ODOR, ADULT ATTACHMENT AND EMOTIONS IN ROMANTIC RELATIONSHIPS

by

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Bachelor of Philosophy, University Honors College, University of Pittsburgh, 1999

Submitted to the Graduate Faculty of

Arts and Sciences in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2008

UNIVERSITY OF PITTSBURGH

COLLEGE OF ARTS AND SCIENCES

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This study explored the reasons why people commonly smell the clothing of loved ones. Romantic partners' scents were compared with (1) that of an unknown other person (placebo) or (2) a neutral odor (control) to examine their effect on anxiety, negative affect and feelings of comfort. Adult attachment was also measured dimensionally with the Bartholomew and Horowitz (1991) Relationship Questionnaire (RQ). All participants rated themselves on each attachment dimension (Secure, Fearful, Preoccupied and Dismissing). Participants presented with the scent of their partner experienced significant increases in comfort when compared to both placebo and control odor, and decreased anxiety and negative affect when compared to neutral odor. Scent of partners and unknown persons were equivalent in their ability to decrease the aversive emotions. Highly Secure participants showed improved comfort and reduced anxiety regardless of condition. Low Fearfulness predicted recovery from anxiety and negative affect regardless of odor. Participants higher in fearfulness had greater decreases in anxiety in the partner condition than those in the control condition. Highly Preoccupied individuals presented with their partner's scent experienced reduction of anxiety when compared to the scent of another person (but not when compared to neutral). An interaction was observed for reduction of negative affect wherein highly preoccupied individuals experienced greater buffering of anxiety when exposed to their partners scent and less when exposed to the scent of an unknown person, whereas those lower on preoccupation did not differ in their response to the scents.

Human scents accentuated the decrease in anxiety for those high in fearfulness. Results are discussed in terms of "olfactory comfort," and implications for affect regulation are addressed.

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PREFACE

My goals could not have been realized without the help and support of many people. First, I would like to offer my most sincere thanks to my adviser, Don McBurney. Without his inspiration and guidance this document and the education it represents could not exist. I also owe a debt of gratitude to my dissertation committee – Kay Jennings, Karen Schmidt and Elizabeth Votruba-Drzal – who provided helpful comments and encouragement throughout the process. I would also like to express my appreciation to the faculty in the Department of Psychology who provided a solid foundation and guidance for the future.

Finally, I also give my heartfelt appreciation to the many friends and family who supported me in countless ways throughout graduate school.

1.0 INTRODUCTION

Previous research has shown that people commonly smell the clothing of their loved ones during periods of separation (McBurney, Shoup & Streeter, 2006). In one study, women engaged in this behavior significantly more often than men did (McBurney, Shoup & Streeter, 2006), but a subsequent study failed to replicate the sex differences, although did find that 77% of women and 66% of men had smelled another person's clothing in order to feel closer to him/her (Shoup, Streeter & McBurney, in press). In response to open-ended questions regarding why they did so and how it made them feel, common reasons given were "it comforts me", "to feel closer to [my partner]", or simply, "it feels good" (Shoup, Streeter & McBurney, in press). To the extent that these behaviors are so common, I wish to investigate potential functions and whether individual differences in Adult Attachment moderate these effects.

Adult attachment reflects an individual's approach to romantic relationships, and individual differences in attachment are associated with response to psychological stressors. The effects of odor on emotion will be reviewed and then a working model will be presented delineating individual differences in adult attachment and how they may moderate the benefits of odor on emotion.

This experiment is designed to further our understanding of the role that the scent of significant other persons have on anxiety, emotion and feelings of comfort. The goals of the present study are to experimentally test whether these personally relevant odors will reduce

anxiety and/or negative affect associated with a mental arithmetic task known to be a mild stressor, or increase feelings of comfort. In addition I will address the question of whether individual differences in adult attachment (Secure, Fearful, Dismissing and Preoccupied) and the higher order dimensions of Self-Model or Other-Model, from which these styles are derived, moderate the effect of scent on emotion.

2.0 ODOR

The role of individual odor in mate choice is unequivocal, but the degree to which humans use it remains unclear. Body odor provides important information about an individual's immune profile, and odors are important for many mammals in choosing mates. Many mammals use scents to recognize conspecifics, assess mate quality and avoid inbreeding. Humans also use odors in the mate selection process, possibly to evaluate a potential partner's Major Histocompatibility Complex (MHC). Women report a clear preference for the scent of men with MHC profiles that are complementary to their own; that is, optimally different, and not *maximally* different (Jacob, McClintock, Zelano & Ober, 2002). Preferences for dissimilar MHC aid in creating offspring who possess optimally competent immune profiles to the local environment. Humans can also detect fluctuating asymmetries (a marker for the ability to withstand environmental insults pre- and post-natally) via smell and prefer the scent of more symmetrical potential partners (Rikowski & Grammer, 1999; Thornhill & Gangestad, 1999), in addition to rating them as most physically attractive.

In response to a survey, women said that dislike of a potential partner's natural body odor would be the most important negative influence on their sexual interest (Herz & Inzlicht, 2002). In choosing a partner, women placed a potential partner's smell above looks, voice and all other factors except for pleasantness. Men rated "looks" as most important, but in previous research they have rated smell as equally important (Herz & Cahill, 1997). While men and women both

place importance on scent in potential partners, men seem to try to avoid unpleasant-smelling partners but do still rank physical attractiveness as important. Women say that "better than average" smell is the most important physical factor in mate choice (Sergeant, Davies, Dickins & Griffiths, 2005). Thus the hedonics of odor is also an important quality in a potential mate; the sexes may have different strategies in that perhaps men "avoid the worst" as opposed to women who wish to "take the best".

In humans, odors can be used as conditioning stimuli to elicit learning independent of the hedonics or valence of the stimuli. The same odor paired with pleasant or unpleasant emotional experiences can later elicit the same emotional response (Herz, Schankler, & Beland, 2004). An unfamiliar odor paired with a stressful stimulus can later elicit stress when presented without the stressful stimulus (Kirk-Smith, Van Toller, & Dodd, 1983). Odors can also be used for recognition. As little as six hours after birth, mothers can identify their own infants by smell alone (Russell, Mendelson, & Peeke, 1983). This recognition is mutual: infants can also readily identify their mothers (Cernoch, & Porter, 1985; Makin & Porter, 1989; Porter, Makin, Davis, & Christensen, 1992) and children can identify peers (Mallet & Schaal, 1998). Olfactory identification appears limited, though. Parents can identify their offspring by smell, but do not appear able to reliably differentiate between offspring, especially same-sex pairs (Weisfeld, Czilli, Phillips, Gall, & Lichtman, 2003).

2.1 ODOR AND MEMORY

Not only do odors trigger memories, but pleasant odors trigger more pleasant memories. Students recalled more pleasant memories triggered by neutral words in the presence of a

pleasant odor than an unpleasant one (Ehrlichman & Halpern, 1988). The salience of odor for memory is consistent with the fact that the olfactory system projects more directly to the amygdala, which is intimately involved with emotional memory, than any other sensory modality (Zald & Pardo, 1997). Furthermore, the amygdala has been shown to respond differentially to the intensity and valence of odors. Based on a double dissociation experiment, the hedonic qualities of odors are functionally segregated; the amygdala responds only to intensity of odors regardless of valence, whereas valence is processed by higher cortical regions (Hamann, 2003).

Moreover, odors serve as excellent candidates for conditioning stimuli to emotional events. Epple and Herz (1999) demonstrated that five-year olds who were given an impossible task to perform in the presence of an odor later performed more poorly on another challenging task in the presence of the same odor than they did with a different odor, or no odor. Conditioning is not limited to unpleasant stimuli, and begins early in life. For example, neonates stroked gently on the cheek in the presence of a citrus scent later turned in the direction of the scent when the scent was presented alone (Sullivan, Taborsky-Barbra, Medoza, Itano, Leon, Cotman, Payne, & Lott, 1991).

Odor is particularly likely to trigger autobiographical memories (Chu & Downes, 2000), and these olfactory memories are especially emotionally laden (e.g., Herz, Eliassen, Beland, & Souza, 2004; Herz & Schooler, 2002). The Proust effect, wherein memories are recalled more easily and seem more salient when paired with an associated odor, was recreated in an experimental setting when subjects exhibited more emotion while recalling personal memories in the context of odor cues (Herz & Schooler, 2002). Similarly, Chu, and Downes (2000) showed that odor cues are more effective than verbal and visual stimuli in triggering autobiographical memories. These memories were also more detailed when an odor was present. In repeated

testing of this phenomenon, sex differences have emerged. Women describe more emotional, vivid, and older memories than men when presented with an odor cue (Herz & Cupchik, 1992). Women have also shown a greater ability to remember and recognize a specific odor among other odors in odor memory tests (Choudhury, Moberg, & Doty, 2003).

2.2 ODOR AND EMOTION

In a questionnaire study (McBurney, Shoup & Streeter, 2006), we asked participants to respond to a number of items with regard to smelling another person's clothing. Specifically, we asked, "How often do/did you intentionally smell your partner's … clothing?" This item was rated on a scale ranging from (never) to (often). Eighty-seven percent of women and 56% of men had engaged in this behavior. The greatest difference occurred in the never category, although women were represented more than men at every scale value above the lowest two.

When asked the reason for engaging in these behaviors, the most common reason given by women (53%) was ''to remember him.'' The most common response by men was ''smells good'' (38%), followed by ''to remember her'' (28%), and ''no reason'' or no response (19%). When asked how it made them feel, the most common response by women was ''happy/good'' (43%). Other responses were quite similar (''comfortable/content,'' ''relaxed,'' ''secure,'' and ''close''). By contrast, the most common response by men was no response.

In an investigation of whether airborne chemical can have an impact on behaviors or mood of the receivers of these chemicals, Chen & Haviland-Jones (1999) found that smelling human underarm odor could reduce negative affect, while having no effect on positive affect. Negative and positive affect are orthogonal; negative affect is not simply the absence of positive

affect. Negative affect reflects the degree of distress or unpleasurable engagement, (anger, contempt, disgust, fear, guilt, and nervousness). Positive affect reflects the degree of pleasurable engagement, (enthusiastic, active, and alert) (Watson & Clark, 1988). Specifically, exposure to underarm odor of women, older adults, and older women decreased depressive mood significantly more than exposure to the underarm odor of young men, men and young adults. Thus volatile chemicals produced by humans can and do influence negative affect (Chen & Haviland-Jones, 1999).

The mechanism involved in these effects remains in question. The role that pheromones may play in human behavior remains controversial, but may provide insight into the possible functions of human odor in general. Resulting from a series of studies, McClintock attributes the effects of androstenone to pheromones and has proposed a new class of "modulator" pheromones which exist solely to affect the psychological or mood state of the receiver (Jacob & McClintock, 2000; Preti, Wysocki, Barnhart, Sondheimer, & Leyden, 2002). Androstenone, a putative human pheromone, has been found to modulate mood in men and women; but its effects were limited to increases in positive mood (as opposed to reduction of negative mood as shown in Chen and Haviland-Jones, 1999) serving primarily to prevent deterioration of general mood states (Jacob & McClintock, 2000). These results suggest that these effects are not simply from learned associations, but rather specific and direct pheromone-like influences.

In light of this, the function of smelling a partner's clothing for comfort may become clearer. While we did not specifically address the issue of pheromones when asking about how often participants purposely smelled their partner's clothing, the possibility of modulator pheromones may nonetheless be one possible proximate cause. It is possible that a sense of comfort is achieved simply by the olfactory cues indicating the presence of another person, and

the fact that odors are less available for verbalization. It is also possible that the receivers of odors are processing putative pheromones that appear to exist solely to modulate mood, as suggested by McClintock's work. In any case, whether true human pheromones are confirmed or not, this controversy serves to enhance interest in the present study; the hypotheses generated here are empirical and possess relevance on their own merit.

2.3 ODOR AND ADULT ATTACHMENT

To the extent that these behaviors have been shown to be so common, we have interpreted them as facilitating attachment. The work of Harlow on attachment in infant monkeys is among the best known in psychology, and has given us the concept of contact comfort (Harlow, Harlow, & Suomi, 1971). We note that Harlow demonstrated that the contact comfort is a prerequisite for attachment bonds to develop. Because of the relationship between olfaction and attachment (discussed below), our working hypothesis is that his argument can be extended beyond the concept of "comfort" as simply a tactile sense to an olfactory one too.

We examined the relations between olfactory comfort and attachment cross-culturally (following McBurney, Shoup & Streeter, 2006), and asked US and German students how frequently they smelled clothing of family members and lovers during periods of separation, and added the Relationship Questionnaire (RQ, presented in Appendix A) a measure of Adult Attachment (McBurney, Euler, Streeter & Shoup, 2005). Because cultural differences are not relevant to the present discussion and for the sake of clarity, I collapsed across nationality and combined the 2 samples for correlational analysis. These correlations are presented in Table 1.

The frequency of intentionally smelling a loved one's clothing correlated significantly and positively with higher scores on Secure and Preoccupied attachment and significantly but negatively with higher scores on Dismissing attachment. Women smelled clothing much more often than men in both samples.

Table 1. Correlations of Adult Attachment with intentionally smelling partner's clothing in a cross-cultural sample

Secure	Fearful	Preoccupied	Dismissing
.081	.021	.099*	-.181**
(p=.06)	(p=.63)	(p=.02)	(p=.00)
(n=545)	(n=543)	(n=543)	(n=544)

The studies described above involved exclusively questionnaires. This approach was a reasonable initial attempt in documenting a behavior previously non-existent in the literature. Sufficient replication has confirmed that people commonly smell the clothing of loved ones, but is methodologically incapable of answering functional questions about the behavior. Essentially, this experiment is designed to explore questions at a different level of analysis: Why do we take comfort in the scent of a significant other, and could individual differences in adult attachment be a moderating factor?

3.0 ADULT ATTACHMENT

Adult attachment can be conceptualized as an extension of infant attachment (Bowlby 1969), but perhaps with different functional qualities. Bowlby (1969) described in detail the ways in which infants become emotionally attached to their primary caregivers. Ainsworth and colleagues (e.g., Ainsworth, Blehar, Waters & Wall, 1978) provided early experimental support for the theory, and defined three fundamental styles of infant attachment: secure, anxious/ambivalent, and avoidant. These categories have received abundant experimental endorsement (e.g., Bartholomew & Horowitz, 1991; Bartholomew & Moretti, 2002; Bartholomew & Shaver, 1998; Belsky, 2002; Bernier & Dozier, 2002; Bradley & Cafferty, 2001; Diamond, 2004; Feeney & Kirkpatrick, 1996; Fraley, Brumbaugh, & Marks, 2005; Fraley & Shaver, 2000; Fuendeling, 1998; Hazan & Diamond, 2000; Hazan & Shaver, 1987; Kirkpatrick, 1999; Kurdek, 2002; Mikulincer & Sheffi, 2000; Shaver & Mikulincer, 2002; Simpson, 1990), and are routinely accepted as valid.

Attachment theorists have explored the individual differences between these types in the service of many goals: parenting skills, psychopathology, adjustment, and relationship quality (e.g., Schmitt et al., 2003; Simpson, Rholes & Nelligan, 1992; Watt, McWilliams, & Campbell, 2005; Weems, Berman, Silverman & Rodriguez, 2002). While it is important to understand both the etiology and predicted outcomes of these different typologies, the present discussion of infant attachment focuses on individual differences in adult attachment and possible adaptive responses

that give rise to these differences, and the possibility that romantic attachments – or pair bonds – can be considered as an extension of the system that is in place in infants. Hazan and Shaver (1987) were the first to consider romantic love as an attachment process, and make an important distinction between the infant system and adult process. The logic underlying the argument is relatively simple: the same qualities that Bowlby describes as hallmarks of the infant system are preserved and co-opted in adults to promote pair bonds. There is little dissent on the matter of the adaptive significance of the attachment system for infants, and the characteristics of the system reveal its function. The unique bond between infant and caregiver is characterized by (1) *proximity maintenance*: the behavior of the infant in seeking physical proximity; (2) *safe haven*: seeking comfort from that same caregiver when distressed; (3) *separation distress:* becoming upset or anxious when separated from the caregiver and (4) *secure base:* utilizing the caregiver as a foundation from which to explore the environment when it appears safe (Chisholm, 1996; Hazan & Diamond 2000, Kirkpatrick, 1998). Figure 1 shows Fraley & Spieker's (2003) control systems model that describes the critical "decision nodes" that activate attachment behavior.

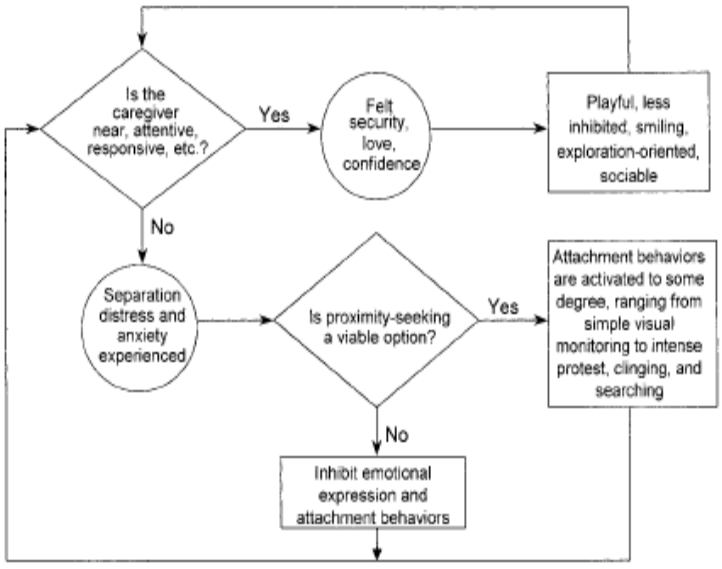

Figure 1. A control systems model of the basic dynamics of the attachment system (Fraley & Spieker, 2003)

Their argument contends that the attachment system function in essentially this context throughout the lifespan, even though the behaviors exhibited by infants and adults will obviously differ (Fraley & Spieker, 2003).

The same hallmarks of infant attachment duly capture many familiar qualities of romantic relationships. Hazan and Shaver maintain that bonds between adult lovers correspond to the infant's bonds to its attachment figure/caregiver. They examined the three basic types of adult attachment and find (1) that the relative prevalence of these attachment styles are similar to those found in infancy, (2) that behavioral differences exist between styles and (3) that there is a meaningful theoretical basis for their model.

The percentage of adults in each category approximates those of infants (Hazan & Shaver, 1987). Secure adults characterize their romantic experiences as happy and trusting. They are able to accept and give support in the relationship. Avoidant (e.g., Fearful and Dismissing) adults characterize their relationships as jealous, fearful of intimacy and having extreme emotional highs and lows. Anxious/ambivalent adults describe their experiences as obsessive, including extreme sexual attraction and jealousy.

3.1 FUNCTION OF ADULT ATTACHMENT

Hazan and Shaver later argue (1994) that the three main components of attachment – proximity maintenance, safe haven, and secure base – are transferred sequentially from parents to peers beginning in adolescence (also see Simpson, 1999). Some have argued that degree of caregiver

sensitivity may be the proximal cause for secure versus insecure attachments. Bowlby's theory of infant attachment is widely considered a mid-level evolutionary theory and thus adult attachment should be similarly grounded by early experiences and sensitive to the local environment. Consequently, we may not expect that individual differences in adult attachment should be necessarily stable. When disparities in mate value exist, different strategies should be explored for potential in a model similar to the Belsky, Steinberg, and Draper (1991) model whereby father-absence leads to early puberty as a response to uncertain environmental conditions. Puberty occurs earlier in girls who are raised in an environment characterized by stress and show insecure attachment as children. Based on adaptationist logic, it is adaptive for an individual to scan the local environment to assess the relative merits of putting effort into current versus future reproductive opportunities (Belsky, 1997; Belsky, Steinberg, & Draper, 1991; Chisholm, 1996). For example, if adult attachment is sensitive to the environment as it should be, one may exhibit Secure attachment to a mate who has proven deserving, or when the sex ratio is relatively equal. On the other hand, in circumstances where there is a dearth of available males it may be wiser for females to err on the side of caution and in general adjust their strategies and reveal more Preoccupied attachment.

In this model, Secure attachment is in part a facultative adaptation to parents' ability and willingness to invest. Avoidant attachment is an adaptation to parents' unwillingness to invest – regardless of their ability to do so. Ambivalent attachment is an adaptation to parents' inability to invest – regardless of their willingness to do so (cf. Figure1). At the core of this model, infant attachment strategies are preserved into adulthood, but become essentially reproductive strategies once the demands shift from survival to reproductive effort (Chisholm, 1996). This life-history approach is also advanced by Kirkpatrick (1998) and others who present compelling

theoretical evidence to suggest that this type of trade-off is a useful explanation for the process of attachment. While there is considerable variability in the way humans approach pair-bonding or romantic relationship, the mechanisms proposed by attachment theory suggest that early relationships (e.g., one with a warm, responsive caregiver) are a factor that facilitate stability to attachment styles, while the ethological position suggests that environmental factors are incorporated into new relationships (Fraley & Spieker, 2000). Thus, the infant attachment system is parsimoniously co-opted by evolution for the maintenance of pair-bonds and continues to operate in essentially the same context (Kirkpatrick, 1998; Zeifman & Hazan, 1997).

Early relationships impact subsequent ones by affecting the nature and development of mental models of self and other (Simpson, Rholes & Nelligan, 1992). This view suggests that deviations from Secure attachment in individuals are not necessarily detrimental to the individual, but perhaps reflect a viable strategy to the current situation. This model also implies that it is the process of attachment that is adaptive, rather than presuming that secure attachment is a goal in and of itself, and focuses on the normative ways in which individuals handle relationships (Fraley & Spieker, 2000).

To the extent that attachment bonds are transferred from caregiver to romantic partner, it is difficult not to view the accompanying behaviors of attachment as comparable. In fact, the response to separation or loss of the attachment figure (protest-despair-detachment) is identified only in circumstances involving caregivers or partners (Hazan & Diamond, 2000). This offers another basis for viewing adult attachment as comparable to that seen in infancy.

3.2 HIGHER ORDER DIMENSIONS UNDERLYING ADULT ATTACHMENT MODELS

According to Bowlby, individual differences in attachment styles result from two separate but related mental models: model of self and model of attachment figure ("other"). Through the attachment process in infancy, the individual is thought to develop a model of self and a model of the attachment figure (other). This also applies to the model of adult attachment and has led to a four-category, dimensional model of adult attachment. Bartholomew and Horowitz (1991) have advanced the original three-category model (secure, anxious/ambivalent, avoidant) to include an additional category, and reconceptualized the original styles into a two-dimensional space, illustrated by Figure 2.

Examining the motivation underlying the behavior exhibited by individuals from the three attachment styles, Bartholomew & Horowitz (1991) found differences in the inner feelings that motivate the behavior of avoidant individuals. Avoidant individuals differed among themselves in their feelings of self worth; however, all avoidant individuals viewed others as unreliable and untrustworthy. Thus the avoidant category was broken down into 2 distinct categories: Dismissing and Fearful. Bartholomew & Horowitz (1991) used this 4 category model to propose that attachment style was not a system of categorization, but rather a result of the intersection of two underlying dimensions: The dimension of Self and the dimension of Other. The dimension of Self is based on the extent to which the individual positively views the self, while the dimension of Other is based on the extent to which the individual positively views others.

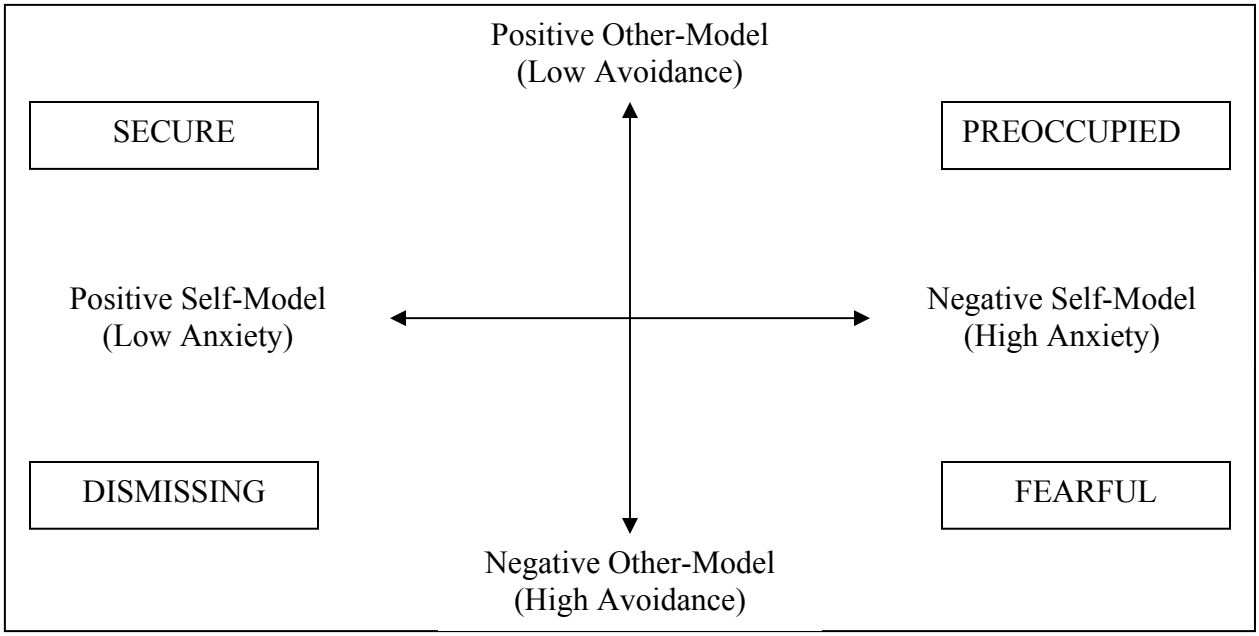

Figure 2. The model of adult attachment (redrawn from Brennan, Clark & Shaver, 1998).

Referring to Figure 2, the higher order dimensions are derived as follows:

- Self Model - patterns characterized by positive self models minus patterns characterized by negative self models [i.e. (secure plus dismissing) minus (fearful plus preoccupied)].
- Other Model - patterns characterized by positive other models minus patterns characterized by negative other models [i.e. (secure plus preoccupied) minus (fearful plus dismissing)].

Based on the interactions between these two dimensions, Bartholomew & Horowitz concluded that there are four adult attachment styles: *Secure* (internalized sense of self-worth; comfortable with intimacy in close relationships), *Fearful* (highly dependent on others' acceptance and affirmation; however, because of their negative expectations, they avoid intimacy to avert the pain of loss or rejection), *Preoccupied* (like *Fearful*, anxiously seek to gain

acceptance and validation from others; persist in the belief that they could attain safety, or security, if they could only get others to respond properly toward them), and *Dismissing* (avoid closeness because of negative expectations; however, maintain a sense of self-worth by defensively denying the value of close relationships). Refer to Figure x for simplification.

3.3 INDIVIDUAL DIFFERENCES IN ADULT ATTACHMENT STYLE

Using Bartholomew & Horowitz's four category model, individual differences in adult attachment styles are manifested in the following ways. The Relationship Questionnaire (RQ) is the briefest measure of adult attachment and asks individuals to select which of the statements best describe them (Appendix A, Bartholomew & Horowitz, 1991). Because objections have been raised regarding whether these types should be considered as categorical styles or dimensional measures, additional instruction usually asks participants to rate each of the statements on a 7-item scale to permit more refined analysis. It is unlikely that any one of these brief statements adequately captures an individual's sentiments about their romantic relationship; deriving a continuous dimensional measure (as in Figure 2) yields more information. (The continuous ratings are used for analysis in the present study.) To date, there is no acceptable metric that can quantify an individual's profile based on all 4 categories. For example, an individual who rated herself as highly Secure, highly Fearful, highly Preoccupied and low Dismissing would contribute the same to analyses of Security as one who rated herself highly Secure, low Fearful, low Preoccupied and high Dismissing.

The RQ has been validated in 62 cultures by Schmitt and colleagues (Schmitt, et al., 2004). Self-ratings of adult attachment generally broadly agree with those of peers and family (Griffin & Bartholomew, 1994).

A number of behavioral and psychological differences have been reported when comparing the different attachment styles as both types and dimensions. Taken together, these indicate that Adult Attachment styles are qualitatively different and independent of one another. Others have documented differences in cognitive and stress reactions according to adult attachment. Preoccupied and Fearful women had lower anxiety in a stressful laboratory situation when accompanied by their romantic partner (Feeney & Kirkpatrick, 1996). Securely attached individuals react to positive affect induction with better scores on cognitive tasks, Preoccupied individuals showed the opposite pattern of cognitive reactions and Avoidant (Fearful & Dismissing) individuals show no difference to positive or negative affect inductions (Mikiluncer & Sheffi, 2000), suggesting that affective changes can be moderated by attachment styles, and notable for the present study.

Relationships between anxiety and attachment style have also been examined by several researchers in natural settings without experimental manipulation. Fearful and Preoccupied individuals score higher on anxiety measures in comparison to the other attachment styles (Weems, Berman, Silverman & Rodriguez, 2002). In addition, Fearful and Preoccupied individuals are associated with clinically significant levels of anxiety sensitivity (Watt, McWilliams, & Campbell, 2005). Simpson, Rholes, & Nelligan (1992) examined relationships between support seeking behavior and attachment style, and found that when confronted with anxiety, Secure women are more apt to use their partners as a source of comfort, whereas avoidant (Fearful and Dismissing) women were more apt to withdraw from their partner.

In times of distress, Secure individuals attempt to deal with their anxious feelings but are comfortable seeking help when it is needed, Fearful individuals become very anxious and reclusive, Preoccupied individuals become very anxious and clingy, Dismissing individuals value self-reliance above all and repress their anxiety and avoid others, and (Bartholomew & Horowitz, 1991).

4.0 DOES ADULT ATTACHMENT MODERATE THE RELATIONSHIP BETWEEN ODOR AND EMOTION?

Because individual differences in Adult Attachment have been shown to moderate the relationship between a stressor task and subsequent anxiety (Feeney & Kirkpatrick, 1996) I hypothesize that they could also moderate the effects of scent on comfort, anxiety and emotion. Differences in adult attachment influence an individual's behavior, regardless of mechanism (i.e., a learned association between emotion and specific scent of the partner, an evolved response to dissimilar MHC, or an evolved reaction to a pheromone-like substance). The link between olfactory processing and attachment is evidenced by the fact that they share several structural elements in the brain and chemicals of neural processing. Hence the proposition that the two may share other important relationships should not be neglected. Additionally, it has been demonstrated that olfactory experiences can alter feelings of comfort, emotions, and affect (Chen & Haviland-Jones, 1999; Jacob & McClintock, 2000; McBurney, Shoup & Streeter, 2006).

Many psychological researchers tend to focus on sex differences in behavior and nowhere more so than in the field of evolutionary psychology. In one study, we found that women smell their partner's clothing more often, and give a variety of sentimental reasons for doing so (McBurney, Shoup, & Streeter, 2006). It is noteworthy that there are few sex differences in attachment styles; men may be more Dismissing than women, but the effect is small and varies a

great deal across cultures (Schmitt et al., 2003). The classic paper written by Buss (1989) that documented mate preferences in 37 different cultures has been widely discussed and produced in essence a mini-industry devoted to exploring the finding that men are more interested in physical appearance and women are more interested in financial resources in potential mates. While this remains a matter of substantial importance, the finding that man and women both seek a partner who is warm, kind, and likes them back is often overlooked. In light of this, I propose that it may be most useful to use Adult Attachment as a framework reflecting individual differences instead of sex differences. This framework also provides additional perspective on emotion regulation. To my knowledge, there is no theoretical justification to assert that (e.g.) highly Preoccupied men should respond differently than highly Preoccupied women in coping with stress, thus sex differences will not be explored in this experiment.

Because there are important areas in which men and women want the same things in a partner (i.e., kindness, intelligence and understanding), individual differences in Adult Attachment may be able to predict differences outcomes from exposure to the scent of a romantic partner. Once a partner has been chosen, psychological and hormonal effects function to reinforce the bond, which is an adaptive process, regardless of whether the attachment is secure or not.

Feeney and Kirkpatrick (1996) hypothesized that the presence of a romantic partner during a stressful laboratory task might serve an anxiety-buffering function among relatively secure participants because the characteristics of securely attached adults lead them to expect attachment figures will provide comfort when needed. They likewise predicted that insecurely attached individuals would not benefit from the presence of a partner during the stressor. Although they explored their data using the higher order dimensions (Anxiety and Avoidance)

and used the three-category model (secure, anxious/avoidant, ambivalent) it can be extrapolated that anxiety would not decrease in the presence of a partner because: insecure individuals either do not rely on others because of negative views of the partner (Dismissing), believe the partner would not respond adequately toward them (Preoccupied) or avoid intimacy entirely (Fearful).

Because the manipulation in the Feeney and Kirkpatrick study involved the physical presence or absence of the partner, it is not possible to determine whether the anxiety buffering effect was a result of visual or olfactory cues. A similar experiment based on this paradigm separating visual from olfactory cues could dissociate these two domains of sensory input to help clarify the effect, or to determine whether individuals differences in adult attachment moderate the general effects of pair bonds. Their results indicate that the effect of presence of a romantic partner is moderated by individual differences in self-reported attachment, particularly with respect to the anxious-nonanxious dimension (cf. Figure 2) (Feeney & Kirkpatrick. 1996).

Though odor contributes to the process of choosing a mate, the studies reviewed here suggest that there may be conditioned associations that form over the course of the relationship. Since highly Preoccupied individuals by definition possess a positive image of the partner and a negative view of the self, they should derive the most benefit from the scent of a partner. Dismissing individuals have a positive view of the self and a negative view of the partner, so should not take comfort from the scent: they look inward for reassurance. Fearful individuals have a negative view of the self and a negative view of the partner, so the pattern of response is less clear; they may be unlikely to seek a partner' scent for comfort.

People commonly smell their romantic partner's clothing during periods of separation to feel comforted, closer to the partner, good, happy, or relaxed (McBurney, Shoup, & Streeter, 2005). Adult Attachment predicts the frequency of using a partner's smell for comfort

(McBurney, Euler, Streeter, & Shoup, 2005) and also influences response to stressors (Feeney & Kirkpatrick, 1996). A test of the proposed model (Figure 3) could provide evidence that the scent of a romantic partner contributes to feelings of comfort or relaxation and experimentally confirm the reasons given in previous open-ended questionnaires (McBurney, Shoup & Streeter, 2006). Adult Attachment may influence the degree to which the scent of one's partner will reduce emotionally aversive states. More Secure individuals should show a moderate buffering effect on anxiety and negative affect; Highly Preoccupied individuals should benefit most; Dismissing and Fearful individuals should benefit least from their partners' scent. Figure 3 is an illustration of this model.

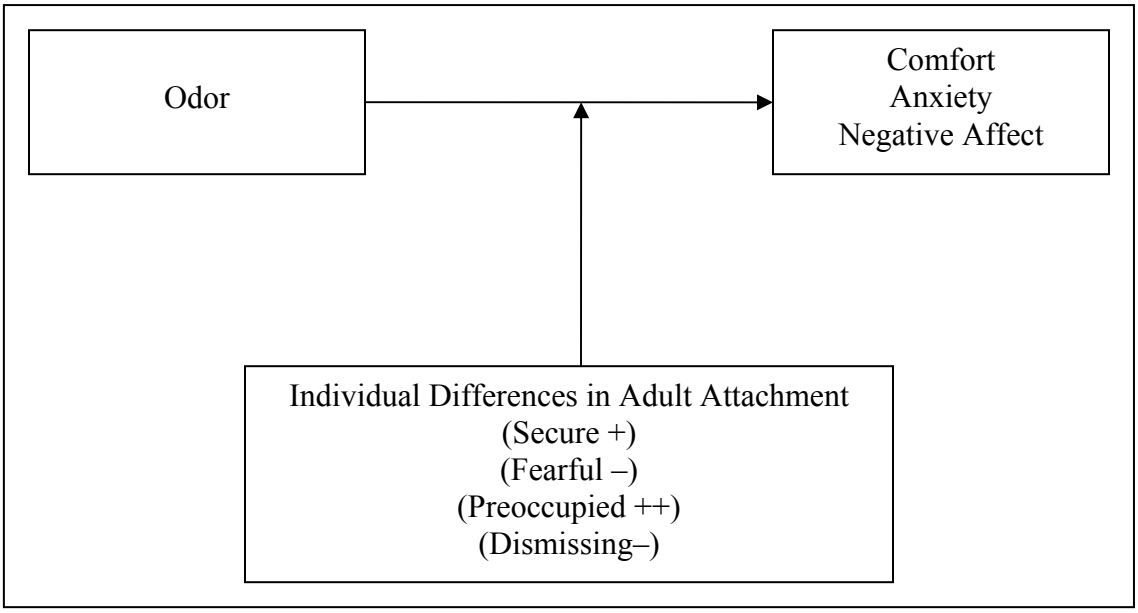

Figure 3. The proposed model of Adult Attachment moderating the relationship of odor on emotion

In conclusion, individual differences in adult attachment may provide insight to the role of odor on feelings of comfort, anxiety or emotion by affecting both the strength and the direction of the effects of odor on emotion – providing support for its role as a moderator variable (cf. Baron & Kenny, 1996). It is also possible that adult attachment could be used to explain the role that non-evaluative emotional social support plays in response to various

stressors (as in Feeney & Kirkpatrick, 1996), potentially through olfactory mechanisms. The present experiment will begin to address the question of whether adult attachment moderates the relationship between scent and emotion and to discover what role adult attachment plays in the model.

5.0 HYPOTHESES AND RATIONALE

5.1 HYPOTHESIS 1: THE SCENT OF A ROMANTIC PARTNER SHOULD DECREASE NEGATIVE AFFECT AND ANXIETY AND INCREASE FEELINGS OF COMFORT

The scent of a romantic partner (Experimental condition) will decrease negative affect (PANAS-N) and state anxiety (S-Anxiety) relative to the neutral odor (Control condition) and the odor of an unfamiliar, unknown other person (Placebo condition). It should also increase feelings of being comforted, as reported by participants in the previously described questionnaires. Thus, a main effect of partner's scent is predicted with S-Anxiety; PANAS-N (the negative affect subscale of PANAS) and "Comforted" as dependent variables, tested by step-wise hierarchical multiple regression. Condition was dummy-coded and all analyses compare the placebo (other) and control (neutral) condition to the experimental (partner).

5.2 HYPOTHESIS 2: SELF-MODELS AND OTHER-MODELS SHOULD MODERATE THE EFFECT OF A PARTNER'S SCENT

Self-Models and Other-Models should moderate the effect of a partner's scent. Specifically, individuals with higher Self-Models should report greater decreases decrease negative affect

(PANAS-N) and state anxiety (S-Anxiety) than those with lower Self-Models when exposed to a partner's scent. High Self-Models should also be associated with increased feelings of being comforted by the partner's scent. (Self-Model is derived as [(secure plus dismissing) minus (fearful plus preoccupied)].

Other-Models should moderate the relationship of odor on emotion; participants with higher Other-Models should report greater decreases in negative affect (PANAS-N) and state anxiety (S-Anxiety) than those with lower Other-Models when exposed to a partner's scent. High Other-Models should also be associated with increased feelings of being comforted by the partner's scent. [Model of Other is derived as [(secure plus preoccupied) minus (fearful plus dismissing)].

This hypothesis is based on the results reported in previous work (McBurney, Euler, Streeter, & Shoup, 2005) where individual differences in Adult Attachment (i.e., Secure, Fearful, Preoccupied and Dismissing) correlated with the reported rate of intentionally smelling a partner's clothing (See Table 1).

5.3 HYPOTHESIS 3: MODERATION BY INDIVIDUAL DIFFERENCES IN ADULT ATTACHMENT

Individual differences in Adult Attachment have been shown to moderate the effects of a stressor task in the presence of a supportive partner (Feeney & Kirkpatrick, 1996). Additionally, attachment is thought to be activated in times of stress (as in the present investigation) then this is when the attachment system should show more clearly:

- Secure individuals should benefit from the scent of a partner, because they believe they can count on that partner in times of distress
- Fearful and Dismissing attachment should be suppressed because they are unlikely to think of their partners as supportive
- Preoccupied attachment thus should be most strongly activated and highly motivated to seek support because they are highly dependent and look to others for support

This hypothesis is a systematic replication of the correlational findings discussed in Hypothesis 2 and is shown as a model in Figure 3. Specifically, the model (Figure 3) predicts the following:

5.3.1 Hypothesis 3a: More securely attached individuals should experience greater benefits from the scent of their partners

In an attempt to decrease negative feelings via emotional contact, highly Secure individuals in the PO condition should report moderate decreases in PANAS-N, State Anxiety and moderate increases in feeling comforted. Secure individuals exhibit a balance of the two extremes whereby they recognize their negative emotions without becoming overwhelmed by them (Mikulincer & Sheffi, 2000). In addition, secure individuals have self worth and view others as accepting and responsive (Bartholomew & Horowitz, 1991).

5.3.2 Hypothesis 3b: More fearful individuals should not experience benefits from the scent of their partners

Highly Fearful individuals should not report decreased PANAS-N, State Anxiety or increased feelings of comfort from the scent of their partner. Fearful individuals maintain a negative view

about the self and others (Bartholomew & Horowitz, 1991) and thus their negative view toward others suggests that emotion will not be affected by the scent of a partner.

5.3.3 Hypothesis 3c: Highly Preoccupied individuals should experience the greatest benefits from the scent of their partners

High Preoccupied individuals in the PO condition should show the greatest reduction in PANAS-N, State Anxiety and the greatest increase in reported feelings of comfort in comparison low Preoccupied individuals. The strongest hypothesis involves highly Preoccupied individuals. Highly Preoccupied individuals have a negative view of the self while holding a positive view of others. Preoccupied individuals excessively experience negative emotions, and react to negative situations by becoming clingy (Mikulincer & Sheffi, 2000). In addition, Preoccupied individuals view themselves as distressed and others as supportive (Bartholomew & Horowitz, 1991).

5.3.4 Hypothesis 3d: Highly Dismissing individuals should not benefit from the scent of their partners

Individuals higher on the Dismissing scale in the PO condition should not report much difference in PANAS-N, State Anxiety or feelings of comfort from Pre- to Post-odor exposure. Highly Dismissing individuals have positive view of the self and negative view of others. Dismissing individuals repress negative emotions (Mikulincer & Sheffi, 2000) and view themselves as not distressed and others as unsupportive (Bartholomew & Horowitz, 1991).

5.4 METHOD

This experiment used two established instruments to measure affect and anxiety: Spielberger's State-Trait Anxiety Inventory (STAI) and the Positive and Negative Affect Schedule (PANAS) (Appendices B and C). In addition to these established measures, and because we have conceptualized the behaviors of intentionally smelling a loved one's clothing as facilitating attachment and because it is important to replicate these findings empirically, I included affective words and phrases (i.e., "comforted", "happy", "good") that appeared most frequently in response to our earlier questionnaires.

Adult attachment also influences responses to affective challenges (Mikulincer & Sheffi, 2000), so this procedure involves a stress-induction. We have also found that Adult Attachment styles may interact with the frequency of using the smell of a partner for comfort (McBurney, Euler, Streeter & Shoup, 2005) the Relationship Questionnaire (RQ) (Bartholomew & Horowitz, 1991) will be administered to measure individual differences according to Adult Attachment Theory (Hazan & Shaver, 1987) to explore the possibility that Adult Attachment moderates the relationship between the scent of a romantic partner and comfort, anxiety and negative affect.

5.5 PARTICIPANTS

Eligible participants were students age 18 or over at the University of Pittsburgh enrolled in Introductory Psychology courses. The only criterion for inclusion was being in possession of an item of clothing that retains the smell of a romantic partner. The final sample was 118 participants (94 females and 24 males). The mean age of the participants was 19.64 (± 4.66);

mean relationship length was 1.52 years (± 16.09) (median = 1 year; mode = 6 months). One participant was removed from the dataset as an outlier on several demographic characteristics.

5.6 MATERIALS

The State Anxiety (S-Anxiety) subscale of Spielberger's State Trait Anxiety Inventory (STAI) is designed to measure transient changes in anxiety, as opposed to the Trait Anxiety subscale (T-Anxiety), which measures persistent and relatively stable individual differences in tendencies toward anxiety-proneness. I modified the S-Anxiety subscale to include affective words that were most common from open-ended questionnaires. Because "comforted" was not captured within the other scales, it was included as a separate item (analyses of "happy", "good", "anxious" and "high strung" are not reported here). Each item was scored on a scale from 1 (Not at all) to 4 (Very much so). Instructions given to "indicate how you feel right now, that is, at this moment" highlight the momentary changes in anxiety. The modified version of the S-Anxiety scale can be found in Appendix B.

With the proper instructions, the Positive and Negative Affect Schedule (PANAS) is designed to measure transient changes in Positive (PANAS-P) and Negative (PANAS-N) orthogonally. On a scale from 1 (Very slightly or not at all) to 5 (Extremely), participants are asked to report the extent to which they feel "right now, that is, at the present moment". Positive affect (PANAS-P) as it is measured consists of feelings of enthusiasm, activity and alertness. Negative affect (PANAS-N) reflects a variety of negative emotions such as anger, contempt, disgust, guilt, fear and nervousness. The measure was developed to subjectively allow participants to report quickly on their emotional state which, by nature, can be fleeting. PANAS

has shown a high rate of internal consistency, regularly been shown to have ample test-retest reliability and is sufficiently generalizable. Studies support the factorial validity and item validity of the scale; external validity has been more than adequate (Watson, et al., 1988). The full version of the PANAS administered can be found in Appendix C.

5.7 DESIGN AND PROCEDURE

Research was performed in a windowless laboratory room**.** Participants were recruited through the Psychology subject pool and all departmental and IRB procedures were followed. No identifying information that could be linked with the participant in any way was recorded; all responses were completely anonymous. Participants were identified by number only; no names were used in the experiment. The only identifiable information collected from this study was the informed consent form.

Estimated total time requirement for participation was approximately 45 minutes. Participants were asked to bring an item of clothing that retains the odor of their romantic partner. The experiment was a between-subjects design with 3 randomized conditions in the experiment:

- Experimental condition; Partner's Odor: the item that smells like their romantic partner; age of item was not controlled for, but was measured in the final questionnaire
- Control condition Neutral Odor;: cotton t-shirt item laundered in unscented detergent

- Placebo condition; Other Odor: a shifting condition that involved clothing with the odor of an unrelated/unknown volunteer; the item of clothing was never more than 3 days old and was different for every participant.

Baseline PANAS and STAI were measured at the beginning of the session. Because the hypotheses are based upon reduction of negative affect and anxiety, and because Bowlby (1979) claims that attachment is most strongly activated in times of distress it is under these conditions that attachment processes should be most evident (Simpson, Rholes & Nelligan, 1992) I artificially inflated these emotions in order to examine changes based on the experimental manipulation. For this reason, participants were asked to perform a challenging mental arithmetic task (counting backwards by 17, 25, 7 and/or 13 from a randomly chosen 4-digit number) shown to be a mild stressor (Feeney & Kirkpatrick, 1996; Kamarck, Manuck, & Jennings, 1990) for 5 minutes. PANAS and STAI were administered immediately following the stressor task (post-stress, but pre-odor exposure). Then the participant was asked to select a folded slip of paper and hand it to the experimenter. Slips were numbered 1-3, which randomly corresponded to condition. At this point, the experimenter was no longer blind to condition, but had been for the stressor task.

Each participant was blindfolded, and instructed to smell the contents of an opaque odorless bucket that contained the item from one of the experimental conditions described above. (IRB procedures also explicitly required that the participants be offered the opportunity to close their eyes if they did not wish to be blindfolded; only one participant did so.) PANAS and STAI were then administered again (post-odor exposure).

Participants were asked to complete a brief questionnaire (Appendix D) to measure

- Participants ratings of qualities and importance of odors, presented and in general

- Nominal demographic information

The final questionnaire given was the RQ (Appendix A) to measure Adult Attachment, which moderates changes in affect (Feeney & Kirkpatrick, 1996) and correlates with frequency of smelling a partner's clothing (McBurney, Euler, Streeter, & Shoup, 2005).

Upon completion of questionnaire, participants were fully debriefed, thanked and given course credit.

6.0 RESULTS

6.1 MANIPULATION CHECK

The stress induction was successful. As shown in Table 2, feelings of Comfort significantly decreased from baseline (M = 2.86, SD = .77) to pre-odor exposure (M = 1.80, SD = .86), t (117) = 12.34, $p < .000$. Negative Affect significantly increased from baseline (M = 10.32, SD = 3.37) to pre-odor exposure (M = 18.16, SD = 6.13), t (117) = -15.18, $p < .000$. Similarly, Anxiety scores also significantly increased from baseline (M = -15.88, SD = 8.56) to pre-odor exposure (M = 1.53, SD = 10.62), t (117) = -18.41, $p < .000$. Taken together, these differences indicate that participants did feel increased negative affect and anxiety, and decreased comfort after the mental arithmetic stressor task.

6.2 DESCRIPTIVE STATISTICS

Descriptive statistics for the independent variables are presented in Table 2. Neither Baseline nor Pre-Odor levels of the dependent variables differed significantly between conditions (all ps > .05). Descriptive statistics for the covariates are presented in Table 3. None of the covariates differed significantly between conditions (all ps > .05).

Table 2. Descriptive statistics of dependent variables by condition

		Partner Condition (Experimental) (n=41)	Neutral Condition (Control) (n=32)	Other Condition (Placebo) (n=45)
		M (sd)	M (sd)	M (sd)
Comfort				
	Baseline	2.80 (.72)	2.84 (.92)	2.93 (.72)
	PreOdor	1.83 (.92)	1.59 (.67)	1.91 (.93)
	PostOdor (DV)	3.05 (.74)	2.34 (.90)	2.60 (.89)
	Post-Pre Difference	1.22	.75	.69
Anxiety	Baseline	-14.30 (8.11)	-16.56 (10.36)	-16.86 (7.43)
	PreOdor	1.29 (11.81)	3.25 (9.60)	.50 (10.22)
	PostOdor (DV)	-13.49 (9.26)	-7.62 (11.60)	-12.82 (8.95)
	Post-Pre Difference	12.20	4.37	7.82
Negative Affect	Baseline	10.85 (3.50)	10.44 (4.15)	9.71 (2.46)
	PreOdor	18.90 (6.87)	18.34 (6.40)	17.34 (5.19)
	PostOdor (DV)	10.70 (4.02)	12.19 (5.26)	10.64 (3.82)
	Post-Pre Difference	8.20	6.15	6.70

Table 3. Descriptive statistics of the covariates by condition

	Partner Condition (Experimental) (n=41)	Neutral Condition (Control) (n=32)	Other Condition (Placebo) (n=45)
	M (sd)	M (sd)	M (sd)
Secure	3.90 (1.46	3.78 (1.73)	4.47 (1.33)
Fearful	3.00 (1.90)	2.97 (2.07)	2.11 (1.77)
Preoccupied	2.80 (1.91)	2.13 (1.80)	2.40 (1.91)
Dismissing	2.83 (1.48)	2.80 (1.71)	2.73 (1.63)
Self-Model	.93 (3.89)	1.50 (4.54)	2.69 (4.17)
Other-Model	.89 (4.09)	.13 (4.10)	2.02 (3.88)

6.3 HYPOTHESIS 1: THE SCENT OF A ROMANTIC PARTNER SHOULD DECREASE NEGATIVE AFFECT AND ANXIETY AND INCREASE FEELINGS OF COMFORT

I predicted that the smell of a romantic partner (PO) should decrease negative affect (PANAS-N) and state anxiety (S-Anxiety) relative to the control condition Neutral Odor (NO) and placebo Other Odor (OO). It should also increase feelings of being comforted, as reported by participants in the previously described questionnaires. Thus, a main effect of PO was predicted with PANAS-N (the negative affect subscale of PANAS); S-Anxiety; and "Comforted" as dependent variables. This hypothesis was partially confirmed.

Participants exposed to their partners' odor had a significant increase in reported feelings of comfort ($M = 3.05$, $sd = .74$) relative to both the control (Neutral odor; $M = 2.34$, $sd = .90$) and placebo (Other odor; $M = 2.60$, $sd = .89$) conditions as illustrated in Figure 4.

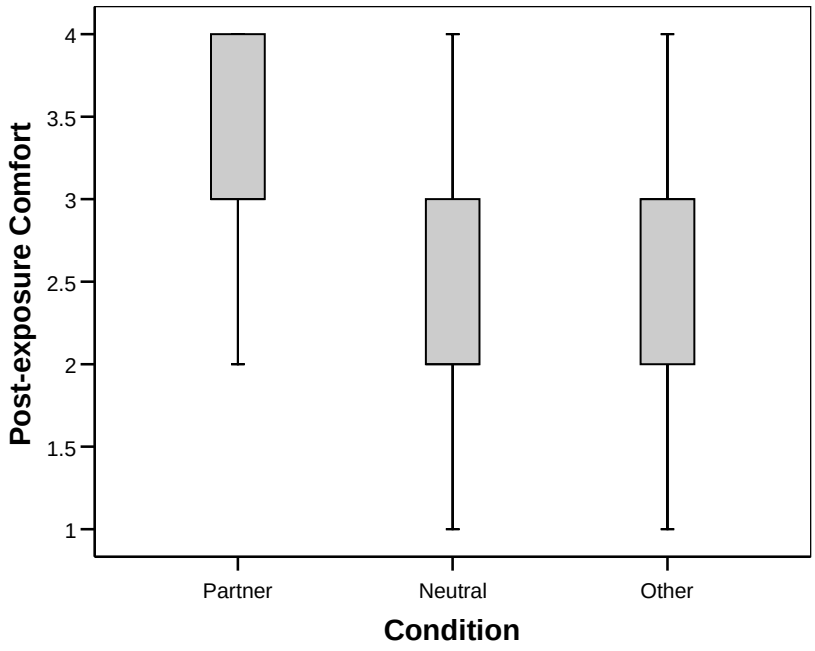

Figure 4. The effect of a partner's scent on Comfort

Exposure to a partner's scent significantly improved Anxiety (M = -13.49, sd = .9.26) only when compared to a neutral odor (M = -7.63, sd = 11.60) but not when compared to other persons (M = -12.82, sd = 8.94). Figure 5 illustrates this effect.

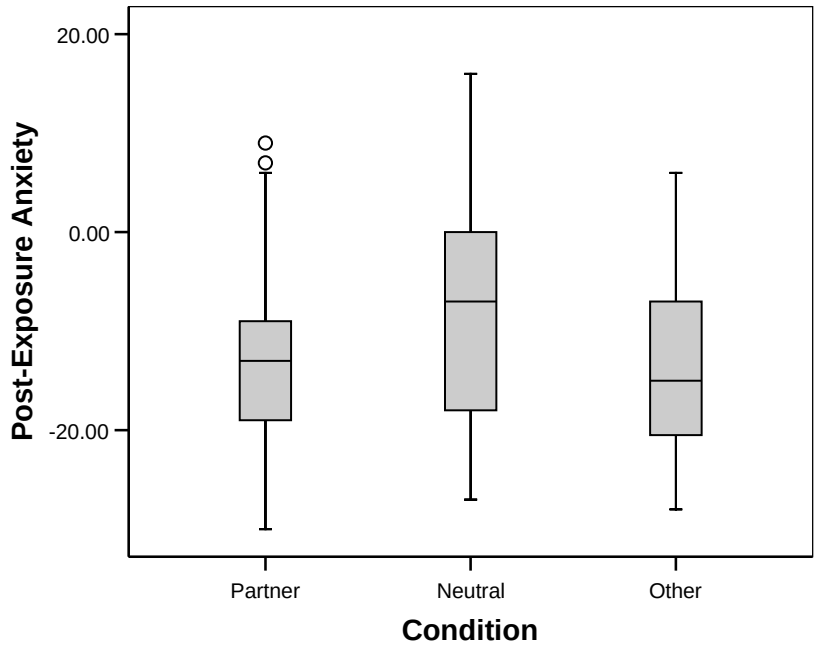

Figure 5. The effect of a partner's scent on Anxiety

The pattern for Negative Affect was similar to that of Anxiety. Figure 6 shows that exposure to a partner's scent significantly improved Anxiety (M = 10.70, sd = 4.02) only when compared to a neutral odor (M = 12.19, sd = 5.26) but not when compared to other persons (M = 10.64, sd = 3.82).

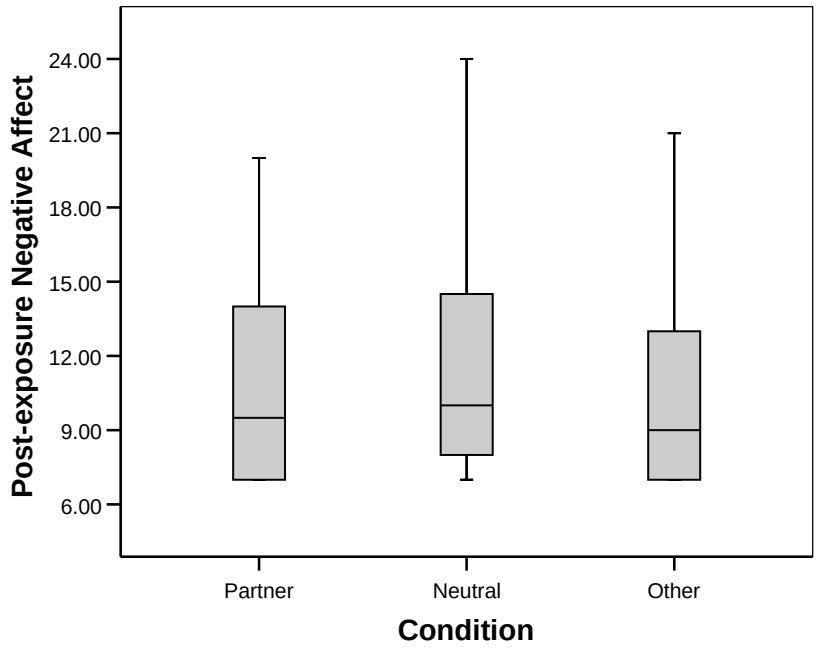

Figure 6. The effect of a partner's scent on Negative Affect

Table 4 shows the results of the regression analyses. Comfort improved when comparing the scent of a partner (Experimental) to both the scent of another person (Placebo; effect size = -.55) and neutral (Control; effect size = -.68). Participants exposed to their partners' odor reported lower Anxiety only when compared to the neutral odor (Control; effect size = .48) but not when compared to another person's scent. Participants exposed to their partners' odor reported lower Negative Affect only when compared to the neutral odor (Control; effect size = .39) but not when compared to another person's scent. On the dependent variable Comfort, the regression equation accounted for 25% of the variance; for Anxiety the equation accounted for

36% of the variance and for Negative Affect 39% of the variance is accounted for by the regression equation.

Table 4. Regression analyses of Condition on Post-Odor Exposure Dependent Variables

Variable	B	SE
COMFORT		
Constant	2.27**	.19
Pre-exposure Comfort	.43**	.08
Placebo	-.48**	.17
Control	-.61**	.18
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]	
ANXIETY		
Constant	-14.18**	1.27
Pre-exposure Anxiety	.53**	.07
Placebo	1.09	1.76
Control	4.82*	1.91
R^2 (ΔR^2) [p]	.36 ** (.37) [p<.000]	
NEGATIVE AFFECT		
Constant	2.45*	1.11
Pre-exposure Negative Affect	.44**	.05
Placebo	.65	.75
Control	1.67*	.81
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

6.4 HYPOTHESIS 2: SELF-MODELS AND OTHER-MODELS SHOULD MODERATE THE EFFECT OF A PARTNER'S SCENT

In the second hypothesis, I ask whether the higher-order dimensions of Self-Model and Other-Model moderate the relationship of odor on Comfort, Anxiety and Negative Affect. Hierarchical linear regression analysis (shown in Tables 5 and 6) was performed on each independent variable

(and for each dependent variable) to assess the relative contribution of these to the model. Hypothesis 2 was also partially supported.

6.4.1 The effect of Self-Model

Table 5 shows that higher self-models predicted increases in feelings of comfort (.02 increase in R^2, $p = .05$) in the second step, indicating that higher self-models can attenuate the effect of a stressor task recovery of feelings of comfort in general. There was no interaction between Self-Model ($\beta = .15$ ($p < .10$) with condition. Thus the effect of condition was not moderated by higher self-models.

Table 5 shows that higher self models also explained decreases in Anxiety in all conditions ($\beta = -.15$, $p < .05$; R^2 change = .03, $p = .03$), but did not interact with condition (the same pattern as Comfort). Thus, it is not a moderator of the relationship between odor and anxiety. Individuals with higher self-models recovered better from Anxiety induced by the stressor task than those with low self-models regardless of the odor presented.

Adding Self-Model to the regression equation for Negative Affect (Table 5) explained additional variance (R^2 change = .02, $p = .05$). The effect of Self-Model on decreased Negative Affect ($\beta = -.15$, $p < .05$) is similar to that of Anxiety and Comfort: Higher Self-Models alone were associated with decreased Negative Affect, but the interaction with condition may be responsible for the effect observed ($\beta = -.07$, $p < .10$ for Placebo x Self-Model). The difference between placebo and partner condition was weaker for those with high self-models.

6.4.2 The effect of Other-Model

No main effect of Other-Model was found for increased Comfort in either step. A marginally significant interaction was found for Control x Other-Model, however (β = -.20, p < .10), suggesting that the difference between the control and experimental groups is accentuated for those high on Other-Model (Table 6).

Statistically, higher Other Models were related to decreased Anxiety alone without regard to condition (β = -.29, p < .05) as shown in Table 6. Anxiety decreased as Other-Models increased for those in the Experimental (Partner) condition, but the interaction indicates that anxiety increased as Other Models increased for those in the Placebo (Other) condition (β = .18, p < .10 for the Placebo x Other-Model term). The difference between placebo and partner condition was thus attenuated for those with high other-models.

A main effect of Other-model on Negative Affect was observed in that participants with higher Other-models experienced greater decreases in negative affect regardless of odor condition (Table 6). The effect of condition was again attenuated as the difference between placebo and partner condition was reversed for those with high other-models.

Table 5. Hierarchical Regression analyses of Self-Model predicting Post-Odor Exposure Dependent Variables

SELF-MODEL	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
COMFORT						
Constant	2.27**	.19	2.27**	.19	2.30**	.19
Pre-exposure Comfort	.43**	.08	.41**	.08	.39**	.08
Placebo	-.48**	.17	-.54**	.17	-.59**	.18
Control	-.61**	.18	-.63**	.18	-.59**	.19
Self-Model			.03+	.02	.03	.13
Placebo x Self-Model					.02	.04
Control x Self-Model					-.03	.04
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.27+ (.02) [p=.06]		.26 (.00) [p=.57]	
ANXIETY						
Constant	-14.18**	1.27	-13.82**	1.26	-13.88	1.28
Pre-exposure Anxiety	.53**	.07	.51**	.07	.51*	.07
Placebo	1.09	1.76	1.73	1.76	2.81	1.92
Control	4.82*	1.91	5.06*	1.90	4.59*	1.96
Self-Model			-.36*	.18	-.29	.32
Placebo x Self-Model					-.45	.43
Control x Self-Model					.30	.45
R^2 (ΔR^2) [p]	.36 ** (.37) [p<.000]		.37* (.02) [p=.05]		.37 (.02) [p=.22]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	2.82*	1.11	2.63*	1.12
Pre-exposure Negative Affect	.44**	.05	.43**	.05	.43**	.05
Placebo	.65	.75	.86	.74	1.38+	.81
Control	1.67*	.81	1.72*	.80	1.98*	.83
Self-Model			-.16*	.08	.04	.14
Placebo x Self-Model					-.31+	.19
Control x Self-Model					-.22	.19
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]		.41* (.02) [p=.05]		.41 (.02) [p=.24]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

Table 6. Hierarchical Regression analyses of Other-Model predicting Post-Odor Exposure Dependent Variables

OTHER-MODEL	Model 1		Model 2		Model 3	
	B	SE	B	SE	B	SE
COMFORT						
Constant	2.27**	.19	2.26**	.20	2.17**	.20
Pre-exposure Comfort	.43**	.08	.43**	.08	.46**	.08
Placebo	-.48**	.17	-.50**	.17	-.47**	.18
Control	-.61**	.18	-.60**	.18	-.55**	.18
Other-Model			.01	.02	.05	.03
Placebo x Other-Model					-.04	.04
Control x Other-Model					-.09+	.05
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.25 (.00) [p=.53]		.30 (.02) [p=.17]	
ANXIETY						
Constant	-14.18**	1.27	-13.92**	1.27	-13.52**	1.28
Pre-exposure Anxiety	.53**	.07	.53**	.07	.53**	.07
Placebo	1.09	1.76	1.36	1.75	.37	1.86
Control	4.82*	1.91	4.61*	1.91	4.19*	1.91
Other-Model			-.29	.19	-.74*	.31
Placebo x Other-Model					.78+	.46
Control x Other-Model					.66	.47
R^2 (ΔR^2) [p]	.36 ** (.37) [p<.000]		.36 (.01) [p=.13]		.37 (.02) [p=.18]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	2.46*	1.11	2.58*	1.11
Pre-exposure Negative Affect	.44**	.05	.44**	.05	.44**	.05
Placebo	.65	.75	.75	.75	.35	.80
Control	1.67*	.81	1.60*	.81	1.49+	.81
Other-Model			-.09	.08	-.22+	.13
Placebo x Other-Model					.27	.19
Control x Other-Model					.11	.20
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]		.39 (.01) [p=.27]		39 (.01) [p-.35]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

6.5 HYPOTHESIS 3: MODERATION BY INDIVIDUAL DIFFERENCES IN ADULT ATTACHMENT

Hypothesis 3 concerns the relationship of individual differences in adult attachment as potential moderators of the relationship of odor on emotions. Tables 7, 8, 9, and 10 show the full hierarchical regression models. Hypothesis 3 was partially confirmed: individual differences in adult attachment did explain changes in the dependent variables in the predicted directions (though the effect was not always statistically significant). Highly Secure participants showed modest increases in Comfort and decreases in Anxiety and Negative Affect from exposure to partners' odors. Highly Fearful participants showed greater reduction in Negative Affect and Anxiety when exposed to partners' odor. As hypothesized, the effect of preoccupation depended upon condition for reduction of Anxiety and Negative Affect. Highly Dismissing participants were relatively unaffected by the experimental manipulation.

6.5.1 Secure Attachment

Table 7 shows that a significant effect of Secure attachment was found for Comfort ($\beta = .24$, $p < .10$). Highly secure individuals exposed to partner's scent had greater increases in feelings of Comfort when compared to either placebo (other person) or control (neutral odor). Adding ratings of Secure accounted for an increase in R^2 of .03 ($p = .05$). The effect of Secure attachment on Comfort was .16 ($p < .05$) in Step 2 and the effect size was .24 ($p < .10$) in Step 3.

The same pattern was observed for Anxiety; highly secure participants exposed to their partners' scent showed greater decreases in Anxiety than those in the placebo or control conditions (β = -.22, $p < .10$) with a significant increase in R^2 of .02, p = .05. The effect of condition was attenuated by scores on Secure attachment. The difference between placebo (other) and partner condition for anxiety scores was stronger for participants who rated themselves as more securely attached.

Overall, highly Secure participants did not differ from less Secure in decreased Negative Affect.

Table 7. Hierarchical Regression analyses of Secure Attachment predicting Post-Odor Exposure Dependent Variables (Placebo and Control conditions compared to the Experimental condition)

SECURE ATTACHMENT	Step 1		Step 2		Step 3	
	B	SE	B	SE	B	SE
COMFORT						
Constant	2.27**	.19	1.92**	.26	1.75**	.37
Pre-exposure Comfort	.43**	.08	.41**	.08	.41**	.08
Placebo	-.48**	.17	-.54**	.17	-.46**	.08
Control	-.61**	.18	-.60**	.18	-.19	.17
Secure			.10*	.05	.14+	.08
Placebo x Secure					-.02	.12
Control x Secure					-.11	.11
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.27* (.03) [p=.05]		.27 (.01) [p=.62]	
ANXIETY						
Constant	-14.18**	1.27	-10.21**	2.35	-8.54*	3.65
Pre-exposure Anxiety	.53**	.07	.51**	.07	.51**	.07
Placebo	1.09	1.76	1.61	.75	-1.05	5.62
Control	4.82*	1.91	4.73**	.89	2.28	5.00
Secure			-1.01*	.51	-1.44+	.88
Placebo x Secure					.65	1.27
Control x Secure					.64	1.21
R^2 (ΔR^2) [p]	.36** (.37) [p<.000]		.37* (.02) [p=.05]		.36 (.00) [p=.84]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	3.64**	1.44	2.71	2.00
Pre-exposure Negative Affect	.44**	.05	.44**	.05	.44**	.05
Placebo	.65	.75	.77	.75	2.83	2.46
Control	1.67*	.81	1.61*	.81	2.33	2.20
Secure			-.28	.22	-.07	.39
Placebo x Secure					-.49	.55
Control x Secure					-.18	.53
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]		.39 (.00) [p=.19]		.39 (.00) [p=.68]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

6.5.2 Fearful Attachment

Table 8 shows the full hierarchical regression for Fearful attachment. Fearfulness did not have an effect on Comfort but scores of Fearfulness did interact with the control (neutral) condition for Comfort ($\beta = .32$, $p < .10$ for the Control x Fearful interaction). As scores on fearful attachment increased, participants presented with a neutral odor increased comfort when compared to those who were exposed to their partners' odor. This may be a reflection of Fearful individuals having a negative view of others.

Less fearful participants reported decreased Anxiety compared to those highly fearful without respect to odor ($\beta = .28$, $p < .05$). Fearfulness did explain additional variance in the model in Step 2 (R^2 change = .03, $p = .03$) and the interaction accounted for significantly more variance when stepped into the model in Step 3 (R^2 change of .03, $p = .07$; See Table 8). Highly Fearful participants exposed to the neutral scent showed greater reductions in Anxiety than those exposed to their partners' scent in the full regression model ($\beta = .32$, $p < .10$ for the interaction of Control x Fearful). Table 8 also shows that the difference between the control (neutral) and partner condition was attenuated by higher scores on Fearful attachment with respect to Anxiety.

Fearfulness ($\beta = .17$, $p < .05$ in Step 2) also explained additional variance in the model for Negative Affect (R^2 change = .03, $p = .02$), but the effect is not seen in the full model (see Step3 of Table 8.

Table 8. Hierarchical Regression analyses of Fearful Attachment predicting Post-Odor Exposure Dependent Variables (Placebo and Control conditions compared to the Experimental condition)

FEARFUL ATTACHMENT	Step 1		Step 2		Step 3	
COMFORT	B	SE	B	SE	B	SE
Constant	2.27**	.19	2.40**	.22	2.56**	.26
Pre-exposure Comfort	.43**	.08	.43**	.08	.43**	.08
Placebo	.-.48**	.17	-.52**	.16	-.55+	.29
Control	-.61**	.18	-.61**	.18	-1.10**	.32
Fearful			-.04	.04	-.10	.06
Placebo x Fearful					-.01	.09
Control x Fearful					.17+	.09
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.26 (.01) [p=.24]		.27 (.03) [p=.11]	
ANXIETY						
Constant	-14.18**	1.27	-16.76**	1.71	-18.56**	2.31
Pre-exposure Anxiety	.53**	.07	.52**	.07	.52**	.07
Placebo	1.09	1.76	1.81	.76	2.21	2.98
Control	4.82*	1.91	4.89**	1.88	10.56**	3.36
Fearful			.87*	.39	1.47*	.65
Placebo x Fearful					.05	.94
Control x Fearful					-1.91*	.94
R^2 (ΔR^2) [p]	.36** (.37) [p<.000]		.38* (.03) [p=.03]		.40+ (.03) [p=.07]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	1.31	1.19	1.26	1.43
Pre-exposure Negative Affect	.44**	.05	.44**	.05	.44**	.05
Placebo	.65	.75	.97	.74	1.18	1.28
Control	1.67*	.81	1.67*	.79	1.44	1.44
Fearful			.39*	.16	.39	.28
Placebo x Fearful					-.10	.40
Control x Fearful					.08	.41
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]		.41* (.03) [p=.02]		.40 (.00) [p=.91]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

6.5.3 Preoccupied Attachment

Table 9 shows that scores on Preoccupied attachment were not associated with feelings of comfort from exposure to partner's odor (experimental condition), nor did higher Preoccupation interact with condition for Comfort.

For highly Preoccupied participants, Anxiety decreased when partners' odor was presented. A relatively large interaction emerged where those high on preoccupied experienced higher levels of Anxiety when presented with the smell of an unknown other person ($\beta = .43$, $p < .00$ in the full model); they were not significantly different from those in the Control (neutral) condition. High Preoccupation accounted for a significant change in R^2 change of .05 ($p = .02$) seen in Step 3 of Table 9.

Similarly, no main effect of preoccupation was observed for Negative Affect, and preoccupation also moderated the effect of condition on Negative Affect. Highly preoccupied individuals showed reduced Negative Affect only when exposed to partners' scent. Participants lower on preoccupation showed no such effect. The effect of scores on Preoccupied accounted for an effect of .44 ($p < .00$) when comparing the Placebo group to the Experimental and effect of .28 ($p < .05$) when comparing the Control group to the Experimental. This moderation is shown in Step 3 of Table 9 as an R^2 change of .05 ($p = .01$) for Negative Affect (experimental condition compared to both placebo and control). The difference in Negative Affect between the placebo and partner condition was accentuated for highly preoccupied participants. High Preoccupation scores also appeared to exacerbate the difference between the control and partner conditions on Negative Affect.

Table 9. Hierarchical Regression analyses of Preoccupied Attachment predicting Post-Odor Exposure Dependent Variables (Placebo and Control conditions compared to the Experimental condition)

PREOCCUPIED ATTACHMENT	Step 1		Step 2		Step 3	
	B	SE	B	SE	B	SE
COMFORT						
Constant	2.27**	.19	2.44**	.23	2.24**	.27
Pre-exposure Comfort	.43**	.08	.41**	.08	.41**	.08
Placebo	-.48**	.17	-.50**	.16	-.20	.28
Control	-.61**	.18	-.64**	.18	-.37	.30
Preoccupied			-.05	.04	.02	.06
Placebo x Preoccupied					-.11	.09
Control x Preoccupied					-.11	.10
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.26 (.01) [p=.20]		.26 (.00) [p=.37]	
ANXIETY						
Constant	-14.18**	1.27	-15.67**	1.70	-11.85**	2.19
Pre-exposure Anxiety	.53**	.07	.52**	.07	.51**	.07
Placebo	1.09	1.76	1.35	1.76	-5.58+	2.91
Control	4.82*	1.91	-5.20**	1.93	1.37	3.08
Preoccupied			.54	.41	-.82	.65
Placebo x Preoccupied					2.69**	.92
Control x Preoccupied					1.38	1.02
R^2 (ΔR^2) [p]	.36** (.37) [p<.000]		.38 (.01) [p=.19]		.40* (.04) p=.02]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	1.92+	1.16	3.88**	1.28
Pre-exposure Negative Affect	.44**	.05	.43**	.05	.43**	.05
Placebo	.65	.75	.73	.74	2.30+	1.22
Control	1.67*	.81	1.84*	.81	-.59	1.29
Preoccupied			.25	.17	-.42	.27
Placebo x Preoccupied					1.14**	.37
Control x Preoccupied					.93*	.42
R^2 (ΔR^2) [p]	.30** (.41) [p<.000]		.40 (.01) [p=.14]		.44* (.05) [p=.01]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

6.5.4 Dismissing Attachment

See Table 10: Dismissing attachment did not contribute to the model for any of the dependent variables in either step.

Table 10. Hierarchical Regression analyses of Dismissing Attachment predicting Post-Odor Exposure Dependent Variables (Placebo and Control conditions compared to the Experimental condition)

DISMISSING ATTACHMENT	Step 1		Step 2		Step 3	
COMFORT	B	SE	B	SE	B	SE
Constant	2.27**	.19	2.26**	.23	2.33**	.29
Pre-exposure Comfort	.43**	.08	.43**	.08	.44**	.09
Placebo	-.48**	.16	-.48**	.16	-.58+	.35
Control	-.61**	.18	-.61**	.18	-.80*	.38
Dismissing			.01	.05	-.03	.08
Placebo x Dismissing					.03	.11
Control x Dismissing					.07	.12
R^2 (ΔR^2) [p]	.25** (.27) [p<.000]		.25 (.00) [p=.89]		.24 (.00) [p=.84]	
ANXIETY						
Constant	-14.18**	1.27	-15.30**	1.85	-15.56**	2.77
Pre-exposure Anxiety	.53**	.07	.53**	.07	.53**	.07
Placebo	1.09	1.76	1.11	1.76	2.70	3.73
Control	4.82*	1.91	4.83*	1.92	3.73	3.94
Dismissing			.40	.48	.49	.87
Placebo x Dismissing					-.57	1.17
Control x Dismissing					.39	1.22
R^2 (ΔR^2) [p]	.36** (.37) [p<.000]		.35 (.00) [p=.41]		.35 (.00) [p=.70]	
NEGATIVE AFFECT						
Constant	2.45*	1.11	2.07	1.28	1.66	1.64
Pre-exposure Negative Affect	.44**	.05	.44**	.05	.44**	.05
Placebo	.65	.75	.67	.75	1.56	1.60
Control	1.67	.81	1.68*	.81	1.88	1.72
Dismissing			.12	.20	.27	.39
Placebo x Dismissing					-.32	.50
Control x Dismissing					-.07	.53
R^2 (ΔR^2) [p]	.39** (.41) [p<.000]		.39 (.00) [p=.55]		.38 (.00) [p=.79]	

Note. **p<.01, *p<.05, +p<.10, n= 118; R^2 values reported are adjusted R^2

7.0 DISCUSSION

The scent of a romantic partner improved feelings of comfort compared to the scent of another person or a neutral scent. This experimental finding validates our conceptualization of "olfactory comfort" in previous work (McBurney, Shoup & Streeter, 2006; Shoup, Streeter & McBurney, in press). The scent of one's partner also improved anxiety and negative affect when compared to a neutral odor, but its ability to reduce these aversive states was not different from the scent of unknown persons. This implies that there may be a specific quality to human odors, possibly an olfactory cue to the presence of another person is sufficient to improve negative emotional states. Although Chen and Haviland-Jones report differences between individual odors in their ability to reduce negative affect as measured in the Differential Emotion Scale (DES), specifically the scent of older women decreased negative mood, a critical difference between that study and the present is that their extensive controls were not implemented in the present. Chen and Haviland-Jones (1999) report that no applied fragrance or antiperspirants were permitted; fragrance-free deodorant was provided; underarms were not shaved and odorous foods were restricted for the odor donors. Gauze pads were applied to underarms for 8 – 10 hours for 3 days for each donor and these pads were frozen to preserve the samples (Chen & Haviland-Jones, 1999).

This is an important distinction, and answers a fundamentally different question regarding human odors: the present hypotheses regard odors with special significance to the participants in the present study, whereas Chen and Haviland-Jones describe broad and direct

effects of biological odors in general. For the present purposes it was most advantageous not to isolate biological odors from those applied artificially. A myriad of factors coalesce to create an individual's distinctive scent: diet (curry and garlic are two obvious sources), general health status (e.g., there is a detectable odor of acetone in diabetic ketosis and infant acidurias is characterized by "maple syrup urine", Labows & Preti, 1992), emotional states (e.g., fear as in Chen, Katdare & Lucas, 2006), environmental exposure (e.g., Steinbeck, 1945), and bacterial colonization all unite with chemicals released form all body sources to make up an individual's distinctive scent. The goals of the present study focus on the consequences of odors as they exist and merge in various ways to create a unique experience corresponding scent of the partner.

Bowlby (1973) defines attachment as "any form of behavior that results in attaining or retaining proximity to some other differentiated and preferred individual, usually conceived as stronger and/or wiser, and attachment theory is generally accepted primarily one of affect regulation. He later argues (1980) that the stability of attachment is primarily the result of internal working models of self and other. Consequently, Hypothesis 2 regarding individual differences in Self-model and Other-model may yield information about relationships in general, where Hypothesis 3 regarding differences in individual styles may be sensitive to the environment and yield information about the current relationship. It is also important to consider that true attachment relationships may take up to 2 years to be fully formed (Hazan & Shaver, 1994). The average length of relationship in the present sample was approximately 1.5 years, with a median of 1 year and a modal value of 6 months. Future research may benefit from exploring these hypotheses in populations with longer relationships.

Odor plays a large role in the behavior of other species and for infants; less is known about its function in adulthood (but see Schiffman, 1997 for important implications for the

elderly). Even the mere suggestion of odor can change responses in laboratory settings (Knasko, Gilbert & Sabini, 1990). This suggests that there may be even greater effects than these data show. The dependent measures were improved in all conditions, suggesting either a rebound or return to baseline, or perhaps a similar response to the mere suggestion of an odor.

7.1 BENEFITS FROM THE SMELL OF A ROMANTIC PARTNER

7.1.1 Positive emotion: Comfort

Overall, the smell of a romantic partner increased feelings of comfort when compare to either a neutral odor or that of another unknown person. This result validates our previous findings (McBurney, Shoup & Streeter, 2006) from questionnaires confirming that people do derive comfort from the smell of a loved one. Even though participants are not always able to accurately report the reasons for engaging in a particular behavior, in this case they appear to be accurately describing the qualia associated with the scent of a romantic partner. This also validates our conceptualization and coining of the term "olfactory comfort". The results presented in this paper suggest that this behavior is not only common, but it is also functional. In this manipulation, Comfort was experimentally decreased and a clear main effect of the scent of the romantic partner emerged: A partner's scent increased comfort when compared to both placebo (unknown persons) and control (neutral).

It has also been shown that conditioned responses to odors can continue to operate in the absence of the odors presented with effects on general mood states. For example, Schiffman and Siebert (1991) taught progressive relaxation techniques to participants and presented the odor of

apricot. Later exposure to the apricot odor alone was sufficient to induce relaxation. It is worth noting that there is congruency in the unconditioned stimuli and desired responses: it is much easier to condition pleasant states to pleasant odors. This suggests that the emotional benefits described here may well generalize to other valued relationships.

Main and colleagues (1985) describe attachment relationships in terms of a hierarchy, and placement in the hierarchical structure can change with time (e.g., the principal caregiver (usually mother) is the primary attachment figure in infancy, but within the first year of life multiple attachments are formed (Bowlby, 1984). Anecdotal evidence suggests that the scent used across a variety of relationships, and we have documented that the prevalence of first-degree relatives dominate in terms of frequency of smelling another for comfort (Shoup, Streeter & McBurney, in press). It would be interesting to replicate this paradigm and allow participants to select an item of clothing without restriction to romantic partner; it is possible that more robust results would be obtained when individuals are allowed to select the attachment figure whose scent comforts them the most. We have collected much anecdotal evidence in conversations about the phenomenon of smelling another person's clothing for comfort. Many colleagues and friends recall the scent of their mothers, or leaving an item with their own scent for children in their absence.

7.1.2 Aversive emotions: Anxiety and Negative Affect

Exposure to the odor of a romantic partner also decreased anxiety and negative affect, but only when compared to a neutral smell. Romantic partners were not significantly better than unfamiliar others in decreasing these aversive states. Participants in all conditions began to show recovery from the aversive states induced by the stressor task, but those exposed to human odors

recovered better, though it is not possible to say that they recovered "faster" because only one post-odor exposure questionnaire was administered. Future research might increase the length of post-odor assessments to address how long these effect last or focus on the rate of recovery in general. Additional questions are raised by the pattern of results suggesting that human smells decrease aversive states such as anxiety and negative affect. Because the placebo condition was a shifting one (each person was presented with a unique item), it is not possible to analyze the individual contributions of these odors. Future research could potentially investigate individual placebo odors to see if there is a specific compound that contributes to recovery from higher levels of anxiety and negative affect. There is also mate selection based on odor, so perhaps the distinctive odor of another person is agreeable to some but not others.

As shown in Table 2 (Hypothesis 1), exposure to a partner's odor was related to decreases in Negative Affect, but comparison with the control group again appears to explain the effect. This suggests that for reduction of negative emotions (Anxiety and Negative Affect), the any human odor may suffice. To increase feelings of comfort, which has a positive valence, it may be that there is something unique to the scent of a partner necessary for an effect.

Common wisdom and lay advice (military, etc) suggest that people use the odor of a romantic partner (or a mother's scent for infants, see Sullivan & Toubas, 1998) to relieve negative emotions and increase positive feelings, but this experiment is the first to demonstrate clear reasons for doing so. When aversive emotional states are inflated, the odor of a loved one serves to reduce the negative emotions and increases feelings of comfort. It is noteworthy that anxiety in infants is commonly triggered by separation from the attachment figure; it is therefore possible that attachment behaviors in adults are also activated by separation, and lends a plausible interpretation of our previous findings that people commonly use the scent of their

partner's in times of absence. This may be a general reflection of the activation of attachment behaviors. Feeney & Kirkpatrick (1996) have also shown that the presence of a non-evaluative partner increases benefits of social support. Cues to the physical presence of a supportive partner may be perceived through different sensory modalities, and perhaps odor is a cue that triggers less fear of evaluation (e.g., people feel better with social support, but this effect can be countered with fears of appraisal and evaluation from others). Researchers have employed several clever techniques to alleviate these fears (blindfolds, earphones, or distracting tasks for the supportive partner; using pet dogs who are presumed to be non-evaluative), but have focused on visual cues. Perhaps odor of a support partner can serve as stress buffering cue without the need to go to such lengths to avoid the evaluative aspects of another's presence.

Anxious and avoidant (e.g., Fearful, Preoccupied and Dismissing) women showed greater arousal to an anticipated stressful situation when their partners were present than when they were alone (Carpenter & Kirkpatrick, 1996). No effect of partner presence was noted for Secure women. These effects are similar to those found I the present study and taken together suggest that olfactory cues are sufficient to elicit similar reactions as actual physical presence.

Chen and Haviland-Jones found that certain odors, specifically older women (and not young women, young or older men, or children) decreased negative emotions, and no attempt was made to measure anxiety. This conflicts somewhat with what was found in the present study. While the placebo condition shifted and was different for each participant, the placebo odor was random, and thus does not have the potential for detailed analysis. The key difference between these two studies is that the present looks for specific effects of one individual while Chen and Haviland-Jones look for direct and general effects of biological odors.

7.2 CONTRIBUTION OF ADULT ATTACHMENT

7.2.1 Working Models: Self and Other

Working models of Self and Other contributed to understanding how people cope with negative emotions. Viewing oneself as competent and loveable (high Self-Model) was associated with greater recovery of comfort, and recovery from, induced anxiety and negative affect in all conditions, suggesting that those with higher self-models can rebound in general better from stressful situations. Higher self-models also moderated the effect of a partner's scent on negative affect; participants who view themselves as more competent and have higher self-esteem gained relief from increased negative affect when presented with any human scent. No meaningful differences in negative affect were observed between those exposed to the scent of a partner and those exposed to the scent of another person. This may indicate again the buffering effects of non-evaluative social support discussed above.

Viewing others more as available for support and caring (high Other-Model) revealed a more straightforward relationship with negative affect. Those higher in Other-Models showed decreased negative affect in all conditions. Because two of the conditions involve human odors, it may be the case that this effect is due to a general preference for human scents or cues to the presence of another person in stressful situations. In a larger sample, this might emerge as an interaction effect.

Having a positive view of one's self as competent and resilient (high self-model) alone explains recovery from the aversive emotion induction, and how one views others also explained differences in relationship between of the scent of a partner with subsequent distress. The hypothesis that the more positively one views others should strengthen the relationship between

a partner's scent and subsequent buffering of aversive emotions was marginally supported; those who view others more positively reported significantly decreased anxiety in the full regression model but the effects seems to be due to an interaction with condition. Higher Other-models reversed the direction of the relationship of odor on anxiety. Negative affect decreased as other models increased only for those exposed to the scent of an unknown person. This may be an artifact the inclusion of Preoccupied attachment in computing Other-models (see Section 7.2.2.3).

Although these working models are considered to be relatively stable, Feeney and Noller (1997) suggest that they may also be partly self-fulfilling and that working models can change, but do so only when they no longer fir the current situation. There is evidence that children choose friendships that reinforce their beliefs from earlier relationships (Sroufe, 1998). It is likely that as adults, these self-fulfilling patterns remain and may be a factor in romantic relationships. Furthermore, insecure individuals are likely to pair with equally insecure romantic partners (Brennan & Shaver, 1995; Collins & Read, 1990).

7.2.2 Individual differences in Adult Attachment

The predictions in Hypothesis 3 were partially confirmed: The trends for Secure, Fearful and Preoccupied attachment support the model proposed in Figure 3 although effects of Dismissing attachment were not detected. Adult attachment impacted post-odor emotions in the predicted directions: when presented with their partners' scent, security predicted improved comfort and anxiety. Fearfulness and preoccupation moderated negative emotions, however the direction of the effect was somewhat different. Highly fearful participants were negatively impacted by

human scents and seemed to prefer neutral odors while highly preoccupied participants greatly preferred the scent of their partners over unfamiliar persons.

7.2.2.1 Secure Attachment

Securely attached adults are most likely to advocate romantic and affectionate sexual behaviors (Brennan & Shaver, 1995). They tend to appraise stressful events as less threatening than do others, and express their emotions in a relatively open way. Most importantly for the present thesis, they are likely to seek support from others in stressful situations and benefit from it (Belsky, 2002).

Participants who described themselves as highly Secure experienced reported greater comfort after exposure to any odor. They also reported attenuation of anxiety in all conditions. In the full regression model, Security was the only significant predictor of Anxiety levels (except pre-exposure levels of anxiety, which were only added to the model for computational purposes). Adding ratings of Secure attachment to the equation accounted for increased variance for both comfort and anxiety.

Despite the observation that Secure attachment can attenuate the effects of one aversive state (anxiety), there was no effect of Security on changes in negative affect. Secure individuals by definition deal with negative emotions and feelings in constructive ways by acknowledging their distress and turning to supportive others when needed, and thus may be better equipped to cope with stressful situations in general. Perhaps this is simply a function of the inherent sense of self-worth and ability to self regulate. Feeney and Kirkpatrick (1996) found that the presence of a partner decreased anxiety only for insecurely attached women. Secure individuals acknowledge the stress of a given situation, but commonly view it as manageable. The failure to

find an effect of Secure attachment on negative affect may be a reflection of this general trend of highly secure individuals to be characterized as resilient (Hazan & Shaver, 1987).

7.2.2.2 Fearful Attachment

Fearful adults are highly dependent on others' acceptance and affirmation, similar to preoccupied individuals (Belsky, 2002). They have negative view of themselves and others.

Fearfulness alone did not contribute to understanding the relationship of odor on comfort levels, but highly fearful participants did recover feelings of comfort when presented with a neutral odor. This moderation effect highlights the negative view of others that highly Fearful individuals have. This finding is likely not a reflection of the odor (or more accurately, a lack thereof) but rather the result of a combination of the relatively deep nasal breaths taken to inhale the odors and a return to baseline comfort following the stressor. In any event, human smells were not comforting to highly fearful participants.

For anxiety, high highly fearful individuals did not rebound as well as those lower on fearfulness. An interaction with condition suggests that again, being highly fearful and exposed to a neutral odor resulted in greater decreases in anxiety. Thus, the pattern appears that those who are highly fearful do not associate human scents with positive emotions; participants who rated themselves a lower on the fearfulness scale experienced greater emotional benefits than those who were highly fearful.

Highly fearful individuals had less attenuation in negative affect in general from the stressor task in terms of negative affect, but this effect was failed to emerge in the full model. This again indicates that the characterization of fearful attachment does indicate a broad negative view of others.

7.2.2.3 Preoccupied Attachment

Preoccupied adults anxiously seek to gain acceptance and validation from others. They tend to focus on their own distress, ruminate on negative thoughts, and adopt emotion-focused coping strategies that exacerbate rather than diminish distress (Belsky, 2002). Highly preoccupied individuals experience reduced benefits of social support (Moreira et al, 2003).

As predicted, preoccupied attachment moderated the relationship of odor on emotion, primarily in terms of aversive emotional states. While preoccupied attachment did not help explain changes in comfort from the different odors presented, highly preoccupied individuals appeared very different from less preoccupied participants in reduction of anxiety and negative affect. When presented with the odor of an unfamiliar person, ratings of anxiety increased as scores on preoccupation increased. The scent of an unknown person was particularly made more preoccupied individuals more anxious. This effect was particularly robust as the full regression model accounted for 40% of the variance in post-exposure anxiety ratings.

Highly preoccupied participants' negative affect significantly decreased when they were presented to the scent of their partners. Exposure to neutral and unknown persons did not help to improve negative affect. Again, a large effect was found for the exposure to unfamiliar persons.

Taken together, these results may indicate that highly preoccupied individuals find the odor of unfamiliar people particularly disagreeable, but this does not fully explain the interaction with neutral odors for negative affect. It is more likely that the qualities associated with high scores on preoccupied attachment (excessive clinginess and reliance on others) lead them to become especially attached to any cue indicating the presence of a preferred significant other.

When olfactory cues to the presence of their partners were unavailable, more preoccupied participants had greater difficulty regulating affect.

7.2.2.4 Dismissing Attachment

Dismissing adults are comfortable without close emotional relationships. They want to feel independent and self-sufficient, and prefer not to depend on others or have others depend on them (Brennan & Shaver, 1995). They avoid closeness because of negative expectations but maintain a sense of self-worth by defensively denying the value of close relationships.

The present study failed to find significant effects of Dismissing attachment for any of the dependent variables. This absence is remarkable only because our previous work has shown a significant negative correlation between the frequency of smelling a romantic partner's clothing for comfort (McBurney, Euler, Streeter & Shoup, 2005) in a large (n=544) cross-cultural sample. If highly dismissive people do not engage in this type of behavior, it is reasonable to assume that they do not experience emotional advantages from the scent of their loved ones, but this should have emerged as a significant effect in the model.

Highly dismissing individuals also fail to fully acknowledge negative emotions (Feeney & Noller, 1996), although a mean split of the Dismissing variable showed no significant differences in baseline or pre-exposure levels of any of the dependent variables. One possible reason for the failure to find significant effects in this category may be a reflection of the adult attachment model itself. Historically, categories of adult attachment were carried over from infant attachment styles. The original model consisted of three categories: Secure Anxious/Avoidant, and Fearful/Avoidant. Bartholomew and Horowitz (1991) noticed differences in the behavior in the Fearful/Avoidant category which would be akin to fearful and

Dismissing categories. It is possible that using the original categories of attachment would yield more meaningful effects by effectively collapsing these categories together.

8.0 CAVEATS AND LIMITATIONS

It is important to note that these data also do not support the dubious claims of aromatherapists except in the sense that these benefits are observed when an individual has formed a positive association with a particular scent. These data more accurately reflect the possibility of conditioned associations to a partner's scent, especially when that partner is seen as supportive and reliable. This explanation was especially true for highly Preoccupied individuals, who benefit most from the scent of a partner when compared to another person. By definition, no partner is ever supportive enough for people high on this scale; this finding supports the idea that the results reported here support the idea of conditioned responses to scent of a partner. Other stimuli perceived as pleasant certainly also improve emotions alone (e.g., food or flowers), but aromatherapy suggests that odors have direct effects on emotions, and this was not shown in the present study. The claim of aromatherapy is that certain odorants can relax, calm, stimulate, etc in the absence of conditioning is one still in need of experimental validation.

Several improvements to the present study are warranted. First, a composite measure that indicates feelings of comfort (as opposed to global increases in mood states) would permit more refined analysis of data such as these. The feelings and reasons for smelling a loved one's clothing described by our previous participants overwhelmingly supported the descriptor "comfort", but the qualia proved difficult to expand into established scales.

The focus of the moderation effects proposed here involve adult attachment, and it has been argued that attachment in adult relationships may take up to 2 years to develop. Restricting samples to couples involved in longer terms relationships may generate results that are more robust and/or reliable in terms of attachment ratings. It should also be noted that other instruments to measure adult attachment exist. A more comprehensive and detailed measure could illuminate differences or trends not possible with the current, brief instrument. It would also be useful to examine both members of the romantic relationships to shed additional light on the functions of attachment in adults overall. Furthermore, the restriction to romantic partners may have been too narrow; allowing participants to select the target person whose scent they prefer may also produce more meaningful conclusions about the capacity of scent to evoke or modulate emotions.

It may also be fruitful to study dyads. Males and females differed in their behaviors as a function of their partner's adult attachment style. Male coping strategies were unrelated to their partner's attachment, but female's choice of coping strategies changed according to increases in their partner's level of Anxious attachment (Feeney, 1998). The advantage in studying both members of a romantic pair could answer questions about how attachment may be sensitive to the environment and whether individuals with different attachment styles elicit different patterns from their partners.

APPENDIX A

RELATIONSHIP QUESTIONNAIRE

Following are four general relationship styles that people often report. Place a checkmark next to the letter corresponding to the style that best describes you or is closest to the way you are.

___A) STYLE A: It is easy for me to become emotionally close to others. I am comfortable depending on them and having them depend on me. I don't worry about being alone or having others not accept me.

___B) STYLE B: I am uncomfortable getting close to others. I want emotionally close relationships, but I find it difficult to trust others completely, or to depend on them. I worry that I will be hurt if I allow myself to become too close to others.

___C) STYLE C: I want to be completely emotionally intimate with others, but I often find that others are reluctant to get as close as I would like. I am uncomfortable being without close relationships, but I sometimes worry that others don't value me as much as I value them.

___D) STYLE D: I am comfortable without close emotional relationships. It is very important to me to feel independent and self-sufficient, and I prefer not to depend on others or have others depend on me.

(Questions 5-8) Now please rate each of the relationship styles above to indicate how well or poorly each description corresponds to your general relationship style.

5. Style A

Disagree Strongly			Neutral/ Mixed			Agree Strongly
0	1	2	3	4	5	6

6. Style B

Disagree Strongly			Neutral/ Mixed			Agree Strongly
0	1	2	3	4	5	6

7. Style C

Disagree Strongly			Neutral/ Mixed			Agree Strongly
0	1	2	3	4	5	6

8. Style D

Disagree Strongly			Neutral/ Mixed			Agree Strongly
0	1	2	3	4	5	6

APPENDIX B

MODIFIED STAI

A number of statements which people have used to describe themselves are given below. Read each statement and then select the appropriate one to indicate ***how you feel right now,*** that is, ***at this moment***. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best. Use the following scale to record your answers.

1	**2**	**3**	**4**
Not at all	**Somewhat**	**Moderately so**	**Very much so**

I feel calm …….	1	2	3	4
I feel secure……	1	2	3	4
I am tense…….	1	2	3	4
I feel strained……	1	2	3	4
I feel upset…….	1	2	3	4
I feel frightened……	1	2	3	4
I feel steady……	1	2	3	4
I feel at ease……	1	2	3	4

I feel indecisive……	1	2	3	4
I feel comfortable……	1	2	3	4
I feel self-confident……	1	2	3	4
I feel comforted……	1	2	3	4
I feel happy……	1	2	3	4
I feel nervous……	1	2	3	4
I am jittery…….	1	2	3	4
I am relaxed……	1	2	3	4
I feel content	1	2	3	4
I am worried……	1	2	3	4
I feel joyful……	1	2	3	4
I feel pleasant……	1	2	3	4
I feel confused……	1	2	3	4
I feel anxious……	1	2	3	4
I feel rested……	1	2	3	4
I feel "high strung"……	1	2	3	4
I feel good…….	1	2	3	4

APPENDIX C

PANAS

This scale consists of a number of words that describe different feelings and emotions. Read each item and then circle the number. Indicate to what extent you feel this way ***right now***, that is, ***at the present moment***.

Use the following scale to record your answers:

1 = very slightly or not at all

2 = a little

3 = moderately

4 = quite a bit

5 = extremely

interested ……...……....1 2 3 4 5

distressed ……..……..1 2 3 4 5

excited …… 1 2 3 4 5

upset ……...…1 2 3 4 5

strong ……... .1 2 3 4 5

hostile……...….. …1 2 3 4 5

enthusiastic ……..……..…1 2 3 4 5

proud ……. 1 2 3 4 5

irritable ……...…….. 1 2 3 4 5

alert …… 1 2 3 4 5

ashamed ……..…...1 2 3 4 5

nervous ……..……1 2 3 4 5

determined ……..…….…..1 2 3 4 5

attentive …… 1 2 3 4 5

jittery ……..…… 1 2 3 4 5

active ……1 2 3 4 5

APPENDIX D

FINAL DEMOGRAPHIC QUESTIONNAIRE

Please answer the following questions on this form.

Complete each page before turning to the next,

Do not go back to the previous pages.

(Questions 1-5) Answer with regard to the item you smelled.

1. Rate the pleasantness of the odor (circle the corresponding number)

Very Unpleasant						Very Pleasant
0	1	2	3	4	5	6

2. Rate the intensity of the odor (circle the corresponding number)

Odorless						Strong
0	1	2	3	4	5	6

3. Rate the erotic quality of the odor (circle the corresponding number)

None						Very Erotic
0	1	2	3	4	5	6

4. Do you think you smelled an item that belongs to your partner?

___ No

___ Yes

5. How confident are you in your answer to number 4?

Not at all Very

0 1 2 3 4 5 6

6. What came to mind when you smelled the item?

___ 0) Nothing associated with my partner

___ 1) A positive memory about my partner

___ 2) A negative memory about my partner

___ 3) A neutral memory about my partner

7. Your Sex

___ 0) Female

___ 1) Male

(Questions 7&8 apply to females only)

8. Are you currently pregnant?

___ 0) No

___ 1) Yes

9. How many weeks ago did your last period begin?

_____

10. Please list any medications you are currently taking (please include birth control) on a daily basis

_____

_____

11. Your Age _____

12. Your Partner's Age _____

13. How long have you been with you current partner? _____

14. Rate the importance of smell to you when deciding whether or not to become romantically involved with someone.

Not at all Important — Extremely Important

0 1 2 3 4 5 6

15. You are devastated, because you just found out that you failed a test, how likely are you to go to your partner for support? Why?

___ 0) Not at all likely

___ 1) Probably Not

___ 2) Maybe

___ 3) Probably Yes

___ 4) Definitely Yes

16. How many photos of family members or friends (people you know personally) do you have on display in your room or apartment?

- Count the number of photos, not the people in the photos.
- Do include posters or pictures of celebrities.
- Do not count roommate's pictures.
- If you are not sure how many photos you have, please estimate.

(Number of photos): _____

17. Whose article of clothing did you bring with you today? (current boyfriend, past boyfriend, etc.) _____

How long have you had this item? _____

How often have you intentionally smelled another person's clothing to feel closer to him or her?

Never Frequently

0 1 2 3 4 5 6

18. How often have you ever slept with (or worn to sleep) another person's clothing (that hadn't been laundered since it had been worn) ***because*** it smelled like him or her?

Never Frequently

0 1 2 3 4 5 6

19. Have you ever given another person (or has another person taken) an article of your own clothing (that hadn't been laundered since it had been worn) ***because*** it smelled like you?

Yes [ ] No [ ]

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