)	4.73 <sup>b</sup> (1.33)	4.02	.019	.017	.27	.28	-.03	H = 9.34 <i>p</i> = .009	
Security											
With outliers	5.24 <sup>a</sup> (1.30)	5.42 <sup>a</sup> (1.13)	5.18 <sup>a</sup> (1.33)	1.39	.250	.006	.14	-.05	.19	H = 1.81 <i>p</i> = .404	
No outliers	5.27 <sup>a</sup> (1.27)	5.42 <sup>a</sup> (1.13)	5.26 <sup>a</sup> (1.20)	0.77	.462	.003	.12	< .001	.13	H = 1.18 <i>p</i> = .554	
PANAS											
Positive Affect	2.68 <sup>ab</sup> (0.90)	2.82 <sup>b</sup> (0.91)	2.58 <sup>a</sup> (0.84)	2.62	.074	.011	.15	-.11	.27	H = 5.75 <i>p</i> = .056	

## Negative Affect

With outliers	2.05 <sup>a</sup> (0.83)	2.00 <sup>a</sup> (0.88)	2.03 <sup>a</sup> (0.86)	0.10	.909	< .001	-.05	-.02	-.03	H = 0.49 <i>p</i> = .781
No outliers	2.05 <sup>a</sup> (0.83)	1.98 <sup>a</sup> (0.85)	2.03 <sup>a</sup> (0.86)	0.23	.796	.001	-.07	-.02	-.06	H = 0.66 <i>p</i> = .719

*Note.* SAAM = State Adult Attachment Measure; PANAS = Positive and Negative Affect Schedule; *d* S - C = Cohen's *d* for secure attachment condition vs. control condition; *d* I - C = Cohen's *d* for insecure attachment condition vs. control condition; *d* S - I = Cohen's *d* for secure attachment condition vs. insecure attachment condition. The degrees of freedom for the error term in the one-way ANOVAs ranged from 458 to 462. There were four outliers on the state attachment security variable and one outlier on the negative affect variable. The equality of variance assumption was met for every one-way ANOVA (*ps* in Levene's test were all > .05). Within rows, means that have different superscripts differ at *p* < .05. Kruskal-Wallis non-parametric tests are presented in the last column because some of the outcome variables were not normally distributed.

Table 7

*Effects of Experimental Manipulation on State Attachment and Affect (Lenient Exclusions) in Study 1*

	Control Condition	Secure Attachment Condition	Insecure Attachment Condition								
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>F</i>	<i>p</i>	$\eta_p^2$	<i>d</i> S - C	<i>d</i> I - C	<i>d</i> S - I	Kruskall- Wallis	
SAAM											
Avoidance	3.14 <sup>a</sup> (1.30)	3.08 <sup>a</sup> (1.21)	3.09 <sup>a</sup> (1.30)	0.11	.900	< .001	-.05	-.04	-.01	H = 0.10 <i>p</i> = .951	
Anxiety	4.38 <sup>a</sup> (1.22)	4.68 <sup>b</sup> (1.18)	4.66 <sup>b</sup> (1.29)	3.10	.046	.012	.24	.22	.02	H = 7.62 <i>p</i> = .022	
Security											
With outliers	5.24 <sup>a</sup> (1.30)	5.40 <sup>a</sup> (1.15)	5.27 <sup>a</sup> (1.31)	0.76	.468	.003	.13	.02	.11	H = 0.80 <i>p</i> = .671	
No outliers	5.27 <sup>a</sup> (1.27)	5.40 <sup>a</sup> (1.15)	5.34 <sup>a</sup> (1.20)	0.53	.589	.002	.11	.06	.05	H = 0.61 <i>p</i> = .736	
PANAS											
Positive Affect <sup>+</sup>	2.68 <sup>a</sup> (0.90)	2.80 <sup>a</sup> (0.93)	2.64 <sup>a</sup> (0.82)	1.55	.214	.006	.13	-.05	.19	H = 3.58 <i>p</i> = .167	

## Negative Affect

With outliers	2.05 <sup>a</sup> (0.83)	1.99 <sup>a</sup> (0.86)	2.02 <sup>a</sup> (0.84)	0.18	.832	.001	-.07	-.03	-.03	H = 0.69 <i>p</i> = .707
No outliers	2.05 <sup>a</sup> (0.83)	1.97 <sup>a</sup> (0.83)	2.02 <sup>a</sup> (0.84)	0.34	.715	.001	-.09	-.03	-.06	H = 0.86 <i>p</i> = .650

*Note.* SAAM = State Adult Attachment Measure; PANAS = Positive and Negative Affect Schedule; *d* S - C = Cohen's *d* for secure attachment condition vs. control condition; *d* I - C = Cohen's *d* for insecure attachment condition vs. control condition; *d* S - I = Cohen's *d* for secure attachment condition vs. insecure attachment condition. The degrees of freedom for the error term in the one-way ANOVAs ranged from 506 to 510. There were four outliers on the state attachment security variable and one outlier on the negative affect variable. The equality of variance assumption was met for almost every one-way ANOVA (*ps* in Levene's test were all > .05, except for the one-way ANOVA involving attachment security with outliers [*p* = .049]). Within rows, means that have different superscripts differ at *p* < .05. Kruskal-Wallis non-parametric tests are presented in the last column because some of the outcome variables were not normally distributed.

<sup>+</sup> The difference between the secure and insecure attachment conditions in positive affect was marginally significant.

condition than the control condition ( $d_{\text{strict}} = .27$ ;  $d_{\text{lenient}} = .24$ ) and did not differ significantly in the secure and insecure attachment conditions ( $d_{\text{strict}} = -.03$ ;  $d_{\text{lenient}} = .02$ ).

**Affect.** To examine if levels of negative and positive affect differed between conditions, one-way between-subjects ANOVA were also conducted with experimental condition (control vs. secure attachment vs. insecure attachment) as the independent variable and each of the subscales of the PANAS as dependent variables (see Tables 6 and 7 for results when strict and lenient exclusions were applied, respectively). Regardless of the exclusion criteria, whether outliers were included/excluded, or whether non-parametric analyses were conducted, no significant differences in negative affect were observed across conditions ( $-.09 \leq ds \leq -.02$ ).

In addition, the effect of the experimental manipulation on positive affect was not significant at the  $p < .05$  level when either exclusion criteria were applied. Nevertheless, it was marginally significant when strict exclusions were applied, with positive affect being significantly higher in the secure attachment condition than the insecure attachment condition ( $d = .27$ ), but not significantly different in the secure attachment condition vs. the control condition ( $d = .15$ ) or the insecure attachment condition vs. the control condition ( $d = -.11$ ). When lenient exclusions were applied, the effect of experimental condition on positive affect was not even marginally significant. In this analysis, the differences in positive affect in the secure attachment condition vs. the control condition ( $d = .13$ ) and the insecure attachment condition vs. the control condition ( $d = -.05$ ) were not significant, while the difference in positive affect between the secure attachment condition vs. the control condition was marginally significant ( $d = .19$ ).

**Moderation by trait attachment.** Some previous research has found that the effect of security priming depends on trait attachment (Gillath et al., 2019). Thus, separate multiple regression analyses were conducted with trait attachment avoidance (centred) or trait attachment

anxiety (centred) as predictors of state attachment avoidance, anxiety, and security, as well as positive and negative affect. These regressions analyses included dummy-coded variables to compare the effect of the secure attachment prime to the control condition, and to compare the effect of the insecure attachment prime to the control condition on each outcome (see Table 8 for exact coding). Moderation was examined by also including interaction terms between each of the dummy-coded variables and trait attachment avoidance or anxiety in the multiple regression analyses.

When some evidence of an interaction between an attachment condition and trait attachment was found (i.e., the interaction was at least marginally significant in one of the analyses), the Johnson-Neyman approach (Bauer & Curran, 2005) was used to unpack the interaction using the PROCESS macro for SPSS (Hayes, 2013). This approach allows one to examine “how the conditional effect of the focal predictor [i.e., attachment condition] changes across the entire range of a continuous moderating variable [i.e., trait attachment]” (Bauer & Curran, 2005, p. 374). This is a more comprehensive way of unpacking interactions compared to examining the conditional effect of the focal predictor (i.e., the attachment condition) at a small number of arbitrarily selected values (e.g.,  $\pm 1 SD$ ) of the moderating variable (i.e., trait attachment). For instance, if there is a conditional effect of one of the attachment conditions for those who score 1.10 standard deviations or more above the mean on trait attachment avoidance (but there is no conditional effect for those who score below 1.10 standard deviations on trait attachment avoidance), this conditional effect would be missed by the traditional  $\pm 1 SD$  approach but not by the Johnson-Neyman approach. The Johnson-Neyman output provides point estimates and confidence intervals of the conditional effect across levels of the moderating variable. The point estimates and 90% confidence intervals of the conditional effect of the attachment

Table 8

*Dummy Coding for Multiple Regression Analyses in Study 1*

	Dummy-coded variables	
	$C_1$	$C_2$
Experimental condition		
Secure attachment	1	0
Insecure attachment	0	1
Control	0	0

*Note.* Dummy-coded variable  $C_1$  tests the effect of the secure attachment condition compared to the control condition, while dummy-coded variable  $C_2$  tests the effect of the insecure attachment condition compared to the control condition.

condition (y axis) across levels of trait attachment (x axis) from this output were plotted. The values(s) of trait attachment at which the conditional effect was at least marginally significant (i.e., the 90% confidence interval did not include 0) was indicated in these plots with a vertical red line, with the percentage of individuals in the sample who scored above or below this value also indicated. These percentages give one a better idea of where in the distribution of trait attachment scores the conditional effect is at least marginally significant.

When some evidence of an interaction was found, I also examined the conditional effect of trait attachment by comparing the association between trait attachment and state attachment/affect in the attachment condition and the control condition.

***Moderation by trait attachment avoidance.*** Results from multiple regression analyses involving trait attachment avoidance and state attachment/affect are presented in Table 9 (this table includes results when strict and lenient approaches were applied). The only statistically significant predictor of state attachment avoidance was trait attachment avoidance. Not

Table 9

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on State Attachment and Affect in Study 1*

Outcome	Strict Exclusions					Lenient Exclusions				
	Predictors					Predictors				
	Secure Condition	Insecure Condition	Trait Attach Avoidance	Secure Condition X Trait Attach Avoidance	Insecure Condition X Trait Attach Avoidance	Secure Condition	Insecure Condition	Trait Attach Avoidance	Secure Condition X Trait Attach Avoidance	Insecure Condition X Trait Attach Avoidance
State Attach Avoidance	$\beta = -.02$ $p = .562$	$\beta = -.02$ $p = .666$	$\beta = .70$ $p < .001$	$\beta = .01$ $p = .893$	$\beta = .01$ $p = .893$	$\beta = -.03$ $p = .422$	$\beta = -.01$ $p = .859$	$\beta = .70$ $p < .001$	$\beta = .004$ $p = .918$	$\beta = -.02$ $p = .668$
State Attach Anxiety	$\beta = .11$ $p = .027$	$\beta = .13$ $p = .010$	$\beta = .03$ $p = .639$	$\beta = -.01$ $p = .913$	$\beta = -.03$ $p = .641$	$\beta = .11$ $p = .032$	$\beta = .11$ $p = .034$	$\beta = .03$ $p = .639$	$\beta = -.03$ $p = .672$	$\beta = -.01$ $p = .880$
State Attach Security (w/ outliers)	$\beta = .07$ $p = .112$	$\beta = -.02$ $p = .708$	$\beta = -.59$ $p < .001$	$\beta = .09$ $p = .080$	$\beta = .08$ $p = .111$	$\beta = .07$ $p = .126$	$\beta = .002$ $p = .968$	$\beta = -.59$ $p < .001$	$\beta = .09$ $p = .079$	$\beta = .06$ $p = .244$
State Attach Security (no outliers)	$\beta = .07$ $p = .143$	$\beta = .001$ $p = .980$	$\beta = -.60$ $p < .001$	$\beta = .09$ $p = .096$	$\beta = .12$ $p = .023$	$\beta = .06$ $p = .163$	$\beta = .02$ $p = .684$	$\beta = -.60$ $p < .001$	$\beta = .08$ $p = .097$	$\beta = .09$ $p = .082$
Positive Affect	$\beta = .07$ $p = .153$	$\beta = -.05$ $p = .305$	$\beta = -.24$ $p = .001$	$\beta = -.003$ $p = .960$	$\beta = .03$ $p = .587$	$\beta = .06$ $p = .194$	$\beta = -.03$ $p = .533$	$\beta = -.24$ $p = .001$	$\beta = -.01$ $p = .929$	$\beta = .01$ $p = .823$
Negative Affect (w/ outliers)	$\beta = -.03$ $p = .541$	$\beta = -.01$ $p = .851$	$\beta = .42$ $p < .001$	$\beta = -.06$ $p = .322$	$\beta = -.14$ $p = .018$	$\beta = -.04$ $p = .425$	$\beta = -.01$ $p = .828$	$\beta = .42$ $p < .001$	$\beta = -.07$ $p = .180$	$\beta = -.13$ $p = .029$

Negative Affect (no outliers)	$\beta = -.04$ $p = .394$	$\beta = -.01$ $p = .848$	<b><math>\beta = .43</math></b> <b><math>p &lt; .001</math></b>	$\beta = -.06$ $p = .322$	<b><math>\beta = -.14</math></b> <b><math>p = .016</math></b>	$\beta = -.05$ $p = .307$	$\beta = -.01$ $p = .825$	<b><math>\beta = .43</math></b> <b><math>p &lt; .001</math></b>	$\beta = -.08$ $p = .179$	<b><math>\beta = -.13</math></b> <b><math>p = .027</math></b>
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*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Insecure Condition = Dummy-coded variable comparing insecure attachment condition to control condition; Attach = Attachment. Significant or marginally significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms ranged from 452 to 456 when strict exclusions were applied and from 500 to 504 when lenient exclusions were applied. Variance inflation factors were all  $\leq 2.61$ .

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surprisingly, individuals who were higher in trait attachment avoidance tended to report feeling more avoidant in the moment. There were no significant effects of either attachment condition (compared to the control condition) on state attachment avoidance and trait attachment avoidance was not a statistically significant moderator of the effect of the attachment conditions (compared to the control condition) on state attachment avoidance. These results involving state attachment avoidance were consistent when either strict or lenient exclusions were applied.

In terms of state attachment anxiety, both dummy-coded variables were statistically significant and indicated that state attachment anxiety was significantly higher in both the secure and insecure attachment conditions than the control condition. This is consistent with what was found in the one-way between-subjects ANOVAs involving state attachment anxiety. Trait attachment avoidance was not a statistically significant predictor of state attachment anxiety and was not a statistically significant moderator of the effect of the attachment conditions (compared to the control condition) on state attachment anxiety. These results involving state attachment anxiety were consistent when either strict or lenient exclusions were applied.

For state attachment security, trait attachment avoidance was a statistically significant predictor. Those who reported higher trait attachment avoidance tended to report lower levels of attachment security in the moment. There were no significant effects of either attachment condition (compared to the control condition) on state attachment security. The interaction between trait attachment avoidance and the secure attachment condition was not significant at the  $p < .05$  level, but it was marginally significant. Unpacking this marginally significant interaction, the secure attachment condition led to higher state attachment security (compared to the control condition) for those who were above average on trait attachment avoidance, but it did not have a significant effect on state attachment security for those who were below average on

trait attachment avoidance (see Figure 2). Looking at this interaction from a different angle, trait attachment avoidance was a significant predictor of lower state attachment security in both the control and secure attachment conditions, but it appeared to be a slightly stronger predictor in the control condition than the secure attachment condition (see Table 10). All the above results involving state attachment security were consistent across both exclusion criteria and when outliers were excluded/included in analyses.

In contrast, interpretation of results involving the interaction between trait attachment avoidance and the insecure attachment condition (compared to the control condition) on state attachment security differed depending on the exclusion criteria and whether outliers were excluded/included. Specifically, this interaction was statistically significant when outliers were excluded and strict exclusions were applied, but it was not significant at the  $p < .05$  level in the other three analyses (although it was marginally significant when outliers were excluded and lenient exclusions were applied). Unpacking the significant and marginally significant interactions, when strict exclusions were applied, the insecure attachment condition led to lower state attachment security for those low in trait attachment avoidance and higher state attachment security for those high in trait attachment avoidance; when lenient exclusions were applied, however, only the positive effect of the insecure attachment condition on state attachment security for those high in trait attachment avoidance remained (see Figure 3). Looking at this interaction from a different angle, trait attachment avoidance was consistently a significant predictor of lower state attachment security in both the control and insecure attachment conditions, but it was consistently a slightly stronger predictor in the control condition than the insecure attachment condition (see Table 10).

The only statistically significant predictor of positive affect was trait attachment

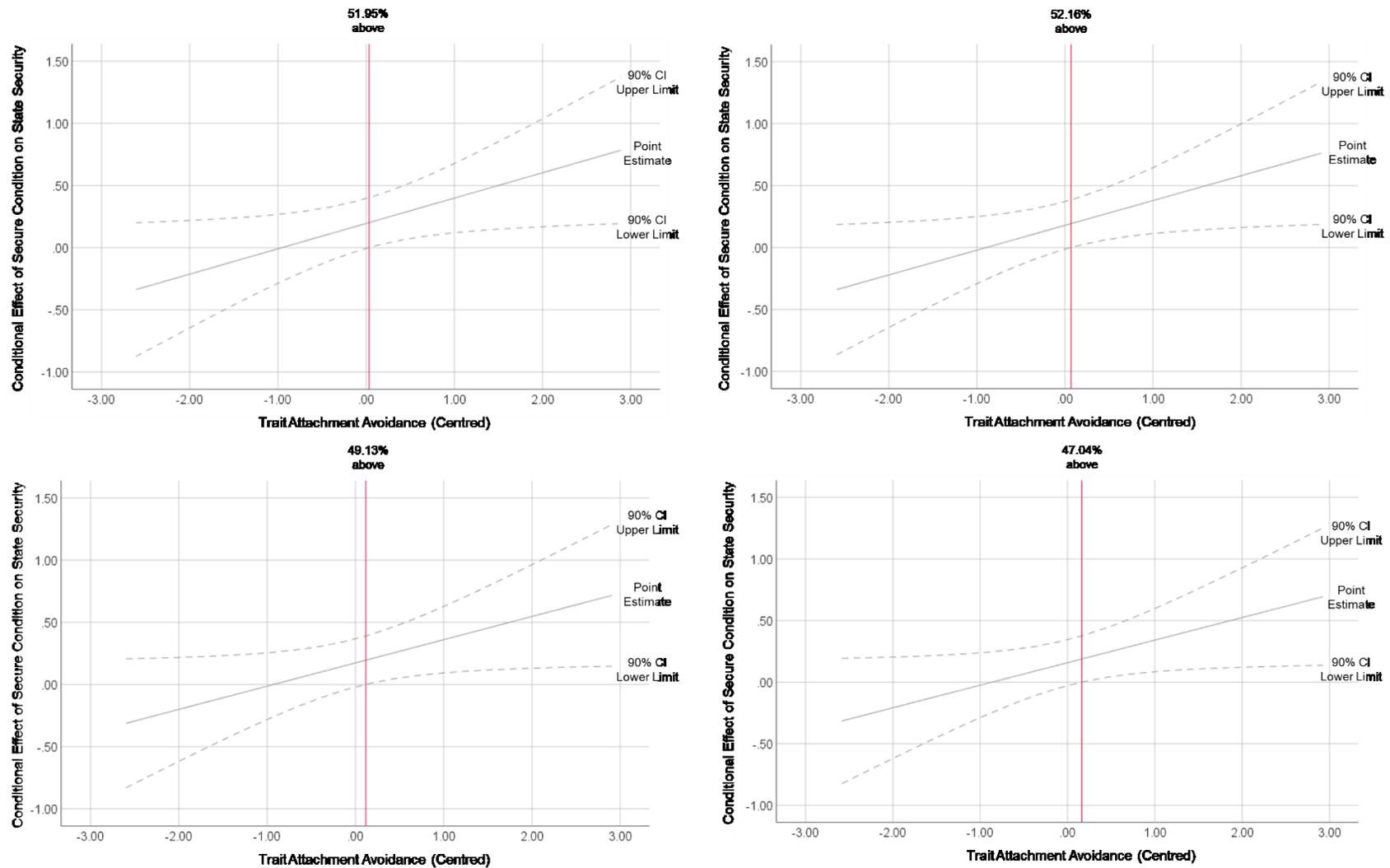


Figure 2. Conditional effect of secure attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 1 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 10

*Investigating Conditional Effects of Trait Attachment Avoidance on State Attachment Security and Negative Affect in Attachment Conditions vs. Control Condition in Study 1*

	Strict Exclusions		Lenient Exclusions	
	With outliers	Without outliers	With outliers	Without outliers
Secure Condition X Trait Attach Avoid → State Attach Security				
Control Condition	<b><math>b = -.707</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.690</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.707</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.690</math></b> <b><math>p &lt; .001</math></b>
Secure Condition	<b><math>b = -.503</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.503</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.507</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.507</math></b> <b><math>p &lt; .001</math></b>
Insecure Condition X Trait Attach Avoid → State Attach Security				
Control Condition	<b><math>b = -.707</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.690</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.707</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.690</math></b> <b><math>p &lt; .001</math></b>
Insecure Condition	<b><math>b = -.523</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.431</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.581</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.505</math></b> <b><math>p &lt; .001</math></b>
Insecure Condition X Trait Attach Avoid → Negative Affect				
Control Condition	<b><math>b = .340</math></b> <b><math>p &lt; .001</math></b>			
Insecure Condition	<b><math>b = .137</math></b> <b><math>p = .037</math></b>	<b><math>b = .137</math></b> <b><math>p = .034</math></b>	<b><math>b = .165</math></b> <b><math>p = .005</math></b>	<b><math>b = .165</math></b> <b><math>p = .005</math></b>

*Note.* Attach Avoid = Attachment Avoidance. Significant coefficients are highlighted in bold. The degrees of freedom for the error terms ranged from 452 to 456 when strict exclusions were applied and from 500 to 504 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 9.

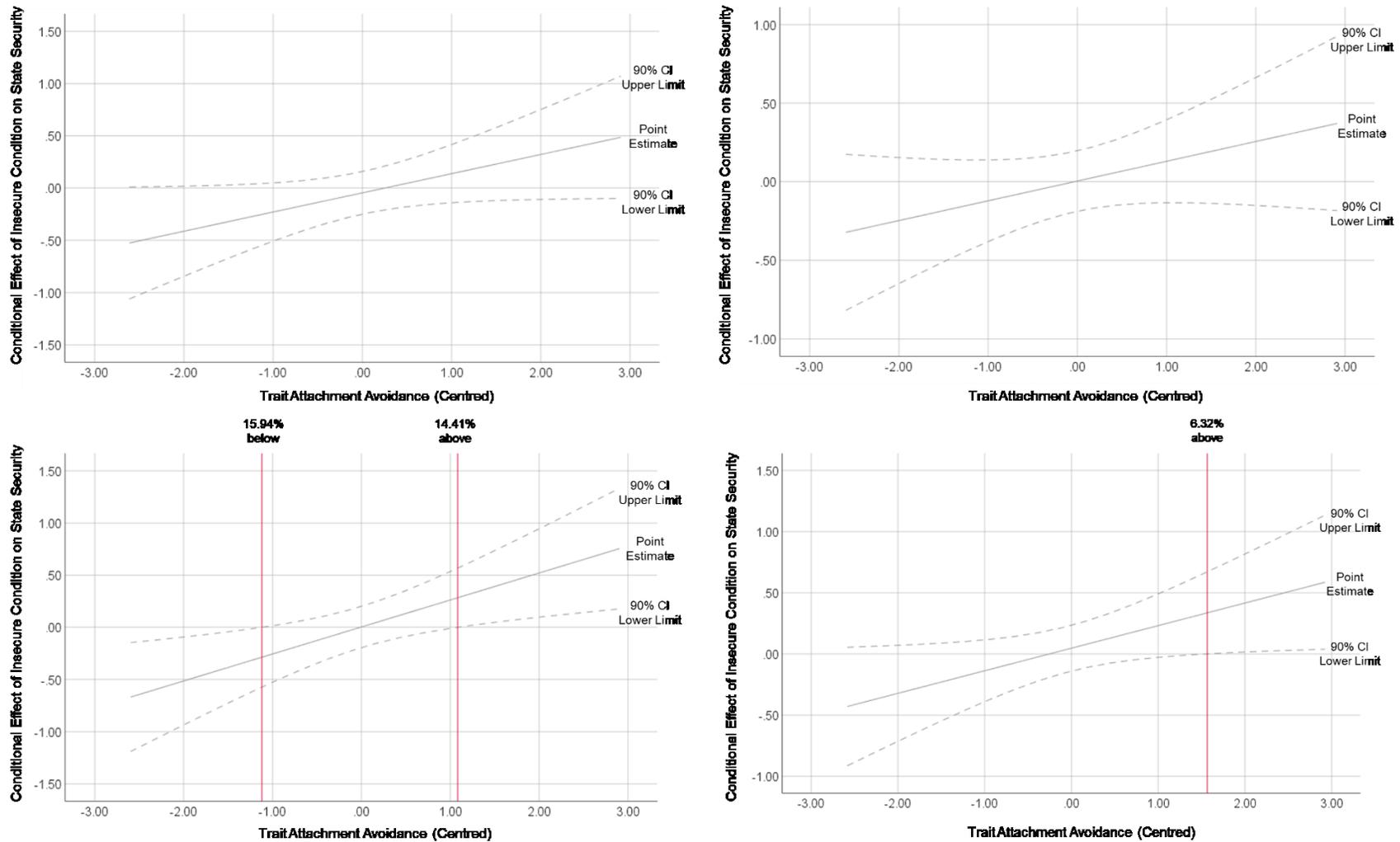


Figure 3. Conditional effect of insecure attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 1 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

avoidance. Individuals who were higher in trait attachment avoidance tended to report feeling lower levels of positive affect in the moment. There were no significant effects of either attachment condition (compared to the control condition) on positive affect and trait attachment avoidance was not a statistically significant moderator of the effect of the attachment conditions (compared to the control condition) on positive affect. These results involving positive affect were consistent when either strict or lenient exclusions were applied.

Finally, negative affect was also predicted by trait attachment avoidance. Those higher in trait attachment avoidance tended to report higher levels of negative affect in the moment. There were no significant effects of either attachment condition (compared to the control condition) on negative affect, but there was a statistically significant interaction between the insecure attachment condition and trait attachment avoidance. The insecure attachment condition led to higher negative affect for those low in trait attachment avoidance, but it led to lower negative affect for those high in trait attachment avoidance (see Figure 4). Looking at this interaction from a different angle, trait attachment avoidance was a significant predictor of higher negative affect in both the control and insecure attachment condition, but it appeared to be a stronger predictor in the control condition than the insecure attachment condition (see Table 10). Trait attachment avoidance was not a statistically significant moderator of the effect of the secure attachment condition (compared to the control condition) on negative affect. The results involving negative affect were consistent when either strict or lenient exclusions were applied and when outliers were excluded/included in analyses.

***Moderation by trait attachment anxiety.*** Results from multiple regression analyses involving trait attachment anxiety and state attachment/affect are presented in Table 11 (this table also includes results when strict and lenient approaches were applied). Across the multiple

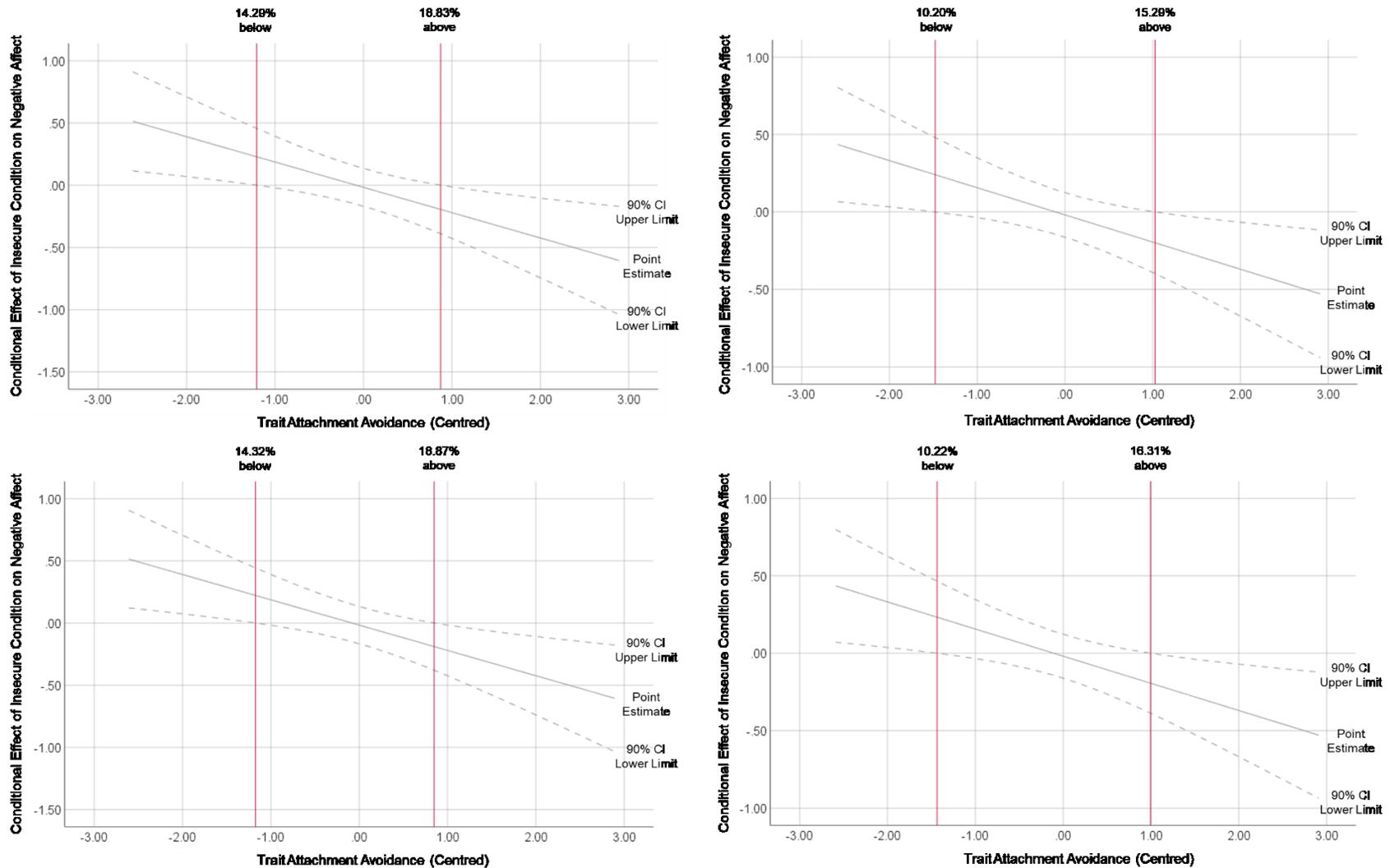


Figure 4. Conditional effect of insecure attachment condition (compared to control condition) on negative affect as a function of trait attachment avoidance in Study 1 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 11

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on State Attachment and Affect in Study 1*

Outcome	Strict Exclusions					Lenient Exclusions				
	Predictors					Predictors				
	Secure Condition	Insecure Condition	Trait Attach Anxiety	Secure Condition X Trait Attach Anxiety	Insecure Condition X Trait Attach Anxiety	Secure Condition	Insecure Condition	Trait Attach Anxiety	Secure Condition X Trait Attach Anxiety	Insecure Condition X Trait Attach Anxiety
State Attach Avoidance	$\beta = -.02$ $p = .643$	$\beta = -.03$ $p = .586$	$\beta = .33$ $p < .001$	$\beta = -.04$ $p = .473$	$\beta = -.04$ $p = .498$	$\beta = -.02$ $p = .631$	$\beta = -.03$ $p = .512$	$\beta = .33$ $p < .001$	$\beta = -.05$ $p = .407$	$\beta = -.02$ $p = .770$
State Attach Anxiety	$\beta = .10$ $p = .031$	$\beta = .08$ $p = .061$	$\beta = .54$ $p < .001$	$\beta = -.05$ $p = .333$	$\beta = .02$ $p = .716$	$\beta = .10$ $p = .027$	$\beta = .08$ $p = .088$	$\beta = .53$ $p < .001$	$\beta = -.08$ $p = .153$	$\beta = .01$ $p = .853$
State Attach Security (w/ outliers)	$\beta = .08$ $p = .105$	$\beta = .01$ $p = .880$	$\beta = -.42$ $p < .001$	$\beta = .11$ $p = .071$	$\beta = .04$ $p = .528$	$\beta = .07$ $p = .152$	$\beta = .03$ $p = .525$	$\beta = -.42$ $p < .001$	$\beta = .10$ $p = .096$	$\beta = .03$ $p = .681$
State Attach Security (no outliers)	$\beta = .07$ $p = .134$	$\beta = .03$ $p = .575$	$\beta = -.43$ $p < .001$	$\beta = .11$ $p = .085$	$\beta = .06$ $p = .376$	$\beta = .06$ $p = .195$	$\beta = .05$ $p = .316$	$\beta = -.42$ $p < .001$	$\beta = .09$ $p = .119$	$\beta = .04$ $p = .510$
Positive Affect	$\beta = .08$ $p = .119$	$\beta = -.04$ $p = .489$	$\beta = -.27$ $p = .001$	$\beta = -.02$ $p = .807$	$\beta = .03$ $p = .605$	$\beta = .07$ $p = .184$	$\beta = -.01$ $p = .785$	$\beta = -.27$ $p < .001$	$\beta = .02$ $p = .811$	$\beta = .01$ $p = .824$
Negative Affect (w/ outliers)	$\beta = -.04$ $p = .419$	$\beta = -.04$ $p = .376$	$\beta = .39$ $p < .001$	$\beta = .003$ $p = .954$	$\beta = .04$ $p = .528$	$\beta = -.04$ $p = .374$	$\beta = -.04$ $p = .413$	$\beta = .40$ $p < .001$	$\beta = .01$ $p = .830$	$\beta = .04$ $p = .505$

Negative Affect (no outliers)	$\beta = -.05$ $p = .280$	$\beta = -.04$ $p = .368$	$\beta = .40$ $p < .001$	$\beta = .01$ $p = .813$	$\beta = .04$ $p = .521$	$\beta = -.05$ $p = .254$	$\beta = -.04$ $p = .405$	$\beta = .40$ $p < .001$	$\beta = .02$ $p = .711$	$\beta = .04$ $p = .498$
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*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Insecure Condition = Dummy-coded variable comparing insecure attachment condition to control condition; Attach = Attachment. Significant or marginally significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms ranged from 452 to 456 when strict exclusions were applied and from 500 to 504 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.18$ .

regression analyses, trait attachment anxiety was a statistically significant predictor of all state attachment and affect outcomes. Those higher in trait attachment anxiety tended to report higher levels of state attachment avoidance, state attachment anxiety, and negative affect, and lower levels of state attachment security and positive affect. Somewhat consistent with the one-way between-subjects ANOVAs, the secure attachment condition (compared to the control condition) significantly predicted higher state attachment anxiety, but the insecure attachment condition (compared to the control condition) was not a significant predictor of state attachment anxiety at the  $p < .05$  level (although it was a marginally significant predictor). Neither attachment condition predicted any other state attachment or affect outcome. All the above results were consistent when either strict or lenient exclusions were applied and when outliers were excluded/included in analyses.

In general, trait attachment anxiety was not a significant moderator. For state attachment security, however, three out of the four analyses looking at the interaction between the secure attachment condition (compared to the control condition) and trait attachment anxiety were marginally significant. Regardless of the exclusion criteria or whether outliers were included/excluded, the secure attachment condition led to higher state attachment security for those who were above average on trait attachment anxiety, but it had no effect for those who were below average on trait attachment anxiety (see Figure 5). Looking at this interaction from a different angle, trait attachment anxiety was a significant predictor of lower state attachment security in both the control condition and the secure attachment condition, but it appeared to be a

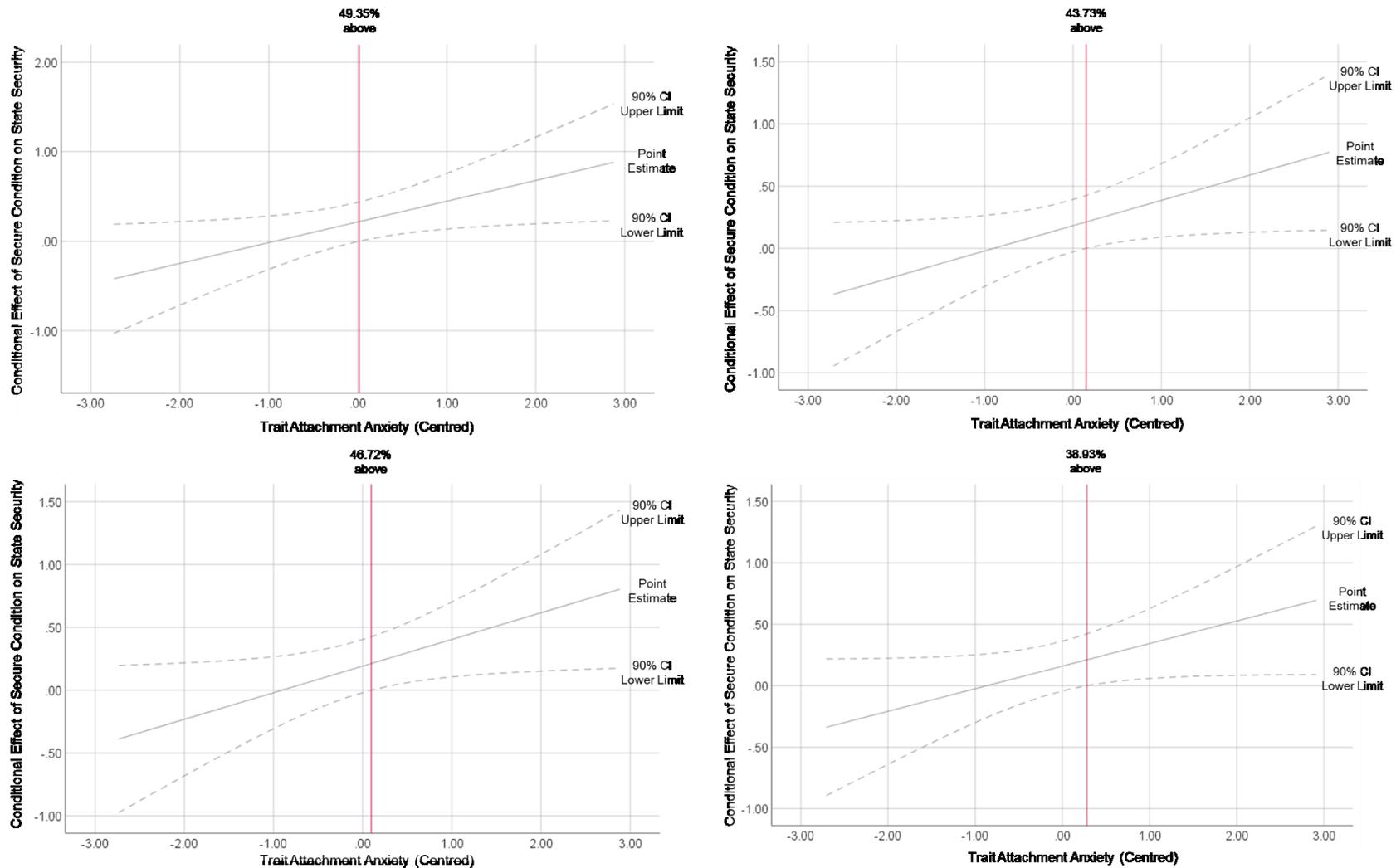


Figure 5. Conditional effect of secure attachment condition (compared to control condition) on state attachment security as a function of trait attachment anxiety in Study 1 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

stronger predictor in the control condition than the secure attachment condition (see Table 12).<sup>21</sup>

### **Experimental Manipulation, Trait Attachment, Trait Nature Connectedness, and Motivation to Connect with Nature**

**Main effects.** To investigate Research Question #2, separate one-way between-subjects ANOVAs were run with experimental condition (control vs. secure attachment vs. insecure attachment) as the independent variable and either of the two measures of current motivation to connect with nature (i.e., the adapted Connectedness to Nature Scale or the adapted Preferences for Nature Questionnaire) as the dependent variable (see Table 13). Regardless of whether strict or lenient exclusions were applied, there were no statistically significant differences between the conditions on either motivation to connect with nature measure.

**Moderation by trait attachment or nature connectedness.** Although there were no significant main effects, the effect of the experimental manipulation on motivation to connect with nature may depend on individual differences in trait attachment or trait nature connectedness (Research Question #3). Thus, separate multiple regression analyses were conducted that tested the potential moderating role of trait attachment avoidance, trait attachment anxiety, or trait nature connectedness on motivation to connect with nature. The same dummy-coded variables used for the multiple regression manipulation checks were used for these analyses and each trait predictor was centred before calculating the interaction terms between each of the dummy-coded variables and the trait predictor. The same approach used to unpack interactions involving state attachment/affect was used to unpack interactions involving the

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<sup>21</sup> As some differences/interactions involving affect were observed in the manipulation checks (and because positive affect was significantly positively associated with adapted Connectedness to Nature scores,  $r_s = .13$ ,  $p_s < .01$  [none of the other associations involving affect and the motivation to connect with nature measures were statistically significant]), supplementary analyses involving motivation to connect with nature were also conducted that controlled for positive affect and negative affect. In general, the interpretation of results was similar when positive affect and negative affect were included as covariates, but when their inclusion resulted in meaningful changes in the interpretation of results it is mentioned in the footnotes in the following section.

Table 12

*Investigating Conditional Effects of Trait Attachment Anxiety on State Attachment Security in Secure Attachment Condition vs. Control Condition in Study 1*

	Strict Exclusions		Lenient Exclusions	
	With outliers	Without outliers	With outliers	Without outliers
Secure Condition X Trait Attach Anxiety → State Attach Security				
Control Condition	<b><math>b = -.500</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.480</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.500</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.480</math></b> <b><math>p &lt; .001</math></b>
Secure Condition	<b><math>b = -.268</math></b> <b><math>p = .004</math></b>	<b><math>b = -.268</math></b> <b><math>p = .003</math></b>	<b><math>b = -.296</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = -.296</math></b> <b><math>p &lt; .001</math></b>

*Note.* Attach Avoid = Attachment Avoidance. Significant coefficients are highlighted in bold. The degrees of freedom for the error terms ranged from 452 to 456 when strict exclusions were applied and from 500 to 504 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 11.

motivation to connect with nature measures.

***Moderation by trait attachment avoidance.*** Results from multiple regression analyses involving trait attachment avoidance and the motivation to connect with nature measures are presented in Table 14 (this table includes results when strict and lenient approaches were applied). Consistent with the one-way between-subjects ANOVAs, neither attachment condition (compared to the control condition) significantly predicted motivation to connect with nature. Moreover, trait attachment avoidance was not a significant predictor of motivation to connect with nature either. Trait attachment avoidance was not a significant moderator of the effect of the insecure attachment condition (compared to the control condition) on motivation to connect with nature, but it was a significant moderator of the effect of the secure attachment condition

Table 13

*Effects of Experimental Manipulation on Motivation to Connect with Nature in Study 1*

	Control Condition	Secure Attachment Condition	Insecure Attachment Condition				<i>d</i> S - C	<i>d</i> I - C	<i>d</i> S - I
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>F</i>	<i>p</i>	$\eta_p^2$			
Strict Exclusions									
Adapted CNS	4.41 <sup>a</sup> (1.02)	4.42 <sup>a</sup> (1.10)	4.44 <sup>a</sup> (1.12)	0.02	.976	< .001	.01	.02	-.02
Adapted PNQ	4.29 <sup>a</sup> (1.14)	4.47 <sup>a</sup> (1.41)	4.45 <sup>a</sup> (1.28)	1.06	.348	.005	.15	.13	.02
Lenient Exclusions									
Adapted CNS	4.41 <sup>a</sup> (1.02)	4.38 <sup>a</sup> (1.12)	4.47 <sup>a</sup> (1.08)	0.32	.725	.001	-.04	.05	-.09
Adapted PNQ	4.29 <sup>a</sup> (1.14)	4.38 <sup>a</sup> (1.44)	4.46 <sup>a</sup> (1.26)	0.75	.472	.003	.07	.14	-.05

*Note.* CNS = Connectedness to Nature Scale; PNQ = Preferences for Nature Questionnaire; *d* S - C = Cohen's *d* for secure attachment condition vs. control condition; *d* I - C = Cohen's *d* for insecure attachment condition vs. control condition; *d* S - I = Cohen's *d* for secure attachment condition vs. insecure attachment condition. The degrees of freedom for the error term in the one-way ANOVAs was 462 when strict exclusions were applied and 510 when lenient exclusions were applied. The equality of variance assumption was met for the one-way ANOVAs involving the adapted CNS (*ps* in Levene's tests were > .05), but it was violated for the one-way ANOVAs involving the adapted PNQ ( $p_{\text{strict}} = .035$ ,  $p_{\text{lenient}} = .014$ ). Nevertheless, similar results were obtained when Kruskal-Wallis non-parametric tests were conducted.

Table 14

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on Motivation to Connect with Nature in Study 1*

Outcome	Strict Exclusions					Lenient Exclusions				
	Predictors					Predictors				
	Secure Condition	Insecure Condition	Trait Attach Avoidance	Secure Condition X Trait Attach Avoidance	Insecure Condition X Trait Attach Avoidance	Secure Condition	Insecure Condition	Trait Attach Avoidance	Secure Condition X Trait Attach Avoidance	Insecure Condition X Trait Attach Avoidance
Adapted CNS	$\beta = .001$ $p = .981$	$\beta = .01$ $p = .869$	$\beta = .03$ $p = .651$	<b><math>\beta = -.14</math></b> <b><math>p = .021</math></b>	$\beta = -.04$ $p = .470$	$\beta = -.01$ $p = .774$	$\beta = .02$ $p = .676$	$\beta = .03$ $p = .649$	<b><math>\beta = -.13</math></b> <b><math>p = .026</math></b>	$\beta = -.08$ $p = .193$
Adapted PNQ	$\beta = .07$ $p = .171$	$\beta = .05$ $p = .308$	$\beta = .02$ $p = .782$	<b><math>\beta = -.13</math></b> <b><math>p = .027</math></b>	$\beta = -.004$ $p = .949$	$\beta = .04$ $p = .437$	$\beta = .06$ $p = .261$	$\beta = .02$ $p = .784$	<b><math>\beta = -.12</math></b> <b><math>p = .038</math></b>	$\beta = -.03$ $p = .575$

*Note.* CNS = Connectedness to Nature Scale; PNQ = Preferences for Nature Questionnaire; Attach = Attachment. Significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms was 456 when strict exclusions were applied and 504 when lenient exclusions were applied. Variance inflation factors were all  $\leq 2.61$ .

(compared to the control condition) on both motivation to connect with nature measures. The secure attachment condition led to higher scores on the adapted Connectedness to Nature Scale for those low in trait attachment avoidance, but it led to lower scores for those high in trait attachment avoidance (see Figure 6). Moreover, the secure attachment condition led to higher scores on the Preferences for Nature Questionnaire for those who were below average on trait attachment avoidance, but it basically had no effect for those who were above average on trait attachment avoidance (see Figure 7).<sup>22</sup> Looking at these interactions from a different angle, trait attachment avoidance significantly predicted lower scores on both motivation to connect with nature measures in the secure attachment condition, but it was not a significant predictor in the control condition (see Table 15).

***Moderation by trait attachment anxiety.*** Results from multiple regression analyses involving trait attachment anxiety and the motivation to connect with nature measures are presented in Table 16 (this table includes results when strict and lenient approaches were applied). Consistent with the one-way between-subjects ANOVAs, neither attachment condition (compared to the control condition) significantly predicted motivation to connect with nature. Moreover, trait attachment anxiety was not a significant predictor of motivation to connect with nature and it did not moderate the effect of the secure attachment condition (compared to the control condition) on motivation to connect with nature. The interaction between trait attachment anxiety and the insecure attachment condition on the adapted Connectedness to Nature Scale was

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<sup>22</sup> When lenient exclusions were applied, the secure attachment condition had a marginally significant negative effect on scores on the adapted Preferences for Nature Questionnaire at extremely high levels of trait attachment avoidance (i.e., only 0.98% of the sample scored that high). Because this applied to so few individuals and was not found when strict exclusions were applied, confidence in this specific conditional effect was low and it was ignored.

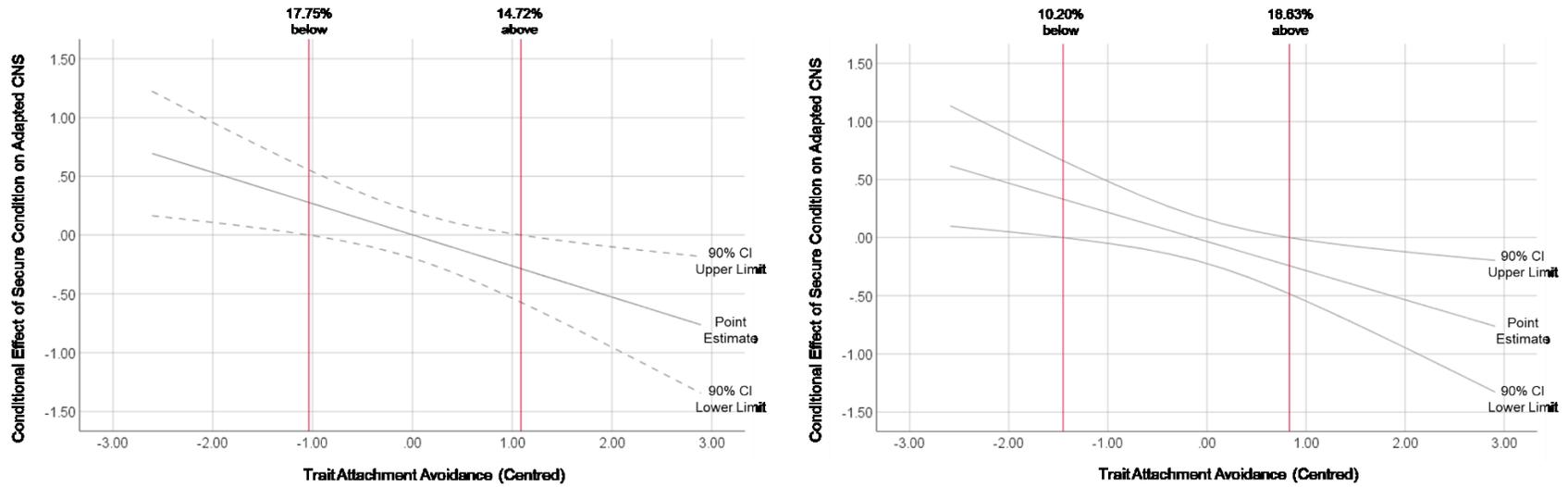


Figure 6. Conditional effect of secure attachment condition (compared to control condition) on the adapted Connectedness to Nature Scale (CNS) as a function of trait attachment avoidance in Study 1 when strict exclusions were applied (left graph) and when lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

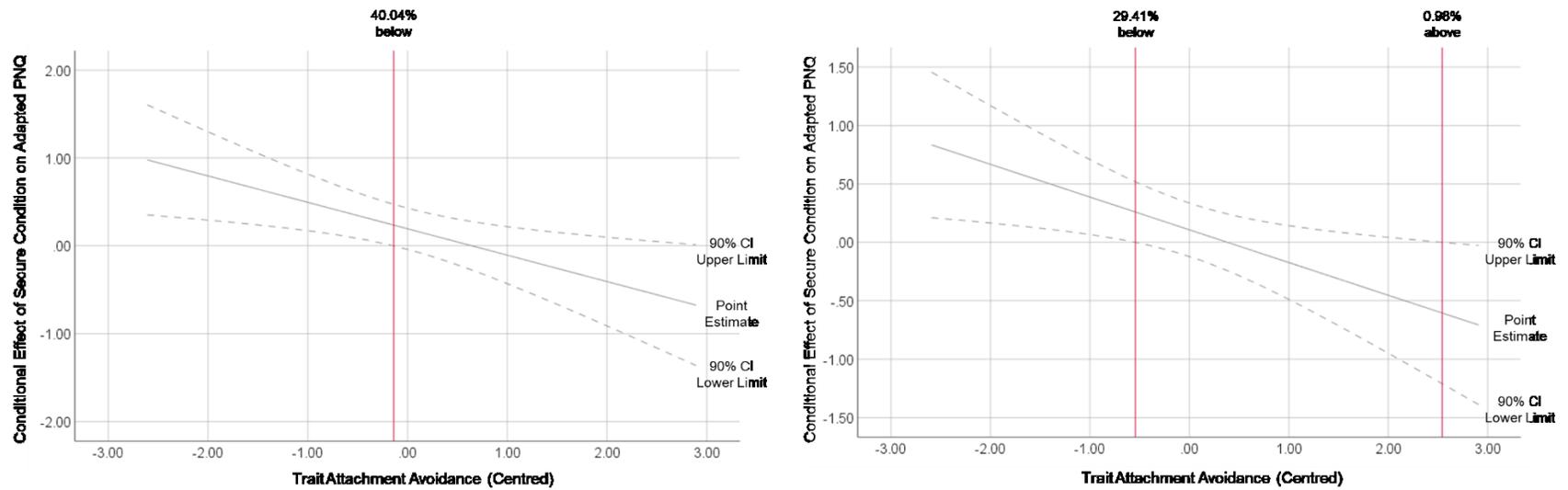


Figure 7. Conditional effect of secure attachment condition (compared to control condition) on the adapted Preferences for Nature Questionnaire (PNQ) as a function of trait attachment avoidance in Study 1 when strict exclusions were applied (left graph) and when lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 15

*Investigating Conditional Effects of Trait Attachment Avoidance on Motivation to Connect with Nature in Secure Attachment Condition vs. Control Condition in Study 1*

	Strict Exclusions		Lenient Exclusions	
	Adapted CNS	Adapted PNQ	Adapted CNS	Adapted PNQ
Secure Condition X Trait Attach Avoid				
Control Condition	$b = .033$ $p = .651$	$b = .024$ $p = .782$	$b = .033$ $p = .649$	$b = .024$ $p = .784$
Secure Condition	<b><math>b = -.232</math></b> <b><math>p = .009</math></b>	<b><math>b = -.277</math></b> <b><math>p = .008</math></b>	<b><math>b = -.218</math></b> <b><math>p = .011</math></b>	<b><math>b = -.256</math></b> <b><math>p = .013</math></b>

*Note.* CNS = Connectedness to Nature Scale; PNQ = Preferences for Nature Questionnaire; Attach Avoid = Attachment Avoidance. Significant coefficients are highlighted in bold. The degrees of freedom for the error terms was 456 when strict exclusions were applied and 504 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 14.

significant when strict exclusions were applied,<sup>23</sup> but it was not significant at the  $p < .05$  level when lenient exclusions were applied (although it was marginally significant). When strict exclusions were applied, the insecure attachment condition (compared to the control condition) led to lower scores on the adapted Connectedness to Nature Scale for those low in trait attachment anxiety, but it led higher scores for those high in trait attachment anxiety (see Figure 8). When lenient exclusions were applied, only the positive effect of the insecure attachment condition on the adapted Connectedness to Nature Scale for those high in trait attachment anxiety remained. Looking at this interaction from a different angle, when strict exclusions were

<sup>23</sup> The statistically significant interaction between trait attachment anxiety and the insecure attachment condition on the adapted Connectedness to Nature Scale when strict exclusions were applied was no longer significant at the  $p < .05$  level when positive affect and negative affect were included as covariates (although it was marginally significant;  $p = .054$ ). Nevertheless, the interpretation of the conditional effects was the same.

Table 16

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on Motivation to Connect with Nature in Study 1*

Outcome	Strict Exclusions					Lenient Exclusions				
	Predictors					Predictors				
	Secure Condition	Insecure Condition	Trait Attach Anxiety	Secure Condition X Trait Attach Anxiety	Insecure Condition X Trait Attach Anxiety	Secure Condition	Insecure Condition	Trait Attach Anxiety	Secure Condition X Trait Attach Anxiety	Insecure Condition X Trait Attach Anxiety
Adapted CNS	$\beta = .003$ $p = .960$	$\beta = .002$ $p = .970$	$\beta = -.06$ $p = .464$	$\beta = -.03$ $p = .631$	<b><math>\beta = .13</math></b> <b><math>p = .047</math></b>	$\beta = -.02$ $p = .745$	$\beta = .02$ $p = .696$	$\beta = -.06$ $p = .463$	$\beta = .01$ $p = .845$	<b><math>\beta = .11</math></b> <b><math>p = .094</math></b>
Adapted PNQ	$\beta = .07$ $p = .182$	$\beta = .05$ $p = .368$	$\beta = .01$ $p = .913$	$\beta = -.08$ $p = .245$	$\beta = .06$ $p = .363$	$\beta = .04$ $p = .484$	$\beta = .06$ $p = .283$	$\beta = .01$ $p = .914$	$\beta = -.03$ $p = .670$	$\beta = .04$ $p = .531$

*Note.* CNS = Connectedness to Nature Scale; PNQ = Preferences for Nature Questionnaire; Attach = Attachment. Significant or marginally significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms was 456 when strict exclusions were applied and 504 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.18$ .

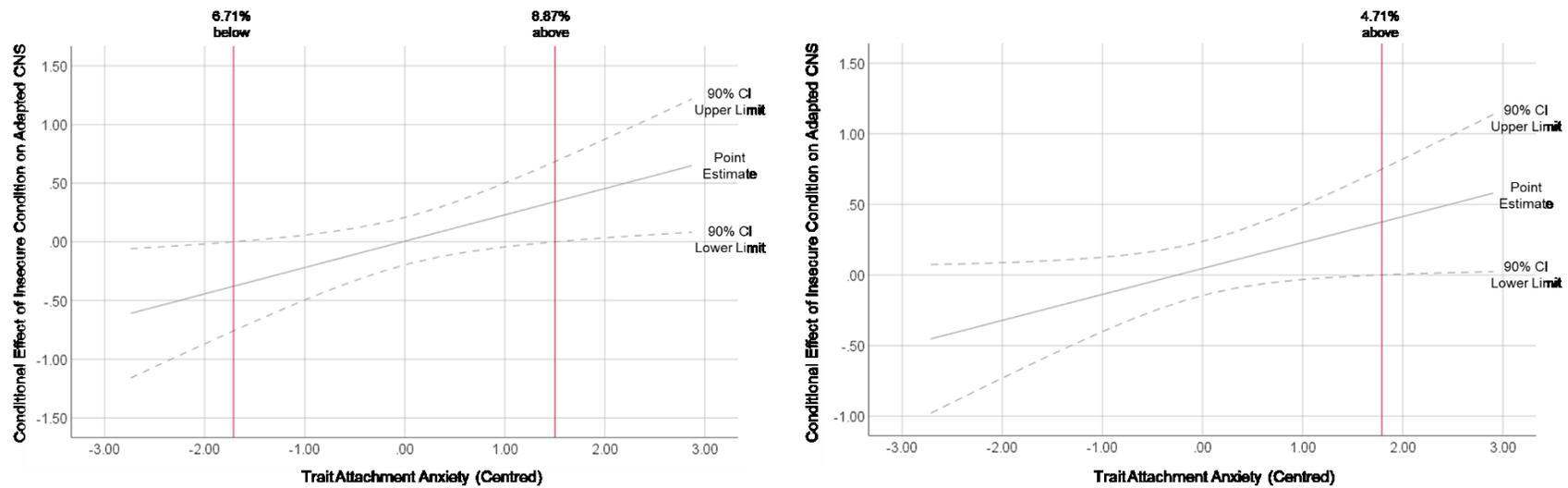


Figure 8. Conditional effect of insecure attachment condition (compared to control condition) on the adapted Connectedness to Nature Scale (CNS) as a function of trait attachment anxiety in Study 1 when strict exclusions were applied (left graph) and when lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

applied, trait attachment anxiety was a significant predictor of higher scores on the adapted Connectedness to Nature Scale in the insecure attachment condition, but it was not a significant predictor in the control condition (see Table 17). When lenient exclusions were applied, trait attachment anxiety was not a significant predictor of scores on the adapted Connectedness to Nature Scale in the control condition or the insecure attachment condition at the  $p < .05$  level (although it was a marginally significant predictor in the insecure attachment condition).<sup>24</sup> Lastly, trait attachment anxiety did not moderate the effect of the insecure attachment condition on the adapted Preferences for Nature Questionnaire.<sup>25</sup>

***Moderation by trait nature connectedness.*** Results from multiple regression analyses involving trait nature connectedness and the motivation to connect with nature measures are presented in Table 18 (this table includes results when strict and lenient approaches were applied). The only significant predictor of motivation to connect with nature in these analyses was trait nature connectedness. Not surprisingly, trait nature connectedness predicted higher scores on both the adapted Connectedness to Nature Scale and the adapted Preferences for Nature Questionnaire. Trait nature connectedness did not moderate the effect of the attachment conditions on motivation to connect with nature. These results were consistent across strict and lenient exclusion criteria.

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<sup>24</sup> When positive affect and negative affect were controlled for when lenient exclusions were applied, the marginally significant conditional effect of trait attachment anxiety on the adapted Connectedness to Nature Scale in the insecure attachment condition became statistically significant ( $p = .037$ ).

<sup>25</sup> Interestingly, differences between the two measures of motivation to connect with nature were also found when their correlation with state attachment anxiety was examined in the overall sample. That is, state attachment anxiety was significantly positively associated with the adapted Connectedness to Nature Scale ( $r_s = .13, p_s \leq .004$ ), but it was not associated with the adapted Preferences for Nature Questionnaire ( $r_{\text{strict}} = .02, p = .722; r_{\text{lenient}} = .01, p = .787$ ). State attachment security and avoidance were consistently not associated with either motivation to connect with nature measure in the overall sample.

Table 17

*Investigating Conditional Effects of Trait Attachment Anxiety on Motivation to Connect with Nature in Insecure Attachment Condition vs. Control Condition in Study 1*

	Strict Exclusions	Lenient Exclusions
	Adapted CNS	Adapted CNS
Insecure Condition X Trait Attach Anxiety		
Control Condition	$b = -.058$ $p = .464$	$b = -.058$ $p = .463$
Insecure Condition	$b = .166$ $p = .038$	$b = .125$ $p = .096$

*Note.* CNS = Connectedness to Nature Scale; Attach = Attachment. Significant or marginally significant coefficients are highlighted in bold. The degrees of freedom for the error terms was 456 when strict exclusions were applied and 504 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 16.

## Discussion

### Correlational Findings

One of the aims of Study 1 was to investigate how interpersonal attachment orientations and nature connectedness might be related at the trait level. Partial evidence was found for a link between trait attachment avoidance and (some aspects of) nature connectedness. Namely, there was some support with those who were more uncomfortable with closeness/intimacy in their interpersonal relationships (i.e., individuals high in attachment avoidance) reporting a weaker connection to nature overall, less concern about the impact of humans on the environment, and less familiarity/comfort/desire to spend time in nature. These results appear to be in line with the correspondence hypothesis, which is consistent with the overall pattern of findings in the

Table 18

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Nature Connectedness on Motivation to Connect with Nature in Study 1*

Outcome	Strict Exclusions					Lenient Exclusions				
	Predictors					Predictors				
	Secure Condition	Insecure Condition	Trait Nature Connect	Secure Condition X Trait Nature Connect	Insecure Condition X Trait Nature Connect	Secure Condition	Insecure Condition	Trait Nature Connect	Secure Condition X Trait Nature Connect	Insecure Condition X Trait Nature Connect
Adapted CNS	$\beta = -.030$ $p = .425$	$\beta < .001$ $p = .992$	<b><math>\beta = .633</math></b> <b><math>p &lt; .001</math></b>	$\beta = .037$ $p = .432$	$\beta = .055$ $p = .241$	$\beta = -.025$ $p = .503$	$\beta = .005$ $p = .892$	<b><math>\beta = .644</math></b> <b><math>p &lt; .001</math></b>	$\beta = .038$ $p = .416$	$\beta = .032$ $p = .496$
Adapted PNQ	$\beta = .042$ $p = .329$	$\beta = .050$ $p = .245$	<b><math>\beta = .512</math></b> <b><math>p &lt; .001</math></b>	$\beta = .048$ $p = .361$	$\beta = .038$ $p = .473$	$\beta = .029$ $p = .485$	$\beta = .046$ $p = .263$	<b><math>\beta = .514</math></b> <b><math>p &lt; .001</math></b>	$\beta = .067$ $p = .201$	$\beta = .035$ $p = .501$

*Note.* CNS = Connectedness to Nature Scale; PNQ = Preferences for Nature Questionnaire; Connect = Connectedness. Significant predictors for each outcome are highlighted in bold. The lenient exclusion results include the outlier on the overall Nature Relatedness Scale, but the interpretation of results was the same when this outlier was excluded. The degrees of freedom for the error terms was 458 when strict exclusions were applied and ranged from 505 to 506 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.15$ .

reanalysis of Zelenski and Nisbet (2014).

Nevertheless, there were discrepancies in which aspects/subscales of nature connectedness were associated with trait attachment avoidance in Study 1 and in the reanalysis of Zelenski and Nisbet (2014). For instance, the association between trait attachment avoidance and the self subscale was marginally significant and small in magnitude in the reanalysis of Zelenski and Nisbet, but it was not even marginally significant and had correlations close to 0 in Study 1. Similarly, the association between trait attachment avoidance and the short-form version of the Nature Relatedness Scale was significant and small in magnitude in the reanalysis of Zelenski and Nisbet, but it was not even marginally significant and had correlations close to 0 in Study 1. Moreover, the associations between trait attachment avoidance and the perspective subscale was either significant or marginally significant in Study 1, while it was not even marginally significant and was close to 0 in the reanalysis of Zelenski and Nisbet. The experience subscale was the only subscale that had an association with trait attachment avoidance that was at least marginally significant (and in the same direction) in both Study 1 and the reanalysis of Zelenski and Nisbet.<sup>26</sup> These inconsistent results could be due to the different measures of trait attachment employed in each study or could just be due to random noise. Whether the partially supported relationships between trait attachment avoidance and some of the indexes of nature connectedness in Study 1 replicate in Study 2 will help determine which of these explanations is most likely to be true.

Like in the reanalysis of Zelenski and Nisbet (2014), no significant or marginally significant associations between trait attachment anxiety and any of the indexes of trait nature

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<sup>26</sup> Although it was not significant in the reanalysis of Zelenski and Nisbet (2014) and was significant/marginally significant in Study 1, the magnitude of the associations between trait attachment avoidance and overall scores on the full-version of the Nature Relatedness Scale were similar in both samples.

connectedness were observed in Study 1. Thus, for trait attachment anxiety, no evidence for the correspondence hypothesis or the compensation hypothesis was found. Moreover, the positive correlations that were interpreted as being potentially suggestive in the reanalysis of Zelenski and Nisbet (e.g., the small but non-significant association between trait attachment anxiety and the experience subscale) were reduced in magnitude in Study 1. Given that even the significant and marginally significant associations involving trait attachment avoidance in Study 1 hovered around the lower cut-off for a small effect, my earlier argument that the limited response options used for the measure of attachment in Zelenski and Nisbet might have attenuated the associations between trait attachment and nature connectedness does not appear to be supported. These results suggest that the link between trait attachment and how people relate to nature is likely to be small in magnitude at best (if existent at all).

Neither interpersonal attachment orientation was a significant or marginally significant predictor of any of the indexes of trait nature connectedness when the big five personality dimensions were controlled for statistically in Study 1. These results suggest that any shared variance observed between trait attachment orientations and trait nature connectedness in Study 1 are probably due to similar underlying personality characteristics. The posited interactions between different behavioral systems or the transference of relational working models to people's relationship with the natural world are theoretical explanations that do not appear to be supported at the trait level when one considers these particular results from Study 1. In line with previous research, openness to experience and agreeableness were the most consistent and strongest predictors of indexes of trait nature connectedness (Nisbet et al., 2009; Tam, 2013a; Zhang, Howell, & Iyer, 2014; Zhang, Piff, et al., 2014).

### **Experimental Findings**

The second aim of Study 1 was to investigate how inducing attachment (in)security might impact people's motivation to connect with nature. In general, motivation to connect with nature did not differ when participants were asked to think and write about an experience that contained elements of attachment security, an experience that contained elements of attachment insecurity, or how they would complete coursework (control condition).

However, it is difficult to discern whether these results are due to a true null effect of social context on motivation to connect with nature or because the attachment conditions did not manipulate attachment-related states of mind in all the ways that were anticipated. The manipulation check analyses found no overall differences on the measures of state attachment security and state attachment avoidance across the experimental conditions. One could argue that the overall causal impact of attachment security on motivation to connect with nature cannot be inferred from Study 1 as the secure attachment condition, in general, did not boost self-reported feelings of attachment security or reduce self-reported feelings of attachment insecurity. Indeed, thinking and writing about attachment-related experiences (regardless of whether the experiences involved others being there for the participant or not) appeared to lead to higher state attachment anxiety in Study 1. Thinking/writing about a situation that they could not solve on their own in both attachment conditions might have primed a negative working model of the self (e.g., viewing oneself as being weak and incapable, and requiring help and support from others; Main et al., 1985) and led to hyperactivation of the attachment behavioural system (and increased state attachment anxiety in both the insecure and secure attachment conditions). Moreover, the lack of differences in state attachment avoidance may have been due to the instructions in the attachment conditions causing people to focus on instances when self-reliance (a key aspect of attachment

avoidance; Brennan et al., 1998) was not a viable strategy (i.e., the problem that participants were asked to think/write had to be one that they could not solve on their own). These potential issues with the specific instructions employed in Study 1 that might explain the unexpected results involving state attachment were avoided in Study 2 as slightly different experimental manipulations were used in each study. At the very least, Study 1 provided an opportunity to examine the overall causal effect of attachment anxiety on motivation to connect with nature: participants in both of the attachment conditions had higher attachment anxiety on average than participants in the control condition, but this was not accompanied by differences in motivation to connect with nature.

Despite the lack of main effects involving motivation to connect with nature in Study 1, some of the moderation analyses suggested that trait attachment might play a role in shaping people's motivation to connect with nature in certain attachment-related contexts. Specifically, evidence was found for trait attachment avoidance moderating the effect of the secure attachment condition on both motivation to connect with nature measures. Participants who were low in trait attachment avoidance were more motivated to connect with nature (i.e., they had higher scores on the adapted Connectedness to Nature Scale and the adapted Preferences for Nature Questionnaire) when they were in the secure attachment condition than the control condition. In other words, for those who tend to be fairly comfortable with closeness, intimacy, and trusting others in their interpersonal relationships, thinking/writing about an experience when they were supported by others motivated them to psychologically and physically connect with nature. This reaction is what one would expect based on the presumed normative functioning of behavioural systems, where having a secure base allows the exploratory behavioural system to become active and function optimally (Mikulincer & Shaver, 2016). However, state attachment security was not

higher in the secure attachment condition compared to the control condition for those who were below average on trait attachment avoidance so there is ambiguity surrounding the exact mechanism that is driving this effect among those who are low in trait attachment avoidance.

In contrast, participants who were high in trait attachment avoidance were less motivated to psychologically connect with nature (i.e., they had lower scores on the adapted Connectedness to Nature Scale) when they were in the secure attachment condition than the control condition. Partial evidence (i.e., marginally significant interactions) was also found for those above average on trait attachment avoidance reporting higher state attachment security in the secure attachment condition than the control condition, which appears to contradict predictions based on how behavioural systems are supposed to interact with one another (i.e., one would expect higher state attachment security to be accompanied by higher exploratory interests). Nonetheless, as the highly avoidant are uncomfortable with closeness/intimacy and have strong desires for self-reliance, when the opportunity to connect with nature is presented to them after they are reminded of a time when they were supported by others, they may have been overwhelmed and shied away from additional external connections in favour of independence. This is consistent with the results of the other follow-up analyses, which found significant negative associations between trait attachment avoidance and scores on both motivation to connect with nature measures in the secure attachment condition, but no significant associations in the control condition. A stronger tendency to feel discomfort with close interpersonal relations may push people away from connecting with nature in secure contexts, but appears to have no impact in contexts that are not already laden with the ‘burden’ of interpersonal intimacy. Lastly, although some interactions between trait attachment avoidance and the insecure attachment condition on state attachment security and negative affect were found in Study 1, no accompanying

interactions between trait attachment avoidance and the insecure attachment condition on motivation to connect with nature were observed.

Beyond trait attachment avoidance, partial evidence was found in Study 1 for trait attachment anxiety moderating the effect of the insecure attachment condition on one of the motivation to connect with nature measures. This interaction and its conditional effects were not as robust across the differing exclusion criteria however (i.e., they tended to be significant when strict exclusions were applied and marginally significant when lenient exclusions were applied) so caution is warranted. Nevertheless, across both exclusion criteria, the insecure attachment condition (compared to the control condition) led to higher scores on the adapted Connectedness to Nature Scale for those who were high in trait attachment anxiety. Moreover, positive associations were found between trait attachment anxiety and scores on the adapted Connectedness to Nature Scale in the insecure attachment condition, but these variables were not associated in the control condition. Both of these findings suggest that those who are highly anxious in their interpersonal relationships may turn to nature for a psychological connection when it does not appear to be available in their social surroundings. This reaction is consistent with the compensation hypothesis and the meaning maintenance model. Given the hyperactive nature of their attachment behavioural system (Cassidy, 1994), their sensitivity to rejection (Brennan et al., 1998), and their greater tendency to anthropomorphize (Bartz et al., 2016), the highly anxious may be particularly susceptible to search for a connection and meaning in nature when social support appears lacking. Partial evidence for an interaction may have been found for the adapted Connectedness to Nature Scale, but not for the adapted Preferences for Nature Questionnaire, because the latter measure is framed less relationally compared to the former measure (this may also explain why the highly avoidant only showed lower motivation to

connect with nature in the secure attachment condition when motivation was measured by the adapted Connectedness to Nature Scale). That is, secondary strategies relied upon by those high in trait attachment anxiety and those high in trait attachment avoidance may primarily impact how they interact with nature in certain socially secure/insecure contexts when the idea of nature as a potential relational partner is explicitly emphasized. Although partial evidence was found for trait attachment anxiety moderating the effect of the insecure attachment condition on motivation to psychologically connect with nature, evidence for accompanying interactions between trait attachment anxiety and the insecure attachment condition on state attachment and affect was absent. Thus, the precise mechanism that was driving the conditional effect of the insecure condition on motivation to psychologically connect with nature among the highly anxious is unclear. Furthermore, although partial evidence was found for some interactions between trait attachment anxiety and the secure attachment condition on state attachment security, no interactions between trait attachment anxiety and the secure attachment condition on either motivation to connect with nature measure were observed. Ultimately, confidence in the moderation results observed in Study 1 (especially when only partial evidence was found) depended on whether a similar pattern of results was observed in Study 2.

### **Study 2**

The second study attempted to conceptually replicate and extend the first. Like Study 1, the second study investigated the link between interpersonal attachment and human-nature relations at both trait and state levels. The questionnaires assessing trait attachment and trait nature connectedness in Study 1 were also employed in Study 2, along with a second popular measure of trait nature connectedness that is more consistently related to social well-being. A slightly different method was used in Study 2 to experimentally manipulate attachment-related

thoughts and feelings by focusing on a specific person instead of a specific experience. Moreover, while Study 1 attempted to activate an insecure state of mind in a third of its participants, Study 2 took an even more nuanced approach by separating the two types of attachment insecurity (i.e., attachment anxiety and attachment avoidance) and attempting to make the working models associated with each salient in a portion of participants. This allowed for a direct causal test of whether the effect of attachment insecurity on human-nature relations depends on the type of insecurity experienced. Furthermore, instead of asking participants to complete adapted versions of self-report questionnaires to assess motivation to connect with nature, Study 2 exposed participants to images of specific natural spaces, and asked how interested they would be in visiting each location, making the act of connecting with nature even more concrete and realistic. To disentangle whether individuals were motivated to spend time in natural environments in particular or simply motivated to explore/connect with the physical world in general, participants in Study 2 were also exposed to images of built spaces, and were asked to what extent they would like to visit these spaces as well. Finally, to increase experimental control and ensure that the physical environment that the study was completed in was similar for all participants, Study 2 was conducted in-lab instead of online. By addressing some of the shortcomings of the first study, and testing the replicability and generalizability of its findings, Study 2 was designed to allow for an even better understanding of the ways in which interpersonal attachment and human-nature relations might intersect. Study 1 and Study 2 were conducted concurrently to maximize the efficiency of data collection efforts.

### **Research Questions**

Despite modifications to the experimental design, Study 2 attempted to answer the same three primary research questions as Study 1. Namely, are attachment orientations and nature

connectedness associated at the trait level (Research Question #1), does priming different attachment schemas impact motivation to connect with nature (Research Question #2), and does trait attachment or nature connectedness moderate the impact of attachment primes on motivation to connect with nature (Research Question #3)? As in Study 1, I also investigated whether trait attachment and nature connectedness are associated after the big five personality dimensions are controlled for in Study 2.

## Method

### Materials

**Experimental manipulation.** Participants were randomly assigned to one of four experimental conditions (see Appendix Q). They were asked to recall, visualize, and write about (1) a relationship characterized by aspects of security (secure attachment condition), (2) a relationship characterized by aspects of avoidance (avoidant attachment condition), (3) a relationship characterized by aspects of anxiety (anxious attachment condition), or (4) the strategies that they typically employ when completing coursework (control condition). In the attachment priming conditions, participants read a paragraph describing the type of relationship that they should recall; these paragraphs were inspired by the descriptions of attachment security, avoidance, and anxiety in Hazan and Shaver's (1987) original measure of adult attachment styles. To make sure that the attention of participants was directed toward a specific person, participants were asked to write the initials of the person they were thinking of and this person's relation to the participant (e.g., parent, friend, romantic partner). Participants were then presented with a series of guided questions about the person and their relationship, and were asked to write for eight minutes about them. Using these experimental manipulations, Luke et al. (2012) showed that individuals primed with attachment security reported higher feelings of security

compared to those primed with attachment anxiety or attachment avoidance. Moreover, the attachment security prime led to greater feelings of security and willingness to explore relative to a neutral or positively valenced control condition (willingness to explore was not assessed when the attachment insecurity primes were employed). Thus, previous research suggested that these attachment primes were effective at inducing attachment-related feelings and motivating individuals in ways that are consistent with attachment theory. The same control condition used in Study 1 was used in Study 2.

**State attachment and affect.** Like Study 1, the 21-item State Adult Attachment Measure (Gillath et al., 2009; see Appendix C) and the 20-item Positive and Negative Affect Schedule (Watson et al., 1988; see Appendix D) were used in Study 2 to assess state attachment avoidance ( $\alpha = .84-.85$ ), state attachment anxiety ( $\alpha = .84-.85$ ), state attachment security ( $\alpha = .90$ ), positive affect ( $\alpha = .89$ ), and negative affect ( $\alpha = .84-.87$ ).<sup>27</sup>

**Motivation to connect with nature.** To assess individuals' motivation to connect with nature, participants were exposed to 52 photographed images of natural and built spaces, and their current interest in visiting each of the spaces was measured (see Appendix R). The images were presented one at a time and their presentation was randomized to avoid any systematic order effects. Below each image, participants were asked how interested they would be in visiting the photographed space on a 7-point Likert-scale ranging from 1 (*not at all interested*) to 7 (*extremely interested*). Overall interest scores were obtained for each type of space by calculating the average interest rating given to the 26 natural spaces ( $\alpha = .96$ ) and the average interest rating given to the 26 built spaces ( $\alpha = .90$ ).<sup>28</sup>

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<sup>27</sup> Throughout the “Materials” subsection of Study 2, the range of Cronbach’s alpha values are reported for when strict and lenient exclusions were applied, and (if applicable) when outliers were included and excluded (see the “Exclusions and Sample Demographics” subsection for more information on specific exclusion criteria).

<sup>28</sup> Although interest in visiting natural spaces and interest in visiting built spaces were significantly positively

The images presented to participants in Study 2 were originally taken for and used in Dopko, Zelenski, and Nisbet (2014), and have several characteristics that make them particularly appealing for use in the current research. All of the photographed spaces were taken locally in the city of Ottawa. Thus, the images reflect potential spaces that individuals might actually encounter and choose to spend time in. Importantly though, according to self-report ratings in Dopko et al. (2014), the 26 natural spaces were, on average, just as familiar to participants as the 26 built spaces. Given that people might be more motivated to spend time in familiar spaces in times of insecurity (Scannell & Gifford, 2014), it was necessary that the set of built and natural spaces did not differ on this characteristic; if they did, it could confound the interpretation of results as it would not be clear whether people are more interested in spending time in one of the two types of spaces in certain psychosocial contexts because the spaces are natural vs. built, or because the spaces are familiar vs. unfamiliar. Relatedly, the photos of natural and built spaces that were selected for inclusion in Dopko et al. were matched by the researchers on a variety of other features, including quality, complexity, lighting, and colour. Nevertheless, participants still perceived the photos of natural spaces to be more pleasant than the photos of built spaces. This is a phenomenon that is consistently found in the environmental psychology literature (Joye, 2007; Ulrich, 1993); differences in pleasantness seem to be a relatively important and common way in which perceptions of natural spaces and built spaces differ. It would likely have been difficult to match images on overall pleasantness without having to employ photos of especially spectacular built spaces and photos of especially unappealing nature, which would have decreased the

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correlated with one another ( $r_s = .38-.40, p_s < .001$ ), support was found for their divergent validity. Specifically, both measures of trait nature connectedness (and all the subscales of the Nature Relatedness Scale) were consistently and significantly positively associated with interest in visiting natural spaces ( $r_s = .22-.44, p_s < .001$ ) and interest in visiting natural spaces over built spaces ( $r_s = .20-.42, p_s < .001$ ), but they tended to not be associated with interest in visiting built spaces ( $r_s = .02-.10$ ). A similar pattern of results emerged when outliers were excluded and when Spearman correlation coefficients were obtained.

applicability and generalizability of results. Moreover, as this study compared interest in spending time in natural vs. built spaces across experimental conditions (e.g., is the difference in interest larger in some conditions), overall differences in the pleasantness of photos of each type of space was thought to not be a major issue.

**Trait attachment.** Similar to Study 1, the 36-item Experiences in Close Relationships Scale (Brennan et al., 1998; see Appendix G) was employed in Study 2 to measure individual differences in trait attachment avoidance ( $\alpha = .90$ ) and trait attachment anxiety ( $\alpha = .91$ ). Trait attachment anxiety and trait attachment avoidance were significantly positively correlated ( $r_s = .28-.30, p < .001$ ).

**Trait nature connectedness.** The 21-item Nature Relatedness Scale (Nisbet et al., 2009) was included in Study 2 to assess individual differences in nature connectedness (see Appendix H). Overall nature connectedness scores for the entire scale ( $\alpha = .86$ ), the short-form version ( $\alpha = .81$ ), and the self ( $\alpha = .83$ ), perspective ( $\alpha = .65-.67$ ), and experience ( $\alpha = .77-.78$ ) subscales were calculated in the same way as they were for Study 1.

Study 2 also included a second popular measure of nature connectedness—the Connectedness to Nature Scale (Mayer & Frantz, 2004; see Appendix S)—to test the robustness of the associations between nature connectedness and interpersonal attachment. This allowed me to check whether the findings depend on how nature connectedness is assessed. Although the Nature Relatedness Scale and Connectedness to Nature Scale are highly correlated with one another (Tam, 2013a), a significant relationship with social well-being appears to be more consistently observed when the Connectedness to Nature Scale is used to measure nature connectedness (Capaldi et al., 2017; Howell et al., 2011; Howell et al., 2013; Nisbet et al., 2011; Windhorst & Williams, 2015). When completing the Connectedness to Nature Scale, participants

were asked to indicate how much they agree with 14 statements (e.g., “I feel as though I belong to the Earth as equally as it belongs to me) using a 5-point Likert-scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Unlike the Nature Relatedness Scale which contains several subscales, the Connectedness to Nature Scale is unidimensional; overall nature connectedness scores on this measure were obtained by calculating the average of the 14 items (after reverse scoring three items;  $\alpha$ s = .82-.84).

**Big five personality factors.** The 100-item IPIP scale based on Costa and McCrae's (1992) NEO-PI-R was employed to measure the big five personality factors in Study 2 (see Appendix T). A slightly shorter scale was used in Study 2 to account for the additional time that participants needed to complete a second measure of nature connectedness. Each of the big five personality dimensions were assessed with 20 statements (many of the items were also included in the IPIP-NEO-120 used in Study 1); participants rated how well each statement described them on a 5-point Likert-scale ranging from 1 (*very inaccurate*) to 5 (*very accurate*). As in Study 1, the beginning of the statements were slightly modified to match the phrasing of the other trait-level measures (e.g., “Find it difficult to get down to work” was changed to “I find it difficult to get down to work”). The five personality dimensions assessed by this 100-item IPIP scale exhibit high internal reliability and are highly correlated with their respective NEO-PI-R domains (International Personality Item Pool, n.d.). Overall scores for agreeableness ( $\alpha$ s = .83-.84), conscientiousness ( $\alpha$ s = .90), extraversion ( $\alpha$ s = .91-.92), neuroticism ( $\alpha$ s = .91), and openness to experience ( $\alpha$ s = .81-.82) were calculated by obtaining the average of their respective items (after reverse scoring relevant items).

## Procedure

A recruitment notice (see Appendix U) was posted on the experimental management

system (SONA) of the Department of Psychology at Carleton University that called for individuals to participate in an in-lab study for course credit. Potential participants were told that the study was examining people’s personality, relationships, emotions, and interests. Individuals were ineligible to sign up for Study 2 if they had already signed up or participated in Study 1 or another research project led by an honours thesis student that used some of the same measures. A maximum of one participant was scheduled for each timeslot, although there were instances when two participants were simultaneously participating in the study in separate rooms (e.g., if a participant was taking longer than expected to complete the study and another participant had arrived for the next scheduled timeslot).

After signing up for a timeslot and coming to the lab at their scheduled time, participants were greeted by the researcher and taken to a small private room in the lab where they were asked to read a printed informed consent form (see Appendix V) and sign it if they consented to participate. While the participant was reading the informed consent form, the researcher recorded the date, arrival time, weather, outside temperature, and the researcher’s initials on an experimenter log sheet. Once the participant had signed the informed consent form, it was collected by the researcher, who then read a brief introductory script<sup>29</sup> and told the participant that they could begin the study. All the tasks and questionnaires in Study 2 were completed by participants on Qualtrics on a computer in the small private room.

At the beginning of the study, Qualtrics randomly assigned participants to the secure attachment condition, the anxious attachment condition, the avoidant attachment condition, or

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<sup>29</sup> This introductory script (1) told participants that the study would take place on the computer in front of them, (2) asked participants to read the instructions carefully and answer the questions honestly, (3) asked participants to turn their phone off or put it on silent and to avoid checking it during the study, and (4) told participants how they can contact the researcher if they have any questions or once they are finished by pressing the on button on a remote control (this would turn on a lamp in another room in the lab where the researcher was waiting).

the control condition. Participants were given eight minutes for the writing task. After the eight minutes had passed, participants were forwarded automatically by Qualtrics to the next part of the study, which involved completing the State Adult Attachment Measure and then the Positive and Negative Affect Schedule. Following this, participants were presented with a message that told them that they will be shown a number of photographs of places located in and around Ottawa, and that they will be asked to indicate how interested they currently are in visiting each place. The 52 photographs of natural and built spaces were then presented to participants in a randomized order and participants were asked to indicate how interested they were in visiting each.

After the photograph rating task, participants were presented with a brief message to help make it clear that the next part of the study contained questionnaires about how they are in general/overall, instead of questionnaires about their current thoughts/feelings/motivations. Participants were then asked to complete the 100-item IPIP scale. This measure of the big five personality dimensions was presented across multiple pages and had the same two attention checks items embedded within it as Study 1 did. Next, participants were asked to complete the Nature Relatedness Scale, the Connectedness to Nature Scale, and the Experiences of Close Relationships Scale; the presentation order of these three trait measures was counterbalanced.<sup>30</sup>

Subsequently, a demographics questionnaire was presented (see Appendix L), which asked about the participant's age, gender, and how rural vs. urban the area they grew up in was

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<sup>30</sup> To check whether the experimental manipulation may have unintentionally influenced participant responses on the Experiences in Close Relationships Scale, separate one-way between-subjects ANOVAs were conducted with experimental condition (control vs. secure attachment vs. anxious attachment vs. avoidant attachment) as the independent variable and trait attachment avoidance or anxiety as the outcome variable. There was not a significant effect of condition on trait attachment avoidance when strict exclusions were applied,  $F(3, 558) = 1.06, p = .366, \eta_p^2 = .006$ , or when lenient exclusions were applied,  $F(3, 682) = 0.74, p = .528, \eta_p^2 = .003$ . Similarly, there was not a significant effect of condition on trait attachment anxiety when strict exclusions were applied,  $F(3, 558) = 1.09, p = .353, \eta_p^2 = .006$ , or when lenient exclusions were applied,  $F(3, 682) = 1.22, p = .301, \eta_p^2 = .005$ .

(from 1 = “*very rural*” to 5 = “*very urban*”).<sup>31</sup> A data quality questionnaire was presented next (see Appendix W), which asked participants in the attachment conditions if they were able to think of a specific person/relationship and to indicate how easy it was to think of a person/relationship that matched the description in the visualization/writing task (from 1 = “*very difficult*” to 7 = “*very easy*”).<sup>32</sup> The data quality questionnaire also asked participants in all four conditions if they spent most of the eight minutes thinking/writing about the topic they were assigned and if there was any reason why their data should not be included in analyses. The same mood booster used in Study 1 was then shown to participants (see Appendix N). After the mood booster, a message appeared on the computer screen to let participants know that the study was finished. At this point, the researcher returned to the room the participant was in, handed the participant a printed debriefing form, verbally summarized the study’s design and purpose, and answered any questions before the participant left the lab.

## Results

### Background & Data Quality

Data for Study 2 was collected in-lab from March 7, 2018 to April 10, 2019. Although a sample of 602 participants was planned based on a priori power analyses (see Appendix X) and

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<sup>31</sup> Consistent with previous research that suggests that childhood experiences in natural environments foster a connection with nature, growing up in a more urban (vs. rural) area was significantly associated with lower overall scores on the Nature Relatedness Scale ( $r_s$  ranged from  $-.17$  to  $-.19$ ,  $p < .001$ ) and lower interest in visiting natural over built spaces ( $r_s$  ranged from  $-.09$  to  $-.11$ ,  $p < .05$ ). Unexpectedly, overall scores on the Connectedness to Nature Scale were not associated with urban vs. rural upbringing ( $r_s$  ranged from  $-.05$  to  $-.06$ ,  $p \geq .135$ ). The interpretation of results was similar when outliers were excluded and when Spearman correlation coefficients were obtained.

<sup>32</sup> Those higher in trait attachment avoidance tended to rate the secure attachment condition as more difficult ( $r_{\text{strict}} = -.30$ ,  $p < .001$ ;  $r_{\text{lenient}} = -.25$ ,  $p < .001$ ), but trait attachment avoidance was not related to difficulty ratings in the anxious attachment condition ( $r_{\text{strict}} = -.10$ ,  $p = .330$ ;  $r_{\text{lenient}} = -.06$ ,  $p = .411$ ) or the avoidant attachment condition ( $r_{\text{strict}} = -.12$ ,  $p = .165$ ;  $r_{\text{lenient}} = -.08$ ,  $p = .283$ ). Trait attachment anxiety, in contrast, was not related to difficulty ratings in the secure attachment condition ( $r_{\text{strict}} = -.04$ ,  $p = .663$ ;  $r_{\text{lenient}} = -.04$ ,  $p = .654$ ), but partial evidence was found for those higher in trait attachment anxiety tending to rate the anxious attachment condition as less difficult ( $r_{\text{strict}} = .13$ ,  $p = .176$ ;  $r_{\text{lenient}} = .16$ ,  $p = .039$ ) and the avoidant attachment condition as more difficult ( $r_{\text{strict}} = -.17$ ,  $p = .056$ ;  $r_{\text{lenient}} = -.11$ ,  $p = .141$ ).

this sample size was achieved near the beginning of March 2019, I decided to continue collecting data until the end of the winter semester to try to reach the planned sample size even after exclusion criteria were applied. A total of 747 individuals completed the study ( $n_{\text{control}} = 186$ ,  $n_{\text{secure}} = 186$ ,  $n_{\text{anxious}} = 187$ ,  $n_{\text{avoidant}} = 188$ ).<sup>33</sup> A detailed discussion of data quality indicators in Study 2 is presented in Appendix Y.

### Exclusions and Sample Demographics

Similar to Study 1, two versions of exclusions were adopted in Study 2. The first version was stricter as it excluded participants for all the reasons listed in Table A3, while the second version was more lenient as it only excluded participants for some of the reasons listed in Table A3. By conducting analyses using both versions of exclusions, the robustness of results can be examined across different exclusion criteria. This was important to examine as the likelihood of incorrectly completing the writing task differed across experimental conditions when a strict coding approach was used, but was similar when a lenient coding approach was used.

**Strict exclusions.** For the strict version of exclusions, individuals were excluded if (1) they did not finish the study, (2) they were coded as not completing the writing task correctly (see Table A3), (3) they indicated that their data should not be used and gave an exclusion-worthy reason or did not offer an explanation (see Table A4), (4) they indicated that their data should be included but they wrote about an exclusion-worthy reason in the follow-up open-ended question, (5) they failed both attention checks, or (6) an idiosyncratic event occurred during the study session that could have plausibly influenced their responses (see Table A5).

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<sup>33</sup> The raw data set downloaded from Qualtrics contained 771 rows. Twenty rows were associated with researcher training sessions or a researcher checking to make sure that the study was running smoothly. One row was associated with a study session that had to be cut short near the beginning of it due to campus-wide internet issues. Three other rows had no participant responses associated with them due to the researcher restarting the Qualtrics survey (1) after they accidentally clicked the next button that began the timed writing task before the participant arrived or (2) after the participant pressed the next button before the researcher was finished reading the introductory script. These 24 rows were deleted, which left a data set with 747 rows of data from 747 participants.

Applying the strict exclusions left a sample of 563 participants ( $n_{\text{control}} = 173$ ;  $n_{\text{secure}} = 153$ ;  $n_{\text{anxious}} = 108$ ;  $n_{\text{avoidant}} = 129$ ).<sup>34</sup> In terms of gender, 440 participants were female (78.15%), 118 participants were male (20.96%), and 5 participants identified as “other” (0.89%). The age of participants ranged from 17 to 49 years old ( $M = 20.36$ ,  $SD = 4.06$ ), although most of the participants ( $n = 478$ ; 84.90%) were between the ages of 18 and 23 years old.

To check if the likelihood of being excluded varied by condition when the strict exclusion criteria was applied, a chi-square analysis was conducted for all those who completed the study. The results from this test suggested that the likelihood of being excluded was not the same across conditions,  $\chi^2(3, N = 747) = 71.81, p < .001$ , with 13 out of the 186 participants in the control condition (6.99%), 33 out of the 186 participants in the secure attachment condition (17.74%), 79 out of the 187 participants in the anxious attachment condition (42.25%), and 59 out of the 188 participants in the avoidant attachment condition (31.38%) being excluded when strict exclusion criteria were applied. Similar chi-square analyses revealed that the likelihood of being excluded was not the same across the three attachment conditions,  $\chi^2(2, N = 561) = 26.53, p < .001$ , or the two insecure attachment conditions,  $\chi^2(1, N = 375) = 4.76, p = .029$ .

**Lenient exclusions.** For the lenient version of exclusions, all the same exclusion criteria mentioned above were used except a more lenient approach to coding the writing task was adopted. Specifically, participants were only excluded for their performance on the writing task if (1) they did not write anything, (2) they explicitly wrote that they could not think of a relationship that matched the description, or (3) their writing focused on the vagueness of the

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<sup>34</sup> Although the sample size of 563 participants when strict exclusions were applied was smaller than the planned sample size of 602 participants (see Appendix X), this sample size was still large enough to achieve at least 80% power for almost all of the estimated effect sizes in the a priori power analyses. The only exception was the power analysis for the linear multiple regression analysis, where the power associated with a sample size of 563 was 76.92%.

instructions in the control condition.

Applying the lenient exclusions left a sample of 687 participant ( $n_{\text{control}} = 173$ ;  $n_{\text{secure}} = 170$ ;  $n_{\text{anxious}} = 172$ ;  $n_{\text{avoidant}} = 172$ ).<sup>35</sup> In terms of gender, 524 participants were female (76.27%), 156 participants were male (22.71%), and 7 participants identified as “other” (1.02%). The age of participants ranged from 17 to 49 years old ( $M = 20.30$ ,  $SD = 4.10$ ), although most of the participants ( $n = 588$ ; 85.59%) were between the ages of 18 and 23 years old.

To check if the likelihood of being excluded varied by condition when the lenient exclusion criteria was applied, a chi-square analysis was conducted for all those who completed the study. The results from this test suggested that the likelihood of being excluded did not significantly differ across conditions,  $\chi^2(3, N = 747) = 0.41$ ,  $p = .937$ . The rates of exclusion in the control condition (6.99%), secure attachment condition (8.60%), anxious attachment condition (8.02%), and the avoidant attachment condition (8.51%) were very similar when a more lenient approach to coding the writing task was taken.

### **Trait-Level Associations Between Interpersonal Attachment and Nature Connectedness**

To investigate Research Question #1, associations between trait interpersonal attachment orientations and nature connectedness were obtained (see Table 19). Regardless of the exclusion criteria and whether outliers were included or excluded,<sup>36</sup> overall scores on the Connectedness to Nature Scale and the Nature Relatedness Scale were not significantly associated with trait attachment avoidance or trait attachment anxiety ( $-.07 \leq r_s \leq -.01$ ). Similarly, the short-form version, the self subscale, and the perspective subscale of the Nature Relatedness Scale were consistently not significantly associated with attachment orientations ( $-.04 \leq r_s \leq .02$ ). However,

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<sup>35</sup> The sample size when lenient exclusion criteria were applied ( $N = 687$ ) exceeded the planned sample size that was based on a priori power analyses ( $N = 602$ ; see Appendix X). Thus, all the analyses with lenient exclusions were adequately powered to observe the effects estimated in the a priori power analyses.

<sup>36</sup> Outliers were identified as scores that were more than three standard deviations from the mean.

Table 19

*Correlations Between Trait Nature Connectedness and Trait Attachment in Study 2*

	Strict Exclusions		Lenient Exclusions	
	Trait Attachment Avoidance	Trait Attachment Anxiety	Trait Attachment Avoidance	Trait Attachment Anxiety
NRS-Overall	-.06	-.07	-.05	-.04
NRS-6	-.03	-.04	-.02	-.01
NRS-Self	-.04	-.03	-.02	-.01
NRS-Perspective	-.04	-.01		
With outliers			-.03	.02
Without outliers			-.04	.02
NRS-Experience	-.07	-.12**	-.07 <sup>+</sup>	-.11**
CNS				
With outliers	-.04	-.05	-.04	-.01
Without outliers	-.05	-.06	-.05	-.02

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale; CNS = Connectedness to Nature Scale. The degrees of freedom ranged from 558 to 560 when strict exclusions were applied and from 681 to 684 when lenient exclusions were applied.

there was a small but significant negative association between trait attachment anxiety and the experience subscale when strict and lenient exclusions were applied ( $r_s = -.12$  and  $-.11$ ). In other words, participants in Study 2 who were more anxious in their close interpersonal relationships tended to report less familiarity, comfort, and desire to spend time in nature in general. Lastly, the association between trait attachment avoidance and the experience subscale was not

significant at the  $p < .05$  level when strict and lenient exclusions were applied (although it was marginally significant when lenient exclusions were applied;  $r_s = -.07$ ).

Multiple regression analyses were also conducted to investigate whether trait attachment might predict trait nature connectedness after controlling for the big five personality dimensions (i.e., agreeableness, conscientiousness, extraversion, neuroticism, and openness to experience). Trait attachment avoidance was not a significant predictor of any index of trait nature connectedness when the big five personality dimensions were controlled for (see Table 20). Trait attachment anxiety also was not a significant predictor of indexes of trait nature connectedness (see Table 21; although it was a marginally significant predictor of lower scores on the perspective subscale of the Nature Relatedness Scale when strict exclusions were applied).

### **Manipulation Checks**

Before investigating Research Questions #2 and #3, manipulation checks were conducted to examine whether the experimental manipulation had an impact on state attachment (and whether trait attachment might have moderated the effect of the attachment conditions on state attachment). The effect of the experimental manipulation on positive and negative affect (and the potential moderating role of trait attachment) was also investigated.

**State attachment.** Separate one-way between-subjects ANOVAs were run with experimental condition (control vs. secure attachment vs. anxious attachment vs. avoidant attachment) as the independent variable and each of the subscales of the SAAM as dependent variables (see Tables 22 and 23 for results when strict and lenient exclusions were applied, respectively, and see Table 24 for all pairwise comparison effect sizes).

The effect of the experimental condition on state attachment avoidance was statistically significant when strict exclusions were applied, but not statistically significant at the  $p < .05$

Table 20

*Multiple Regression Analyses with Big Five Personality and Trait Attachment Avoidance as Predictors of Indexes of Trait Nature Connectedness in Study 2*

Outcome		Strict Exclusions					Trait Attach Avoid	Lenient Exclusions					Trait Attach Avoid
		Predictors						Predictors					
		Agree	Consc	Extra	Neur	Open		Agree	Consc	Extra	Neur	Open	
NRS-Overall	Step 1	$\beta = .19$ $p < .001$	$\beta = .13$ $p = .003$	$\beta = -.01$ $p = .830$	$\beta = .09$ $p = .036$	$\beta = .35$ $p < .001$		$\beta = .19$ $p < .001$	$\beta = .10$ $p = .007$	$\beta = .01$ $p = .733$	$\beta = .11$ $p = .007$	$\beta = .35$ $p < .001$	
	Step 2	$\beta = .20$ $p < .001$	$\beta = .13$ $p = .002$	$\beta = .01$ $p = .814$	$\beta = .09$ $p = .047$	$\beta = .35$ $p < .001$	$\beta = .05$ $p = .328$	$\beta = .20$ $p < .001$	$\beta = .11$ $p = .006$	$\beta = .03$ $p = .474$	$\beta = .10$ $p = .010$	$\beta = .34$ $p < .001$	$\beta = .04$ $p = .344$
NRS-6	Step 1	$\beta = .12$ $p = .004$	$\beta = .06$ $p = .183$	$\beta = -.03$ $p = .516$	$\beta < .01$ $p = .947$	$\beta = .31$ $p < .001$		$\beta = .13$ $p = .001$	$\beta = .04$ $p = .351$	$\beta < .01$ $p = .991$	$\beta = .04$ $p = .401$	$\beta = .30$ $p < .001$	
	Step 2	$\beta = .13$ $p = .002$	$\beta = .07$ $p = .150$	$\beta = -.01$ $p = .918$	$\beta < -.01$ $p = .963$	$\beta = .31$ $p < .001$	$\beta = .05$ $p = .272$	$\beta = .14$ $p < .001$	$\beta = .04$ $p = .306$	$\beta = .02$ $p = .587$	$\beta = .03$ $p = .493$	$\beta = .29$ $p < .001$	$\beta = .06$ $p = .217$
NRS-Self	Step 1	$\beta = .11$ $p = .011$	$\beta = .10$ $p = .027$	$\beta = -.01$ $p = .781$	$\beta = .05$ $p = .317$	$\beta = .37$ $p < .001$		$\beta = .12$ $p = .001$	$\beta = .06$ $p = .137$	$\beta = .01$ $p = .896$	$\beta = .05$ $p = .198$	$\beta = .35$ $p < .001$	
	Step 2	$\beta = .12$ $p = .007$	$\beta = .10$ $p = .021$	$\beta = .01$ $p = .847$	$\beta = .04$ $p = .372$	$\beta = .36$ $p < .001$	$\beta = .05$ $p = .311$	$\beta = .13$ $p = .001$	$\beta = .06^a$ $p = .115$	$\beta = .03$ $p = .520$	$\beta = .05$ $p = .258$	$\beta = .34$ $p < .001$	$\beta = .05$ $p = .223$
NRS-Perspective	Step 1	$\beta = .23$ $p < .001$	$\beta = .14$ $p = .001$	$\beta = .02$ $p = .662$	$\beta = .26$ $p < .001$	$\beta = .24$ $p < .001$		$\beta = .22$ $p < .001$	$\beta = .12$ $p = .002$	$\beta = .02$ $p = .592$	$\beta = .25$ $p < .001$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .23$ $p < .001$	$\beta = .14$ $p = .001$	$\beta = .03$ $p = .543$	$\beta = .26$ $p < .001$	$\beta = .24$ $p < .001$	$\beta = .02$ $p = .623$	$\beta = .22$ $p < .001$	$\beta = .12$ $p = .002$	$\beta = .03$ $p = .542$	$\beta = .24$ $p < .001$	$\beta = .26$ $p < .001$	$\beta = .01$ $p = .769$

NRS- Experience	Step 1	$\beta = .14$ $p = .002$	$\beta = .08$ $p = .070$	$\beta = -.02$ $p = .643$	$\beta = -.05$ $p = .324$	$\beta = .22$ $p < .001$		$\beta = .14$ $p < .001$	$\beta = .08$ $p = .058$	$\beta = .02$ $p = .721$	$\beta = -.01$ $p = .808$	$\beta = .21$ $p < .001$	
	Step 2	$\beta = .14$ $p = .001$	$\beta = .09$ $p = .061$	$\beta = -.01$ $p = .913$	$\beta = -.05$ $p = .293$	$\beta = .22$ $p < .001$	$\beta = .04$ $p = .483$		$\beta = .15$ $p < .001$	$\beta = .08$ $p = .053$	$\beta = .03$ $p = .570$	$\beta = -.01$ $p = .757$	$\beta = .21$ $p < .001$
CNS	Step 1	$\beta = .15$ $p < .001$	$\beta = .06$ $p = .189$	$\beta = -.04$ $p = .441$	$\beta = -.01$ $p = .815$	$\beta = .31$ $p < .001$		$\beta = .14$ $p < .001$	$\beta = .05$ $p = .225$	$\beta = -.01$ $p = .794$	$\beta < .01$ $p = .933$	$\beta = .30$ $p < .001$	
	Step 2	$\beta = .16$ $p < .001$	$\beta = .06^a$ $p = .153$	$\beta = -.01$ $p = .865$	$\beta = -.02$ $p = .725$	$\beta = .30$ $p < .001$	$\beta = .06$ $p = .232$		$\beta = .15$ $p < .001$	$\beta = .05$ $p = .199$	$\beta = .01$ $p = .820$	$\beta < -.01$ $p = .965$	$\beta = .30$ $p < .001$

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale; CNS = Connectedness to Nature Scale; Agree = Agreeableness; Consc = Conscientiousness; Extra = Extraversion; Neur = Neuroticism; Open = Openness to Experience; Attach Avoid = Attachment Avoidance. Significant and marginally significant predictors for each outcome are highlighted in bold. The results reported in this table did not exclude any outliers; a superscript (next to relevant coefficients) and an explanation (at the bottom of this note) is provided when the interpretation of results differed when outliers were excluded. The degrees of freedom for the error terms in Step 2 ranged from 549 to 555 when strict exclusions were applied and from 672 to 679 when lenient exclusions were applied. Variance inflation factors were all  $\leq 1.61$ .

<sup>a</sup> Conscientiousness changed from a non-significant to marginally significant predictor when outliers were excluded.

Table 21

*Multiple Regression Analyses with Big Five Personality and Trait Attachment Anxiety as Predictors of Indexes of Trait Nature Connectedness in Study 2*

		Strict Exclusions					Lenient Exclusions						
		Predictors					Predictors						
Outcome		Agree	Consc	Extra	Neur	Open	Trait Attach Anx	Agree	Consc	Extra	Neur	Open	Trait Attach Anx
NRS-Overall	Step 1	$\beta = .19$ $p < .001$	$\beta = .13$ $p = .003$	$\beta = -.01$ $p = .830$	$\beta = .09$ $p = .036$	$\beta = .35$ $p < .001$		$\beta = .19$ $p < .001$	$\beta = .10$ $p = .007$	$\beta = .01$ $p = .733$	$\beta = .11$ $p = .007$	$\beta = .35$ $p < .001$	
	Step 2	$\beta = .18$ $p < .001$	$\beta = .12$ $p = .005$	$\beta = -.01$ $p = .840$	$\beta = .12$ $p = .017$	$\beta = .36$ $p < .001$	$\beta = -.06$ $p = .256$	$\beta = .19$ $p < .001$	$\beta = .10$ $p = .011$	$\beta = .01$ $p = .730$	$\beta = .13$ $p = .006$	$\beta = .35$ $p < .001$	$\beta = -.04$ $p = .400$
NRS-6	Step 1	$\beta = .12$ $p = .004$	$\beta = .06$ $p = .183$	$\beta = -.03$ $p = .516$	$\beta < .01$ $p = .947$	$\beta = .31$ $p < .001$		$\beta = .13$ $p = .001$	$\beta = .04$ $p = .351$	$\beta < .01$ $p = .991$	$\beta = .04$ $p = .401$	$\beta = .30$ $p < .001$	
	Step 2	$\beta = .12$ $p = .004$	$\beta = .06$ $p = .190$	$\beta = -.03$ $p = .517$	$\beta < .01$ $p = .938$	$\beta = .31$ $p < .001$	$\beta < -.01$ $p = .968$	$\beta = .13$ $p = .001$	$\beta = .04$ $p = .334$	$\beta < .01$ $p = .992$	$\beta = .03$ $p = .580$	$\beta = .29$ $p < .001$	$\beta = .02$ $p = .735$
NRS-Self	Step 1	$\beta = .11$ $p = .011$	$\beta = .10$ $p = .027$	$\beta = -.01$ $p = .781$	$\beta = .05$ $p = .317$	$\beta = .37$ $p < .001$		$\beta = .12$ $p = .001$	$\beta = .06$ $p = .137$	$\beta = .01$ $p = .896$	$\beta = .05$ $p = .198$	$\beta = .35$ $p < .001$	
	Step 2	$\beta = .11$ $p = .011$	$\beta = .10$ $p = .029$	$\beta = -.01$ $p = .782$	$\beta = .05$ $p = .375$	$\beta = .37$ $p < .001$	$\beta < -.01$ $p = .952$	$\beta = .13$ $p = .001$	$\beta = .06^a$ $p = .124$	$\beta = .01$ $p = .897$	$\beta = .04$ $p = .395$	$\beta = .35$ $p < .001$	$\beta = .02$ $p = .604$
NRS-Perspective	Step 1	$\beta = .23$ $p < .001$	$\beta = .14$ $p = .001$	$\beta = .02$ $p = .662$	$\beta = .26$ $p < .001$	$\beta = .24$ $p < .001$		$\beta = .22$ $p < .001$	$\beta = .12$ $p = .002$	$\beta = .02$ $p = .592$	$\beta = .25$ $p < .001$	$\beta = .26$ $p < .001$	
	Step 2	$\beta = .22$ $p < .001$	$\beta = .13$ $p = .004$	$\beta = .02$ $p = .647$	$\beta = .30$ $p < .001$	$\beta = .25$ $p < .001$	$\beta = -.09$ $p = .087$	$\beta = .22$ $p < .001$	$\beta = .12$ $p = .004$	$\beta = .02$ $p = .589$	$\beta = .27$ $p < .001$	$\beta = .26$ $p < .001$	$\beta = -.05$ $p = .235$

NRS- Experience	Step 1	<b><math>\beta = .14</math></b> <b><math>p = .002</math></b>	<b><math>\beta = .08</math></b> <b><math>p = .070</math></b>	$\beta = -.02$ $p = .643$	$\beta = -.05$ $p = .324$	<b><math>\beta = .22</math></b> <b><math>p &lt; .001</math></b>		<b><math>\beta = .14</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .08</math></b> <b><math>p = .058</math></b>	$\beta = .02$ $p = .721$	$\beta = -.01$ $p = .808$	<b><math>\beta = .21</math></b> <b><math>p &lt; .001</math></b>	
	Step 2	<b><math>\beta = .13</math></b> <b><math>p = .002</math></b>	$\beta = .08$ $p = .103$	$\beta = -.02$ $p = .652$	$\beta = -.02$ $p = .781$	<b><math>\beta = .22</math></b> <b><math>p &lt; .001</math></b>	$\beta = -.06$ $p = .271$		<b><math>\beta = .14</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .07^b</math></b> <b><math>p = .089</math></b>	$\beta = .02$ $p = .716$	$\beta = .03$ $p = .595$	<b><math>\beta = .22</math></b> <b><math>p &lt; .001</math></b>
CNS	Step 1	<b><math>\beta = .15</math></b> <b><math>p &lt; .001</math></b>	$\beta = .06$ $p = .189$	$\beta = -.04$ $p = .441$	$\beta = -.01$ $p = .815$	<b><math>\beta = .31</math></b> <b><math>p &lt; .001</math></b>		<b><math>\beta = .14</math></b> <b><math>p &lt; .001</math></b>	$\beta = .05$ $p = .225$	$\beta = -.01$ $p = .794$	$\beta < .01$ $p = .933$	<b><math>\beta = .30</math></b> <b><math>p &lt; .001</math></b>	
	Step 2	<b><math>\beta = .15</math></b> <b><math>p &lt; .001</math></b>	$\beta = .06$ $p = .177$	$\beta = -.04$ $p = .439$	$\beta = -.02$ $p = .702$	<b><math>\beta = .31</math></b> <b><math>p &lt; .001</math></b>	$\beta = .02$ $p = .724$		<b><math>\beta = .14</math></b> <b><math>p &lt; .001</math></b>	$\beta = .05$ $p = .180$	$\beta = -.01$ $p = .790$	$\beta = -.02$ $p = .627$	<b><math>\beta = .30</math></b> <b><math>p &lt; .001</math></b>

*Note.* NRS-Overall = Overall scores on the Nature Relatedness Scale (all 21 items); NRS-6 = Scores on the short-form version of the Nature Relatedness Scale (just 6 items); NRS-Self = Self subscale of the Nature Relatedness Scale; NRS-Perspective = Perspective subscale of the Nature Relatedness Scale; NRS-Experience = Experience subscale of the Nature Relatedness Scale; CNS = Connectedness to Nature Scale; Agree = Agreeableness; Consc = Conscientiousness; Extra = Extraversion; Neur = Neuroticism; Open = Openness to Experience; Attach Anx = Attachment Anxiety. Significant and marginally significant predictors for each outcome are highlighted in bold. The results reported in this table did not exclude any outliers; a superscript (next to relevant coefficients) and an explanation (at the bottom of this note) is provided when the interpretation of results differed when outliers were excluded. The degrees of freedom for the error term in Step 2 ranged from 549 to 555 when strict exclusions were applied and from 672 to 679 when lenient exclusions were applied. Variance inflation factors were all  $\leq 1.86$ .

<sup>a</sup> Conscientiousness changed from a non-significant to marginally significant predictor when outliers were excluded.

<sup>a</sup> Conscientiousness changed from a marginally significant to non-significant predictor when outliers were excluded.

Table 22

*Effects of Experimental Manipulation on State Attachment and Affect (Strict Exclusions) in Study 2*

	Control Condition	Secure Attachment Condition	Anxious Attachment Condition	Avoidant Attachment Condition				Kruskall- Wallis
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>F</i>	<i>p</i>	$\eta_p^2$	
SAAM								
Avoidance <sup>+</sup>	3.01 <sup>a</sup> (1.20)	3.01 <sup>a</sup> (1.27)	3.30 <sup>ab</sup> (1.33)	3.36 <sup>b</sup> (1.22)	3.16	.024	.017	H = 9.09 <i>p</i> = .028
Anxiety	4.29 <sup>a</sup> (1.26)	4.30 <sup>a</sup> (1.16)	4.40 <sup>a</sup> (1.23)	4.32 <sup>a</sup> (1.27)	0.18	.911	.001	H = 0.30 <i>p</i> = .961
Security <sup>++</sup>	5.37 <sup>a</sup> (1.10)	5.47 <sup>a</sup> (1.06)	5.23 <sup>a</sup> (1.30)	5.36 <sup>a</sup> (1.19)	0.95	.416	.005	H = 1.38 <i>p</i> = .710
PANAS								
Positive Affect	2.75 <sup>a</sup> (0.83)	2.78 <sup>a</sup> (0.74)	2.67 <sup>a</sup> (0.89)	2.64 <sup>a</sup> (0.94)	0.77	.509	.004	H = 2.58 <i>p</i> = .461
Negative Affect								
With outliers	1.72 <sup>a</sup> (0.65)	1.68 <sup>a</sup> (0.64)	1.79 <sup>ab</sup> (0.70)	1.90 <sup>b</sup> (0.83)	2.64	.049	.014	H = 5.20 <i>p</i> = .158
No outliers <sup>+++</sup>	1.71 <sup>ab</sup> (0.62)	1.67 <sup>a</sup> (0.60)	1.76 <sup>ab</sup> (0.63)	1.84 <sup>b</sup> (0.74)	1.72	.162	.009	H = 3.96 <i>p</i> = .266

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*Note.* SAAM = State Adult Attachment Measure; PANAS = Positive and Negative Affect Schedule. The degrees of freedom for the error term in the one-way ANOVAs ranged from 551 to 559. There were seven outliers on the negative affect variable. The equality of variance assumption was met for the one-way ANOVAs involving state attachment and negative affect without outliers ( $ps > .05$ ), it but was not met for the ANOVAs involving positive affect or negative affect with outliers ( $ps < .05$ ). Within rows, means that have different superscripts differ at  $p < .05$ . Kruskal-Wallis non-parametric tests are presented in the last column because some of the outcome variables were not normally distributed.

<sup>+</sup> There were marginally significant differences in state attachment avoidance in the anxious attachment condition compared to the control condition and the secure attachment condition.

<sup>++</sup> There was a marginally significant difference in state attachment security between the secure attachment condition and the anxious attachment condition.

<sup>+++</sup> There was a marginally significant difference in negative affect between the avoidant attachment condition and the control condition.

Table 23

*Effects of Experimental Manipulation on State Attachment and Affect (Lenient Exclusions) in Study 2*

	Control Condition	Secure Attachment Condition	Anxious Attachment Condition	Avoidant Attachment Condition	<i>F</i>	<i>p</i>	$\eta_p^2$	Kruskall- Wallis
	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )	<i>M</i> ( <i>SD</i> )				
SAAM								
Avoidance	3.01 <sup>a</sup> (1.20)	3.10 <sup>ab</sup> (1.29)	3.29 <sup>b</sup> (1.26)	3.31 <sup>b</sup> (1.20)	2.46	.061	.011	H = 7.44 <i>p</i> = .059
Anxiety	4.29 <sup>a</sup> (1.26)	4.38 <sup>a</sup> (1.22)	4.44 <sup>a</sup> (1.26)	4.37 <sup>a</sup> (1.24)	0.40	.750	.002	H = 0.95 <i>p</i> = .813
Security	5.37 <sup>a</sup> (1.10)	5.43 <sup>a</sup> (1.06)	5.28 <sup>a</sup> (1.26)	5.32 <sup>a</sup> (1.20)	0.54	.659	.002	H = 0.52 <i>p</i> = .915
PANAS								
Positive Affect	2.75 <sup>a</sup> (0.83)	2.80 <sup>a</sup> (0.76)	2.75 <sup>a</sup> (0.87)	2.69 <sup>a</sup> (0.92)	0.54	.655	.002	H = 1.44 <i>p</i> = .696
Negative Affect								
With outliers <sup>+</sup>	1.72 <sup>a</sup> (0.65)	1.74 <sup>ab</sup> (0.69)	1.84 <sup>ab</sup> (0.73)	1.89 <sup>b</sup> (0.81)	2.18	.089	.010	H = 4.82 <i>p</i> = .185
No outliers <sup>+</sup>	1.71 <sup>a</sup> (0.62)	1.73 <sup>ab</sup> (0.66)	1.83 <sup>ab</sup> (0.69)	1.86 <sup>b</sup> (0.78)	2.08	.102	.009	

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*Note.* SAAM = State Adult Attachment Measure; PANAS = Positive and Negative Affect Schedule. The degrees of freedom for the error term in the one-way ANOVAs ranged from 677 to 683. There were five outliers on the negative affect variable. The equality of variance assumption was met for the one-way ANOVAs involving state attachment ( $ps > .05$ ), but it was not met for the ANOVAs involving positive affect or negative affect ( $ps < .05$ ). Within rows, means that have different superscripts differ at  $p < .05$ . Kruskal-Wallis non-parametric tests are presented in the last column because some of the outcome variables were not normally distributed.

<sup>+</sup> There was a marginally significant difference in negative affect between the secure attachment condition and the avoidant attachment condition.

Table 24

*Effect Sizes for Pairwise Comparisons with State Attachment and Affect as Outcomes in Study 2*

	Secure Condition vs. Control Condition		Anxious Condition vs. Control Condition		Avoidant Condition vs. Control Condition		Secure Condition vs. Anxious Condition		Secure Condition vs. Avoidant Condition		Anxious Condition vs. Avoidant Condition	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
SAAM												
Avoidance	<i>d</i> = .002	<i>d</i> = .07	<b><i>d</i> = .23</b>	<b><i>d</i> = .23</b>	<b><i>d</i> = .30</b>	<b><i>d</i> = .25</b>	<b><i>d</i> = -.22</b>	<i>d</i> = -.16	<b><i>d</i> = -.28</b>	<i>d</i> = -.17	<i>d</i> = -.05	<i>d</i> = -.01
Anxiety	<i>d</i> = .01	<i>d</i> = .07	<i>d</i> = .08	<i>d</i> = .12	<i>d</i> = .02	<i>d</i> = .06	<i>d</i> = -.08	<i>d</i> = -.05	<i>d</i> = -.02	<i>d</i> = .01	<i>d</i> = .06	<i>d</i> = .06
Security	<i>d</i> = .10	<i>d</i> = .06	<i>d</i> = -.12	<i>d</i> = -.08	<i>d</i> = -.01	<i>d</i> = -.04	<b><i>d</i> = .21</b>	<i>d</i> = .13	<i>d</i> = .10	<i>d</i> = .10	<i>d</i> = -.10	<i>d</i> = -.03
PANAS												
Positive Affect	<i>d</i> = .04	<i>d</i> = .07	<i>d</i> = -.09	<i>d</i> = .01	<i>d</i> = -.12	<i>d</i> = -.07	<i>d</i> = .13	<i>d</i> = .06	<i>d</i> = .16	<i>d</i> = .14	<i>d</i> = .04	<i>d</i> = .07
Negative Affect												
With outliers	<i>d</i> = -.06	<i>d</i> = .03	<i>d</i> = .10	<i>d</i> = .18	<b><i>d</i> = .25</b>	<b><i>d</i> = .23</b>	<i>d</i> = -.16	<i>d</i> = -.15	<b><i>d</i> = -.30</b>	<b><i>d</i> = -.20</b>	<i>d</i> = -.15	<i>d</i> = -.06
No outliers	<i>d</i> = -.07	<i>d</i> = .03	<i>d</i> = .08	<i>d</i> = .18	<b><i>d</i> = .19</b>	<b><i>d</i> = .22</b>	<i>d</i> = -.15	<i>d</i> = -.15	<b><i>d</i> = -.25</b>	<b><i>d</i> = -.19</b>	<i>d</i> = -.11	<i>d</i> = -.05

*Note.* SAAM = State Adult Attachment Measure; PANAS = Positive and Negative Affect Schedule. Effects sizes that were significant or marginally significant were bolded.

level when lenient exclusions were applied (although it was marginally significant). Across exclusion criteria, those in the avoidant and anxious attachment conditions reported significantly higher state attachment avoidance than those in the control condition ( $.23 \leq ds \leq .30$ ). When strict exclusions were applied, those in the secure attachment condition had lower state attachment avoidance compared to those in the avoidant attachment condition ( $d = -.28$ ) and those in the anxious attachment condition ( $d = -.22$ ), but only the secure attachment condition vs. avoidant attachment condition comparison was significant at the  $p < .05$  level (the secure attachment condition vs. anxious attachment condition comparison was only marginally significant). When lenient exclusions were applied, the differences between the secure attachment condition and the insecure attachment conditions reduced in magnitude ( $ds = -.17$  and  $-.16$ ) and became nonsignificant. When both strict and lenient exclusions were applied, state attachment avoidance did not differ significantly between the secure attachment condition and the control condition ( $ds = .002$  and  $.07$ ) or between the avoidant attachment condition and the anxious attachment condition ( $ds = -.05$  and  $-.01$ ).

The effect of experimental condition on state attachment anxiety was not statistically significant across either strict or lenient exclusion criteria. Average levels of state attachment anxiety were quite similar across the four conditions ( $-.08 \leq ds \leq .12$ ). Similarly, the effect of experimental condition on state attachment security was not statistically significant when either exclusion criteria were applied. All pairwise comparisons involving state attachment security were not significant at the  $p < .05$  level and almost all were trivial in magnitude ( $-.12 \leq ds \leq .13$ ); the only exception was a small (marginally significant) difference between the secure and anxious attachment conditions when strict exclusions were applied ( $d = .23$ ).

**Affect.** To investigate whether levels of positive and negative affect varied across

conditions, separate one-way between-subjects ANOVA were conducted with experimental condition (control vs. secure attachment vs. anxious attachment vs. avoidant attachment) as the independent variable and each of the subscales of the PANAS as dependent variables (see Tables 22 and 23 for results when strict and lenient exclusions were applied, respectively, and see Table 24 for all pairwise comparison effect sizes). Regardless of the exclusion criteria, no significant differences in positive affect were observed across conditions ( $-.12 \leq ds \leq .16$ ).

When strict exclusion criteria were applied, the omnibus effect of experimental condition on negative affect was statistically significant when outliers were included and not statistically significant when outliers were excluded. When lenient exclusion criteria were applied, the omnibus effect of experimental condition on negative affect was not statistically significant at the  $p < .05$  level when outliers were included or excluded (although it was marginally significant when outliers were included). Average levels of negative affect were significantly higher in the avoidant attachment condition compared to the control condition at the  $p < .05$  level in three out of four analyses (and was marginally significant in the fourth analysis;  $.19 \leq ds \leq .25$ ). Moreover, average levels of negative affect were significantly higher in the avoidant attachment condition compared to the secure attachment condition in two out of four analyses (and was marginally significant in the two other analyses;  $-.30 \leq ds \leq -.19$ ). Although those in the anxious attachment condition tended to report higher levels of negative affect than those in the secure attachment condition ( $-.16 \leq ds \leq -.15$ ) and the control condition ( $.08 \leq ds \leq .18$ ), these differences were not statistically significant in any of the analyses. Average levels of negative affect among those in the secure attachment condition vs. the control condition ( $-.07 \leq ds \leq .03$ ) and among those in the avoidant attachment condition vs. the anxious attachment ( $-.15 \leq ds \leq -.05$ ) were also not statistically significant in any of the analyses.

**Moderation by trait attachment.** To investigate whether the effect of experimental condition on state attachment and affect might be moderated by trait attachment, separate multiple regression analyses were conducted with trait attachment avoidance (centred) or trait attachment anxiety (centred) as predictors of state attachment avoidance, anxiety, and security, as well as positive and negative affect. These analyses included dummy-coded variables to compare the effects of the secure attachment prime, the anxious attachment prime, and the avoidant attachment prime to the control condition (see Table 25 for exact coding). Moderation was examined by including interaction terms between each of the dummy-coded variables and trait attachment avoidance or anxiety in the multiple regression analyses. If evidence of an interaction was found, the Johnson-Neyman approach (Bauer & Curran, 2005; Hayes, 2013) was used to investigate the conditional effect of the attachment condition at varying levels of trait attachment. The association between trait attachment and state attachment/affect in the attachment condition vs. the control condition was also investigated when evidence of an interaction was found.

***Moderation by trait attachment avoidance.*** Results from multiple regression analyses involving trait attachment avoidance and state attachment/affect are presented in Table 26 (this table includes results when strict and lenient approaches were applied).

State attachment avoidance was significantly higher in the anxious attachment condition and the avoidant attachment condition compared to the control condition, while there was not a significant difference in the secure attachment condition vs. the control condition. Not surprisingly, trait attachment avoidance was a statistically significant predictor of higher state attachment avoidance. The interactions between trait attachment avoidance and the attachment conditions on state attachment avoidance were not statistically significant at the  $p < .05$  level,

Table 25

*Dummy Coding for Multiple Regression Analyses in Study 2*

	Dummy-coded variables		
	$C_1$	$C_2$	$C_3$
Experimental condition			
Secure	1	0	0
Anxious	0	1	0
Avoidant	0	0	1
Control	0	0	0

*Note.* Dummy-coded variable  $C_1$  tests the effect of the secure attachment condition compared to the control condition, dummy-coded variable  $C_2$  tests the effect of the anxious attachment condition compared to the control condition, and dummy-coded variable  $C_3$  tests the effect of the avoidant attachment condition compared to the control condition.

although the interaction between trait attachment avoidance and the secure attachment condition was marginally significant. The secure attachment condition led to higher state attachment avoidance (compared to the control condition) for those who were above average on trait attachment avoidance, but it did not have an effect on state attachment avoidance for those who were below average on trait attachment avoidance (see Figure 9). Looking at this interaction from a different angle, trait attachment avoidance was a significant predictor of higher state attachment avoidance in both the secure attachment condition and the control condition, but the relationship was slightly stronger in the secure attachment condition (see Table 27). The results involving state attachment avoidance were consistent across strict and lenient exclusion criteria. In contrast, when state attachment anxiety was the outcome of interest, none of the predictor variables were statistically significant when either exclusion criteria was applied.

In terms of state attachment security, none of the attachment conditions had a significant

Table 26

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on State Attachment and Affect in Study 2*

Outcome	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait Attachment Avoidance		Secure Condition X Trait Attachment Avoidance		Anxious Condition X Trait Attach Avoidance		Avoidant Condition X Trait Attachment Avoidance	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
State Attach Avoidance	$\beta = .03$ $p = .374$	$\beta = .05$ $p = .109$	<b><math>\beta = .08</math></b> <b><math>p = .011</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .005</math></b>	<b><math>\beta = .08</math></b> <b><math>p = .015</math></b>	<b><math>\beta = .07</math></b> <b><math>p = .020</math></b>	<b><math>\beta = .68</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .68</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .07</math></b> <b><math>p = .081</math></b>	<b><math>\beta = .07</math></b> <b><math>p = .056</math></b>	$\beta = .05$ $p = .225$	$\beta = .05$ $p = .151$	$\beta = .01$ $p = .779$	$\beta = .01$ $p = .758$
State Attach Anxiety	$\beta = .01$ $p = .885$	$\beta = .04$ $p = .449$	$\beta = .04$ $p = .410$	$\beta = .06$ $p = .227$	$\beta = .02$ $p = .743$	$\beta = .03$ $p = .517$	$\beta = -.01$ $p = .940$	$\beta = -.01$ $p = .940$	$\beta = .03$ $p = .611$	$\beta = .04$ $p = .501$	$\beta = -.02$ $p = .772$	$\beta = -.05$ $p = .314$	$\beta = -.06$ $p = .259$	$\beta = -.06$ $p = .262$
State Attach Security	$\beta = .02$ $p = .647$	$\beta = .01$ $p = .793$	$\beta = -.04$ $p = .327$	$\beta = -.02$ $p = .539$	$\beta = .03$ $p = .522$	$\beta = .01$ $p = .865$	<b><math>\beta = -.44</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = -.43</math></b> <b><math>p &lt; .001</math></b>	$\beta = -.08$ $p = .116$	$\beta = -.04$ $p = .328$	<b><math>\beta = -.08</math></b> <b><math>p = .076</math></b>	<b><math>\beta = -.09</math></b> <b><math>p = .061</math></b>	$\beta = -.05$ $p = .252$	<b><math>\beta = -.08</math></b> <b><math>p = .089</math></b>
Positive Affect	$\beta = .01$ $p = .843$	$\beta = .03$ $p = .534$	$\beta = -.03$ $p = .495$	$\beta = .01$ $p = .862$	$\beta = -.04$ $p = .435$	$\beta = -.02$ $p = .732$	<b><math>\beta = -.22</math></b> <b><math>p = .004</math></b>	<b><math>\beta = -.22</math></b> <b><math>p = .004</math></b>	$\beta = .01$ $p = .882$	$\beta = .04$ $p = .389$	$\beta = -.05$ $p = .407$	$\beta = -.05$ $p = .339$	$\beta = -.03$ $p = .613$	$\beta = -.06$ $p = .261$
Negative Affect														
With outliers	$\beta = -.01$ $p = .797$	$\beta = .02$ $p = .657$	$\beta = .03$ $p = .455$	$\beta = .07$ $p = .123$	<b><math>\beta = .09</math></b> <b><math>p = .067</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .057</math></b>	<b><math>\beta = .23</math></b> <b><math>p = .001</math></b>	<b><math>\beta = .22</math></b> <b><math>p = .002</math></b>	$\beta = .05$ $p = .338$	$\beta = .06$ $p = .223$	$\beta = .03$ $p = .607$	$\beta = .02$ $p = .640$	<b><math>\beta = .10</math></b> <b><math>p = .060</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .068</math></b>
No outliers	$\beta = -.02$ $p = .744$	$\beta = .02$ $p = .656$	$\beta = .03$ $p = .525$	$\beta = .07$ $p = .115$	$\beta = .07$ $p = .149$	<b><math>\beta = .09</math></b> <b><math>p = .057</math></b>	<b><math>\beta = .26</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .24</math></b> <b><math>p = .001</math></b>	$\beta = .05$ $p = .370$	$\beta = .06$ $p = .248$	$\beta < .01$ $p = .982$	$\beta < .01$ $p = .938$	$\beta = .05$ $p = .342$	$\beta = .07$ $p = .176$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; Attach = Attachment. Significant or marginally significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms ranged from 546 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.93$ .

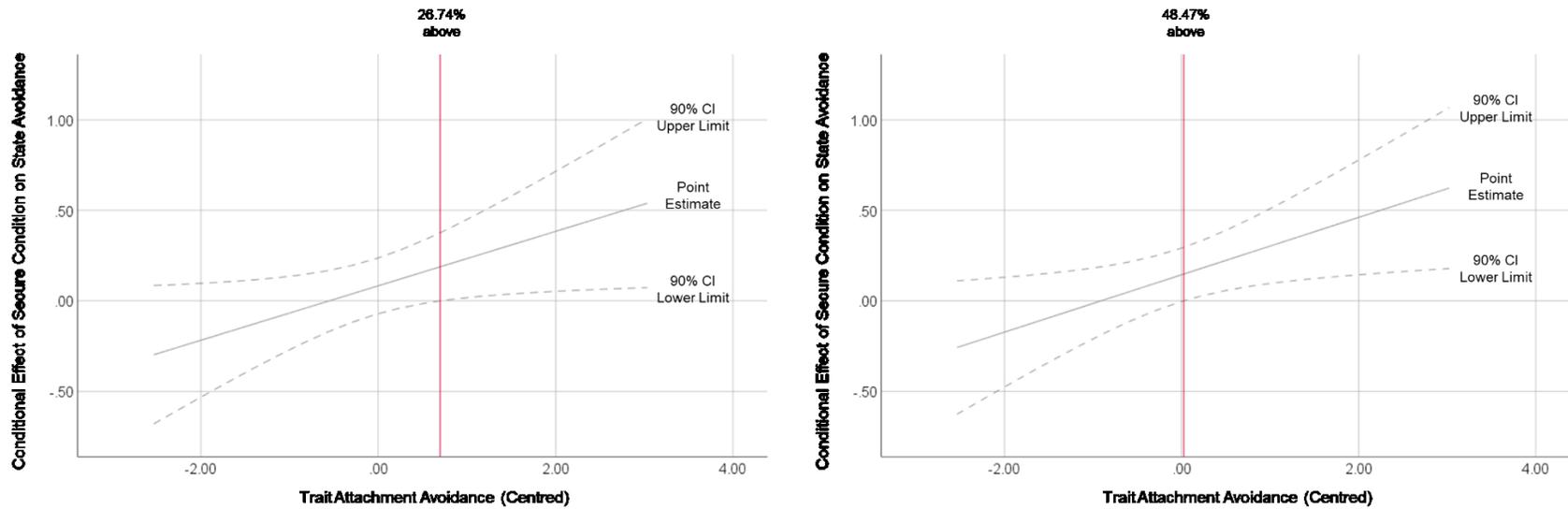


Figure 9. Conditional effect of secure attachment condition (compared to control condition) on state attachment avoidance as a function of trait attachment avoidance in Study 2 when strict exclusions were applied (left graph) and lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 27

*Investigating Conditional Effects of Trait Attachment Avoidance on State Attachment Avoidance/Security and Negative Affect in Attachment Conditions vs. Control Condition in Study 2*

	Strict Exclusions		Lenient Exclusions	
	With outliers (if applicable)	Without outliers (if applicable)	With outliers (if applicable)	Without outliers (if applicable)
Secure Condition X Trait Attach Avoid → State Attach Avoidance				
Control Condition	$b = .77$ $p < .001$		$b = .77$ $p < .001$	
Secure Condition	$b = .92$ $p < .001$		$b = .93$ $p < .001$	
Anxious Condition X Trait Attach Avoid → State Attach Security				
Control Condition	$b = -.46$ $p < .001$		$b = -.46$ $p < .001$	
Anxious Condition	$b = -.64$ $p < .001$		$b = -.64$ $p < .001$	
Avoidant Condition X Trait Attach Avoid → State Attach Security				
Control Condition	$b = -.46$ $p < .001$		$b = -.46$ $p < .001$	
Avoidant Condition	$b = -.57$ $p < .001$		$b = -.62$ $p < .001$	
Avoidant Condition X Trait Attach Avoid → Negative Affect				
Control Condition	$b = .15$ $p = .001$	$b = .15$ $p < .001$	$b = .15$ $p = .002$	$b = .15$ $p = .001$

Avoidant Condition	<b><math>b = .28</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .21</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .27</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .24</math></b> <b><math>p &lt; .001</math></b>
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*Note.* Attach Avoid = Attachment Avoidance. Significant coefficients are highlighted in bold. As negative affect was the only manipulation check outcome variable with outliers, results with and without outliers are only presented for negative affect. The degrees of freedom for the error terms ranged from 546 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 26.

effect (compared to the control condition), but trait attachment avoidance was a statistically significant predictor (these results were consistent across strict and lenient exclusions). Those who were higher in trait attachment avoidance tended to report lower state attachment security. The interactions between trait attachment avoidance and the attachment conditions on state attachment security were not significant at the  $p < .05$  level, but the interaction between trait attachment avoidance and the anxious attachment condition was marginally significant (across both exclusion criteria) and the interaction between trait attachment avoidance and the avoidant attachment condition was marginally significant when lenient exclusions were applied (but not when strict exclusions were applied). The anxious attachment condition only had an effect on state attachment security for those who were high in trait attachment avoidance. For this group of highly avoidant individuals, the anxious attachment condition led to lower state attachment security (compared to the control condition; see Figure 10). Looking at this interaction from a different angle, trait attachment avoidance was a significant predictor of lower state attachment security in both the anxious attachment condition and the control condition, but the relationship was slightly stronger in the anxious attachment condition (see Table 27). For the interaction between trait attachment avoidance and the avoidant attachment condition, there was no effect of the avoidant attachment condition (compared to the control condition) on state attachment security at any levels of trait attachment avoidance when either exclusion criteria were applied

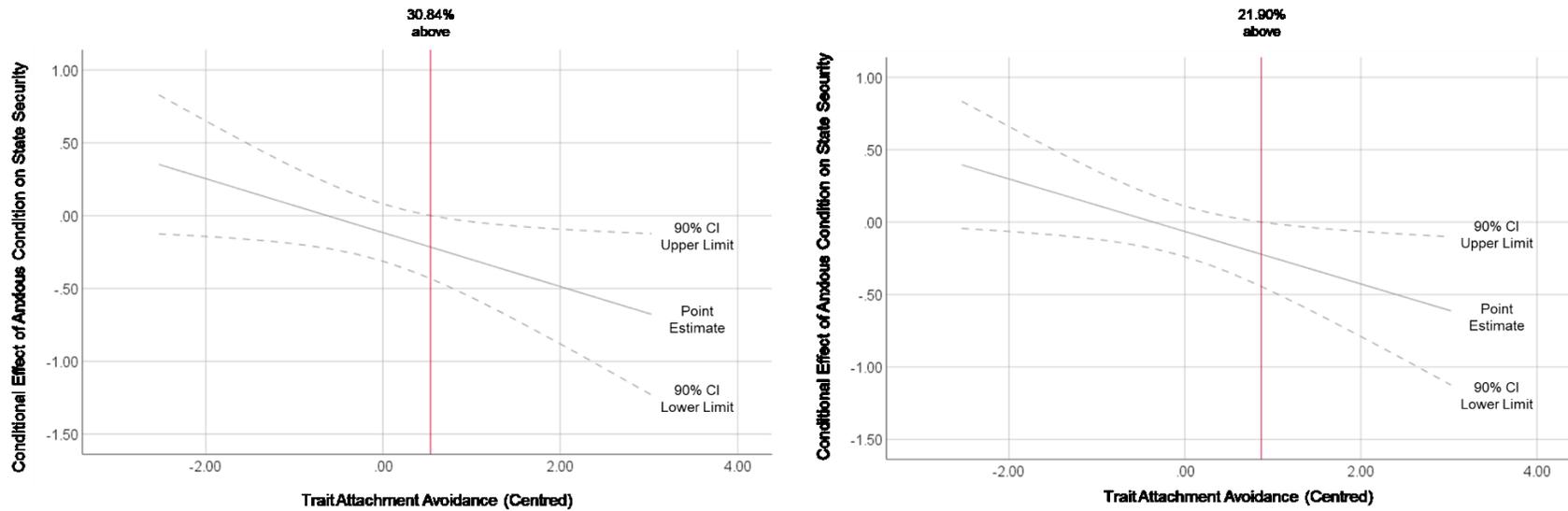


Figure 10. Conditional effect of anxious attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 2 when strict exclusions were applied (left graph) and lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

(see Figure 11). Looking at the interaction from a different angle, trait attachment avoidance was a significant predictor of lower state attachment security in both the avoidant attachment condition and the control condition, but the relationship was slightly stronger in the avoidant attachment condition (see Table 27).

The only statistically significant predictor of positive affect was trait attachment avoidance. Individuals higher in trait attachment avoidance tended to report feeling lower level of positive affect in the moment. There were no significant effects of any of the attachment conditions (compared to the control condition) on positive affect and trait attachment avoidance was not a statistically significant moderator of the effect of the attachment conditions (compared to the control condition) on positive affect. These results involving positive affect were consistent when either strict or lenient exclusions were applied.

Lastly, negative affect was consistently predicted by trait attachment avoidance. Individuals higher in trait attachment avoidance tended to report higher levels of negative affect in the moment. There were no significant effects or interactions involving the secure attachment condition or the anxious attachment condition on negative affect when compared to the control condition (regardless of whether outliers were included or excluded, or when strict or lenient exclusions were applied). The effect of the avoidant attachment condition on negative affect was not significant at the  $p < .05$  level, although it was marginally significant in three out of the four analyses (i.e., when outliers were excluded or included and lenient exclusions were applied, and when outliers were included and strict exclusions were applied). In these instances, negative affect was higher in the avoidant attachment condition than the control condition. The interaction between trait attachment avoidance and the avoidant attachment condition was not significant at the  $p < .05$  level across the four analyses, although it was marginally significant when outliers

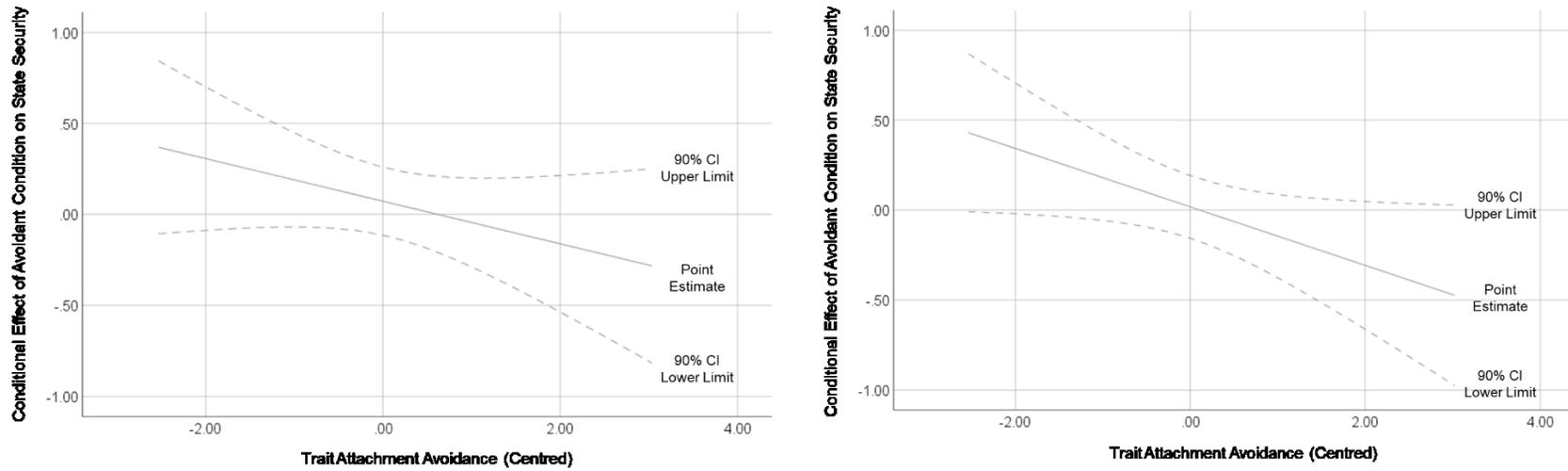


Figure 11. Conditional effect of avoidant attachment condition (compared to control condition) on state attachment security as a function of trait attachment avoidance in Study 2 when strict exclusions were applied (left graph) and lenient exclusions were applied (right graph).

were included (but not when outliers were excluded) across both strict and lenient exclusions. In three out of four follow-up conditional effect analyses (see Figure 12), the avoidant attachment condition led to higher negative affect (compared to the control condition) for those who were average or higher on trait attachment avoidance, but it did not have an effect on negative affect for those who were below average on trait attachment avoidance.<sup>37</sup> Looking at the interaction from a different angle, trait attachment avoidance significantly predicted higher negative affect in both the avoidant attachment condition and the control condition, but the relationship appeared to be slightly stronger in the avoidant attachment condition (regardless of whether outliers were included or excluded, or whether strict or lenient exclusions were applied; see Table 27).

***Moderation by trait attachment anxiety.*** Results from multiple regression analyses involving trait attachment anxiety and state attachment/affect are presented in Table 28 (this table includes results when strict and lenient approaches were applied).

The avoidant attachment condition had significantly higher levels of state attachment avoidance compared to the control condition. State attachment avoidance was also higher in the anxious attachment condition than the control condition, but the effect was not significant at the  $p < .05$  level (it was marginally significant however). The difference between the secure attachment condition and the control condition on state attachment avoidance was not statistically significant. Trait attachment anxiety was a significant predictor of higher levels of state attachment avoidance, but it did not interact significantly with any of the attachment conditions. The results involving state attachment avoidance were consistent across strict and lenient exclusion criteria.

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<sup>37</sup> When outliers were excluded and strict exclusions were applied, the avoidant attachment condition did not lead to increased negative affect for those who were high or below average on trait attachment avoidance (it only had an effect for those who were slightly above average on trait attachment avoidance).

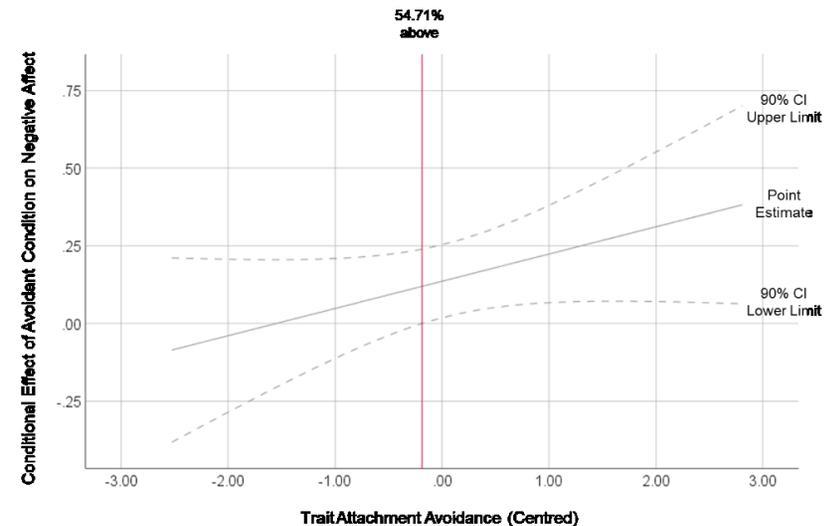
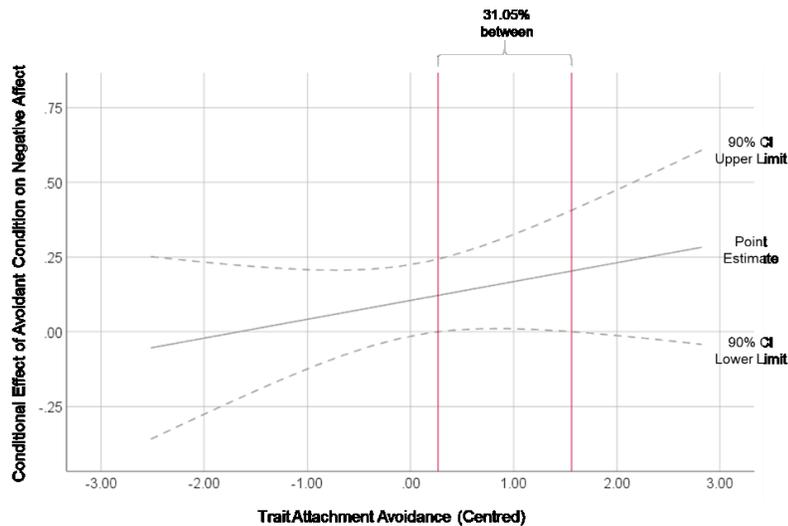
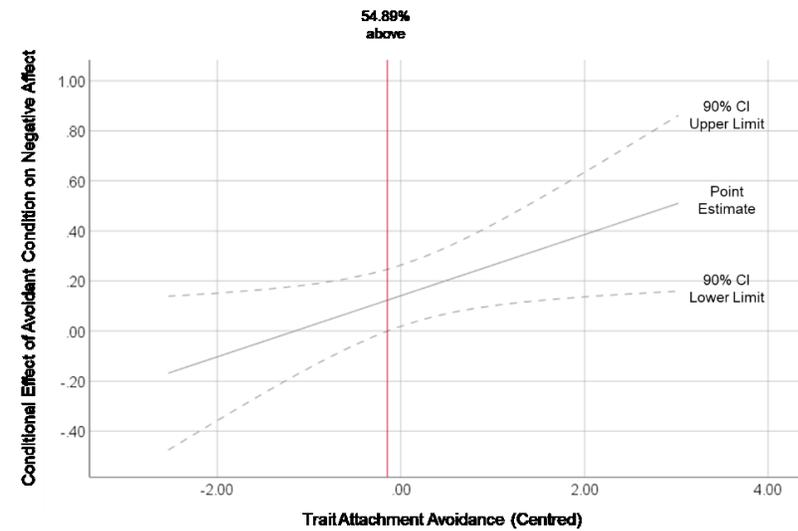
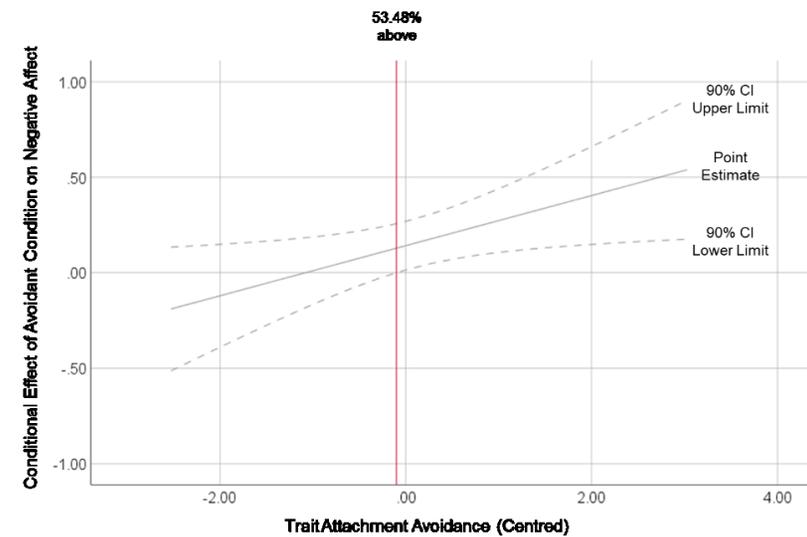


Figure 12. Conditional effect of avoidant attachment condition (compared to control condition) on state negative affect as a function of trait attachment avoidance in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 28

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on State Attachment and Affect in Study 2*

Outcome	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait Attachment Anxiety		Secure Condition X Trait Attachment Anxiety		Anxious Condition X Trait Attachment Anxiety		Avoidant Condition X Trait Attachment Anxiety	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
State Attach Avoidance	$\beta = .02$ $p = .652$	$\beta = .04$ $p = .323$	<b><math>\beta = .09</math></b> <b><math>p = .059</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .051</math></b>	<b><math>\beta = .11</math></b> <b><math>p = .018</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .033</math></b>	<b><math>\beta = .29</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .30</math></b> <b><math>p &lt; .001</math></b>	$\beta = .05$ $p = .373$	$\beta = .05$ $p = .326$	$\beta = .02$ $p = .633$	$\beta < .01$ $p = .946$	$\beta = .02$ $p = .777$	$\beta = .01$ $p = .882$
State Attach Anxiety	$\beta = .04$ $p = .376$	$\beta = .05$ $p = .180$	$\beta = .03$ $p = .536$	$\beta = .03$ $p = .487$	$\beta = -.01$ $p = .800$	$\beta = .01$ $p = .874$	<b><math>\beta = .55</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .54</math></b> <b><math>p &lt; .001</math></b>	$\beta = .02$ $p = .746$	$\beta = .02$ $p = .615$	$\beta = -.01$ $p = .913$	$\beta = -.01$ $p = .768$	$\beta = .03$ $p = .515$	$\beta = .03$ $p = .542$
State Attach Security	$\beta = .02$ $p = .611$	$\beta = .02$ $p = .722$	$\beta = -.04$ $p = .387$	$\beta = -.02$ $p = .730$	$\beta = .01$ $p = .864$	$\beta = -.01$ $p = .905$	<b><math>\beta = -.41</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = -.41</math></b> <b><math>p &lt; .001</math></b>	$\beta = .05$ $p = .367$	$\beta = .06$ $p = .257$	$\beta = .01$ $p = .843$	$\beta = .04$ $p = .492$	$\beta = .02$ $p = .693$	$\beta = .03$ $p = .568$
Positive Affect	$\beta = .01$ $p = .805$	$\beta = .03$ $p = .517$	$\beta = -.03$ $p = .511$	$\beta = .01$ $p = .791$	$\beta = -.05$ $p = .334$	$\beta = -.02$ $p = .634$	<b><math>\beta = -.28</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = -.28</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .11</math></b> <b><math>p = .058</math></b>	<b><math>\beta = .10</math></b> <b><math>p = .069</math></b>	$\beta = .03$ $p = .555$	$\beta = .07$ $p = .180$	$\beta = .05$ $p = .403$	$\beta = .06$ $p = .274$
Negative Affect														
With outliers	$\beta = -.002$ $p = .965$	$\beta = .03$ $p = .533$	$\beta = .03$ $p = .548$	$\beta = .05$ $p = .222$	<b><math>\beta = .09</math></b> <b><math>p = .038</math></b>	<b><math>\beta = .09</math></b> <b><math>p = .041</math></b>	<b><math>\beta = .36</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .35</math></b> <b><math>p &lt; .001</math></b>	$\beta = .03$ $p = .541$	$\beta = .06$ $p = .238$	$\beta = .05$ $p = .334$	$\beta = .04$ $p = .457$	<b><math>\beta = .08</math></b> <b><math>p = .098</math></b>	$\beta = .07$ $p = .170$
No outliers	$\beta = -.004$ $p = .925$	$\beta = .03$ $p = .513$	$\beta = .03$ $p = .570$	$\beta = .06$ $p = .189$	$\beta = .07$ $p = .143$	<b><math>\beta = .08</math></b> <b><math>p = .055</math></b>	<b><math>\beta = .38</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .36</math></b> <b><math>p &lt; .001</math></b>	$\beta = .01$ $p = .842$	$\beta = .04$ $p = .370$	$\beta = .01$ $p = .815$	$\beta = .01$ $p = .774$	$\beta = .08$ $p = .104$	$\beta = .07$ $p = .133$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; Attach = Attachment. Significant or marginally significant predictors for each outcome are highlighted in bold. The degrees of freedom for the error terms ranged from 546 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.98$ .

The only significant predictor of state attachment anxiety and state attachment security was trait attachment anxiety. Those who were higher in trait attachment anxiety tended to report higher levels of state attachment anxiety and lower levels of state attachment security. None of the attachment conditions significantly differed from the control condition on state attachment anxiety or state attachment security, and trait attachment anxiety did not interact significantly with any of the attachment conditions in influencing these outcome variables. The results involving state attachment anxiety and state attachment security were consistent across strict and lenient exclusion criteria.

Positive affect also did not differ significantly in any of the attachment conditions (when compared to the control condition), but trait attachment anxiety was a significant predictor of lower positive affect (regardless of whether strict or lenient exclusion criteria were used). The interactions between trait attachment anxiety and the attachment conditions were not significant at the  $p < .05$  level, although the interaction between trait attachment anxiety and the secure attachment condition was marginally significant (when both strict and lenient exclusion were applied). Across both exclusion criteria, the secure attachment condition led to higher positive affect (compared to the control condition) for those high in trait attachment anxiety (see Figure 13). The secure attachment condition led to lower positive affect for those low in trait attachment anxiety when strict exclusions were applied, but this did not replicate in the conditional effect analysis when lenient exclusions were applied. Looking at this interaction from a different angle, across both exclusion criteria, trait attachment anxiety was a significant predictor of lower positive affect in the control condition, but it was not a significant predictor of positive affect in the secure attachment condition (see Table 29).

Trait attachment anxiety was also consistently a significant predictor of negative affect.

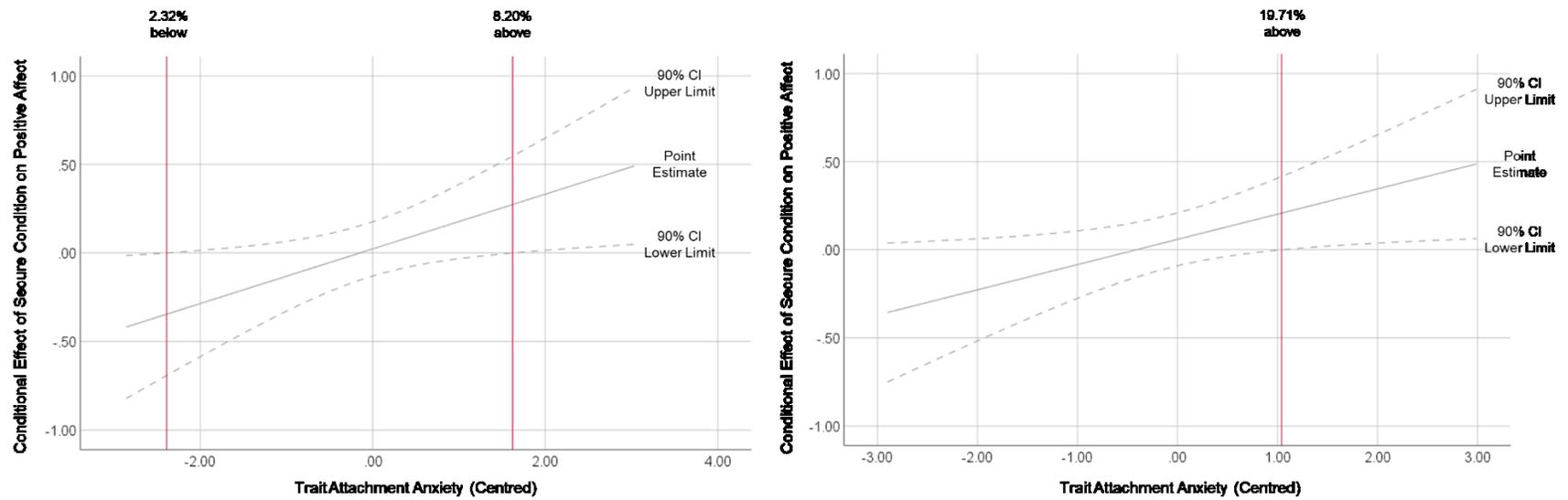


Figure 13. Conditional effect of secure attachment condition (compared to control condition) on positive affect as a function of trait attachment anxiety in Study 2 when strict exclusions were applied (left graph) and lenient exclusions were applied (right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 29

*Investigating Conditional Effects of Trait Attachment Anxiety on Positive and Negative Affect in Attachment Conditions vs. Control Condition in Study 2*

	Strict Exclusions		Lenient Exclusions	
	With outliers (if applicable)	Without outliers (if applicable)	With outliers (if applicable)	Without outliers (if applicable)
Secure Condition X Trait Attach Anxiety → Positive Affect				
Control Condition	<b><math>b = -.21</math></b> <b><math>p &lt; .001</math></b>		<b><math>b = -.21</math></b> <b><math>p &lt; .001</math></b>	
Secure Condition	$b = -.06$ $p = .342$		$b = -.07$ $p = .218$	
Avoidant Condition X Trait Attach Anxiety → Negative Affect				
Control Condition	<b><math>b = .22</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .22</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .22</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .22</math></b> <b><math>p &lt; .001</math></b>
Avoidant Condition	<b><math>b = .33</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .32</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .31</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .31</math></b> <b><math>p &lt; .001</math></b>

*Note.* Significant coefficients are highlighted in bold. As negative affect was the only manipulation check outcome variable with outliers, results with and without outliers are only presented for negative affect. The degrees of freedom for the error terms ranged from 546 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 28.

Those who were higher on trait attachment anxiety tended to report higher levels of negative affect. There were no significant effects or interactions involving the secure attachment condition or the anxious attachment condition (compared to the control condition) on negative affect (regardless of exclusion criteria and whether outliers were included/excluded). In contrast, the

effect of the avoidant attachment condition on negative affect was significant when outliers were included (across both exclusion criteria), but not significant at the  $p < .05$  level when outliers were excluded (although the effect was marginally significant when lenient exclusions were applied). In the significant and marginally significant analyses, negative affect was higher in the avoidant attachment condition than the control condition. The interaction between trait attachment anxiety and the avoidant attachment condition on negative affect was not significant at the  $p < .05$  level, although it was marginally significant when outliers were included and strict exclusion criteria were applied. Nevertheless, across exclusion criteria and inclusion/exclusion of outliers, the conditional effect analyses showed that the avoidant attachment condition led to higher negative affect (compared to the control condition) for those who were average or higher on trait attachment anxiety, but it did not have an effect on negative affect for those who were below average on trait attachment anxiety (see Figure 14). Looking at this interaction from a different angle, trait attachment anxiety was a significant predictor of negative affect in the avoidant attachment condition and the control condition, but it was a slightly stronger predictor in the avoidant attachment condition (see Table 29).

### **Experimental Manipulation, Trait Attachment, Trait Nature Connectedness, and Motivation to Connect with Nature**

**Main effects.** To answer Research Question #2, mixed-design ANOVAs were conducted with type of space (natural vs. built) as the within-subjects factor and experimental condition (secure attachment vs. anxious attachment vs. avoidant attachment vs. control) as the between-

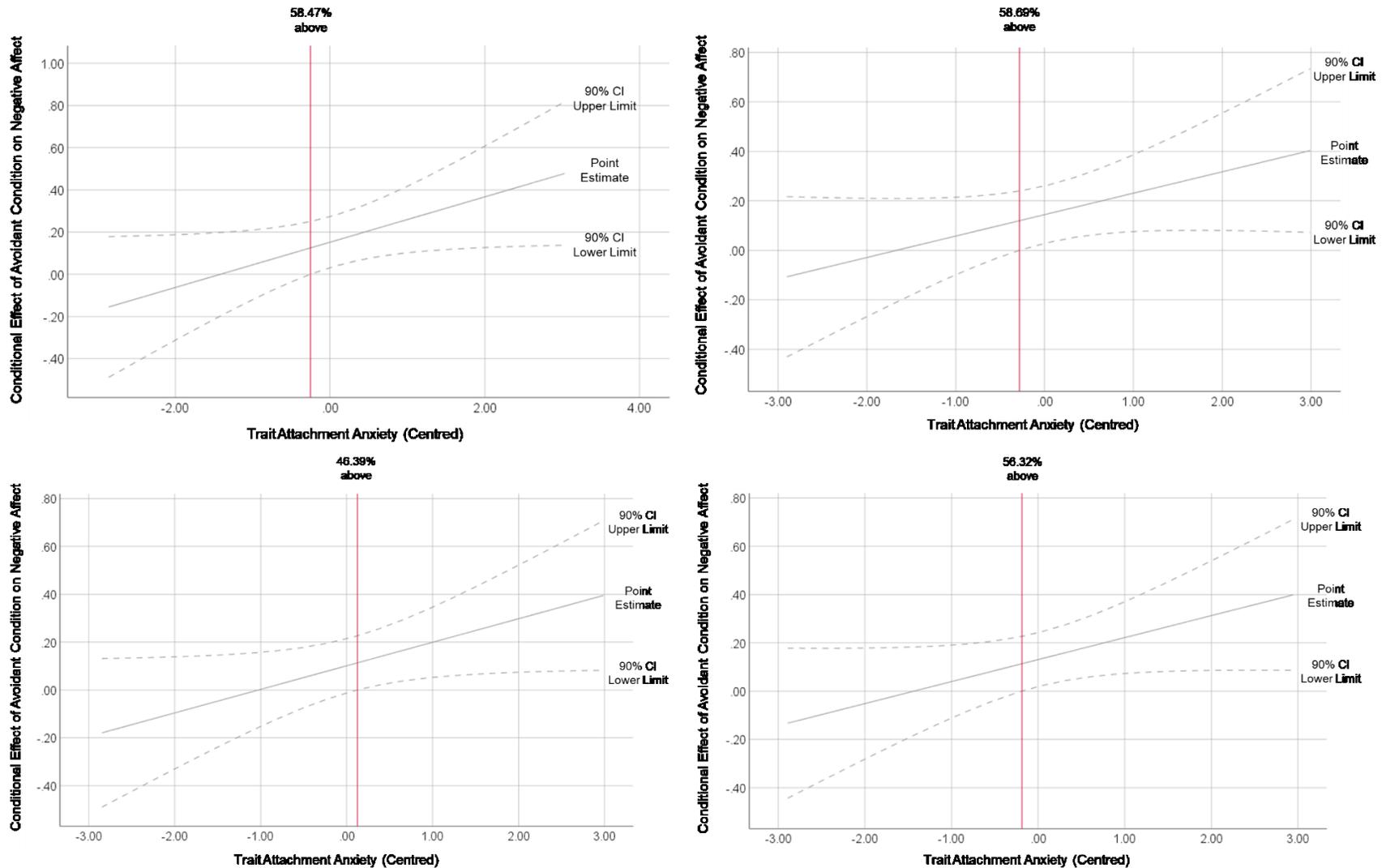


Figure 14. Conditional effect of avoidant attachment condition (compared to control condition) on state negative affect as a function of trait attachment anxiety in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

subjects factor, and interest in visiting as the outcome variable.<sup>38</sup> The omnibus ANOVA results are presented in Table 30 and mean interest in visiting natural vs. built spaces in each condition is illustrated in Figure 15 (this table and figure show the results when strict or lenient exclusions were applied with/without outliers). Across the mixed-design ANOVAs, there was a significant main effect of type of space. In general, participants reported that they were more interested in visiting natural spaces than built spaces. The main effect of experimental condition was not statistically significant. Participants overall interest in visiting spaces (regardless of whether they were natural or built) was similar across conditions. Finally, there also was not a significant interaction between type of space and experimental condition. The preference for visiting natural spaces over built spaces did not vary across conditions.

**Moderation by trait attachment or nature connectedness.** Although there was not a significant main effect of experimental condition or a significant interaction between type of space and experimental condition, the effect of the experimental manipulation on interest in visiting natural spaces (vs. built spaces) may depend on trait attachment or trait nature connectedness (Research Question #3). Separate multiple regression analyses were conducted that tested the potential moderating role of trait attachment avoidance, trait attachment anxiety, or trait nature connectedness on interest in visiting natural spaces (vs. built spaces). The same dummy-coded variables used for the multiple regression manipulation checks were used for these analyses and each trait predictor was centred before calculating the interaction terms between each of the dummy-coded variables and the trait predictor. The same approach used to

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<sup>38</sup> As some differences/interactions involving affect were observed in the manipulation checks, supplementary analyses involving motivation to connect with nature were also conducted that controlled for positive affect and negative affect. In general, the interpretation of results was similar when positive affect and negative affect were included as covariates, but when their inclusion resulted in meaningful changes in the interpretation of results it is mentioned in the footnotes.

Table 30

*Effects of Type of Space and Experimental Condition on Interest in Visiting in Study 2*

	Strict Exclusions							
	With Outliers				No Outliers			
	<i>F</i>	<i>df</i>	<i>p</i>	$\eta_p^2$	<i>F</i>	<i>df</i>	<i>p</i>	$\eta_p^2$
Type of Space	603.13	1, 558	< .001	.519	624.71	1, 554	< .001	.530
Experimental Condition	0.56	3, 558	.643	.003	0.82	3, 554	.481	.004
Type of Space X Experimental Condition	0.37	3, 558	.779	.002	0.18	3, 554	.911	.001
	Lenient Exclusions							
	With Outliers				No Outliers			
	<i>F</i>	<i>df</i>	<i>p</i>	$\eta_p^2$	<i>F</i>	<i>df</i>	<i>p</i>	$\eta_p^2$
Type of Space	772.84	1, 682	< .001	.531	794.08	1, 677	< .001	.540
Experimental Condition	0.07	3, 682	.977	< .001	0.20	3, 677	.897	.001
Type of Space X Experimental Condition	0.45	3, 682	.719	.002	0.24	3, 677	.867	.001

*Note.* The equality of variance assumption was met for all the ANOVAs reported in this table (Levene's test all had  $ps > .05$ ).

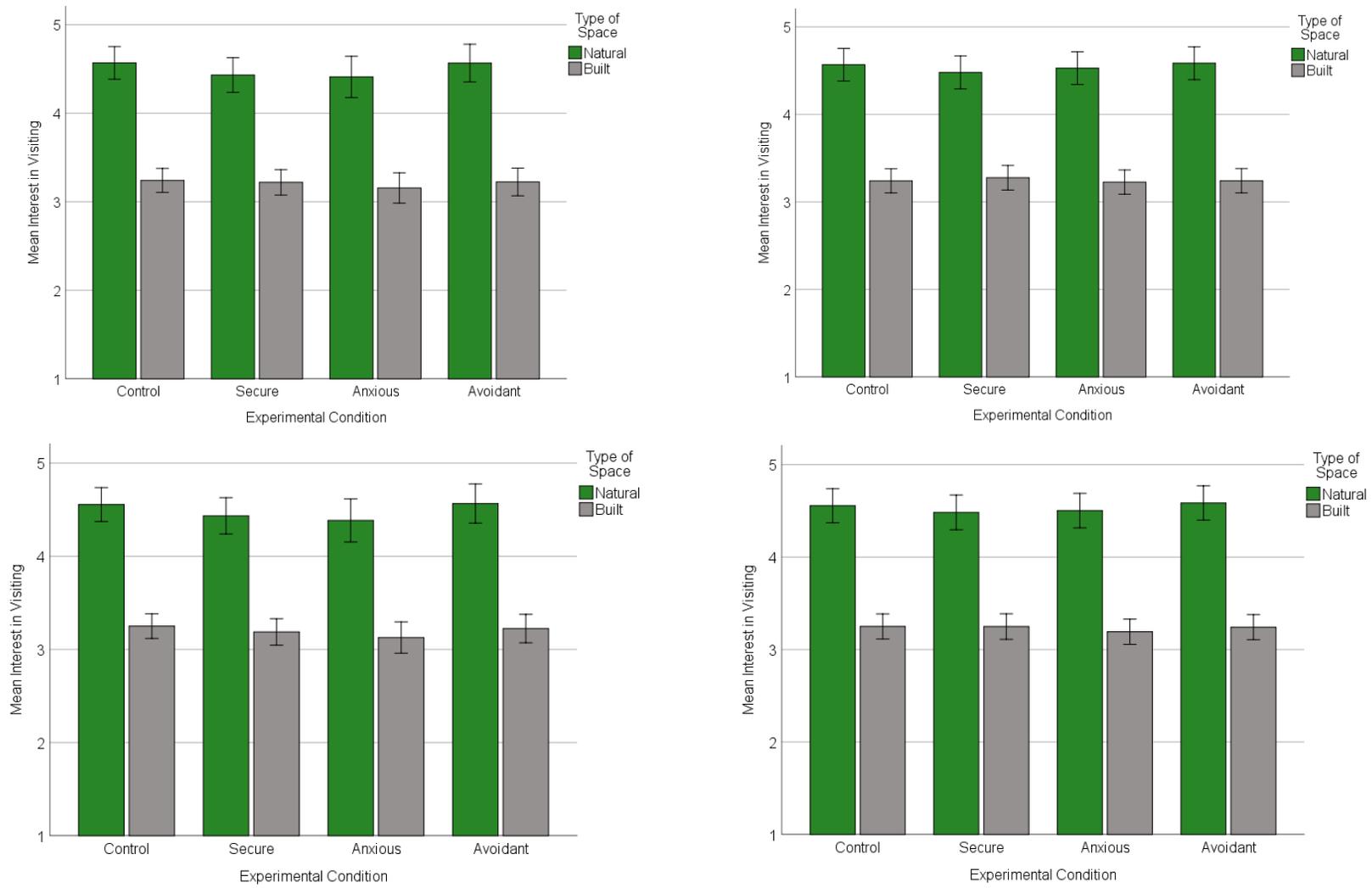


Figure 15. Effects of experimental condition and type of space on interest in visiting (natural vs. built) spaces in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Error bars are 95% confidence intervals.

unpack interactions involving state attachment/affect was used to unpack interactions involving interest in visiting natural spaces over built spaces. For these multiple regression analyses, overall interest in visiting built spaces was subtracted from overall interest in visiting natural spaces for each participant to create the criterion variable (i.e., interest in visiting natural spaces over built spaces). Positive scores on this variable indicate that the participant was more interested in visiting natural spaces, while negative scores indicate that the participant was more interested in visiting built spaces.

***Moderation by trait attachment avoidance.*** Results from multiple regression analyses involving trait attachment avoidance are presented in Table 31 (this table includes results when strict and lenient approaches were applied with/without outliers). None of the attachment conditions had a significant effect on interest in visiting natural spaces over built spaces (compared to the control condition), trait attachment avoidance was not a significant predictor of interest in visiting natural spaces over built spaces, and trait attachment avoidance was not a significant moderator of the effect of the secure attachment condition or the avoidant attachment condition on interest in visiting natural spaces over built spaces (these results were consistent across exclusion criteria and when outliers were excluded or included). The interaction between trait attachment avoidance and the anxious attachment condition was not significant at the  $p < .05$  level in any of the analyses, although it was marginally significant when outliers were included and strict exclusion criteria were applied. In this one analysis, the anxious attachment condition led to lower interest in visiting natural spaces over built spaces for those who were high on trait attachment avoidance, but it had no effect at other levels of trait attachment avoidance (see Figure 16). However, this conditional effect was not found in the other three analyses (i.e., when strict exclusions were applied and outliers were excluded, and when lenient

Table 31

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Avoidance on Interest in Visiting Natural Over Built Spaces in Study 2*

	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait Attach Avoidance		Secure Condition X Trait Attach Avoidance		Anxious Condition X Trait Attach Avoidance		Avoidant Condition X Trait Attach Avoidance	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
With Outliers	$\beta = -.05$ $p = .348$	$\beta = -.05$ $p = .311$	$\beta = -.03$ $p = .594$	$\beta = -.01$ $p = .827$	$\beta = .01$ $p = .876$	$\beta = .01$ $p = .877$	$\beta = .01$ $p = .947$	$\beta = .01$ $p = .947$	$\beta = -.06$ $p = .284$	$\beta = -.06$ $p = .270$	<b><math>\beta = -.10</math></b> <b><math>p = .085</math></b>	$\beta = -.08$ $p = .151$	$\beta = -.03$ $p = .581$	$\beta = -.03$ $p = .561$
No Outliers	$\beta = -.02$ $p = .631$	$\beta = -.03$ $p = .562$	$\beta = -.02$ $p = .725$	$\beta < .01$ $p = .985$	$\beta = .02$ $p = .743$	$\beta = .02$ $p = .734$	$\beta = -.02$ $p = .758$	$\beta = -.02$ $p = .759$	$\beta = -.02$ $p = .683$	$\beta = -.03$ $p = .637$	$\beta = -.08$ $p = .132$	$\beta = -.06$ $p = .236$	$\beta = -.02$ $p = .755$	$\beta = -.02$ $p = .748$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; Attach = Attachment. Marginally significant predictor is highlighted in bold. The degrees of freedom for the error terms ranged from 549 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.91$ .

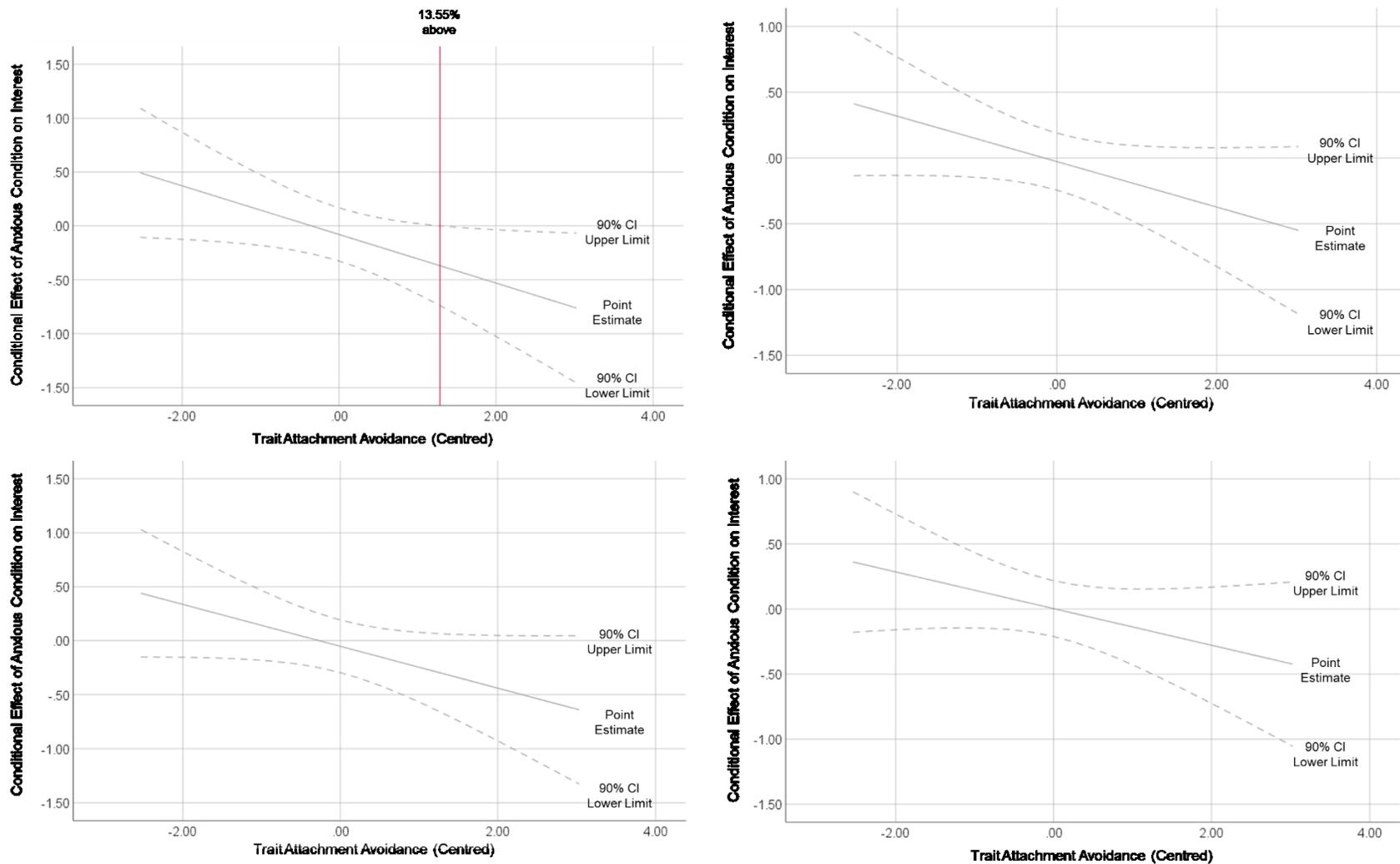


Figure 16. Conditional effect of anxious attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait attachment avoidance in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). The red line indicates where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

exclusions were applied and outliers were included/excluded). Looking at this interaction from a different angle, trait attachment avoidance was a significant predictor of lower interest in visiting natural spaces over built spaces in the anxious attachment condition in three out of four analyses (and was a marginally significant predictor in the fourth analysis), but it was not a significant predictor in the control condition across the four analyses; see Table 32).<sup>39</sup>

***Moderation by trait attachment anxiety.*** Results from multiple regression analyses involving trait attachment anxiety are presented in Table 33 (this table includes results when strict and lenient approaches were applied with/without outliers). None of the attachment conditions had a significant effect on interest in visiting natural spaces over built spaces (compared to the control condition), trait attachment anxiety was not a significant predictor of interest in visiting natural spaces over built spaces, and trait attachment anxiety was not a significant moderator of the effect of the secure attachment condition or the avoidant attachment condition on interest in visiting natural spaces over built spaces (these results were consistent across exclusion criteria and when outliers were excluded or included). However, when strict exclusions were applied (regardless of whether outliers were included or excluded), there was a significant interaction between trait attachment anxiety and the anxious attachment condition. The anxious attachment condition led to lower interest in visiting natural spaces over built spaces for those who were high in trait attachment anxiety, but it led to greater interest for those who were low in trait attachment anxiety (see Figure 17). Looking at this interaction from a different angle, trait attachment anxiety was a significant predictor of lower interest in visiting natural spaces over built spaces in the anxious attachment condition,<sup>40</sup> but it was not a significant

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<sup>39</sup> When lenient exclusions were applied and outliers were excluded, trait attachment avoidance changed from being a significant predictor to a marginally significant predictor ( $p = .070$ ) of lower interest in visiting natural spaces over built spaces in the anxious condition when positive and negative affect were controlled for.

<sup>40</sup> When the strict exclusion criteria were applied and outliers were included, trait attachment anxiety was no longer

Table 32

*Investigating Conditional Effects of Trait Attachment Avoidance on Interest in Visiting Natural Over Built Spaces in Anxious Attachment Condition vs. Control Condition in Study 2*

	Strict Exclusions		Lenient Exclusions	
	With outliers	Without outliers	With outliers	Without outliers
Anxious Condition X Trait Attach Avoidance → Interest in Visiting Natural > Built Spaces				
Control Condition	$b = .01$ $p = .947$	$b = -.03$ $p = .758$	$b = .01$ $p = .947$	$b = -.03$ $p = .759$
Anxious Condition	<b><math>b = -.22</math></b> <b><math>p = .028</math></b>	<b><math>b = -.22</math></b> <b><math>p = .026</math></b>	<b><math>b = -.17</math></b> <b><math>p = .051</math></b>	<b><math>b = -.17</math></b> <b><math>p = .049</math></b>

*Note.* Significant and marginally significant coefficients are highlighted in bold. The degrees of freedom for the error terms ranged from 549 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 31.

predictor in the control condition (see Table 34). When lenient exclusions were applied though, the interaction between trait attachment anxiety and the anxious attachment condition was not significant, there were no conditional effects of the anxious attachment condition at any levels of trait attachment anxiety, and trait attachment anxiety was not a significant predictor in the control condition or the anxious attachment condition.

***Moderation by trait nature connectedness.*** Results from multiple regression analyses involving trait nature connectedness (as measured by the Nature Relatedness Scale) are presented

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a significant predictor at the  $p < .05$  level of lower interest in visiting natural spaces over built spaces in the anxious attachment condition when positive and negative affect were controlled for (although it was a marginally significant predictor,  $p = .058$ ).

Table 33

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Trait Attachment Anxiety on Interest in Visiting Natural Over Built Spaces in Study 2*

	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait Attach Anxiety		Secure Condition X Trait Attach Anxiety		Anxious Condition X Trait Attach Anxiety		Avoidant Condition X Trait Attach Anxiety	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
With Outliers	$\beta = -.04$ $p = .399$	$\beta = -.04$ $p = .348$	$\beta = -.02$ $p = .647$	$\beta = -.01$ $p = .822$	$\beta = .01$ $p = .905$	$\beta < .01$ $p = .927$	$\beta = .10$ $p = .206$	$\beta = .10$ $p = .207$	$\beta = -.05$ $p = .409$	$\beta = -.03$ $p = .568$	<b><math>\beta = -.13</math></b> <b><math>p = .015</math></b>	$\beta = -.08$ $p = .144$	$\beta = -.06$ $p = .267$	$\beta = -.06$ $p = .284$
No Outliers	$\beta = -.02$ $p = .664$	$\beta = -.03$ $p = .586$	$\beta = -.01$ $p = .769$	$\beta < .01$ $p = .997$	$\beta = .01$ $p = .782$	$\beta = .01$ $p = .793$	$\beta = .09$ $p = .265$	$\beta = .09$ $p = .267$	$\beta = -.04$ $p = .468$	$\beta = -.03$ $p = .642$	<b><math>\beta = -.13</math></b> <b><math>p = .018</math></b>	$\beta = -.08$ $p = .162$	$\beta = -.06$ $p = .309$	$\beta = -.05$ $p = .333$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; Attach = Attachment. Significant predictors are highlighted in bold. The degrees of freedom for the error terms ranged from 549 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.97$ .

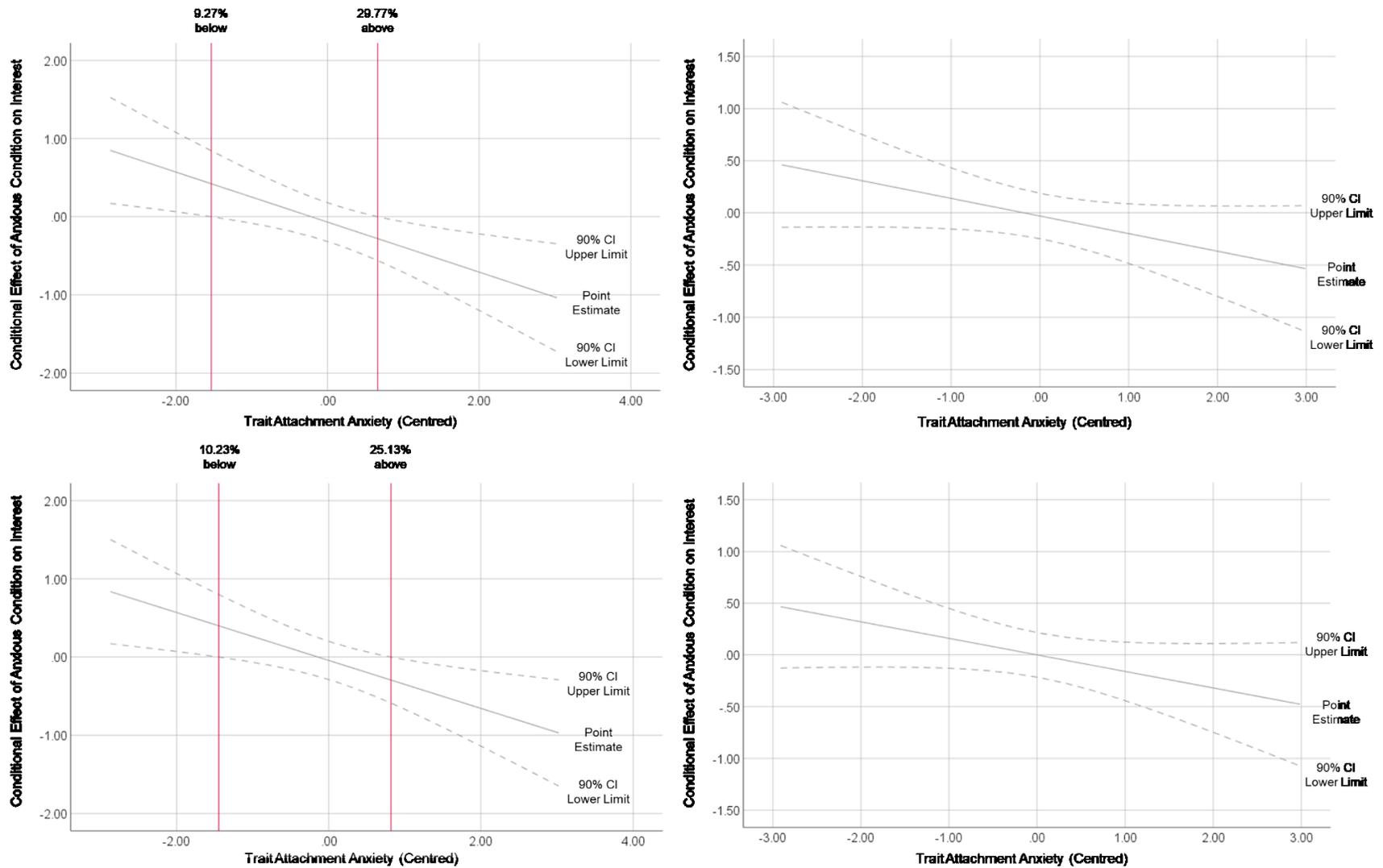


Figure 17. Conditional effect of anxious attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait attachment anxiety in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red lines indicate where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 34

*Investigating Conditional Effects of Trait Attachment Anxiety on Interest in Visiting Natural Over Built Spaces in Anxious Attachment Condition vs. Control Condition in Study 2*

	Strict Exclusions		Lenient Exclusions	
	With outliers	Without outliers	With outliers	Without outliers
Anxious Condition X Trait Attach Anxiety → Interest in Visiting Natural > Built Spaces				
Control Condition	$b = .10$ $p = .206$	$b = .09$ $p = .265$	$b = .10$ $p = .207$	$b = .09$ $p = .267$
Anxious Condition	<b><math>b = -.22</math></b> <b><math>p = .036</math></b>	<b><math>b = -.22</math></b> <b><math>p = .033</math></b>	$b = -.07$ $p = .423$	$b = -.07$ $p = .384$

*Note.* Significant coefficients are highlighted in bold. The degrees of freedom for the error terms ranged from 549 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 33.

in Table 35 (this table includes results when strict and lenient approaches were applied with/without outliers). Overall scores on the Nature Relatedness Scale was the only significant predictor of interest in visiting natural spaces over built spaces. Those who scored higher on the Nature Relatedness Scale tended to report being more interested in visiting natural spaces over built spaces. In contrast, none of the attachment conditions or the interactions involving the Nature Relatedness Scale were significant predictors. These results were consistent across strict and lenient exclusion criteria with/without outliers.

Results from multiple regression analyses involving trait nature connectedness (as measured by the Connectedness to Nature Scale) are presented in Table 36 (this table includes results when strict and lenient approaches were applied with/without outliers). Overall scores on

Table 35

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Overall Scores on the Nature Relatedness Scale on Interest in Visiting Natural Over Built Spaces in Study 2*

	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait NRS		Secure Condition X Trait NRS		Anxious Condition X Trait NRS		Avoidant Condition X Trait NRS	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
With Outliers	$\beta = -.02$ $p = .740$	$\beta = -.03$ $p = .550$	$\beta = -.01$ $p = .792$	$\beta = .01$ $p = .857$	$\beta < .01$ $p = .977$	$\beta = .01$ $p = .804$	<b><math>\beta = .41</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .41</math></b> <b><math>p &lt; .001</math></b>	$\beta = .05$ $p = .316$	$\beta = .05$ $p = .356$	$\beta = -.02$ $p = .671$	$\beta = -.03$ $p = .525$	$\beta = -.04$ $p = .400$	$\beta = -.05$ $p = .314$
No Outliers	$\beta < .01$ $p = .975$	$\beta = -.01$ $p = .802$	$\beta = -.01$ $p = .892$	$\beta = .02$ $p = .730$	$\beta = .01$ $p = .883$	$\beta = .02$ $p = .710$	<b><math>\beta = .39</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .38</math></b> <b><math>p &lt; .001</math></b>	$\beta = .06$ $p = .272$	$\beta = .05$ $p = .307$	$\beta = -.01$ $p = .872$	$\beta = -.02$ $p = .724$	$\beta = -.03$ $p = .561$	$\beta = -.04$ $p = .470$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; NRS = Nature Relatedness Scale. Significant predictors are highlighted in bold. The degrees of freedom for the error terms ranged from 549 to 553 when strict exclusions were applied and from 672 to 677 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.86$ .

Table 36

*Multiple Regression Analyses Investigating Interactions Between Experimental Manipulations and Overall Scores on the Connectedness to Nature Scale on Interest in Visiting Natural Over Built Spaces in Study 2*

	Predictors													
	Secure Condition		Anxious Condition		Avoidant Condition		Trait CNS		Secure Condition X Trait CNS		Anxious Condition X Trait CNS		Avoidant Condition X Trait CNS	
	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient	Strict	Lenient
With Outliers	$\beta = -.03$ $p = .544$	$\beta = -.04$ $p = .332$	$\beta = -.02$ $p = .701$	$\beta = -.01$ $p = .838$	$\beta = .01$ $p = .779$	$\beta = .01$ $p = .761$	<b><math>\beta = .39</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .38</math></b> <b><math>p &lt; .001</math></b>	$\beta = .03$ $p = .580$	$\beta = .02$ $p = .731$	$\beta = -.02$ $p = .747$	$\beta = -.01$ $p = .812$	<b><math>\beta = -.10</math></b> <b><math>p = .073</math></b>	$\beta = -.07$ $p = .155$
No Outliers	$\beta = -.01$ $p = .808$	$\beta = -.03$ $p = .542$	$\beta = -.01$ $p = .785$	$\beta = -.001$ $p = .987$	$\beta = .01$ $p = .778$	$\beta = .02$ $p = .726$	<b><math>\beta = .36</math></b> <b><math>p &lt; .001</math></b>	<b><math>\beta = .35</math></b> <b><math>p &lt; .001</math></b>	$\beta = .03$ $p = .559$	$\beta = .02$ $p = .705$	$\beta = -.003$ $p = .953$	$\beta = .01$ $p = .917$	$\beta = -.06$ $p = .256$	$\beta = -.04$ $p = .438$

*Note.* Secure Condition = Dummy-coded variable comparing secure attachment condition to control condition; Anxious Condition = Dummy-coded variable comparing anxious attachment condition to control condition; Avoidant Condition = Dummy-coded variable comparing avoidant attachment condition to control condition; CNS = Connectedness to Nature Scale. Significant predictors are highlighted in bold. The degrees of freedom for the error terms ranged from 547 to 552 when strict exclusions were applied and from 669 to 675 when lenient exclusions were applied. Variance inflation factors were all  $\leq 3.74$ .

the Connectedness to Nature Scale was consistently a significant predictor of greater interest in visiting natural spaces over built spaces. None of the attachment conditions had a significant effect on interest in visiting natural over built spaces (compared to the control condition), and overall scores on the Connectedness to Nature Scale did not moderate the effect of the secure attachment condition or the anxious attachment condition (these results were consistent across exclusion criteria and when outliers were excluded/included). The interaction between scores on the Connectedness to Nature Scale and the avoidant attachment condition was not significant at the  $p < .05$  level, although it was marginally significant when outliers were included and strict exclusions were applied. Unpacking this marginally significant interaction, the avoidant attachment condition led to greater interest in visiting natural over built spaces for those who were very low on trait nature connectedness, but it had no effect at all other levels of trait nature connectedness (see Figure 18). However, for the other three analyses where the interaction was not even marginally significant, there were no conditional effects of the avoidant attachment condition at any levels of trait nature connectedness. Looking at this interaction from a different angle, overall scores on the Connectedness to Nature Scale was a consistent significant predictor of greater interest in visiting natural over built spaces in the control and avoidant attachment conditions, although it appeared to be a stronger predictor in the control condition (see Table 37).

## **Discussion**

### **Correlational Findings**

The first aim of Study 2 was to examine how interpersonal attachment orientations and nature connectedness might be related at the trait level. Diverging from the correlational results of Study 1 and the reanalysis of Zelenski and Nisbet (2014), trait attachment avoidance was not significantly associated with any of the indexes of trait nature connectedness in Study 2. The

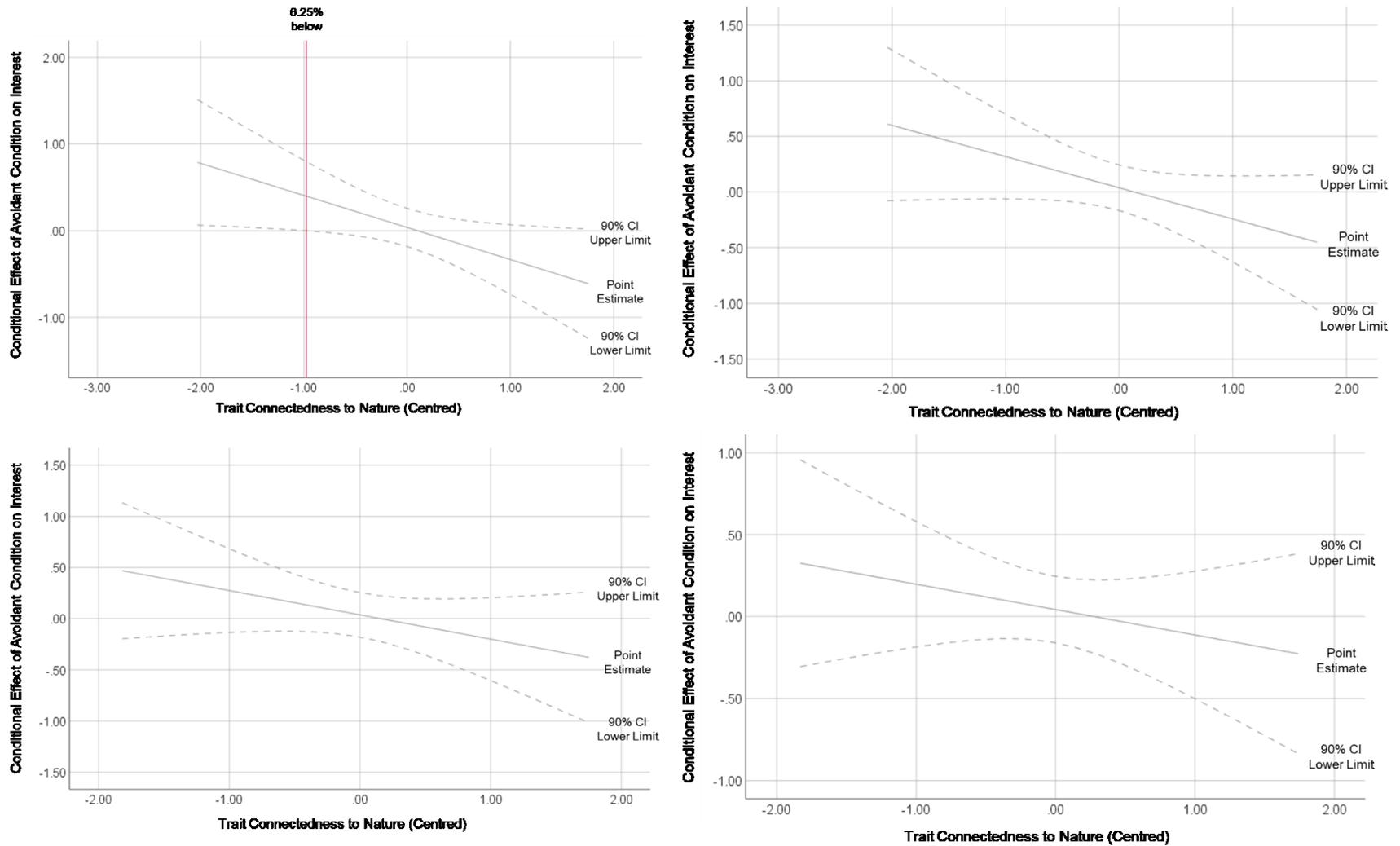


Figure 18. Conditional effect of avoidant attachment condition (compared to control condition) on interest in visiting natural over built spaces as a function of trait connectedness to nature in Study 2 when outliers were included and strict exclusions were applied (top left graph), when outliers were excluded and strict exclusions were applied (bottom left graph), when outliers were included and lenient exclusions were applied (top right graph), and when outliers were excluded and lenient exclusions were applied (bottom right graph). Red line indicates where conditional effects became at least marginally significant (i.e., when confidence intervals do not include 0).

Table 37

*Investigating Conditional Effects of Trait Connectedness to Nature on Interest in Visiting Natural Over Built Spaces in Avoidant Attachment Condition vs. Control Condition in Study 2*

	Strict Exclusions		Lenient Exclusions	
	With outliers	Without outliers	With outliers	Without outliers
Avoidant Condition X Trait CNS → Interest in Visiting Natural > Built Spaces				
Control Condition	<b><math>b = .74</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .68</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .74</math></b> <b><math>p &lt; .001</math></b>	<b><math>b = .68</math></b> <b><math>p &lt; .001</math></b>
Avoidant Condition	<b><math>b = .38</math></b> <b><math>p = .015</math></b>	<b><math>b = .45</math></b> <b><math>p = .005</math></b>	<b><math>b = .46</math></b> <b><math>p = .001</math></b>	<b><math>b = .53</math></b> <b><math>p &lt; .001</math></b>

*Note.* CNS = Connectedness to Nature Scale. Significant coefficients are highlighted in bold. The degrees of freedom for the error terms ranged from 547 to 552 when strict exclusions were applied and from 669 to 675 when lenient exclusions were applied. Conditional effects were not investigated for interactions that were not at least marginally significant in any of the analyses in Table 36.

negative association between trait attachment avoidance and the experience subscale of the Nature Relatedness Scale was marginally significant when lenient exclusion criteria were applied in Study 2, but the trivially sized association was not even marginally significant when strict exclusion criteria were applied. Moreover, trait attachment anxiety was found to be more or less unrelated to almost all indexes of trait nature connectedness in Study 2, which is consistent with the results from Study 1 and the reanalysis of Zelenski and Nisbet. The only exception was a small but significant negative association between trait attachment anxiety and the experience subscale of the Nature Relatedness Scale that was found across both exclusion criteria in Study 2. In line with the correspondence hypothesis, participants in Study 2 who were more anxious in

their close interpersonal relationships also tended to report less familiarity/comfort/desire to spend time in nature. This is also in line with predictions based on the expected interactions between behavioural systems as a chronically hyperactive attachment behavioural system should inhibit willingness to explore one's surroundings. Nevertheless, the small (negative and significant) association found between trait attachment anxiety and the experience subscale in Study 2 was in the opposite direction compared to the small (positive but non-significant) association between these two constructs in the reanalysis of Zelenski and Nisbet (while the two constructs were more or less unrelated in Study 1). The null associations between trait attachment anxiety/avoidance and overall scores on the Connectedness to Nature Scale in Study 2 suggest that the lack of persuasive results is likely not due to the particular measure of trait nature connectedness chosen in Study 1 and Zelenski and Nisbet. Overall, one could conclude that evidence for relationships between interpersonal attachment orientations and nature connectedness in the current line of research is weak and inconsistent (even when individuals are sampled from the same population as they were in Study 1 and Study 2) at the trait level.

The relative independence of the ways people generally relate to nature and how they generally relate to close others that was observed in the current line of research is not completely unexpected when one takes into account findings that were recently published by Moreton et al. (2019). These researchers found that trait nature connectedness tended to be more strongly and consistently associated with connectedness to more distant and abstract social entities (e.g., humanity, strangers) than connectedness to specific close others (e.g., family, best friend). As the conceptualization and measurement of trait attachment primarily focuses on how people feel and behave with potential attachment figures (e.g., with romantic partners, close friends, or family members) instead of more distant and abstract social entities, one would expect the association

between interpersonal attachment orientations and trait nature connectedness to be fairly weak and not robust based on the results from Moreton et al, which is what was observed in the current research. Moreton et al. posited that shared underlying personality traits, such as openness to experience, moral expansiveness, and honesty–humility (a sixth personality dimension from the HEXACO model of personality that shares some similarities with agreeableness; Moshagen, Thielmann, Hilbig, & Zettler, 2019; Saucier, 2009) might explain why nature connectedness is associated with some social aspects of connectedness. Consistent with this idea, the limited evidence for links between trait attachment and nature connectedness in the zero-order correlational results disappeared when the big five personality dimensions were controlled for in both Study 1 and Study 2, and openness to experience and agreeableness consistently emerged as unique predictors of higher trait nature connectedness across all indexes of nature connectedness in both studies. This seems to argue against predictions from attachment theory (e.g., the interactions between behavioural systems or applications of working models to non-social relationships).

### **Experimental Findings**

The second aim of Study 2 was to examine how secure, avoidant, and anxious attachment primes might impact people’s motivation to connect with nature, which was operationalized in Study 2 as individuals’ interest in visiting natural spaces vs. built spaces. Consistent with findings on environmental preferences in the environmental psychology literature (Joye, 2007; Kaplan & Kaplan, 1989; McMahan & Josh, 2017; Ulrich, 1993; cf. Meidenbauer et al., 2019), interest in visiting natural spaces was considerably higher than interest in visiting built spaces in Study 2. Unexpectedly, overall interest in visiting the various spaces (regardless of the type of space) did not differ across conditions and the magnitude of people’s interest in visiting natural

over built spaces did not differ across conditions either. This first null finding in Study 2 contradicts predictions and previous research based on attachment theory (Green & Campbell, 2000) as individuals should have been more willing to explore their environment (regardless of whether it is natural or built) when a secure base/safe haven was brought to mind (i.e., in the secure attachment condition), and individuals should have been less willing to explore their environment when the lack of a secure base/safe haven was highlighted (i.e., in the anxious and avoidant attachment conditions). One explanation for this null finding is that because the photographs included in Study 2 were of *local* natural and built spaces (and participants were explicitly told this), the spaces might have been too familiar and not novel enough for visiting them to be considered exploratory behaviour or to activate participants' exploratory behavioral systems. Future research could use photographs of spaces from outside of individuals' local area (and/or tell individuals that the spaces are in a foreign location) in order to address this shortcoming. The second null finding of no interaction between experimental condition and type of space suggests that motivation to connect with/explore the natural environment in particular does not depend on the social context, which contradicts previous research on the effects of ostracism (Lovell, 2010; Poon et al., 2015) but is consistent with the lack of overall main effects observed in Study 1.<sup>41</sup>

As in Study 1, the manipulation check analyses in Study 2 suggest that the attachment conditions may not have impacted state attachment in all the ways that were anticipated, which might explain the null findings mentioned above. Specifically, state attachment anxiety and

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<sup>41</sup> A simpler (albeit non-experimental) approach to investigate whether attachment-related states of mind are associated with motivation to connect with nature could be to simply examine zero-order correlations between state attachment and the motivation to connect with nature measures used in Study 1 and Study 2. To be comprehensive, I report these correlations in Table A6. In general, a consistent pattern of associations across studies and across measures of motivation to connect with nature was not found.

security largely did not differ across conditions in Study 2. However, state attachment avoidance tended to be higher in the avoidant attachment conditions and the anxious attachment condition than the control condition. Thinking and writing about an insecure relationship (regardless of whether one was instructed to focus on an avoidant or anxious relationship) appeared to lead to higher state attachment avoidance. As overall differences were not observed in motivation to connect with nature in the conditions with higher state attachment avoidance (as observed in Study 2) or in the conditions with higher state attachment anxiety (as observed in Study 1), the current line of research could be interpreted as suggesting that these insecure states of mind do not generally influence human–nature relations in the moment. Alternatively, the differences in state attachment avoidance and state attachment anxiety were small in magnitude (Cohen, 1998; Funder & Ozer, 2019) so it is also possible that the manipulation may have been too subtle to observe any downstream effects on the motivation to connect with nature outcome measures. Regardless, as state attachment security tended to not be higher in the secure attachment condition than the other conditions in either study, it is unclear whether bringing to mind secure relationships/experiences actually has no effect on motivation to connect with nature or might have had an effect if the experimental manipulation was more effective. Thus, additional experimental research is needed to more definitely test whether attachment security has an impact on human–nature relations in the moment.

There are a few potential reasons why the experimental manipulations might not have influenced state attachment outcomes as intended in Study 1 and Study 2. First, much of the attachment priming research reviewed earlier has used the Felt Security Scale (Luke et al., 2012) to check the effectiveness of their manipulations. Although the State Adult Attachment Measure was chosen as it allows one to assess attachment-related states of mind across more than one

dimension (cf. insecurity–security), the items in the Felt Security Scale are more framed more affectively (i.e., individuals indicate how “comforted”, “supported”, “secure”, etc., they currently feel), which may make it more sensitive to subtle changes than the State Adult Attachment Measure. Indeed, expected differences in state attachment security, avoidance, and anxiety across all attachment priming conditions are not always found when the State Adult Attachment Measure has been used in previous research (e.g., Bosmans, Bowles, Dewitte, De Winter, & Braet, 2014; Gillath et al., 2009). The control condition used in both studies might have also contributed to the less than ideal manipulation check results. When manually coding written responses in the control condition, I noticed that many participants mentioned eliciting help from others (e.g., professors, teaching assistants, classmates) as a strategy they would use for completing coursework. Moreover, the stress of completing coursework (especially when they know nothing about it) was another theme I noticed in the writing of those in the control condition. In other words, the control condition might have been more social and negatively valenced than anticipated. It might be wise to use different control conditions in future research so that the attachment conditions can be compared to a more neutral and non-social control group. Alternatively, this control condition may have unintentionally influenced motivation to connect with nature as Felsten (2009) found that students perceive spaces with natural elements as being more effective at restoring their ability to study or work optimally on a class project than similar spaces without natural elements.

When coding the written responses in Study 1 and Study 2, I also noticed that the writing of participants was often cut-off mid-sentence and many participants appeared to run out of time before they were able to write all of what they wanted to say. Furthermore, in the second study, which was conducted in-lab, many participants appeared to press the back button after the eight

minutes for the writing task had elapsed and Qualtrics automatically forwarded them to the next part of the study. When participants did this (presumably because they were trying to finish what they wanted to write), a non-Qualtrics webpage would appear on the screen and the researcher was notified by participants in order to bring them back to the Qualtrics page (the researcher simply clicked a bookmark to bring the participants back to where they left off in the survey before they pressed the back button). These observations suggest that the time allocated for the writing task may have been too short for some participants, which may have attenuated the effect of the experimental manipulation on some of the state attachment outcomes. This might also explain the lack of a strong main effect of the experimental manipulation on positive and negative affect in both studies. Extending the amount of time for the writing task to ten minutes (e.g., Carnelley & Rowe, 2007) or giving participants more control over when they advanced to the next part of the study could have minimized these potential issues. That the researcher was frequently called upon and helped participants immediately following the experimental manipulation (i.e., to bring them back to the Qualtrics webpage) might have also interfered with the induction of attachment-related states of mind in some of the conditions in Study 2. Such procedural confounds should be avoided whenever possible in future research (e.g., by including an automatic message that tells participants that the writing task is finished and instructs them to not press the back button).

Keeping these potential confounds/limitations in mind, partial evidence was found for interpersonal attachment orientations moderating the effect of the anxious attachment condition on motivation to connect with nature in Study 2 (albeit not robustly across exclusion criteria). When strict exclusions were applied in Study 2, the anxious attachment condition (compared to the control condition) led to higher interest in visiting natural spaces over built spaces for those

who were low on trait attachment anxiety, but it led to lower interest in visiting natural spaces over built spaces for those who were high on trait attachment anxiety. These conditional effects are in the opposite direction as what was observed in Study 1 (i.e., the highly anxious showed increased motivation to connect with nature—when measured by the adapted Connectedness to Nature Scale—in the insecure attachment condition in Study 1). Moreover, trait attachment anxiety was (either significantly or marginally significantly) positively associated with the adapted Connectedness to Nature Scale in the insecure condition in Study 1, but was (significantly) negatively associated with interest in visiting natural over built spaces in the anxious attachment condition when strict exclusions were applied in Study 2. These discrepancies between studies are difficult to reconcile, but the different ways in which motivation to connect with nature was measured may be an important factor that explains the diverging results. Namely, the highly anxious may be more willing to connect with nature in socially insecure contexts when interactions with nature are framed more relationally (as it was in the adapted Connectedness to Nature Scale used in Study 1), but may be less willing to connect with nature in socially insecure contexts when nature is simply framed as a physical environment (as it was in the photographs and the “interest in visiting” questions in Study 2). When their hyperactive behavioural system is activated, the idea of nature as a potential relational partner may led the highly anxious to want to connect with nature in order to satiate strong desires for some sort of connection or sense of belonging, but the idea of nature as just a physical environment to explore (with potential risks and limited opportunities for social connection) may decrease interest among the highly anxious (or have no effect on interest as it did in Study 1 with responses on the adapted Preferences for Nature Questionnaire). It should be noted, however, that evidence of an interaction between trait attachment anxiety and the anxious

attachment condition, along with any conditional effects, was absent when lenient exclusions were applied in Study 2. The results when strict exclusions were applied may be more valid as the individuals in these analyses appeared to follow the experimental manipulation more closely, or these results may be biased and less reflective of the ‘true effect’ due to the particularly high rate of exclusions in the anxious attachment condition. It is difficult to discern which is accurate so caution is warranted when interpreting these findings, especially considering the lack of accompanying interactions between trait attachment anxiety and the anxious attachment condition on state attachment/affect, which creates further ambiguity surrounding potential mechanisms underlying the observed effects.

Beyond trait attachment anxiety, almost no evidence was found for trait attachment avoidance or trait nature connectedness moderating the effect of an attachment condition on interest in visiting natural spaces over built spaces in Study 2. There was a marginally significant interaction between trait attachment avoidance and the anxious attachment condition, as well as a marginally significant interaction between the avoidant attachment condition and scores on the Connectedness to Nature Scale, but these interactions were only significant when strict exclusion criteria were applied and outliers were included (i.e., they were not even marginally significant when outliers were excluded, when lenient exclusion criteria were applied, or when the other measure of trait nature connectedness was considered). Given the minimal evidence for both of these interactions across analyses conducted in Study 2, my confidence in their robustness and replicability is extremely low so I will avoid interpreting these specific conditional effects here. It is interesting to note, however, that the significant interactions between trait attachment avoidance and the secure attachment condition on both measures of motivation to connect with nature in Study 1 were not replicated in Study 2. This is surprising given the presumed

similarities between the adapted Preferences for Nature Questionnaire used in Study 1 and the interest in visiting photographed natural spaces method used to assess motivation to connect with nature in Study 2; both of these were measures thought to capture more exploratory and physical ways of engaging with the natural world. The change in focus from experiences to specific relational partners in the experimental manipulation employed in Study 1 vs. Study 2 could have led to these differences as it may be easier for the avoidantly attached to think of an experience instead of an entire relationship that is characterized by security. Indeed, some researchers recommend priming experiences over relationships, especially for samples of undergraduates who tend to be relatively young and may have a limited number of relevant close interpersonal relationships to bring to mind (Sakaluk, 2014). Finally, although it did not reliably interact with the attachment conditions in either study, trait nature connectedness consistently predicted motivation to connect with nature in Study 1 and Study 2 (regardless of how trait nature connectedness was measured, how motivation to connect with nature was measured, whether outliers were included/excluded, or whether strict/lenient exclusion criteria were applied). This extends previous research on the association between nature connectedness and frequency of contact with nature (e.g., Tam, 2013a) by showing that nature connectedness robustly predicts momentary desires to engage with nature in a variety of ways across a number of social contexts.

### **General Discussion**

Despite numerous theoretical and empirical suggestions of a potential role of interpersonal attachment in shaping human–nature relations, the current research generally does not provide clear and consistent evidence for a link between how people relate to close others and how they relate to nature, or for attachment-related contexts impacting people’s motivation to connect with nature. The broad literature that I reviewed did lead to two plausible, yet

diverging, hypotheses. Thus, it is possible that compensation and correspondence processes might both be working in opposing directions, which may cancel each other and have led to the weak and inconsistent findings observed in the current investigation. Several limitations/confounds of the research designs that were mentioned earlier could also explain the lack of persuasive evidence. For these reasons, the applicability of attachment theory to human–nature relations should not be completely ruled out. Nevertheless, there are strengths of the current research, which might suggest that caution/skepticism concerning attachment theory’s relevance to how/when people engage with the natural world is warranted. I discuss these strengths, along with some additional limitations and directions for future research, in the remainder of this dissertation.

One of the biggest strengths of the current line of research are the relatively large sample sizes and high statistical power of the research designs in Study 1 and Study 2. As previously mentioned, the average sample sizes in the relevant research on the effects of ostracism ranged from only 33-39 participants in each condition (Lovell, 2010; Poon et al., 2015, 2016). Even recent research on attachment security priming still frequently uses small samples: almost half of the studies identified in the systematic review by Gillath and Karantzas (2019) had total sample sizes with less than 100 participants, and three-quarters of the studies had total sample sizes with less than 150 participants. As areas of research that consist of small sample sizes and low-powered studies are more likely to produce false positive results (Fraley & Vazire, 2014; Ioannidis, 2005; Simmons, Nelson, & Simonsohn, 2011), the replicability of some of the research that the current studies were based on can be questioned. Indeed, the effect of social exclusion on desires to connect with nature also did not replicate in two recent (albeit smaller;  $N$ s = 66 and 281) experimental studies by Moreton (2018). In terms of the attachment literature, the

findings in the current research may be idiosyncratic, but the high-powered designs and transparent reporting of results could hint at underlying replicability issues with attachment priming paradigms as well (similar to concerns about other priming research; e.g., Lodder, Ong, Grasman, & Wicherts, 2019). Greater use of pre-registration (Wagenmakers, Wetzels, Borsboom, van der Maas, & Kievit, 2012) and the adoption of meta-analytic techniques to examine potential issues of publication bias (e.g., Sterne et al., 2011; van Assen, van Aert, & Wicherts, 2015) by attachment (and other) researchers could increase understanding of the robustness and replicability of previous findings.

My use of a more validated measure of interpersonal attachment (cf. Zelenski & Nisbet, 2014) and multiple widely used measures of nature connectedness are additional strengths of the current research. However, the inconsistent zero-order correlations between trait attachment and different versions/subscales of the Nature Relatedness Scale across the three analyzed samples raise questions about whether the relatively highly correlated versions/subscales of the Nature Relatedness Scale (Nisbet et al., 2009; Nisbet & Zelenski, 2013) are actually assessing distinct aspects of a person's connection to nature or whether the irregular results might just be due to random noise. More advanced psychometric validation of the Nature Relatedness Scale (e.g., based on item response theory; Embretson & Reise, 2000) and further examinations of the discriminant validity of its subscales may be needed.

Another strength of the current research is that broad personality dimensions were assessed and accounted for when examining the relationship between the constructs of interests. This is in line with recommendations from Donnellan et al. (2008), who found that shared genetic influences partly explained the associations between interpersonal attachment orientations and the big five personality dimensions. Importantly, when associations between

trait attachment and (aspects of) nature connectedness were infrequently found in the current research, they consistently disappeared when the big five personality dimensions were statistically controlled for. More basic individual differences in temperament could shape both nature connectedness and interpersonal attachment orientations, which might explain why associations between trait attachment and indexes of nature connectedness were sometimes observed and why they were attenuated when the big five personality dimensions were statistically controlled for. To my knowledge, no research has been published that has examined the heritability of nature connectedness. Such studies might lead to a better understanding of the antecedents of nature connectedness. For instance, the importance of family members in fostering concern and connection to nature (e.g., Evans et al., 2018; Windhorst & Williams, 2015) might be due (in part) to shared genetic factors and not just social learning.

The current research also raises questions about the link between social well-being and nature connectedness that has been observed in previous studies (e.g., Capaldi et al., 2017; Howell et al., 2011, 2013). Why is nature connectedness more consistently associated with social well-being than with interpersonal attachment orientations? One reason could be that social well-being is typically conceptualized and operationalized at a more distinct and abstract level (i.e., community/societal; Keyes, 1998) than trait attachment, which focuses on close others. This appears to be an important distinction according to recent research by Moreton et al. (2019). Feeling connected to nature may satisfy broader relatedness needs (e.g., “to feel like a part of a functioning system”; Clayton, 2003, p. 50) and existential anxieties concerning isolation (Passmore & Howell, 2014b), but may be inadequate for satisfying the need for close, intimate, and interactive relationships with other people. Whether nature connectedness’ association with social well-being is similarly attenuated when the big five personality dimensions are accounted

for (as it was for its labile associations with trait attachment) is another question raised by the current findings.

The distinction between abstract/distant vs. specific/close social connections highlighted in Moreton et al. (2019) may also be applicable to the types of connections to nature that people develop and have implications for the relevance of attachment theory at different levels of specificity. The conceptualization and measurement of nature connectedness tend to broadly focus on people's relationship with the natural world in its entirety and not with specific natural environments. Nature, as framed in many measures of nature connectedness, is diffuse and abstract. Perhaps interpersonal attachment orientations and processes might be more important in shaping attachment to specific natural places (instead of nature in general). In this sense, conceptual integration of the interpersonal attachment and place attachment literatures (Scannell, 2013; Scannell & Gifford, 2014) may be a more plausible and fruitful route forward. Indeed, a focus on more specific relational targets would more closely follow the approach taken in other research on nonhuman attachment (e.g., to one's pet; Keefer et al., 2014). The weak and inconsistent findings in the current research may simply be attributable to the different levels of specificity of interpersonal attachment vs. nature connectedness. Alternatively, the development of a novel measure of people's relationship to nature that is directly inspired by attachment theory and assesses ways in which people can be anxiously/avoidantly/securely attached to nature could be another direction for future research that may be more successful at integrating these literatures.

Both studies found some evidence that individuals who reported growing up in more rural areas tended to be more connected to nature at the trait level and were more motivated to connect with nature in the moment. This replicates past research that suggests that childhood

experiences in natural environments may foster a connection with nature (see earlier section on developing a connection to nature). However, there is a paucity of longitudinal evidence to validate this (and other) proposed antecedent(s) of nature connectedness; existing studies are largely retrospective/cross-sectional. By following individuals over extended periods of time, stronger evidence for the potential causes of and changes in nature connectedness across development and significant life events may be obtained. A similar approach to the longitudinal study on the childhood origins of proenvironmental behaviours by Evans et al. (2018) could be adopted by researchers interested in nature connectedness. As two of the big five personality dimensions were found to be robust predictors of indexes of nature connectedness in the current research (i.e., agreeableness and openness to experience), longitudinal research could also examine whether typical age-related changes in personality (Roberts & Mroczek, 2008) are accompanied by changes in nature connectedness over the lifespan.

It is important to note that the recruitment of undergraduate students from one Canadian university across both studies limits the generalizability of the results. Different results might have been found with older community samples with more attachment-related experiences to draw upon (Sakaluk, 2014) and with stronger connections to nature (Hughes, Rogerson, Barton, & Bragg, 2019), or in non-Western countries where normative attachment processes and parenting styles might differ (e.g., Lancy, 2010). The reliance on self-report measures could be seen as another limitation of the current research (Baumeister, Vohs, & Funder, 2007). Using more behavioural measures to assess motivation to connect with nature, for instance, could have increased ecological validity and led participants to respond in a more naturalistic manner. Nevertheless, when attempting to understand individuals' thoughts and feelings regarding the natural and social worlds, there is still value in simply asking them via self-report measures (e.g.,

Jetten & Haslam, 2018). It is also possible that attachment (in)security may not influence conscious motivation to connect with nature, but may have an effect on the way people think and feel about nature at a more implicit and subconscious level. Future studies could test this idea by employing implicit measures of nature connectedness as the outcome of interest (e.g., using the modified Implicit Association Test from Schultz et al., 2004; but see Forscher et al., 2019 and Gawronski 2019 for recent discussions concerning the validity of implicit measures).

In sum, although the current line of research does not provide consistent support for the applicability of attachment theory (or for the correspondence or compensation hypotheses), it does raise a number of ideas for future research, and suggests ways in which these two disparate literatures can be strengthened. Understanding why and when people care about and engage with the natural world is essential at this moment in history where humanity is facing a climate crisis (World Meteorological Organization, 2019), a high burden of mental health issues (Rehm & Shield, 2019), and increasing urbanization (United Nations Department of Economic and Social Affairs, 2019). The promotion of nature connectedness could provide a unique route for addressing all three of these societal challenges given nature connectedness' well-supported link with proenvironmental behaviour (Mackay & Schmitt, 2019; Whitburn et al., 2019), positive mental health (Capaldi et al., 2014; Pritchard et al., 2019), and spending time outdoors in nature (e.g., Tam, 2013a).

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**Appendix A:  
Rescoring the Trait Attachment Measure in Zelenski and Nisbet (2014)**

Two subscales were obtained following alternative scoring instructions (Collins, 2008) for the original and revised Adult Attachment Scale (Collins & Read, 1990; Collins, 1996). The Adult Attachment Scale is also based on Hazan and Shaver's (1987) one-item, categorical measure and includes some of the same items as the ones used by Zelenski and Nisbet (2014).

The first subscale measuring trait attachment avoidance was based on five items tapping discomfort with closeness and discomfort with interdependence: (1) "I find it fairly easy to get close to others" (reverse scored), (2) "I am somewhat uncomfortable being close to others", (3) "I am comfortable depending upon others and having them depend on me" (reverse scored), (4) "I find it difficult to trust others completely", and (5) "People want to be more intimate than I am comfortable with being". Although these two aspects of discomfort were analyzed separately in earlier work (e.g., Collins & Read, 1990), they tend to be highly correlated and subsequent research has shown that they are best conceptualized as being part of one underlying factor, namely, attachment avoidance (e.g., Brennan et al., 1998). Collins, one of the creators of the Adult Attachment Scale, even uses a two-dimensional approach in her more recent research (e.g., Collins & Feeney, 2004).

The second subscale was based on three items assessing trait attachment anxiety: (1) "I find that others are reluctant to get as close to me as I would like", (2) "I often worry that my partner doesn't really love me or won't want to stay with me", and (3) "My desire to be close sometimes scares people away". The attachment avoidance subscale had superior internal reliability compared to the general measure of healthy attachment used in Zelenski and Nisbet (Cronbach's  $\alpha$  of .79 versus .69), while the internal reliability of the attachment anxiety subscale was weaker ( $\alpha = .52$ ).

The item “I don’t often worry about being abandoned or about someone getting too close to me” was excluded because it confounds the two dimensions of attachment; concern about being abandoned is reflective of attachment anxiety and concern about others getting too close is reflective of attachment avoidance. Other measures, like the original Adult Attachment Scale (Collins & Read, 1990), avoid this issue by separating each component into its own statement (e.g., “I do not worry about being abandoned” and “I do not worry about someone getting too close to me”) and allowing responses to each contribute to separate subscales.

**Appendix B:  
Experimental Manipulation (Study 1)**

*[Secure Attachment Condition]*

**Instructions:** We now want you to complete a visualization task. Imagine yourself in a problematic situation that you cannot solve on your own. Imagine that you are surrounded by people who are sensitive and responsive to your distress, want to help you only because they love you, and set aside other activities in order to assist you.

Please write about an experience you have had that is similar to the one described in the scenario for 8 minutes. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about the scenario and write down anything else that comes to mind.

*[Insecure Attachment Condition]*

**Instructions:** We now want you to complete a visualization task. Imagine yourself in a problematic situation that you cannot solve on your own. Imagine that you are surrounded by people who are insensitive and unresponsive to your distress. These are people you know but are too busy with their own activities and schedule to help or assist you. You are alone with this problem.

Please write about an experience you have had that is similar to the one described in the scenario for 8 minutes. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about the scenario and write down anything else that comes to mind.

*[Control Condition]*

**Instructions:** We are interested in how people feel after thinking about particular topics. We would like you to write for 8 minutes about a coursework writing scenario. Imagine you are about to start an important piece of coursework that you know nothing about. Describe how you go about completing this work. For example, the resources you use, any routines you have in completing the work, how you structure your time, etc.

Please try to give as much detail as possible about how you plan your coursework. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about the scenario and write down anything else that comes to mind.

**Appendix C:**  
**State Adult Attachment Measure**  
**(Study 1 & 2)**

**Instructions:** The following statements concern how you feel *right now*. Please respond to each statement by indicating how much you agree or disagree with it as it reflects your *current* feelings. Please select the number on the 1-to-7 scale that best indicates how you feel at the moment.

1	2	3	4	5	6	7
Disagree strongly			Neutral/ mixed			Agree strongly

***Right now ...***

1. I wish someone would tell me they really love me.
2. I would be uncomfortable having a good friend or a relationship partner close to me.
3. I feel alone and yet don't feel like getting close to others.
4. I feel loved.
5. I wish someone close could see me now.
6. If something went wrong right now I feel like I could depend on someone.
7. I feel like others care about me.
8. I feel a strong need to be unconditionally loved right now.
9. I'm afraid someone will want to get too close to me.
10. If someone tried to get close to me, I would try to keep my distance.
11. I feel relaxed knowing that close others are there for me right now.
12. I really need to feel loved right now.
13. I feel like I have someone to rely on.
14. I want to share my feelings with someone.
15. I feel like I am loved by others but I really don't care.
16. The idea of being emotionally close to someone makes me nervous.
17. I want to talk with someone who cares for me about things that are worrying me.
18. I feel secure and close to other people.
19. I really need someone's emotional support.
20. I feel I can trust the people who are close to me.
21. I have mixed feelings about being close to other people.

**Appendix D:**  
**Positive and Negative Affect Schedule**  
**(Study 1 & 2)**

**Instructions:** Below is a scale which consists of a number of words that describe different feelings and emotions. Read each item and then indicate to what extent you feel this way *right now*.

1	2	3	4	5
Very slightly or not at all	A little	Moderately	Quite a bit	Extremely

1. Interested
2. Distressed
3. Excited
4. Upset
5. Strong
6. Guilty
7. Scared
8. Hostile
9. Enthusiastic
10. Proud
11. Irritable
12. Alert
13. Ashamed
14. Inspired
15. Nervous
16. Determined
17. Attentive
18. Jittery
19. Active
20. Afraid

**Appendix E:**  
**Adapted Connectedness to Nature Scale**  
**(Study 1)**

**Instructions:** Please answer each of these questions in terms of the way you feel *right now*. There are no right or wrong answers.

1	2	3	4	5	6	7
Strongly disagree						Strongly agree

1. I want to feel a sense of oneness with the natural world around me.
2. I want to think of the natural world as a community to which I belong.
3. I want to recognize and appreciate the intelligence of other living organisms.
4. I want to feel disconnected from nature.
5. When I think of my life, I want to imagine myself to be part of a larger cyclical process of living.
6. I want to feel a kinship with animals and plants.
7. I want to feel as though I belong to the Earth as equally as it belongs to me.
8. I want to have a deep understanding of how my actions affect the natural world.
9. I want to feel part of the web of life.
10. I want to feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’.
11. Like a tree can be part of a forest, I want to feel embedded within the broader natural world.
12. When I think of my place on Earth, I want to consider myself to be a top member of a hierarchy that exists in nature.
13. I want to feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
14. I want to think that my personal welfare is independent of the welfare of the natural world.

**Appendix F:**  
**Adapted Preferences for Nature Questionnaire**  
**(Study 1)**

**Instructions:** The following statements concern how you feel *right now*. Select the number that best indicates your *present* agreement or disagreement with each statement.

1	2	3	4	5	6	7
Strongly disagree	Disagree somewhat	Disagree slightly	Neither agree nor disagree	Agree slightly	Agree somewhat	Strongly agree

***Right now ...***

1. I want to be in nature more than a town or urban area.
2. I want to go to a natural area, such as a national park, for a vacation over an urban area, such as a large city.
3. I want to be more of a city person than a nature person.
4. I want to engage in outdoor leisure activities, like hiking and camping, over indoor leisure activities, like going to the movies or museums.
5. I want to live in a city rather than in a rural area.
6. I want to explore the city more than I want to explore a natural area.
7. I would find natural landscapes more aesthetically pleasing than cityscapes.
8. If I was in a town or city, I would want to go to a natural area.
9. If I was in nature, I would be very excited to get back to the city.
10. I would prefer being in a town or city more than being out in nature.

**Appendix G:**  
**Experiences in Close Relationships Scale**  
**(Study 1 & 2)**

**Instructions:** The following statements concern how you *generally* feel in close relationships (e.g., with romantic partners, close friends, or family members). Respond to each statement by indicating how much you agree or disagree with it.

1	2	3	4	5	6	7
Disagree strongly	Disagree	Disagree slightly	Neutral/ mixed	Agree slightly	Agree	Agree strongly

1. I prefer not to show others how I feel deep down.
2. I worry about being rejected or abandoned.
3. I am very comfortable being close to other people.
4. I worry a lot about my relationships.
5. Just when someone starts to get close to me I find myself pulling away.
6. I worry that others won't care about me as much as I care about them.
7. I get uncomfortable when someone wants to be very close to me.
8. I worry a fair amount about losing my close relationship partners.
9. I don't feel comfortable opening up to others.
10. I often wish that close relationship partners' feelings for me were as strong as my feelings for them.
11. I want to get close to others, but I keep pulling back.
12. I want to get very close to others, and this sometimes scares them away.
13. I am nervous when another person gets too close to me.
14. I worry about being alone.
15. I feel comfortable sharing my private thoughts and feelings with others.
16. My desire to be very close sometimes scares people away.
17. I try to avoid getting too close to others.
18. I need a lot of reassurance that close relationship partners really care about me.
19. I find it relatively easy to get close to others.
20. Sometimes I feel that I try to force others to show more feeling, more commitment to our relationship than they otherwise would.
21. I find it difficult to allow myself to depend on close relationship partners.
22. I do not often worry about being abandoned.
23. I prefer not to be too close to others.
24. If I can't get a relationship partner to show interest in me, I get upset or angry.
25. I tell my close relationship partners just about everything.
26. I find that my partners don't want to get as close as I would like.
27. I usually discuss my problems and concerns with close others.
28. When I don't have close others around, I feel somewhat anxious and insecure.
29. I feel comfortable depending on others.
30. I get frustrated when my close relationship partners are not around as much as I would like.
31. I don't mind asking close others for comfort, advice, or help.

32. I get frustrated if relationship partners are not available when I need them.
33. It helps to turn to close others in times of need.
34. When other people disapprove of me, I feel really bad about myself.
35. I turn to close relationship partners for many things, including comfort and reassurance.
36. I resent it when my relationship partners spend time away from me.

**Appendix H:  
Nature Relatedness Scale  
(Study 1 & 2)**

**Instructions:** For each of the following, please rate the extent to which you agree with each statement, using the scale from 1 to 5 as shown below. Please respond in terms of *the way you generally feel*, rather than how you think “most people” feel.

1	2	3	4	5
Disagree strongly	Disagree a little	Neither agree or disagree	Agree a little	Agree strongly

1. I enjoy being outdoors, even in unpleasant weather.
2. Some species are just meant to die out or become extinct.
3. Humans have the right to use natural resources any way we want.
4. My ideal vacation spot would be a remote, wilderness area.
5. I always think about how my actions affect the environment.
6. I enjoy digging in the earth and getting dirt on my hands.
7. My connection to nature and the environment is a part of my spirituality.
8. I am very aware of environmental issues.
9. I take notice of wildlife wherever I am.
10. I don't often go out in nature.
11. Nothing I do will change problems in other places on the planet.
12. I am not separate from nature, but a part of nature.
13. The thought of being deep in the woods, away from civilization, is frightening.
14. My feelings about nature do not affect how I live my life.
15. Animals, birds and plants should have fewer rights than humans.
16. Even in the middle of the city, I notice nature around me.
17. My relationship to nature is an important part of who I am.
18. Conservation is unnecessary because nature is strong enough to recover from any human impact.
19. The state of non-human species is an indicator of the future for humans.
20. I think a lot about the suffering of animals.
21. I feel very connected to all living things and the earth.

**Appendix I:**  
**IPIP-NEO-120**  
**(Study 1)**

**Instructions:** Describe yourself as you honestly see yourself by indicating the accuracy or inaccuracy of each of the following statements. Please describe yourself as you *generally* are, not as you wish to be in the future.

1	2	3	4	5
Very inaccurate	Moderately inaccurate	Neither accurate nor inaccurate	Moderately accurate	Very accurate

1. I complete tasks successfully.
2. I believe in the importance of art.
3. I take charge.
4. I prefer to be alone.
5. I enjoy wild flights of fantasy.
6. I have a vivid imagination.
7. I do a lot in my spare time.
8. I seek adventure.
9. I insult people.
10. I rarely notice my emotional reactions.
11. I try to lead others.
12. I take no time for others.
13. I put little time and effort into my work.
14. I believe that there is no absolute right or wrong.
15. I tend to vote for liberal political candidates.
16. I excel in what I do.
17. I love to help others.
18. I find it difficult to approach others.
19. I have a high opinion of myself.
20. I jump into things without thinking.
21. I love excitement.
22. I have difficulty understanding abstract ideas.
23. I am always busy.
24. I know how to get things done.
25. I feel comfortable around people.
26. I take advantage of others.
27. I don't understand people who get emotional.
28. I only feel comfortable with friends.
29. I work hard.
30. I take control of things.
31. I do just enough work to get by.
32. I am attached to conventional ways.
33. I make friends easily.
34. I have a lot of fun.

35. I am afraid of many things.
36. I tend to vote for conservative political candidates.
37. I distrust people.
38. I feel that I'm unable to deal with things.
39. I love life.
40. I boast about my virtues.
41. I try not to think about the needy.
42. I experience my emotions intensely.
43. I believe that I am better than others.
44. I enjoy being reckless.
45. I rarely overindulge.
46. I look at the bright side of life.
47. I get back at others.
48. I am able to control my cravings.
49. I use others for my own ends.
50. I feel others' emotions.
51. I do not like poetry.
52. I see beauty in things that others might not notice.
53. I love large parties.
54. I rush into things.
55. I wait for others to lead the way.
56. I like to get lost in thought.
57. I get angry easily.
58. I avoid philosophical discussions.
59. I leave a mess in my room.
60. I like to tidy up.
61. I break my promises.
62. I love to daydream.
63. I radiate joy.
64. I am not bothered by difficult social situations.
65. I dislike changes.
66. I believe that others have good intentions.
67. I sympathize with the homeless.
68. I waste my time.
69. I make rash decisions.
70. I am not interested in other people's problems.
71. I break rules.
72. I believe that we should be tough on crime.
73. I often feel blue.
74. I am not interested in theoretical discussions.
75. I feel sympathy for those who are worse off than myself.
76. I act without thinking.
77. I trust others.
78. I keep my promises.
79. I panic easily.
80. I am afraid to draw attention to myself.

81. I cheat to get ahead.
82. I obstruct others' plans.
83. I handle tasks smoothly.
84. I act wild and crazy.
85. I tell the truth.
86. I worry about things.
87. I remain calm under pressure.
88. I am often down in the dumps.
89. I lose my temper.
90. I go on binges.
91. I fear for the worst.
92. I am concerned about others.
93. I yell at people.
94. I do not enjoy going to art museums.
95. I become overwhelmed by events.
96. I prefer to stick with things that I know.
97. I feel comfortable with myself.
98. I love to read challenging material.
99. I do more than what's expected of me.
100. I avoid crowds.
101. I get stressed out easily.
102. I leave my belongings around.
103. I love a good fight.
104. I often forget to put things back in their proper place.
105. I avoid contacts with others.
106. I am always on the go.
107. I like to take it easy.
108. I get irritated easily.
109. I am indifferent to the feelings of others.
110. I dislike myself.
111. I prefer variety to routine.
112. I easily resist temptations.
113. I have difficulty starting tasks.
114. I am always prepared.
115. I talk to a lot of different people at parties.
116. I keep others at a distance.
117. I trust what people say.
118. I think highly of myself.
119. I carry out my plans.
120. I am not easily annoyed.

**Appendix J:  
SONA Recruitment Notice  
(Study 1)**

**Study Name:** Visualization, Memory, Affect, Motivation, and Personality

**Study Type:** Online Study

**Duration:** 60 minutes

**Percentage:** 0.5 Percentage

**Description:** This study is investigating the links between visualization, autobiographical memories, motivation, affect, and personality. Participants will be asked to engage in visualization/writing tasks, and complete questionnaires about their feelings, motivations, personality, and demographic characteristics. Risks: Some of the topics may cause discomfort as we ask about negative personal experiences/feelings. At any point during your participation, you are free to withdraw from the study and still receive credit. You will also be able to withdraw your data after completing (part of) the study by contacting the researchers and you will still receive credit. The deadline to withdraw your data is the day after the last day of classes of the current semester. This study has received clearance by the Carleton University Research Ethics Board B (CUREB-B Clearance # 108530). If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at [ethics@carleton.ca](mailto:ethics@carleton.ca)).

**Eligibility Requirements:** Must not have participated in “Personality, Relationships, Emotions, and Interests” or “Interpersonal Conflict in Close Relationships”.

**Researchers:** Colin Capaldi  
John Zelenski

**Appendix K:  
Informed Consent Form  
(Study 1)**

The purpose of an informed consent form is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent must provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

**Present Study: Visualization, Memory, Affect, Motivation, and Personality**

**Purpose.** The purpose of this study is to investigate the links between visualization, autobiographical memories, motivation, affect, and personality.

**Task Requirements.** Participants will be asked to engage in an 8-minute visualization and writing task about a particular topic that may be of a personal nature. They will then be asked to complete a series of questionnaires about their feelings, motivations, personality, and demographic characteristics. Participants will then be asked to answer questions about their experience in the study, followed by a couple brief visualization tasks. This study will take less than 60 minutes to complete.

**Benefits/Compensation.** You will receive a 0.50% increase in your final grade in PSYC 1001, 1002, 2001, or 2002 for participating in this study.

**Potential Risks/Discomfort.** Some of the topics may cause some psychological discomfort as we ask about negative personal experiences/feelings. Your responses will remain completely confidential, and you may skip any questions or tasks that you do not feel comfortable completing. You can withdraw from the study at any time without any explanation or penalty by closing this tab in your internet browser. If you are experiencing distress, we encourage you to contact the health and counseling/distress resources provided on the debriefing form at the end of the study. As some of the questions/tasks are of a personal nature, there is a minor risk of social harm in the unlikely event of a data breach.

**Anonymity/Confidentiality.** All research data will remain completely confidential. An anonymized data set without any personal identifiers may be shared with other trusted researchers as required by professional guidelines and may eventually be made available online on the Open Science Framework, a non-profit website dedicated to making research more transparent, reproducible, and open. Your written response in the visualization/writing task will not be posted online and will not be made public by us at any point. Your data will be stored and protected by Qualtrics in Toronto, but may be disclosed via a court order or data breach. Data will be deleted from Qualtrics once this research has been published.

**Right to Withdraw.** Your participation in this study is entirely voluntary. If you do not feel comfortable answering a question, you can leave it blank. You will not be penalized for this. If you wish to withdraw from the study after consenting to participate, you can simply exit the survey in your internet browser or repeatedly click the next button until you reach the end of the

study (you may need to wait at certain points in the study before the next button appears). If you would like to withdraw your data after completing (part of) the study, please contact the researchers. The deadline to withdraw your data is the day after the last day of classes of the current semester. If you choose to not answer questions or withdraw, you will still receive course credit for participating.

**Research Personnel.** The following people are involved in this online study, and may be contacted at any time if you have questions or concerns: Colin Capaldi (PhD student, Department of Psychology, colin\_capaldi@carleton.ca), Dr. John Zelenski (Professor, Department of Psychology, john.zelenski@carleton.ca, 613-520-2600, ext. 1609).

**Concerns.** Should you have any ethical concerns about this research, please contact Dr. Andy Adler (Chair, Carleton University Research Ethics Board-B, by phone: 613-520-2600 ext. 4085 or email: ethics@carleton.ca).

This study has received clearance by the Carleton University Research Ethics Board-B (CUREB-B Clearance # 108530).

*Do you agree to participate in this study?*

- Yes, I agree to participate in this study \_\_\_\_\_
- No, I do not want to participate in this study \_\_\_\_\_

**Appendix L:  
Demographics Questionnaire  
(Study 1 & 2)**

1. What is your age?

2. What is your gender?

Male

Female

Other:

3. How rural or urban was the area you grew up in?

1	2	3	4	5
Very rural				Very urban

**Appendix M:  
Data Quality Questionnaire  
(Study 1)**

**Instructions:** We would like to ask you a few questions about your experience during this study. It is vital that the data we collect are of high quality so please answer honestly. Your response to these questions will not in any way influence the course credit you receive for participating.

1. Were you able to think of a personal experience to write about that matched the situation you were asked to visualize? *[This question was not included for those in the control condition]*

- Yes  
 No

2. How easy was it to think of a personal experience to write about that matched the situation you were asked to visualize? *[This question was not included for those in the control condition]*

1	2	3	4	5	6	7
Very difficult						Very easy

3. Did you spend most of the 8 minutes thinking/writing about your personal experience? *[Control condition wording: Did you spend most of the 8 minutes thinking/writing about how you plan your coursework?]*

- Yes  
 No

4. Do you believe there is any reason we should not include your data in our analyses?

- No, my data is fine to include  
 Yes, you should not include my data

5. If you selected yes, please indicate in the text box below why we should not include your data.

**Appendix N:  
Mood Booster  
(Study 1 & 2)**

[*Scenario 1*]

**Instructions:** Please read the following paragraph and imagine yourself in this scenario.

You have just spent a wonderful evening with a friend in whom you have had a growing romantic interest. You are sharing drinks in their apartment when they begin to hint that they are romantically interested in you as well. Your palms become sweaty and your heart begins to beat faster as you consider telling them how you feel. Your heart leaps when they confess that they would love to go out with you. You are ecstatic as they lean over and give you a long intimate embrace.

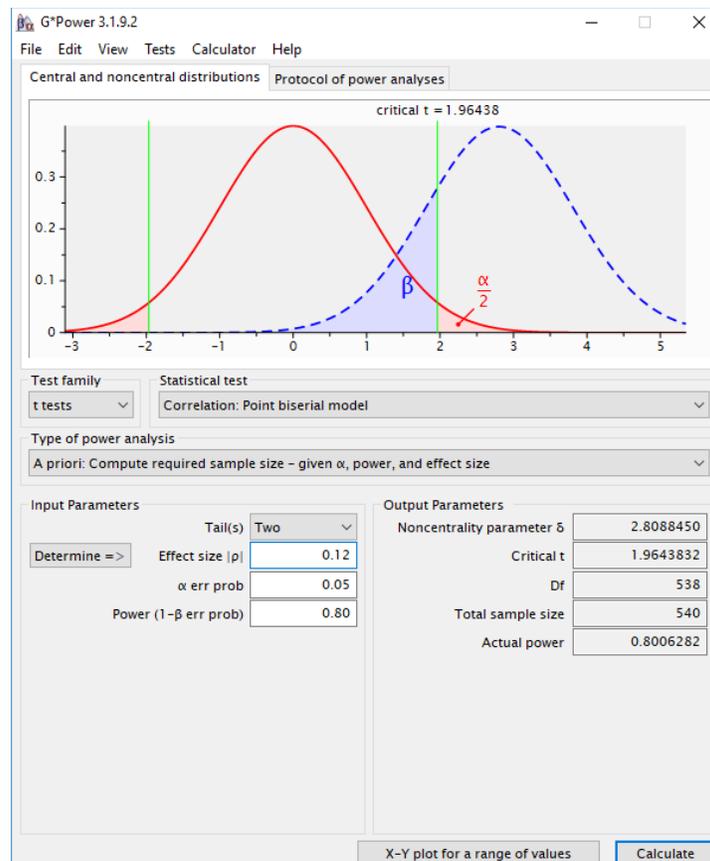
[*Scenario 2*]

**Instructions:** Please read the following paragraph and imagine yourself in this scenario.

Your hands tremble in anticipation as you hold the envelope. The return address indicates it is from the number one employer in your field - the place you most wanted to be. You felt the interviews had gone very well, and that it would be an excellent position for you. You rip open the envelope and discover that they have offered you the job! Your insides feel like they are going to burst. You are trembling with excitement and you want to scream "yea" and run out and tell the world.

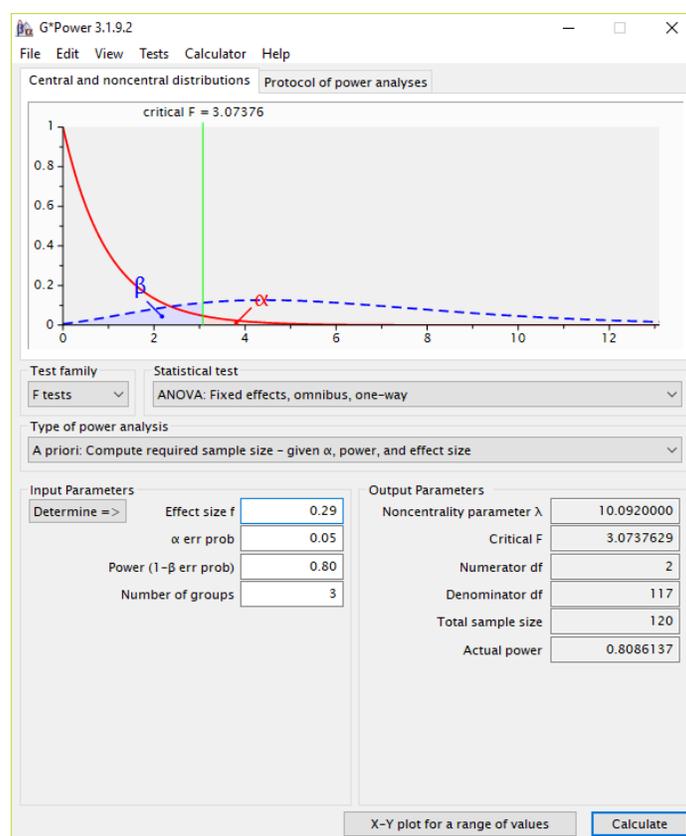
### Appendix O: A Priori Power Analyses (Study 1)

Before any data was collected, separate power analyses were conducted for each main research question and the largest required sample size was chosen to ensure that all statistical tests of interest were adequately powered. For Research Question #1, the effect size that was estimated for the power analysis was based on the reanalysis of Zelenski and Nisbet (2014). Specifically, ignoring the basically null correlations involving the perspective subscale, as well as the correlation between attachment anxiety and the self subscale, the average effect size observed in the reanalysis was an  $r$  of .12. According to power analyses in G\*Power, a sample size of 540 was required to have 80% power to detect effects of this size.



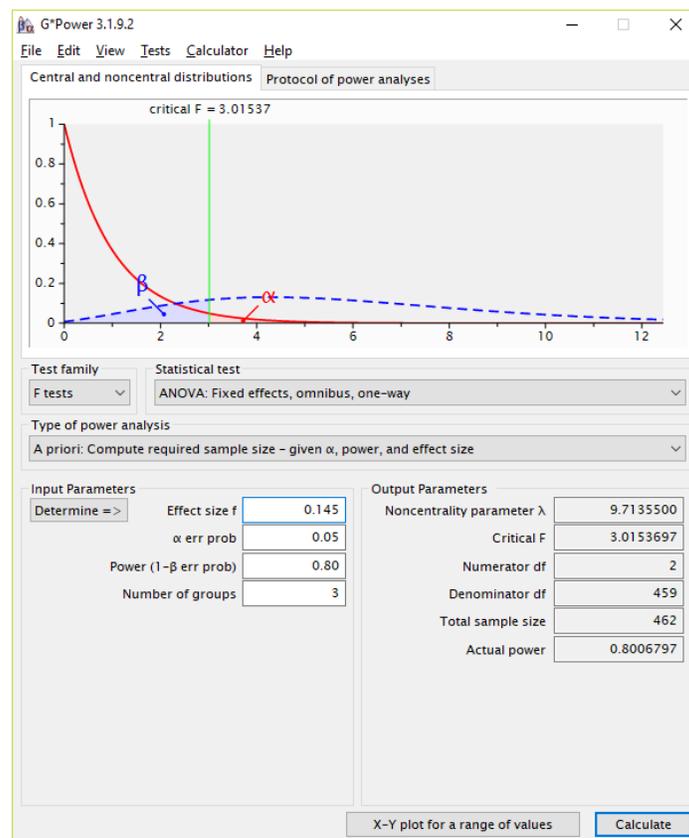
In terms of predicting likely effect sizes at the state level (Research Question #2), the

meta-analysis cited in Gillath et al. (2016) found that security priming has an average effect equal to an  $r$  of .28, a Cohen's  $d$  of .58, or an  $f$  of .29, which can be considered moderate in magnitude according to conventions from Cohen (1988) or fairly large compared to other social psychological effects (Richard et al., 2003). Taking the average effect size from the meta-analysis cited in Gillath et al. (2016) at face value, the required sample size would only have to be 120 participants to achieve 80% power for an ANOVA that tested whether the desire to connect to nature was the same across the three experimental conditions.



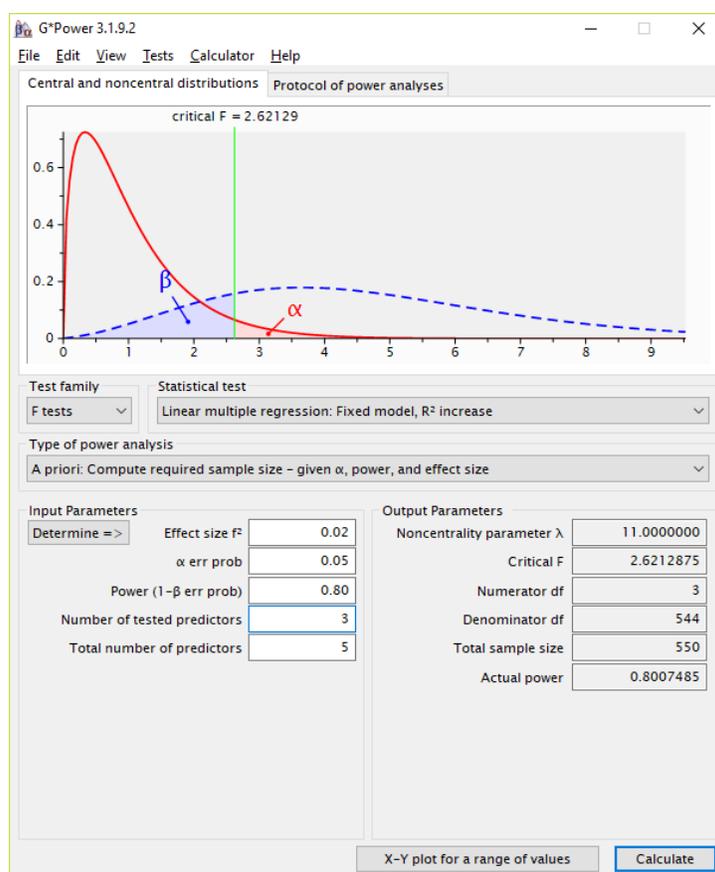
As alluded to earlier however, Gillath et al. (2016) acknowledge (but do not test or account for) potential issues of publication bias and small sample sizes that are commonly employed in this area of research, and even speculate that “the effects that are statistically significant are likely to be overestimates of the true effect” (p. 167). Taking this into account, along with other research suggesting that published results are often inflated (e.g., Ebersole et al.,

2016), imputing a more conservative effect size in the power analysis was thought to be appropriate. The Open Science Collaboration (2015) attempted to replicate 100 published psychology studies and observed effects sizes that were on average half the size of what was reported in the original research; thus, including an effect size estimate that was half the magnitude as what was found in the meta-analysis cited in Gillath et al. (2016; i.e., an  $r$  of .14, a  $d$  of .29, or an  $f$  of .145) was thought to be appropriate to calculate the required sample size. When this approach was used, a sample size of 462 individuals was needed to achieve 80% power.



Finally, power analyses also needed to be conducted to ensure that the sample size was large enough to have a reasonable opportunity to detect the potential moderating role of interpersonal attachment orientations or nature connectedness on the effect of the experimental manipulations (Research Question #3). Given the inconsistent empirical support found for trait

attachment moderating responses to attachment primes, it was thought that if there was an interaction it would likely be fairly subtle and small in magnitude. Considering that interaction effects also tend to be smaller in magnitude than main effects (Maxwell & Delaney, 2004), it was thought that it would probably be best to be conservative when estimating its potential size in the current research. Thus, a small effect size according to conventions from Cohen (1992) was used to calculate the recommended sample size for a multiple regression analysis. This power analysis in G\*Power revealed that a sample size of 550 participants was needed to obtain 80% power.<sup>42</sup>



Based on the above reasoning and power analyses, I planned to recruit 550 undergraduate

<sup>42</sup> There were five predictor variables in the multiple regression analyses for Research Question #3, but only three were of primary interest. The statistical significance of the coefficients for the dummy-coded variables capturing the effect of the secure attachment condition (vs. the control condition) and the effect of the insecure attachment condition (vs. the control condition) were not as important to interpret in these analyses because the effect of the experimental conditions on motivation to connect with nature was tested in an earlier between-subjects ANOVA test.

students to participate in Study 1 as this sample size was large enough for statistical power to be at least 80% when conducting tests relating to each of the three research questions of interest.

**Appendix P:  
Detailed Data Quality Information  
(Study 1)**

**Writing Task Completion**

Of the 648 participants who finished the study, 545 were coded as completing the writing task correctly (84.10%) and 103 were coded as not completing the writing task correctly (15.90%). Six out of the 219 participants in the control condition (2.74%), 44 out of the 213 participants in the secure attachment condition (20.66%), and 53 out of the 216 participants in the insecure attachment condition (24.54%) were coded as not completing the writing task correctly (see Table A1 for the specific reasons why participants were coded as not completing the writing task correctly in each condition). Although the likelihood of being coded as not completing the writing task correctly was significantly different across the three conditions,  $\chi^2(2, N = 648) = 44.03, p < .001$ , this was driven by the especially low rates of completing the writing task incorrectly in the control condition; the likelihood of being coded as not completing the writing task correctly did not differ significantly between the secure and insecure attachment conditions,  $\chi^2(1, N = 429) = 0.92, p = .337$ .

**Attention Checks**

Out of the 648 participants who finished the study, 524 participants ( $n_{\text{control}} = 174; n_{\text{security}} = 174, n_{\text{insecurity}} = 176$ ) did not fail any of the attention checks (80.86%), 63 participants ( $n_{\text{control}} = 24; n_{\text{security}} = 19, n_{\text{insecurity}} = 20$ ) failed one of the attention checks (9.72%), and 61 participants ( $n_{\text{control}} = 21; n_{\text{security}} = 20, n_{\text{insecurity}} = 20$ ) failed both attention checks (9.41%). The number of attention checks failed did not differ significantly across the three conditions,  $\chi^2(4, N = 648) = 0.63, p = .960$ . However, the number of attention checks failed did differ significantly across those who were coded as completing the writing task correctly vs. incorrectly,  $\chi^2(2, N = 648) =$

Table A1

*Reasons for Coding Writing Task as Incorrectly Completed in Each Experimental Condition in Study 1*

Control Condition		Secure Attachment Condition		Insecure Attachment Condition	
<i>n</i>	Reason	<i>n</i>	Reason	<i>n</i>	Reason
3	*Did not write anything.	6	*Did not write anything.	10	*Did not write anything.
2	*Did not seem to understand instructions (i.e., wrote about an idea for a study instead of how they study).	9	*Wrote that they could not think of any experiences that matched the scenario.	6	*Wrote that they could not think of any experiences that matched the scenario.
1	Wrote that they experienced a technical issue that erased their answer (but still wrote a few short sentences after stating this).	8	Wrote about an experience where someone else was in need.	14	Wrote about experiences where others were notably there for them (even though other people may not have been).
		18	Appeared to run out of time before they were able to explain how they were supported/helped by others.	10	Wrote about how they would approach a situation like the one described instead of sharing an actual experience.
		2	Wrote about an experience where others were not supportive/sensitive.	7	Did not mention how others were insensitive, unresponsive, or unavailable.
		1	*Wrote that they were not comfortable sharing their experience.	4	Wrote about experiences where they felt alone at the time but realized now that they were not alone.
				2	*Wrote about the current study instead of a previous experience.

*Note.* An asterisk beside a reason indicates that these participants were still coded as not completing the writing task properly when a more lenient approach to coding was employed.

8.24,  $p = .016$ , with those who were coded as not completing the writing task correctly being around twice as likely to fail both attention check items (16.50%) compared to those who were coded as completing the writing task correctly (8.07%).

### **Self-Reported Exclusion of Data**

Out of the 648 participants who finished the study, 618 participants indicated that their data were fine to include (95.37%), 28 participants indicated that their data should not be included (4.32%), and two participants did not respond to this item (0.31%). The reasons given by the 28 participants for why their data should be excluded are listed in Table A2, and were classified as being exclusion worthy ( $n = 13$ ) or not exclusion worthy ( $n = 15$ ). The number of participants who indicated that their data should not be used for an exclusion-worthy reason or who did not respond to this item was similar across conditions ( $n_{\text{control}} = 6$ ;  $n_{\text{security}} = 5$ ,  $n_{\text{insecurity}} = 4$ ), but more than half failed at least one attention check ( $n = 8$ ) and two-fifths were coded as not completing the writing task correctly ( $n = 6$ ).

Seven of the 618 participants who indicated that their data were fine to include wrote something in the textbox that was supposed to be reserved for those who indicated that their data should not be used. Four of these seven participants simply reiterated that they carefully/properly completed the study. One participant indicated that they ran out of time and did not write anything for the writing task but had an experience in mind (they were already coded as not completing the writing task correctly). Another participant wrote a few sentences expanding on their personality and how they believe their responses are common. The seventh participant, who was assigned to the control condition, wrote that they were tired and that recent events influenced how they answered questions about their current emotional state. It was determined that this last participant was the only one out of the seven who mentioned something novel that

Table A2

*Reasons Why Participants Indicated that Their Data Should Be Excluded in Study 1*

<i>n</i>	Explanation given by participant	Why explanation is or is not exclusion-worthy
<u>Exclusion-worthy reasons</u>		
6	Wrote that they rushed through the study or were distracted/inaccurate while completing the study.	Participants admitted that their data are low quality.
5	Did not write anything to explain why data should be excluded.	It is not clear why these participants indicated that their data should not be used. It could be for exclusion-worthy reasons.
1	Wrote that they did not understand the question and thought they answered it wrong.	This was one of the participants in the control condition who wrote about an idea for a study instead of how they study. Eliciting confusion was not the purpose of the control condition.
1	Wrote that they were currently experiencing mental health issues that likely influenced their responses.	Mental health issues could have biased this participant's responses (especially considering that this participant was assigned to the secure attachment condition).
<u>Not exclusion-worthy reasons</u>		
7	Wrote something related to their responses being personal or wanting to remain anonymous.	The purpose of the secure/insecure conditions and some of the questionnaires were to elicit responses about personal issues. Moreover, the specific responses of these participants remain confidential. These reasons are not data quality concerns.
2	Wrote that they did not finish the writing task.	These participants were not the only ones to be forwarded to the next part of the study before they finished writing (e.g., the writing of many participants ended mid-sentence).

2	Wrote that their data are accurate, or they could not think of a reason why their data should be excluded.	These participants appeared to misinterpret the question about excluding their data. They gave reasons that suggest that their data are acceptable to use.
2	Wrote that there was nothing special about them or their situation.	There is not a need in this study for participants and their experiences to be perceived as unique.
1	Wrote that they had trouble thinking of an experience and were not sure if what they wrote fit the criteria.	This participant was coded as completing the writing task correctly.
1	Rewrote and expanded their answer for the writing task.	This participant was coded as completing the writing task correctly.

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was exclusion worthy that was not already covered by other data quality checks.

### **Self-Reported Ability to Think of Personal Experience**

Of the 429 participants assigned to the attachment conditions who finished the study, 373 participants indicated that they were able to think of a personal experience to write about that matched the situation they were asked to visualize (86.95%), 55 participants indicated that they were not able to think of a personal experience (12.82%), and one participant did not respond to this question (0.23%). There was a marginally significant difference in the likelihood of indicating the inability to think of a personal experience in the secure vs. insecure attachment conditions,  $\chi^2(1, N = 428) = 3.25, p = .071$ , with 21 out of the 212 participants in the secure attachment condition (9.91%) and 34 out of 216 participants in the insecure attachment condition (15.74%) indicating that they were not able to think of a personal experience. Of those who indicated that they were not able to think of a personal experience, 36 of them were coded as not completing the writing task correctly (65.45%) and 19 of them were coded as completing the writing task correctly (34.55%; it was assumed that these participants misinterpreted the question). The likelihood of indicating the inability to think of a personal experience differed significantly for those who were coded as completing the writing task correctly vs. incorrectly,  $\chi^2(1, N = 428) = 65.93, p < .001$ .

### **Study Completion Time**

The last indicator of data quality that was considered was the amount of time it took for participants to finish the study. Of the 648 participants who finished the study, 263 participants (40.59%) finished the study within the expected time of 30 to 60 minutes, 297 participants (45.83%) finished the study in less than 30 minutes, and 88 participants (13.58%) finished the study in more than 60 minutes. Using a broader range, 595 participants (91.82%) took at least

half of the minimum expected time (i.e., 15 minutes) or no more than double the maximum expected time (i.e., 120 minutes) to finish the study, while 20 participants (3.09%) took less than 15 minutes and 33 participants (5.09%) took more than 120 minutes. As taking less time than 15 minutes to finish the study was likely too quick to read and respond to all the questionnaire items in a thoughtful and accurate manner, and more than 120 minutes was likely too long to finish the study in one sitting (potentially impeding the continued salience of the experimental manipulation), participants who finished the study outside of 15 to 120 minutes were classified as problematic and exclusion worthy.

**Appendix Q:  
Experimental Manipulation  
(Study 2)**

[*Secure Attachment Condition*]

**Instructions:** Please think about a relationship you have had in which you have found that it was relatively easy to get close to the other person and you felt comfortable depending on the other person. In this relationship, you didn't often worry about being abandoned by the other person and you didn't worry about the other person getting too close to you. It is crucial that the nominated relationship is (or was) important and meaningful to you.

What are the initials of the person's name that came to mind?

What is the relation of this person to you (e.g., parent, friend, romantic partner)?

Now, take a moment and try to get a visual image in your mind of this person. What does this person look like? What is it like being with this person? You may want to remember a time when you were actually with this person. What would he or she say to you? What would you say in return? What does this person mean to you? How do you feel when you are with this person? How would you feel if this person was here with you now?

For the next 8 minutes, please write about this person and your interactions with them. You can draw on the questions in the preceding paragraph to guide your writing. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about this person and write down anything else that comes to mind.

*[Anxious Attachment Condition]*

**Instructions:** Please think about a relationship you have had in which you have felt like the other person was reluctant to get as close as you would have liked. In this relationship, you worried that the other person didn't really like you, or love you, and you worried that they wouldn't want to stay with you. In this relationship, you wanted to get very close to the other person but you worried that this would scare the other person away. It is crucial that the nominated relationship is (or was) important and meaningful to you.

What are the initials of the person's name that came to mind?

What is the relation of this person to you (e.g., parent, friend, romantic partner)?

Now, take a moment and try to get a visual image in your mind of this person. What does this person look like? What is it like being with this person? You may want to remember a time when you were actually with this person. What would he or she say to you? What would you say in return? What does this person mean to you? How do you feel when you are with this person? How would you feel if this person was here with you now?

For the next 8 minutes, please write about this person and your interactions with them. You can draw on the questions in the preceding paragraph to guide your writing. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about this person and write down anything else that comes to mind.

*[Avoidant Attachment Condition]*

**Instructions:** Please think about a relationship you have had in which you have found that you were somewhat uncomfortable being too close to the other person. In this relationship you found it was difficult to trust the other person completely and it was difficult to allow yourself to depend on the other person. In this relationship, you felt yourself getting nervous when the other person tried to get too close to you and you felt that the other person wanted to be more intimate than you felt comfortable being. It is crucial that the nominated relationship is (or was) important and meaningful to you.

What are the initials of the person's name that came to mind?

What is the relation of this person to you (e.g., parent, friend, romantic partner)?

Now, take a moment and try to get a visual image in your mind of this person. What does this person look like? What is it like being with this person? You may want to remember a time when you were actually with this person. What would he or she say to you? What would you say in return? What does this person mean to you? How do you feel when you are with this person? How would you feel if this person was here with you now?

For the next 8 minutes, please write about this person and your interactions with them. You can draw on the questions in the preceding paragraph to guide your writing. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about this person and write down anything else that comes to mind.

*[Control Condition]*

**Instructions:** We are interested in how people feel after thinking about particular topics. We would like you to write for 8 minutes about a coursework writing scenario. Imagine you are about to start an important piece of coursework that you know nothing about. Describe how you go about completing this work. For example, the resources you use, any routines you have in completing the work, how you structure your time, etc.

Please try to give as much detail as possible about how you plan your coursework. Once the 8 minutes have elapsed, you will automatically be forwarded to the next part of the study. If you finish before the 8 minutes are up, please continue to think about the scenario and write down anything else that comes to mind.

**Appendix R:  
Motivation to Connect with Nature  
(Study 2)**

**Instructions:** For the next part of the study, you will be shown a number of photographs of different spaces located in and around Ottawa. For each photographed space, you will be asked to indicate how interested you currently are in visiting the space. Please click the next button to begin.

*[Natural space example photo]*



How interested are you right now in visiting this space?

1	2	3	4	5	6	7
Not at all interested						Extremely interested

[Built space example photo]



How interested are you right now in visiting this space?

1	2	3	4	5	6	7
Not at all interested						Extremely interested

**Appendix S:**  
**Connectedness to Nature Scale**  
**(Study 2)**

**Instructions:** Please answer each of these questions in terms of *the way you generally feel*. There are no right or wrong answers. Simply state as honestly and candidly as you can how you typically feel.

1	2	3	4	5
Strongly disagree		Neutral		Strongly agree

1. I often feel a sense of oneness with the natural world around me.
2. I think of the natural world as a community to which I belong.
3. I recognize and appreciate the intelligence of other living organisms.
4. I often feel disconnected from nature.
5. When I think of my life, I imagine myself to be part of a larger cyclical process of living.
6. I often feel a kinship with animals and plants.
7. I feel as though I belong to the Earth as equally as it belongs to me.
8. I have a deep understanding of how my actions affect the natural world.
9. I often feel part of the web of life.
10. I feel that all inhabitants of Earth, human, and nonhuman, share a common ‘life force’.
11. Like a tree can be part of a forest, I feel embedded within the broader natural world.
12. When I think of my place on Earth, I consider myself to be a top member of a hierarchy that exists in nature.
13. I often feel like I am only a small part of the natural world around me, and that I am no more important than the grass on the ground or the birds in the trees.
14. My personal welfare is independent of the welfare of the natural world.

**Appendix T:**  
**100-item IPIP Representation of NEO-PI-R Domains**  
**(Study 2)**

**Instructions:** Describe yourself as you honestly see yourself by indicating the accuracy or inaccuracy of each of the following statements. Please describe yourself as you *generally* are now, not as you wish to be in the future.

1	2	3	4	5
Very inaccurate	Moderately inaccurate	Neither accurate nor inaccurate	Moderately accurate	Very accurate

1. I respect others.
2. I would describe my experiences as somewhat dull.
3. I am the life of the party.
4. I am easy to satisfy.
5. I have difficulty understanding abstract ideas.
6. I don't see things through.
7. I worry about things.
8. I do not like art.
9. I contradict others.
10. I find it difficult to approach others.
11. I enjoy hearing new ideas.
12. I cheer people up.
13. I hold a grudge.
14. I complete tasks successfully.
15. I have a sharp tongue.
16. I get stressed out easily.
17. I get back at others.
18. I insult people.
19. I believe that too much tax money goes to support artists.
20. I tend to vote for liberal political candidates.
21. I do things according to a plan.
22. I am skilled in handling social situations.
23. I make friends easily.
24. I treat all people equally.
25. I talk to a lot of different people at parties.
26. I start conversations.
27. I am relaxed most of the time.
28. I rarely get irritated.
29. I mess things up.
30. I remain calm under pressure.
31. I avoid philosophical discussions.
32. I have a vivid imagination.
33. I am often down in the dumps.
34. I feel comfortable with myself.

35. I am concerned about others.
36. I have a rich vocabulary.
37. I shirk my duties.
38. I keep others at a distance.
39. I rarely look for a deeper meaning in things.
40. I need a push to get started.
41. I am not easily frustrated.
42. I feel comfortable around people.
43. I am not interested in abstract ideas.
44. I fear for the worst.
45. I believe in the importance of art.
46. I pay attention to details.
47. I sympathize with others' feelings.
48. I avoid contacts with others.
49. I believe that I am better than others.
50. I make a mess of things.
51. I am out for my own personal gain.
52. I leave things unfinished.
53. I retreat from others.
54. I am not easily bothered by things.
55. I believe that others have good intentions.
56. I suspect hidden motives in others.
57. I don't like to draw attention to myself.
58. I don't put my mind on the task at hand.
59. I panic easily.
60. I don't mind being the center of attention.
61. I am exacting in my work.
62. I waste my time.
63. I get chores done right away.
64. I carry out my plans.
65. I do just enough work to get by.
66. I know how to captivate people.
67. I enjoy thinking about things.
68. I accept people as they are.
69. I follow through with my plans.
70. I feel threatened easily.
71. I am hard to get to know.
72. I cut others to pieces.
73. I make plans and stick to them.
74. I tend to vote for conservative political candidates.
75. I rarely lose my composure.
76. I enjoy wild flights of fantasy.
77. I make people feel at ease.
78. I seldom get mad.
79. I finish what I start.
80. I often feel blue.

81. I am always prepared.
82. I seldom feel blue.
83. I am filled with doubts about things.
84. I do not like poetry.
85. I carry the conversation to a higher level.
86. I do not enjoy going to art museums.
87. I keep in the background.
88. I have frequent mood swings.
89. I have little to say.
90. I find it difficult to get down to work.
91. I am very pleased with myself.
92. I trust what people say.
93. I am not interested in theoretical discussions.
94. I have a good word for everyone.
95. I get excited by new ideas.
96. I can say things beautifully.
97. I warm up quickly to others.
98. I don't talk a lot.
99. I dislike myself.
100. I make demands on others.

**Appendix U:  
SONA Recruitment Notice  
(Study 2)**

**Study Name:** Personality, Relationships, Emotions, and Interests

**Study Type:** Standard (lab) study

**Duration:** 60 minutes

**Percentage:** 1 Percentage

**Description:** This study examines people’s personality, relationships, emotions, and interests. Participants will be asked to engage in visualization/writing tasks and complete questionnaires about their feelings, relationships, personality, and interests. Risks: Some of the topics may cause discomfort as we ask about negative personal experiences/feelings. At any point during your participation, you are free to withdraw from the study and still receive credit. You will also be able to withdraw your data after completing (part of) the study by contacting the researchers and you will still receive credit. The deadline to withdraw your data is the day after the last day of classes of the current semester. This study has received clearance by the Carleton University Research Ethics Board B (CUREB-B Clearance # 108530). If you have any ethical concerns with the study, please contact Dr. Andy Adler, Chair, Carleton University Research Ethics Board-B (by phone at 613-520-2600 ext. 4085 or via email at [ethics@carleton.ca](mailto:ethics@carleton.ca)).

**Eligibility Requirements:** Must not have participated in “Visualization, Memory, Affect, Motivation, and Personality” or “Interpersonal Conflict in Close Relationships”.

**Location:** Human Computer Interaction Building Room 6111

**Researchers:** Colin Capaldi  
John Zelenski  
Sarah Hobson  
Rafia Junaid  
Neha Khanna  
Tyler Kydd  
Joy McLeod  
Sarah Rosenbloom  
Madison Waller

**Appendix V:  
Informed Consent Form  
(Study 2)**

The purpose of an informed consent form is to ensure that you understand the purpose of the study and the nature of your involvement. The informed consent must provide sufficient information such that you have the opportunity to determine whether you wish to participate in the study.

**Present Study: Personality, Relationships, Emotions, and Interests**

**Purpose.** The purpose of this study is to examine people's personality, relationships, emotions, and interests.

**Task Requirements.** Participants will be asked to engage in an 8-minute visualization and writing task about a particular topic that may be of a personal nature. They will then be asked to complete a couple questionnaires about their feelings. Next, participants will be shown a series of photos and will be asked to indicate their interest in visiting each photographed place. They will then be asked to complete some questionnaires about their personality, personal relationships, demographic characteristics, and experience during the study. The study will end with a couple brief visualization tasks. This study will take less than 60 minutes to complete.

**Benefits/Compensation.** You will receive a 1.00% increase in your final grade in PSYC 1001, 1002, 2001, or 2002 for participating in this study.

**Potential Risks/Discomfort.** Some of the topics may cause some psychological discomfort as we ask about negative personal experiences/feelings. Your responses will remain completely confidential, and you may skip any questions or tasks that you do not feel comfortable completing. You can withdraw from the study at any time without any explanation or penalty by letting the experimenter know that you do not wish to continue. If you are experiencing distress, we encourage you to contact the health and counseling/distress resources provided on the debriefing form at the end of the study. As some of the questions/tasks are of a personal nature, there is a minor risk of social harm in the unlikely event of a data breach.

**Anonymity/Confidentiality.** All research data will remain completely confidential. An anonymized data set without any personal identifiers may be shared with other trusted researchers as required by professional guidelines and may eventually be made available online on the Open Science Framework, a non-profit website dedicated to making research more transparent, reproducible, and open. Your written response in the visualization/writing task will not be posted online and will not be made public by us at any point. Your data will be stored and protected by Qualtrics in Toronto, but may be disclosed via a court order or data breach. Data will be deleted from Qualtrics once this research has been published.

**Right to Withdraw.** Your participation in this study is entirely voluntary. If you do not feel comfortable answering a question, you can leave it blank. You will not be penalized for this. If you wish to withdraw from the study after consenting to participate, you can simply inform the

experimenter that you do not wish to continue. If you would like to withdraw your data after completing (part of) the study, please let the experimenter know verbally or contact the researchers via email. The deadline to withdraw your data is the day after the last day of classes of the current semester. If you choose to not answer questions or withdraw, you will still receive course credit for participating.

**Research Personnel.** The following people are involved in this study, and may be contacted at any time if you have questions or concerns: Colin Capaldi (PhD student, Department of Psychology, colin\_capaldi@carleton.ca), Dr. John Zelenski (Professor, Department of Psychology, john.zelenski@carleton.ca, 613-520-2600, ext. 1609).

**Concerns.** Should you have any ethical concerns about this research, please contact Dr. Andy Adler (Chair, Carleton University Research Ethics Board-B, by phone: 613-520-2600 ext. 4085 or email: ethics@carleton.ca).

This study has received clearance by the Carleton University Research Ethics Board-B (CUREB-B Clearance # 108530).

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*If you agree to participate in this study, please write your name and sign below.*

Participant's Name: \_\_\_\_\_ Participant's Signature: \_\_\_\_\_

Researcher's Name: \_\_\_\_\_ Researcher's Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**Appendix W:  
Data Quality Questionnaire  
(Study 2)**

**Instructions:** We would like to ask you a few questions about your experience during this study. It is vital that the data we collect are of high quality so please answer honestly. Your response to these questions will not in any way influence the course credit you receive for participating.

1. Were you able to think of a specific person/relationship that matched the description in the visualization/writing task? *[This question was not included for those in the control condition]*

- Yes  
 No

2. How easy was it to think of a person/relationship that matched the description in the visualization/writing task? *[This question was not included for those in the control condition]*

1	2	3	4	5	6	7
Very difficult						Very easy

3. Did you spend most of the 8 minutes thinking/writing about the specific relationship/person? *[Control condition wording: Did you spend most of the 8 minutes thinking/writing about how you plan your coursework?]*

- Yes  
 No

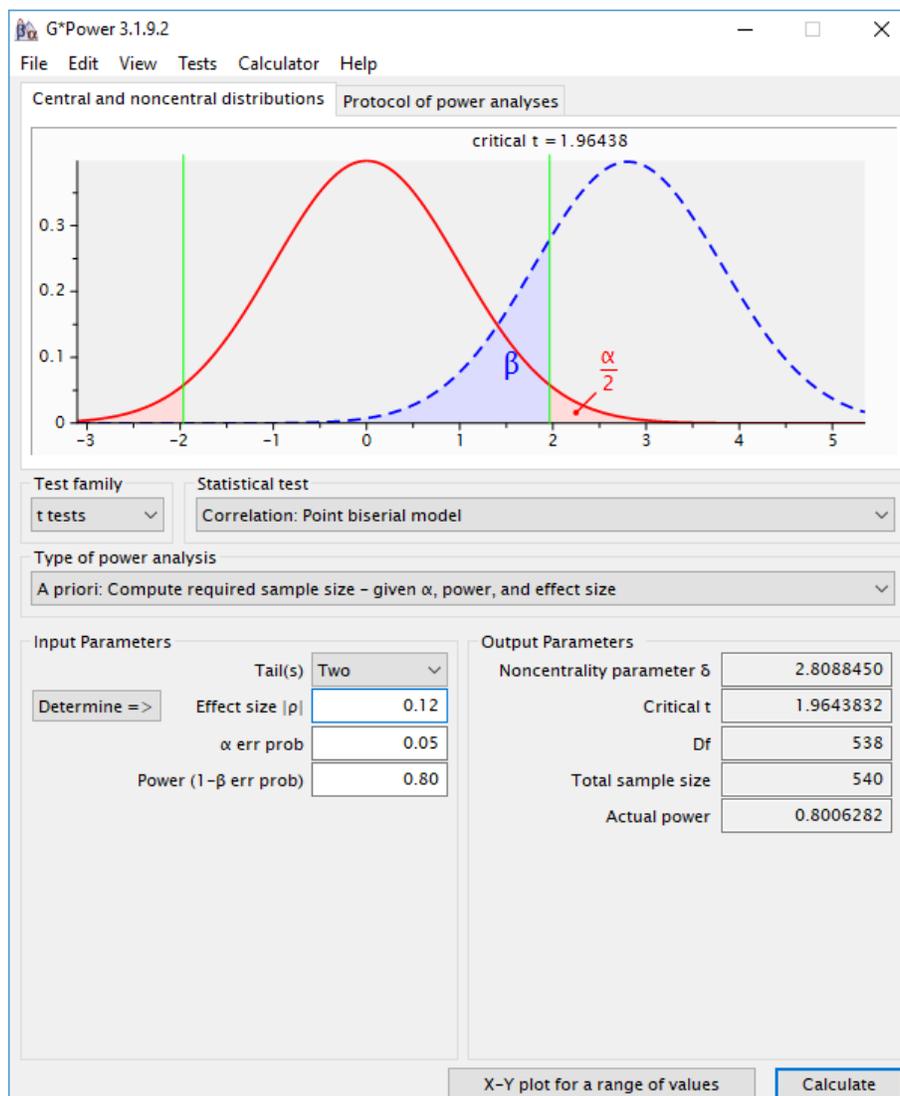
4. Do you believe there is any reason we should not include your data in our analyses?

- No, my data is fine to include  
 Yes, you should not include my data

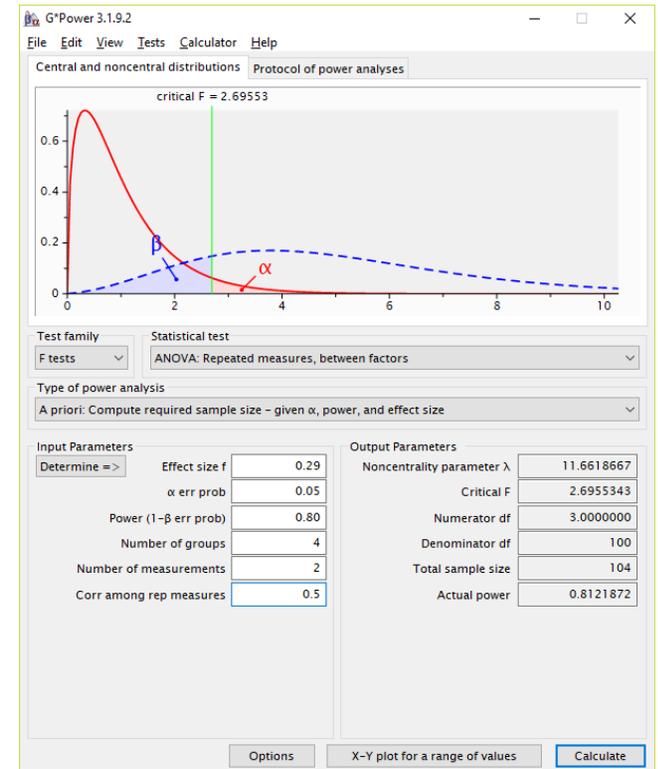
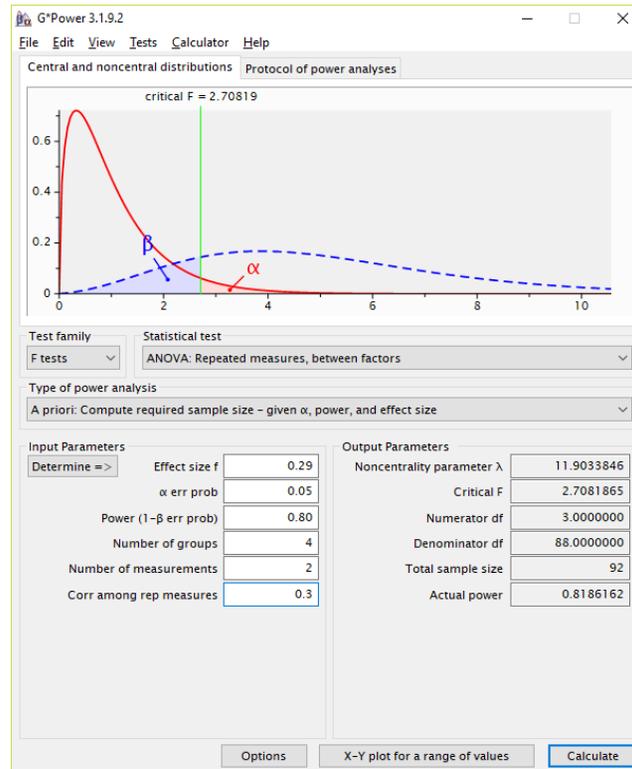
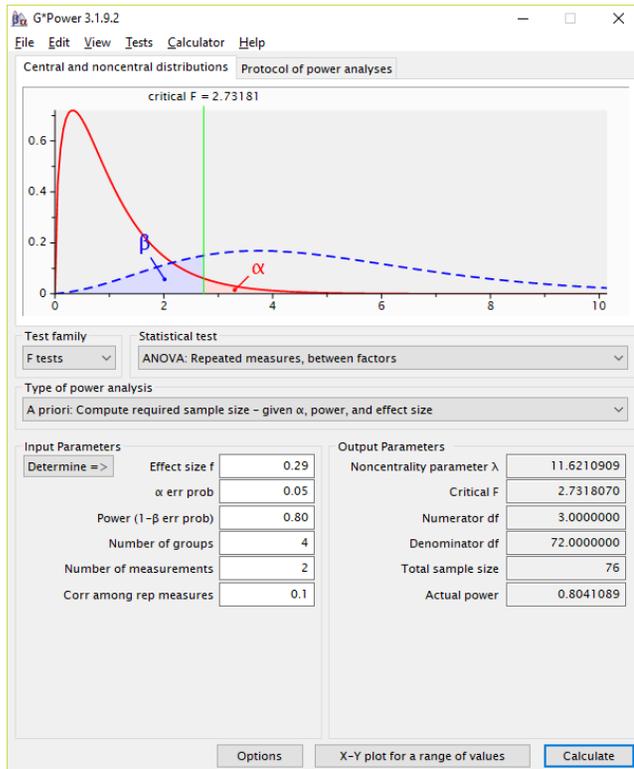
5. If you selected yes, please indicate in the text box below why we should not include your data.

### Appendix X: A Priori Power Analyses (Study 2)

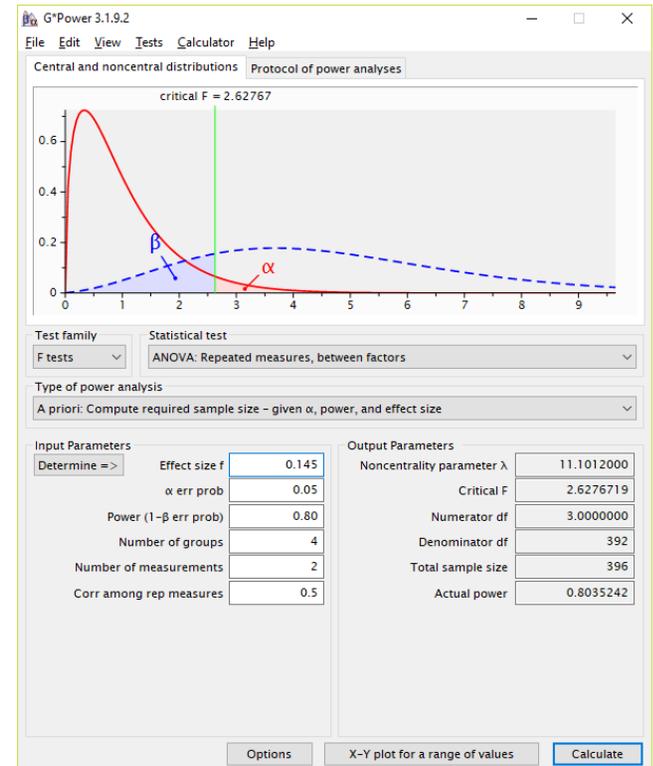
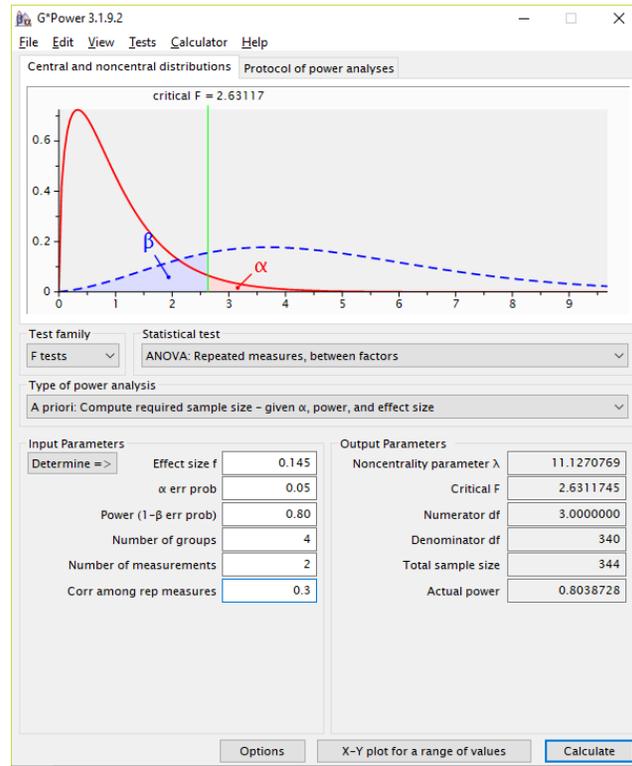
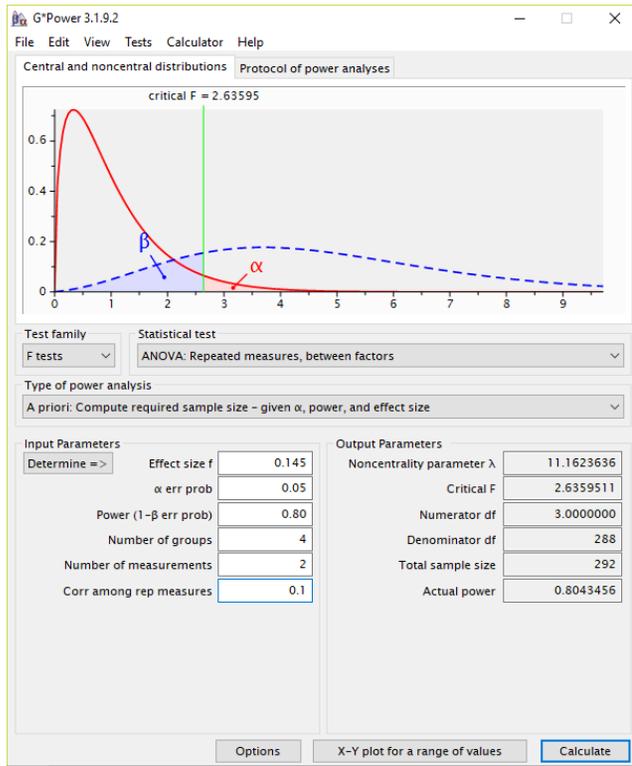
Before any data was collected for Study 2, separate power analyses were conducted for each main research question and the largest required sample size (i.e.,  $N = 602$ ) was chosen to ensure that all statistical tests of interest were adequately powered. A sample size of 602 participants provided enough statistical power (i.e.,  $> 80\%$ ) to observe associations between trait measures of nature connectedness and interpersonal attachment (Research Question #1) that were of the same magnitude as what was estimated for Study 1 (i.e.,  $r = .12$ ).



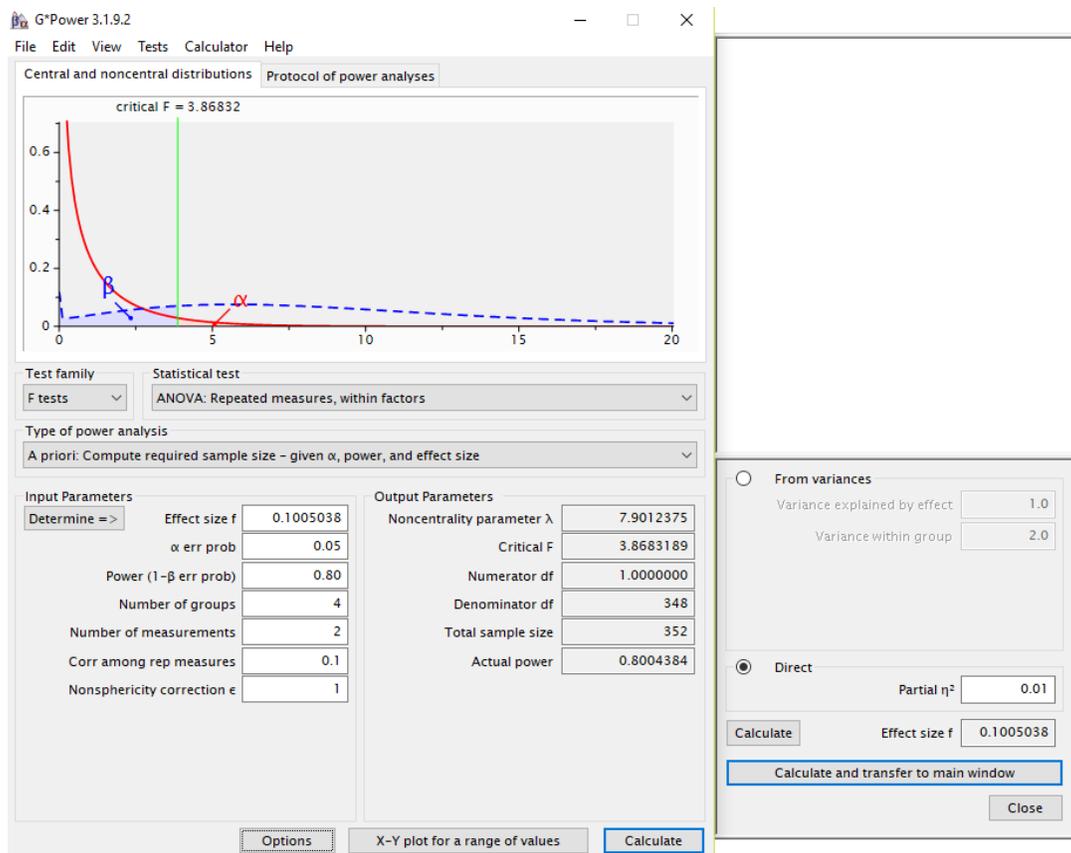
A sample size of 602 participants was large enough to detect with more than 80% power a between-subjects main effect of experimental condition in a mixed-design ANOVA that was based on the average effect size (i.e.,  $r = .28$ ,  $d = .58$ , or  $f = .29$ ) from the meta-analysis cited in Gillath et al. (2016), regardless of whether the association of interest ratings for visiting natural spaces and visiting built spaces was small, moderate, or large in magnitude (Cohen, 1988).

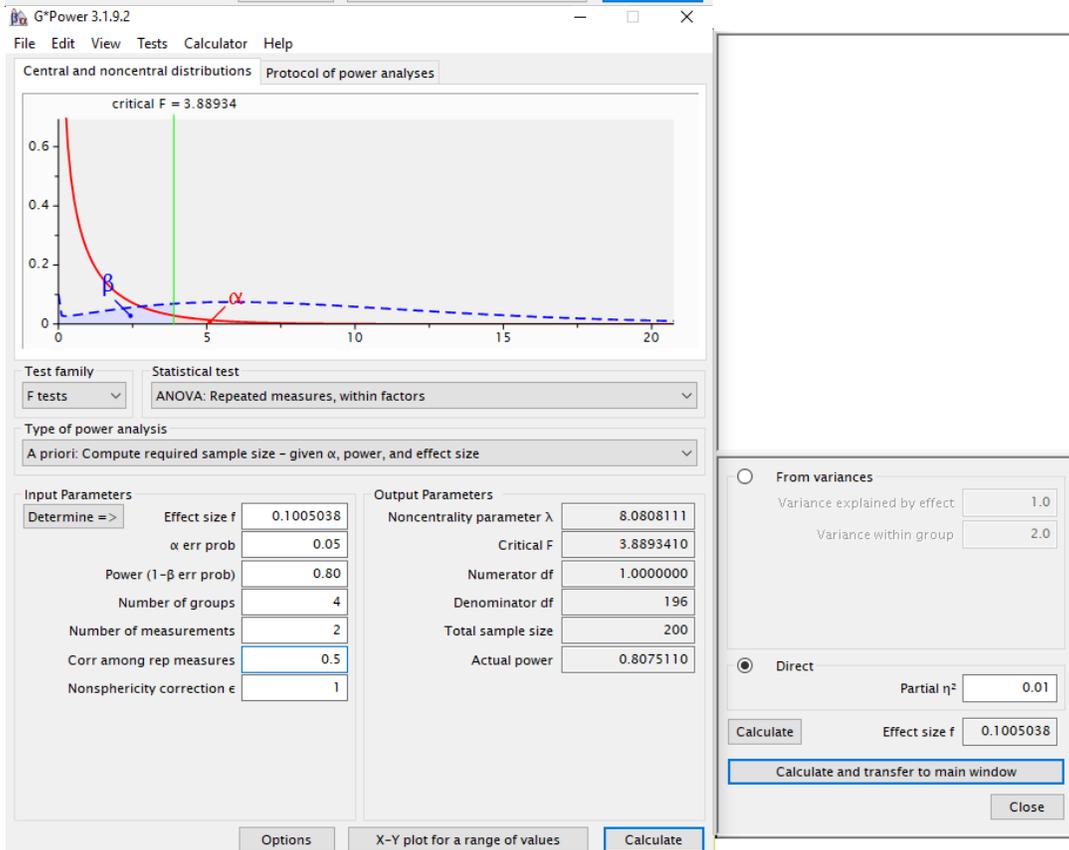
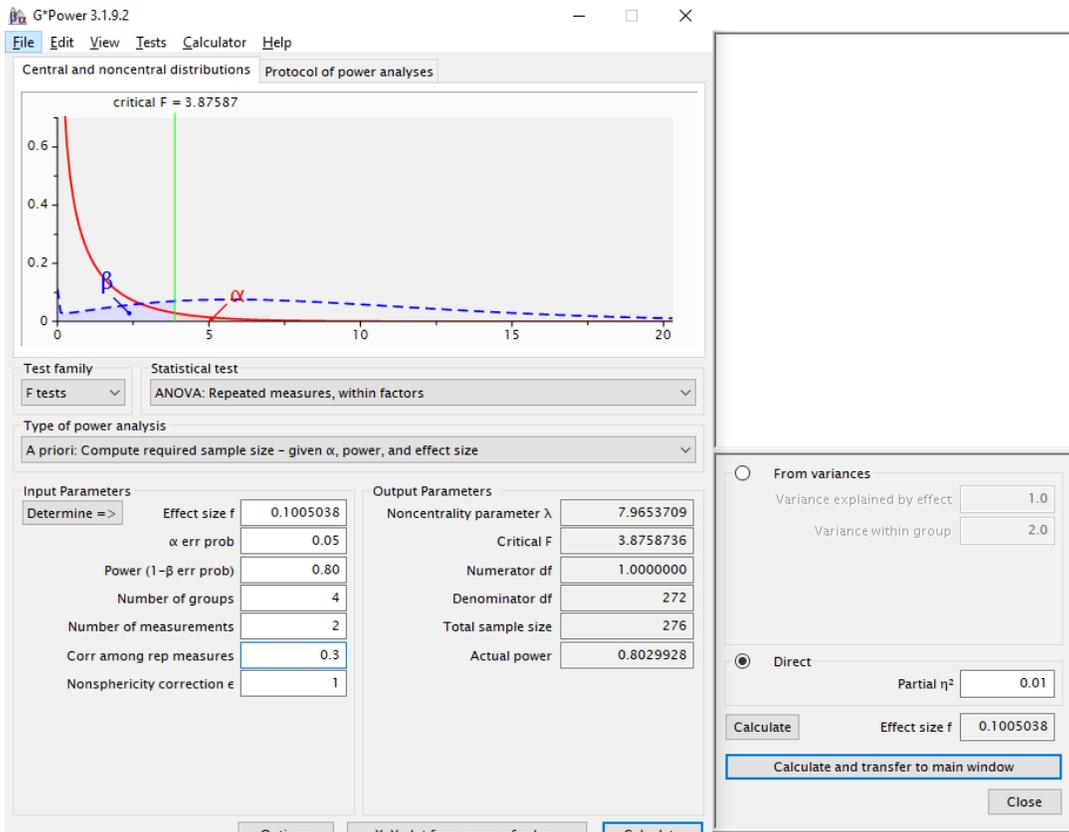


A sample size of 602 participants was also large enough to detect with more than 80% power a between-subjects main effect of experimental condition in a mixed-design ANOVA that was half the size of the average effect size (i.e.,  $r = .14$ ,  $d = .29$ , or  $f = .145$ ) from the meta-analysis cited in Gillath et al. (2016), regardless of whether the association of interest ratings for visiting natural spaces and visiting built spaces was small, moderate, or large in magnitude (Cohen, 1988).

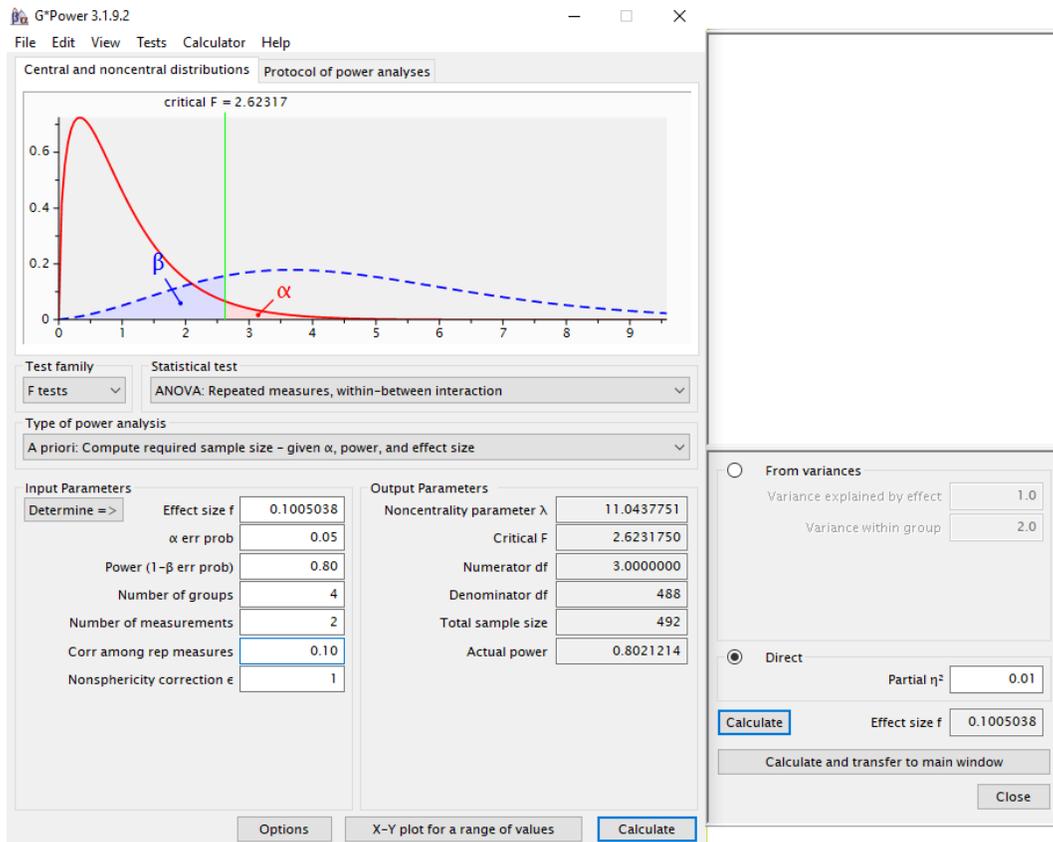


Although the large difference in pleasantness ratings of the photos of natural and built spaces in Dopko et al. (2014) suggested that interest in visiting natural vs. built spaces would be relatively large in general, a sample size of 602 was still able to detect a within-subjects main effect of type of space in a mixed-design ANOVA that was small in magnitude (i.e.,  $\eta_p^2 = .01$ ; Cohen, 1988; Richardson, 2011) with more than 80% power, regardless of whether the association between interest ratings for visiting natural spaces and visiting built spaces was small, moderate, or large in magnitude.





Moreover, a sample size of 602 participants allowed for more than 80% power to detect a between-subjects factor by within-subjects factor interaction (Research Question #2) that was small in magnitude (i.e.,  $\eta_p^2 = .01$ ), regardless of whether the association between interest ratings for visiting natural spaces and visiting built spaces was small, moderate, or large in magnitude.



G\*Power 3.1.9.2

File Edit View Tests Calculator Help

Central and noncentral distributions Protocol of power analyses

critical F = 2.62839

Test family: F tests  
Statistical test: ANOVA: Repeated measures, within-between interaction

Type of power analysis: A priori: Compute required sample size - given alpha, power, and effect size

Input Parameters		Output Parameters	
Determine =>	Effect size f	0.1005038	Noncentrality parameter $\lambda$
	$\alpha$ err prob	0.05	Critical F
	Power (1- $\beta$ err prob)	0.80	Numerator df
	Number of groups	4	Denominator df
	Number of measurements	2	Total sample size
	Corr among rep measures	0.30	Actual power
	Nonsphericity correction $\epsilon$	1	

Options X-Y plot for a range of values Calculate

From variances: Variance explained by effect: 1.0, Variance within group: 2.0

Direct: Partial  $\eta^2$ : 0.01, Effect size f: 0.1005038

Calculate Calculate and transfer to main window Close

G\*Power 3.1.9.2

File Edit View Tests Calculator Help

Central and noncentral distributions Protocol of power analyses

critical F = 2.63779

Test family: F tests  
Statistical test: ANOVA: Repeated measures, within-between interaction

Type of power analysis: A priori: Compute required sample size - given alpha, power, and effect size

Input Parameters		Output Parameters	
Determine =>	Effect size f	0.1005038	Noncentrality parameter $\lambda$
	$\alpha$ err prob	0.05	Critical F
	Power (1- $\beta$ err prob)	0.80	Numerator df
	Number of groups	4	Denominator df
	Number of measurements	2	Total sample size
	Corr among rep measures	0.50	Actual power
	Nonsphericity correction $\epsilon$	1	

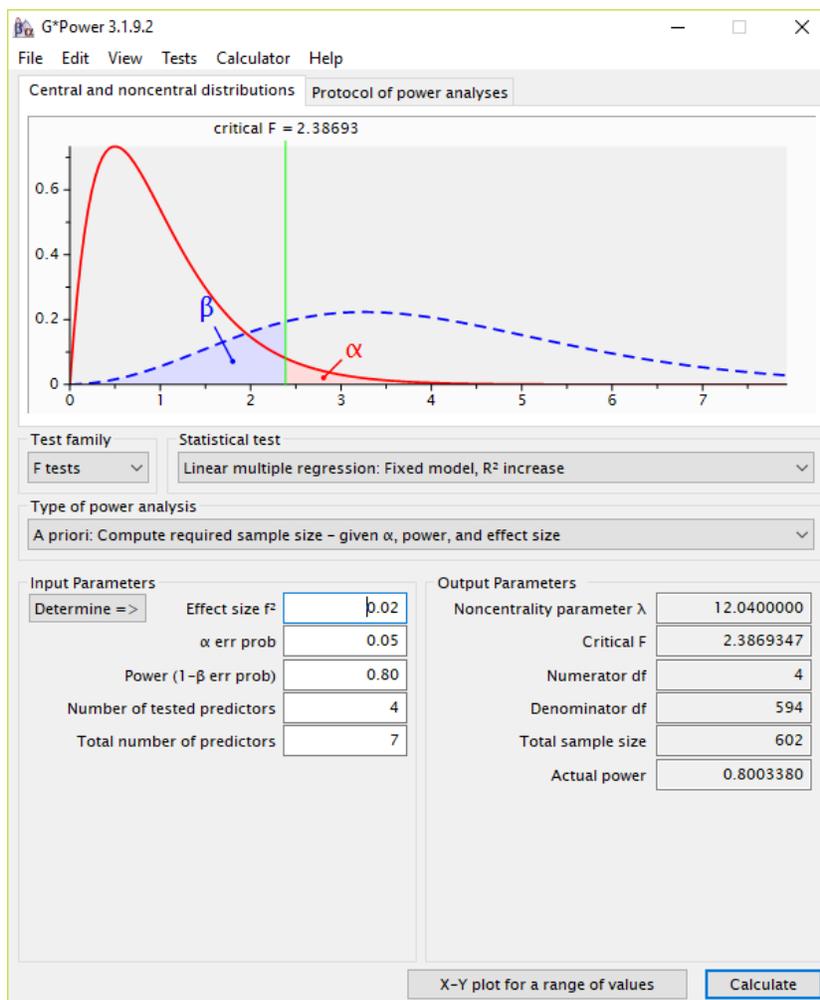
Options X-Y plot for a range of values Calculate

From variances: Variance explained by effect: 1.0, Variance within group: 2.0

Direct: Partial  $\eta^2$ : 0.01, Effect size f: 0.1005038

Calculate Calculate and transfer to main window Close

Lastly, assuming that the moderating role of trait attachment or nature connectedness on the effect of the experimental manipulations on motivation to connect with nature (Research Question #3) would be small (Cohen, 1992), a sample size of 602 participants was required to detect it with 80% power.<sup>43</sup>



In sum, based on the above reasoning and power analyses, I planned to recruit 602 undergraduate students to participate in Study 2.

<sup>43</sup> There were seven predictor variables in the multiple regression analyses for Research Question #3, but only four were of primary interest. The statistical significance of the coefficients for the dummy-coded variables capturing the effect of the secure attachment condition (vs. the control condition), the effect of the anxious attachment condition (vs. the control condition), and the effect of the avoidant attachment condition (vs. the control condition) were not as important to interpret in these analyses because the effect of the experimental conditions on motivation to connect with nature was tested in an earlier mixed-design ANOVA test.

**Appendix Y:  
Detailed Data Quality Information  
(Study 2)**

**Writing Task Completion**

Of the 747 participants who completed the study, 593 were coded as completing the writing task correctly (79.38%) and 154 were coded as not completing the writing task correctly (20.62%). Two out of the 186 participants in the control condition (1.08%), 23 out of the 186 participants in the secure attachment condition (12.37%), 74 out of the 187 participants in the anxious attachment condition (39.57%), and 55 out of the 188 participants in the avoidant attachment condition (29.26%) were coded as not completing the writing task correctly (see Table A3 for the specific reasons why participants were coded as not completing the writing task correctly in each condition). The likelihood of being coded as not completing the writing task correctly was significantly different across the four conditions,  $\chi^2(3, N = 747) = 100.77, p < .001$ , was significantly different across the three attachment conditions,  $\chi^2(2, N = 561) = 35.61, p < .001$ , and was significantly different across the two insecure attachment conditions,  $\chi^2(1, N = 375) = 4.42, p = .035$ .

**Attention Checks**

Out of the 747 participants who completed the study, 709 participants ( $n_{\text{control}} = 176$ ;  $n_{\text{secure}} = 172$ ,  $n_{\text{anxious}} = 182$ ;  $n_{\text{avoidant}} = 179$ ) did not fail any of the attention checks (94.91%), 19 participants ( $n_{\text{control}} = 5$ ;  $n_{\text{secure}} = 6$ ;  $n_{\text{anxious}} = 1$ ;  $n_{\text{avoidant}} = 7$ ) failed one of the attention checks (2.54%), and 19 participants ( $n_{\text{control}} = 5$ ;  $n_{\text{secure}} = 8$ ;  $n_{\text{anxious}} = 4$ ;  $n_{\text{avoidant}} = 2$ ) failed both attention checks (2.54%). Those who were coded as not completing the writing task correctly were more than twice as likely to have failed both attention checks items (5.19%) compared to those who were coded as completing the writing task correctly (1.85%). However, given the relatively small

Table A3

*Reasons for Coding Writing Task as Incorrectly Completed in Each Experimental Condition in Study 2*

Control Condition		Secure Attachment Condition		Anxious Attachment Condition		Avoidant Attachment Condition	
<i>n</i>	Reason	<i>n</i>	Reason	<i>n</i>	Reason	<i>n</i>	Reason
2	*Writing focused on vagueness of instructions instead of pragmatics of completing coursework.	11	Relationship ended on bad terms.	57	Writing entirely or mostly focused on positive/ secure aspects of relationship.	19	Writing contained more anxious than avoidant elements.
		5	Writing contained notable elements of attachment anxiety/avoidance.	6	No anxiety-related elements mentioned in writing.	17	Writing entirely or mostly focused on positive/secure aspects of relationship.
		2	*Did not write anything.	4	*Wrote that they could not think of a relationship that matched.	7	No avoidant-related elements mentioned in writing.
		2	Lost connection with this person.	5	Writing contained more avoidant than anxious elements.	4	*Did not write anything.
		1	Only wrote about this person passing away.	2	*Did not write anything.	4	*Wrote that they could not think of a relationship that matched.
		1	Wrote about unrequited crush and not being honest with this person.			3	Did not explain why participant felt bad when around this person.
		1	Wrote about person who never trusted or treated participant well.			1	Wrote about this person being avoidant instead of participant being avoidant.

*Note.* An asterisk beside a reason indicates that these participants were still coded as not completing the writing task properly when a more lenient approach to coding was employed.

numbers of those failed the attention checks items, chi-square tests of homogeneity could not be conducted to test whether the likelihood of failing the attention checks significantly differed between conditions or between those who were coded as completing the writing task correctly vs. incorrectly (i.e., some of the cells had expected frequencies below 5).

### **Self-Reported Exclusion of Data**

Out of the 747 participants who completed the study, 735 participants indicated that their data were fine to include (98.39%) and 12 participants indicated that their data should not be included (1.61%). The reasons given by the 12 participants for why their data should be excluded are listed in Table A4, and were classified as being exclusion worthy ( $n = 9$ ) or not exclusion worthy ( $n = 3$ ). The number of participants who indicated that their data should not be used for an exclusion-worthy reason was relatively low across all conditions ( $n_{\text{control}} = 0$ ;  $n_{\text{secure}} = 3$ ;  $n_{\text{anxious}} = 4$ ;  $n_{\text{avoidant}} = 2$ ); two of these participants failed both attention check items and more than half of them were coded as not completing the writing task correctly ( $n = 5$ ).

Eight of the 735 participants who indicated that their data were fine to include wrote something in the textbox that was supposed to be reserved for those who indicated that their data should not be used. Two of these eight participants wrote “not applicable”, two participants simply reiterated that they answered carefully/honestly, one participant wrote that they were insecure about their information and feelings, and one participant noted that they did not finish the writing task. These were not deemed to be exclusion-worthy reasons. Another participant wrote that they completed the photograph rating task according to their own interest and the interests of the person they wrote about. As the photograph rating task was supposed to just assess the interest of the participant (and not the person the participant wrote about), this was deemed to be an exclusion-worthy reason. Lastly, one participant wrote that they thought their

Table A4

*Reasons Why Participants Indicated that Their Data Should Be Excluded in Study 2*

<i>n</i>	Explanation given by participant	Why explanation is or is not exclusion-worthy
<u>Exclusion-worthy reasons</u>		
4	Did not write anything to explain why their data should be excluded.	It is not clear why these participants indicated that their data should not be used. It could be for exclusion-worthy reasons.
1	Wrote that their data towards the person was not completely accurate.	Although originally coded as completing writing task correctly, participant admitted that they were not completely truthful.
1	Wrote that they could not deeply relate to the description.	This participant was in the anxious attachment condition, but only wrote about positive aspects of the relationship (coded as not completing the writing task correctly). As participant explicitly acknowledged issue, they should be excluded.
1	Wrote that they had not tried to get close to someone who was reluctant to do the same.	This participant informed the researcher that they did not have a relationship that matched the description in the writing task (anxious attachment condition) and they wrote that this type of relationship was not applicable to them. As experimental manipulation was not relevant to this participant, they should be excluded.
1	Wrote that term “close others” was difficult to define and that they have complicated feelings.	This participant appeared to have issues with completing the Experiences in Close Relationships Scale.
1	Wrote that it was too basic and may not be what we were looking for in this experiment.	This participant was in the anxious attachment condition, but only wrote about positive aspects of the relationship (coded as not completing the writing task correctly). As participant explicitly acknowledged issue, they should be excluded.
<u>Not exclusion-worthy reasons</u>		
2	Wrote that they did not finish the writing task or did not spend that much time writing.	These participants were not the only ones to be forwarded to the next part of the study before they finished writing (e.g., the writing of many participants ended mid-sentence).
1	Wrote that the relationship they wrote about had a big impact on who they are.	The instructions for the attachment writing tasks explicitly mentioned that the relationship is (or was) important and meaningful to the participant.

data were fine, but they were not sure if they translated a few of the statements correctly (this participant was eventually excluded based on their performance on the writing task as they did not write anything).

### **Self-Reported Ability to Think of Specific Person/Relationship**

Of the 561 participants assigned to the attachment conditions who completed the study, 535 participants indicated that they were able to think of a specific person/relationship to write about that matched the description (95.37%), and 26 participants indicated that they were not able to think of a specific person/relationship (4.63%). There was a statistically significant difference in the likelihood of indicating the inability to think of a specific person/relationship between the attachment conditions,  $\chi^2(2, N = 561) = 8.20, p = .017$ , with 11 out of the 187 participants in the anxious attachment condition (5.88%), 13 out of the 188 participants in the avoidant attachment condition (6.91%), and 2 out of the 186 participants in the secure attachment condition (1.08%) indicating that they were not able to think of a specific person/relationship. Of those who indicated that they were not able to think of a specific person/relationship, 17 of them were coded as not completing the writing task correctly (65.38%) and 9 of them were coded as completing the writing task correctly (34.62%; it was assumed that these participants misinterpreted the question). The likelihood of indicating the inability to think of a personal experience differed significantly for those who were coded as completing the writing task correctly vs. incorrectly,  $\chi^2(1, N = 561) = 20.24, p < .001$ .

### **Study Completion Time**

Another potential indicator of data quality that was considered was the amount of time it took for participants to finish the study. Of the 747 participants who completed the study, 654 participants (87.55%) finished the study within the expected time of 30 to 60 minutes, 79

participants (10.58%) finished the study in less than 30 minutes, and 14 participants (1.87%) finished the study in more than 60 minutes. Using a broader range, all 747 participants took at least half of the minimum expected time (i.e., 15 minutes) or no more than double the maximum expected time (i.e., 120 minutes) to finish the study. Thus, no extremely fast or slow study completion times were observed in Study 2, and study completion time was not used as an indicator of data quality (unlike Study 1).

### **Idiosyncratic Events**

Table A5 lists exclusion-worthy idiosyncratic events that occurred before/during data collection sessions, along with explanations for why each event necessitated the exclusion of participant data.

Table A5

*Exclusion-Worthy Idiosyncratic Events in Study 2*

<i>n</i>	Event	Why event is exclusion worthy
3	Participant accidentally given debriefing form instead of informed consent form at beginning of the study.	They were unintentionally exposed to the full purpose of the study and were aware of the different conditions.
2	Participated on day of false bomb threat.	This false threat could have made them more anxious and may have biased their responses.
2	False shooter alert occurred earlier in day.	This false alert could have made them more anxious and may have biased their responses.
1	Participant was distressed about automatic SONA email reminder that said it was too late to cancel.	This misunderstanding appeared to cause stress in the participant and may have biased their responses.
1	Participant arrived with their mother, who stayed in a separate room with the researcher while the participant completed the study.	The presence of a potential attachment figure in a nearby location may have biased their responses.
1	University was officially closed for statutory holiday. Participant was trying to enter building. Carleton security approached participant and called the researcher to ask if participant was here to participate in study.	Being questioned by security (especially as the participant was a person of colour) could have affected the participant's mood and may have biased their responses.
1	Researcher forgot keys and participant had to wait one hour until they could participate.	This inconvenience could have affected the participant's mood and may have biased their responses.
1	Participant went to same high school as the researcher (they knew each other).	A prior relationship with the researcher may have led the participant to feel more comfortable and may have biased their responses.
1	Emergency weather alert about tornado occurred during study session.	This weather alert could have made them more anxious and may have influenced their interest in visiting different places.
1	Researcher complimented participant's name at beginning of study.	This compliment could have affected the participant's mood and may have biased their

- responses.
- |   |  |   |
|---|--|---|
| 1 | Participant told researcher friend has same name and engaged in conversation with researcher in conversation at beginning of study.  | This participant appeared to be more comfortable with researcher as they had same name as participant’s friend. This may have biased their responses. |
| 1 | Participant mentioned to researcher that they think they suffer from a serious mental illness that made it difficult to answer questionnaires.   | This participant stated that their mental state had a negative effect on their ability to complete the study properly.                                |
| 1 | Previous participant was heard talking to this participant about the study.  | This participant likely knew more about the study than they should have before they participated.   |
| 1 | Emergency alert test message sent at the beginning of the study session.   | Although it was just a test, the emergency alert could have made the participant more anxious and may have biased their responses.                    |
| 1 | Participant clicked next button before introductory script was finished. Researcher reset the study instead of allowing them to continue. Because of this, participant was exposed to more than one condition. | This participant was likely aware that there was more than one condition in the study.  |
-

Table A6

*Correlations Between State Attachment and Motivation to Connect with Nature Measures in Study 1 and Study 2*

	Motivation to Connect with Nature							
	Study 1				Study 2			
	Adapted Connectedness to Nature Scale		Adapted Preferences for Nature Questionnaire		Interest in Visiting Natural Spaces > Built Spaces			
	Strict	Lenient	Strict	Lenient	Strict		Lenient	
				With outliers	No outliers	With outliers	No outliers	
SAAM								
Avoidance	.01	-.003	-.05	-.07	-.11**	-.11*	-.11**	-.11*
Anxiety	.13**	.13**	.02	.01	.01	.03	.05	.06
Security	-	-	-	-	.06	.07 <sup>+</sup>	.07 <sup>+</sup>	.08*
With outliers	.05	.05	.01	.03	-	-	-	-
No outliers	.03	.04	.02	.04	-	-	-	-

*Note.* SAAM = State Adult Attachment Measure. In Study 1, the degrees of freedom ranged from 459 to 463 when strict exclusions were applied and ranged from 507 to 511 when lenient exclusions were applied. In Study 2, the degrees of freedom ranged from 558 to 560 when strict exclusions were applied and ranged from 682 to 684 when lenient exclusions were applied. Interpretation of results was similar when Spearman correlation coefficients were obtained, with one exception: the association between state attachment security and interest in visiting natural spaces over built spaces when strict exclusions were applied and outliers were included became marginally significant.

<sup>+</sup>  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ .