



Sex differences on emotional processing are modulated by subclinical levels of alexithymia and depression: A preliminary assessment using event-related potentials

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ABSTRACT

Several studies have suggested that women are more sensitive than men to emotions in general. Event-related potential (ERP) studies have demonstrated N2 and P3b modulations, suggesting that women allocate more attentional resources to emotions than men do. However, the exact origin of this emotional modulation by sex is still a matter of debate. We wondered whether these sex differences might be due to some specific personality traits of women and men. Thirty participants (15 males and 15 females) were selected so that there were no sex differences on alexithymia, or depression and anxiety scales. The participants were asked to complete a “modified emotional” oddball task, in which they had to detect deviant stimuli among frequent neutral ones as quickly as possible. Behavioral performance, N2 and P3b ERP data were analyzed. When personality factors were controlled for, the sex differences on N2 and P3b components of the ERPs disappeared. Moreover, linear regression analyses showed that alexithymia was much better than sex at predicting the N2 latencies, while depression was the best factor for predicting the P3b latency. These results suggest that personality factors should be taken into account when sex differences on emotional processing are investigated.

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1. Introduction

Women are seen as more skilled than men in interpersonal perception (Hall and Schmid-Mast, 2008). Indeed, many studies have shown that females are more accurate than males in terms of judging the meaning of nonverbal cues, i.e., in recalling other people's nonverbal behavior (e.g., smiling) (Hall et al., 2006), remembering their physical appearance (Schmid-Mast and Hall, 2006), or judging profiles of their personalities (e.g., Vogt and Colvin, 2003). Accordingly, there is great deal of evidence suggesting that females have an advantage over males in understanding other people's emotional expressions from faces, postures and voices (see Hall, 1978 for a meta-analysis of 75 studies), even among children and adolescents (McClure, 2000).

Emotional facial expressions (EFE) constitute a particular category of stimuli. Indeed, the more we are efficient in detecting and processing emotions, the more we are efficient in social communication and interactions with other people (Persad and Polivy, 1993). However, a lower sensitivity of males to emotionally negative stimuli has been noted in many empirical studies showing, for instance, that men (1) are less

accurate in recognizing EFE, in particular, fear, disgust and sadness (Hall, 1978); (2) are less likely to be influenced by an emotionally negative context (Schirmer et al., 2004); and (3) display less activation in several neural regions (including the amygdala) in response to emotionally negative pictures (Wrase et al., 2003; Hofer et al., 2006). These results can appear as surprising, since we know that, due to adaptive values, emotionally negative signals (e.g., fear, anger) are preferentially treated throughout the information-processing stream by males as well as by females (e.g., Campanella et al., 2002; Delplanque et al., 2004; Pourtois et al., 2005).

With this in mind, Li et al. (2008) investigated, by means of an event-related potential (ERP) study, the neural mechanisms underlying the female advantage in identifying negative emotions. Due to their high sensitivity, ERPs have the potential to monitor brain electrical activity with a high temporal resolution (on the order of milliseconds) and are therefore of interest in determining the relationships between behavioural performance and cerebral activity (Rugg and Coles, 1995). By manipulating the intensity of emotionally negative stimuli, Li et al. (2008) showed that prominent emotional responses, indexed by larger N2 and P3b components, were evoked by highly negative stimuli in both males and females, but only females displayed similar activation in response to less intense negative stimuli. Accordingly, in an emotional oddball design in which participants had to detect deviant fearful and happy faces among standard neutral ones, Campanella et al. (2004)

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showed that deviant fearful stimuli evoked larger N2 and P3b components than deviant happy stimuli in both sexes, but the processing of deviant happy stimuli was significantly slower in men than in women.

Data from Campanella et al. (2004) and Li et al. (2008) suggest that men as well as women are sensitive to emotionally negative events of enhanced salience in their environment, while negative stimuli of lesser intensity and positive stimuli best demonstrated females' greater sensitivity (Li et al., 2008). These data are in perfect agreement with a more recent study of Lithari et al. (2010), showing that if unpleasant or high arousing stimuli are temporally prioritized during visual processing by both genders, females responded with enhanced negative components, in comparison to males, to these stimuli. Overall, this female-specific sensitivity is neurophysiologically mainly indexed by modulation of the N2 and P3b components, while earlier components such as the P100 and the N170 do not display any significant differences. The visual N2 component, peaking at posterior electrodes around 250 ms, indicates a switch of attention to biologically significant events in order to cope with them (e.g., Halgren et al., 1994; Campanella et al., 2002). The P3b component has been maximally recorded at parietal sites around 450 ms, and is functionally related to the closure of ongoing cognitive activity (e.g., Tomberg and Desmedt, 1998), i.e., to later conscious, decisional and premotor response-related stages (Bentin et al., 1999; Polich, 2004). In other words, the N2–P3b distinction allows separate the attentional (preparation-to-process) and the task-decisional (preparation-to-respond) steps of a task (e.g., Campanella and Philippot, 2006). In this particular case, it suggests that the well-known behavioral female advantage in identifying negative emotions may be attributable to a higher sensitivity to negative stimuli of lesser emotional saliency, indicated by the allocation of higher attentional resources (N2) which enable a quicker reaction (P3b) to these stimuli. Men's processing of these stimuli is slower, as shown by their delayed N2–P3b components.

Based on epidemiological studies on different representative community surveys (from the US, Canada, Europe as well as New Zealand and Australia), the consensus is that women and men differ strikingly in the prevalence, incidence and morbidity risk of specific mental disorders (Klose and Jacobi, 2004). Accordingly, in the present study, we hypothesize that sex differences in interpersonal perception may be related to inherent "female-related" and "male-related" personality factors. Alexithymia is the term applied to a clinical state and a personality trait characterized by difficulties in processing emotion (Sifneos, 1973). Several studies have found people with alexithymic characteristics to be less accurate in the recognition of EFE (e.g., Lane et al., 1996; 2000; Prkachin et al., 2009), and even if some studies found inconclusive association with sex (e.g., Lane et al., 1998), a recent meta-analysis suggests that this personality trait is more common among men (Levant et al., 2009). On the other hand, mood disorders are one of the most impairing classes of emotional and behavioral disturbances, causing problems in social, professional and interpersonal functioning (Zender and Olshansky, 2009). Depression is the most common mental illness experienced by women (Peden, 1994), and is approximately twice as frequent among women as among men. This sex ratio is cross-culturally consistent. Similarly, anxiety disorders are diagnosed twice as often in women as in men, and about half of all women with a primary diagnosis of major depression also have an anxiety disorder (Zender and Olshansky, 2009). Women are therefore more likely than men to develop co-morbid anxious and depressive disorders. Many studies investigated whether alexithymia is a predisposing or vulnerability factor that influences the onset or course of a disorder such as depression, or merely a state reaction to its presence (e.g., Haviland et al., 1988). In this view, Luminet et al. (2001) showed that, even in the context of large changes in depressive symptoms (baseline vs 14 weeks follow-up treatment), a relative stability of alexithymia was demonstrated (as TAS-20 scores at follow-up were predicted by TAS-20 scores at baseline beyond the variance explained by depression

severity), indicating its status as a stable personality trait and not a state-dependent variable.

The cause of alexithymia and depression sex-based differences is not yet precisely understood, although different factors such as brain structure, brain chemistry or hormonal balance are certainly involved. Developments in understanding the psychosocial aspects of depression have linked the well-known sex difference in its prevalence to styles of support-seeking/support-giving which involve some nonverbal communication (such as through EFE) and are more pronounced in women (Harris, 2001). In this view, it is suggested that, as women are more sensitive to emotions in their environment, they react more strongly and positively to social support than men do (Beehr et al., 2003). However, women are also more prone to suffer from affective disorders, such as depression or anxiety in the course of their life (Harris, 2001). Therefore, the "natural" advantage healthy women have in processing EFE may be reversed, as many psychopathological symptoms in co-morbid anxiety and depression are also associated with difficulties in the identification of emotions (e.g., Conrad et al., 2009).

Overall, we are confronted with two phenomena, both closely related to EFE processing: (1) a personality trait (alexithymia) in the healthy population which is more prevalent in men, and which induces poorer performance in emotional tasks; and (2) mood disorders (depression with co-morbid anxiety), which are more frequent in women, perhaps as a result of their higher general sensitivity to emotional cues in normal conditions (e.g., Kemp et al., 2004). The interaction of these phenomena has furthermore received some support, as modulations of EFE processing have mainly been investigated using ERPs, and it has been shown that depression, anxiety and alexithymia affect the same neural processes as sex in normal emotional processing (e.g., Campanella et al., 2004; Li et al., 2008), i.e., the N2 and P3b components, even at a subclinical level (e.g., Rossignol et al., 2008; Vermeulen et al., 2008).

The main objective of the present study is to investigate whether the classical sex modulation of EFE processing (i.e., women's greater efficiency at processing emotions in general), is linked to personality factors (such as the presence of alexithymia in men and subclinical depressive and anxious tendencies in women). To test this hypothesis, we selected two groups of participants (women and men), who were asked to complete an emotional oddball task. This task seems to us particularly well-suited to investigate the combined effects of sex and psychological traits on emotion processing. Indeed, this task has already been used to investigate how sex modulates EFE processing (e.g., Campanella et al., 2004) as well as to describe how some psychological characteristics (subclinical levels of depression, anxiety and alexithymia, see respectively, Rossignol et al., 2008; Vermeulen et al., 2008) interfere with emotional processing. In this study, for the first time, the respective contribution of sex and personality traits on emotional processing will be envisaged together. Participants had to detect deviant faces (displaying happiness or fear) as quickly as possible from a sequence of neutral faces. The important point is that the groups were constituted such that the sex did not differ in their levels of anxiety, depression or alexithymia. Our main hypothesis is that, in this particular case, when these personality variables are controlled, differences in amplitude and/or in latency in EFE processing due to sex will disappear, whereas these personality factors will influence, in amplitude and/or in latency, N2 component for alexithymia (Vermeulen et al., 2008) and P3 for depression (Maurage et al., 2008). Indeed, by means of an emotional oddball task similar to the one we used here, Vermeulen et al. (2008) showed that, as compared to matched controls, alexithymic people displayed a delayed N2 component in response to deviant emotional faces (while no difference was observed on P3), and Maurage et al. (2008) showed that, as compared to alcoholic patients with co-morbid depressive disorder, patients with depression "alone" do show a preserved N2 and a specific impairment of the P3 component.

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