



Adult attachment and emotional processing biases: An Event-Related Potentials (ERPs) study

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ABSTRACT

Attachment-related electrophysiological differences in emotional processing biases were examined using Event-Related Potentials (ERPs). We identified ERP correlates of emotional processing by comparing ERPs elicited in trials with angry and neutral faces. These emotional expression effects were then compared across groups with secure, anxious and avoidant attachment orientations. Results revealed significant interactions between attachment orientation and facial expression in mean amplitudes of the early C1 (50–80 ms post-stimulus) and P1 (80–120 ms post-stimulus) ERP components. Significant differences in C1 and P1 mean amplitudes were found at occipital and posterior-parietal channels in response to angry compared with neutral faces only within the avoidant attachment group. No such differences were found within the secure or anxious attachment groups. The present study underscores the usefulness of the ERP methodology, as a sensitive measure for the study of emotional processing biases in the research field of attachment.

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1. Introduction

Attachment theory (Bowlby, 1973, 1982) focuses on how early experiences with primary caregivers influence behavior and emotion regulation, as well as on how attachment-relevant stimuli are perceived and interpreted later in life (e.g., Bowlby, 1982; Hazan and Shaver, 1987; Spangler and Zimmermann, 1999; Stern, 1985; Suslow et al., 2009). Differences in attachment style may predict selective biases in attention toward certain types of emotional information from the external environment (e.g., Edelstein and Gillath, 2008; Feeney et al., 1994; Tucker and Anders, 1999). Early experiences with attachment figures are also assumed to affect the development and maturation of the brain and to have long-lasting effects on brain structures and brain function (Schore, 1994). Indeed, attachment-related differences in brain function have been reported in several fMRI studies (e.g., Buchheim et al., 2006; Coan et al., 2006; Gillath et al., 2005; Lemche et al., 2006; Vrticka et al., 2008; Warren et al., 2010).

Adult attachment is best conceptualized using two dimensions: anxiety and avoidance (Bartholomew and Horowitz, 1991; Brennan et al., 1998; Mikulincer and Shaver, 2007). Attachment anxiety is

characterized by a lack of attachment security, a strong need for closeness, worries about relationships, and fear of being rejected. Some evidence indicates that adults with an anxious attachment style tend to exhibit hyper-vigilance in response to emotional facial expressions (Fralely et al., 2006; Maier et al., 2005; Niedenthal et al., 2002; Shaver and Hazan, 1993) and heightened cognitive accessibility to attachment-related material (e.g., Gillath et al., 2005; Mikulincer et al., 2002; Mikulincer and Orbach, 1995). Yet other findings suggest that such individuals may be less attentive to this type of emotional material (Van Emmichoven et al., 2003).

Attachment avoidance is marked by a lack of attachment security as well as by compulsive self-reliance and a preference for emotional distance from others. Bartholomew and Horowitz (1991) reported that the behavioral patterns shown by individuals with anxious attachment were the opposite of those exhibited by individuals with avoidant attachment in almost every respect. Although avoidant individuals are thought to rely on deactivating or defensive strategies (Fralely et al., 1998, 2000), there is very little direct evidence for emotional processing biases among avoidant adults. Avoidant adults may perhaps be less attentive to attachment-related experiences. Thus, their defense mechanisms may operate preemptively to limit the amount of information that gets encoded. Alternately, avoidant individuals may reflect less and elaborate less on the emotional experiences they have encoded. In this case, defense mechanisms may operate after the fact, or post-emptively, to suppress or deactivate ideas and memories that have already been attended to or encoded (Edelstein, 2006; Fralely et al., 1998, 2000).

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In this two-dimensional space, the “secure style” is a region where both anxiety and avoidance are low. Secure individuals show neither of these biases and exhibit balanced and moderate responses to emotional information and events (Shaver and Hazan, 1993).

Despite theoretical claims and considerable evidence that individual differences in attachment security provide a foundation for emotional perception (Sroufe et al., 2005), surprisingly few studies have investigated the specific neural mechanisms underlying these patterns. Most of the literature integrating attachment and neuroscience is theoretical rather than empirical, and studies of the neural circuitry associated with attachment are quite rare (Coan, 2008).

The aim of the present study was to identify patterns of behavioral responses and brain activity during emotion perception among adults with differing attachment representations. More specifically, we sought to explore the interaction effects between attachment anxiety and avoidance and the initial neural changes associated with automatic attention to emotional facial expressions.

Electroencephalogram-Event Related Potentials (EEG-ERPs), a technique used to investigate the temporal brain dynamics of attentive processing at fine temporal resolution, was the method of choice. Since evaluation of emotional faces seems to occur as early as 100 ms following stimulus presentation (Halgren et al., 2000; Liu et al., 2002), we focused on the early C1 and P1 ERP components.

ERP dot-probe studies with healthy adults have shown emotion-related modulation in the C1 component time locked to the faces display (Pourtois et al., 2004) and in the P1 component time locked to target onset (Pourtois et al., 2004; Santesso et al., 2008). The C1 component (~50–100 ms post-stimulus) is the first ERP component triggered by the appearance of a stimulus in the visual field and is thought to be pre-attentive and independent of spatial attention (Clark and Hillyard, 1996; Foxe and Simpson, 2002; Fu et al., 2005; Hillyard and Anllo-Vento, 1998; Stolarova et al., 2006). C1 has been found to be more intense in displays containing threatening faces than in displays containing non-threatening faces (Pourtois et al., 2004). It has been suggested that the modulation of C1 by the emotional valence of the cue display on the dot-probe task could be the consequence of an interaction between the primary visual cortex and the subcortical limbic structures responsible for the detection of threats (Pourtois et al., 2004; Stolarova et al., 2006). The P1 component, an early sensory component peaking around 100 ms post-stimulus, may constitute an index of mobilization of automatic attentional resources (see review in Hopfinger and Mangun, 2001). Carretié et al. (2004) reported that automatic attention (P1) is initially captured by negative pictures rather than by those that are positive or non-emotional. According to these researchers, the fact that negative stimuli mobilize attentional resources as early as 105 ms post-stimulus is probably a manifestation of the negativity bias.

To the best of our knowledge, only two ERP studies have examined the relations between attachment orientation and facial emotional perception (Fraedrich et al., 2010; Zhang et al., 2008). Another ERP study used emotional pictures from the IAPS as stimuli (Zilber et al., 2007). All of these studies reported relatively late ERP (N170 and later) differences between attachment orientations.

In the present study, we sought to identify ERP correlates of emotional face-processing by comparing early ERPs (C1 and P1) elicited in trials using angry and neutral faces. Emotional expression effects were then compared across groups with secure, anxious and avoidant attachment orientations. The perception of angry faces may be suitable for studies of attachment, since such facial expressions signal social disapproval and threat and the violation of social rules or expectations (Averill, 1983; Öhman, 1986; Santesso et al., 2008). In healthy populations, a processing bias toward

threat-related (angry) faces has been demonstrated in visual search tasks using both schematic (Eastwood et al., 2001; Fox et al., 2000) and real (Horstmann and Bauland, 2006; Williams et al., 2005) face stimuli.

In general, we hypothesized that attachment orientation would interact with behavioral and ERP patterns in response to angry facial expressions, compared with neutral expressions. More specifically, we hypothesized (following Edelstein, 2006; Fraley et al., 2000) that in order for attachment-avoidant individuals to apply deactivating/defensive strategies, they must first attend to the valence of a face stimulus and must very quickly differentiate emotional faces from neutral ones. Therefore, we expected processing bias reflected in longer RTs, as well as differential (i.e., greater) C1 and P1 amplitudes in response to angry compared to neutral faces within the avoidant group. In contrast, at these very early stages of information processing, attachment-anxious individuals may be equally attentive and hyper-vigilant to all kinds of faces in the environment. We therefore expected anxious individuals to have the same RTs as well as the same C1 and P1 amplitudes in response both to angry and to neutral faces. In other words, we hypothesized that avoidant rather than anxious individuals would show an early processing bias towards emotional faces.

2. Methods

2.1. Participants

Participants were 50 undergraduate students (32 females), mean age 23.58 ± 3.31 years, selected on the basis of their attachment scores from the Experiences in Close Relationships (ECR) scale (Brennan et al., 1998). The participants were allocated to three attachment groups. Those with low scores both on avoidance and anxiety scales were allocated to the secure group ($n = 17$; 11 females). Those with low scores on the avoidance scale and high scores on the anxiety scale were allocated to the anxious group ($n = 17$; 11 females) and, those with high scores on the avoidance scale and low scores on the anxiety scale were allocated to the avoidant group ($n = 16$; 10 females). All the participants were healthy and none of them had a prior history of neurological or psychiatric disorders. All of them gave informed consent. The experiment was approved by the academic committee of the Yezreel Valley College.

2.2. Assessment of attachment

One to two weeks before the ERP experiment, 363 undergraduate students completed a Hebrew version of the Experiences in Close Relationships (ECR) scale (Brennan et al., 1998). This self-report questionnaire assesses individual differences on the two major dimensions of adult attachment style: avoidance of intimacy and interdependence, and anxiety about rejection and abandonment. The Avoidance scale contains 18 Likert-type items (e.g., I prefer not to show a partner how I feel deep down), as does the Anxiety scale (e.g., I worry about being abandoned). Each item is rated on a 7-point scale ranging from 1 (“not at all”) to 7 (“very much”). This two-dimensional perspective for representing attachment relationships is considered the “gold-standard” in self-report measures of adult-attachment (Brennan et al., 1998; Mikulincer and Shaver, 2007). In the current study, internal consistencies were $\alpha = 0.86$ for the anxiety and $\alpha = 0.83$ for the avoidance subscales.

2.3. Stimuli

Photographs of faces of 20 different individuals, 10 male and 10 female, were used as stimuli. All faces were taken from a standard set of pictures of facial affect, the NimStim face stimulus set (Tottenham et al., 2002). Facial expression was angry or neutral. Each actor presented both angry and neutral faces and each face was presented four times, resulting in a total of 160 stimuli (divided into four blocks of 40 trials each). All trials began with a 1000 ms fixation display (white cross on a black background) followed by 500 ms of the target faces (angry or neutral) display. Following target display the screen went blank for an inter-trial interval (ITI) of 1000 ms. The experiment began with a short practice block which contained neutral and angry faces corresponding to those presented in the experimental blocks. Participants were allowed a rest period after the practice block. In the experimental session, targets were displayed with equal probability and their presentation was randomized between trials.

2.4. Procedure

Participants were seated in a comfortable chair in a dimly lit room at a distance of 80 cm from a 19” computer screen. They were instructed to focus their gaze on the

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