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Neural evidence for a multifaceted model of attachment security

Melanie Canterberry [1], Omri Gillath *

University of Kansas, 1415 Jayhawk Blvd, Department of Psychology, Lawrence, KS 66045, United States

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ABSTRACT

The sense of attachment security has been linked with a host of beneficial outcomes related to personal and relational well-being. Moreover, research has demonstrated that the sense of attachment security can be enhanced via cognitive priming techniques. Studies using such techniques have shown that security priming results with similar outcomes as dispositional attachment security. The way security priming leads to these effects, however, is yet to be unveiled. Using fMRI we took one step in that direction and examined the neural mechanisms underlying enhanced attachment security. Participants were exposed to explicit and implicit security- and insecurity-related words. Security priming led to co-occurring activation in brain areas reflective of cognitive, affective, and behavioral processes (e.g., medial frontal cortex, parahippocampus, BA 6). There were activation differences based on attachment style. This research serves as an important step in mapping out the security process and supports a conceptualization of security as part of a behavioral system with multiple components.

1. Introduction

Attachment security is defined as the sense that one is worthy of being loved, close others will be there when needed, the world is generally safe. It is associated with a sense that one can explore the environment curiously and confidently while engaging rewardingly with others (Mikulincer and Shaver, 2007a). According to Bowlby (1969/1982), being securely attached, or having a secure *attachment style*, involves having a set of mental representations or *Internal Working Models* (IWMs) of oneself (as competent and worthy of being loved), others (as trustworthy and helpful), and the world/relationships in general (as safe, just, and positive). People develop these models through repeated experiences with their primary caregivers named *attachment figures*. IWMs are thought to be relatively stable and represent a trait-like characteristic, known as *attachment style* (Fraley et al., 2011).

The function of the attachment system is to guide behavior when people are threatened or stressed, in a way that would enhance their survivability. Attachment security is thought to facilitate people's ability to cope with threats when the attachment system is activated. Feeling secure, or having a sense of attachment security, however, goes beyond coping with threats; it facilitates more general capabilities such as emotion regulation, and behaviors such as exploration, caregiving, and affiliation. Security is also known to be associated with numerous positive outcomes, including personal factors such as self-esteem and positive mood, and relational factors such as greater relationship satisfaction and stability.

Despite the broad literature on attachment security, its development, and its outcomes (see reviews by Gillath et al., 2008; Mikulincer and Shaver, 2007b), relatively less is known about its underlying mechanisms. Recent papers (Coan, 2010; Gillath et al., 2012; Tomlinson and Aron, 2012) have suggested examining the associations between attachment and the brain as a likely fruitful direction to determine these underpinnings. Mapping the brain regions that are associated with core relationship processes, like attachment security, is likely to contribute to our understanding of these processes and finding ways to improve them (i.e., interventions or security enhancing treatments). Further, neuroimaging can elucidate ways in which attachment security is unique or similar to other more general systems such as self-esteem, mood, or personality traits. Finally, neuroimaging can help avoid some of the biases associated with self-reports and behavioral measures that exist in many of the studies on attachment security and its effects (see similar approach in Gillath et al., 2005). In line with these suggestions, in the current study we used fMRI and priming techniques to investigate the components of attachment security and the role of attachment style in its enhancement.

1.1. Attachment style

Not everyone develops a secure attachment style. Insensitive, unsupportive, or rejecting experiences with caregivers can lead people to develop either an *anxious* or *avoidant* insecure attachment style (e.g., Brennan et al., 1998; Fraley and Waller, 1998; Hazan and Shaver, 1987). Being high on *attachment anxiety* reflects a tendency to worry about potential rejection or others' lack of availability in

* Corresponding author at: Department of Psychology, University of Kansas, 1415 Jayhawk Blvd. Rm 518, Lawrence, KS 66045, United States. Tel.: +1 785 864 1772; fax: +1 785 864 5696.
E-mail address: ogillath@ku.edu (O. Gillath).
[1] Present address: Medical University of South Carolina, Departments of Psychiatry, 67 President St. Rm. 502 North, Charleston, SC 29425, United States.

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times of need. Rather than using primary coping strategies (e.g., reaching out in times of need) anxiously attached individuals are likely to use hyperactivating secondary strategies, have their attachment system chronically activated, and therefore be hypervigilant to attachment-related threats. Anxiously attached people tend to be clingy, feel that others do not love them or won't remain with them, and appear vulnerable and in need of help (Mikulincer and Shaver, 2007a).

Being high on *attachment avoidance* reflects a tendency to distrust relationship partners' availability and maintain behavioral independence and emotional distance from partners. People high on attachment avoidance tend to adopt deactivating secondary strategies, which involve increased threshold for threat (any perceived threat that may lead to security-seeking) and attempts to downplay the need for closeness or help—which Bowlby referred to as compulsive self-reliance (Mikulincer and Shaver, 2007a).

However, even people who are generally high on attachment insecurity (anxiety or avoidance) can be induced to feel, at least temporarily, secure. Thus, attachment security can be situationally enhanced via cognitive methods, such as exposure to attachment security-related words or images (i.e., security priming). Moreover, like dispositional attachment security, enhanced security was found to have beneficial effects, such as increasing ethnic tolerance, cognitive openness, emotional stability, and well-being both in the short- and the long-term (e.g., Gillath et al., 2008; Mikulincer and Shaver, 2001; Mikulincer et al., 2006). Although a few theoretical explanations have been suggested to account for the effects of security priming (e.g., increased mental resources, enhanced positive affect, a calming sensation; see Mikulincer and Shaver, 2007b), the exact mechanisms underlying attachment security and its enhancement are still poorly understood. We suggest that security enhancement is a complex process that involves at least three different components. Here we use neuroimaging to test this conceptualization.

1.2. Security priming

The sense of attachment security can be primed using implicit (unconscious) or explicit (conscious) methods (for reviews see Gillath et al., 2008; Mikulincer and Shaver, 2007b). Successful methods to enhance security include the presentation of attachment-related cues [e.g., the presentation of the name of an attachment figure or words associated with the sense of security (e.g., love, hug, affectionate)] and guided imagery concerning the availability and supportiveness of attachment figures. These research techniques seem to temporarily activate mental representations of attachment figures and the support and comfort associated with them (e.g., secure IWMs).

According to Mikulincer and Shaver (2007b) and Gillath et al. (2008), security priming leads to changes in domains such as: perceptions of self and others, prosociality, intergroup processes, and mental health. Based on the studies examining security priming, security enhancement seems to involve at least three main components: affective, cognitive, and behavioral or motivational. In the affective domain, security is associated with attenuation of negative affect and an increase in positive affect (e.g., Mikulincer et al., 2001, 2006). In the cognitive domain, security is associated with processes such as spreading activation of attachment-related memories, accessibility of self, others, and helping representations, and availability of regulatory strategies (e.g., Schimel et al., 2001; Rowe and Carnelley, 2003). Finally, in the behavioral domain, security is associated with motivation, behavioral tendencies, and actual behaviors such as support receipt or provision (e.g., Gillath and Shaver, 2007; Gillath et al., 2010; Mikulincer et al., 2005). Although previous studies have examined the effects following exposure to security primes, most studies focused on only one of these components per study (or per series of studies). Thus, it is not clear if all of these components are being activated when people are primed with security or only one or some of them are being activated depending on the context.

1.3. Potential underlying neural mechanisms of security

Because security has been shown to lead to affective, cognitive, and behavioral or motivational changes, the enhancement of security is expected to be associated with areas of the brain linked with these processes more generally. Although there has not been a direct investigation of brain activation underlying attachment security, some human studies have provided insight into the potential neural mechanisms that may be involved. For example, in fMRI studies investigating love, researchers have found activation in reward-related regions, such as the ventral tegmental area (VTA) and caudate (Aron et al., 2005; Bartels and Zeki, 2000, 2004; Ortigue et al., 2007). Bartels and Zeki (2004) additionally found overlapping areas of activation in response to romantic and maternal love objects in the striatum (e.g., putamen, globus pallidus, caudate), insula, and the anterior cingulate cortex (ACC). All of these areas have been previously associated with positive affect (and motivation, see more below), which suggests that attachment security will also be associated with activation in these areas. These activations represent the positive aspect of the *affective component* of security.

Ortigue et al. (2007) found presentation of a loved one's name to be uniquely associated with bilateral angular gyri and bilateral fusiform regions and note that these areas are associated with memory retrieval and abstract representations of others. These findings support our claim that beyond an affective component, security priming will also have a *cognitive component*—associated with retrieval of mental representations of others and times they helped the self. Memory and representations of others, however, are only part of the cognitive component of attachment security. Past research found security as compared with insecurity to be associated with better emotion-regulation, information processing, and thought control (e.g., Mikulincer, 1997; Mikulincer et al., 2004; Fraley and Shaver, 1997). Hence, we expected areas of the brain that have been linked with regulatory processes, to also become more active following security priming.

For instance, the medial frontal cortex (MFC) has been associated with anticipating outcomes, accessing self-knowledge (or authentic feelings like in Gillath et al., 2010), perception of others, and making inferences about others' thoughts (Amodio and Frith, 2006). In addition, the prefrontal cortex (PFC), orbitofrontal cortex (OFC), and the cingulate cortex are associated with regulatory, top-down processes, which can affect the interpretation of stimuli and expectations about outcomes (Ochsner and Gross, 2005). The controlled regulatory processes suggested by Ochsner and Gross are similar to those expected as a result of the activation of a secure IWM. Thus, security may allow people to implement reappraisal processes, affecting such things as the interpretation of the environment and one's emotional state in a way that is more in line with a secure IWM. Observing brain activation in these areas would provide evidence to support the conceptualization of security as a mental resource, which provides people with an increased ability to process information and regulate their responses to stimuli.

Some brain areas mentioned above, related to affective and regulatory processes, are likely to also be linked with *behavioral motivation* and the tendency to act in a secure way. For instance, it has been suggested that the positive feelings that result from attachment relationships, may be facilitated by oxytocin release in the brain and associated with brain areas involving oxytocin receptors and behavioral motivation (Campbell, 2010; Coan, 2010; Diamond, 2001; Insel, 2010). Thus, when primed with security reward-related response may lead to motivation to engage in bonding-related behavior (e.g., reflected by activation in premotor areas).

Because attachment style was shown in previous studies to affect reactions to primes, it was also expected to affect the brain activation in response to priming (e.g., Cassidy et al., 2009). The hyperactivating strategies used by people high on anxiety may lead to heightened