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Electrophysiological evidence of early processing deficits in alexithymia

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ABSTRACT

Alexithymia describes difficulties to identify and describe one's emotions. Previous research focused on difficulties associated with the later processing stages of appraisal in alexithymia. We tested whether early processing deficits are apparent in alexithymic persons and whether these abnormalities contribute to later processing difficulties. 20 participants were selected and identified as either having high (HDA) or low (LDA) degrees of alexithymia. IAPS pictures were presented while EEG was recorded. For HDA subjects processing of emotional pictures was accompanied by reduced P1 amplitudes most pronounced for pleasant and neutral pictures. In response to unpleasant pictures the P3 amplitudes were reduced. These amplitude modulations were predicted only by one alexithymia facet. P1 amplitudes systematically covaried with P3 amplitudes supporting the assumption that deficits in early emotional processing contribute to later processing deficits.

1. Introduction

Alexithymia, a syndrome that involves a marked inability to identify, describe, regulate, and express one's emotions (Sifneos, 1976; Taylor and Doody, 1985), was originally described by Sifneos in patients with psychosomatic disorders and has been related to a broad range of physical and psychiatric disorders (e.g., alcoholism, drug addiction, and post traumatic stress disorders; see Taylor et al., 1999). At the present time, both within clinical and nonclinical populations, alexithymia is considered a continuous personality trait, with people differing in their ability to identify and describe their feelings (Jessimer and Markham, 1997). The construct of alexithymia is most widely assessed by the Toronto Alexithymia Scale (Bagby et al., 1994), a well-validated self-report questionnaire (Bagby et al., 1994; Mattila et al., 2007; Parker et al., 2003), whereby three main facets, namely *D*ifficulties in *I*dentifying *F*eelings (DIF), *D*ifficulties in *D*escribing *F*eelings (DDF) and *E*xternally *O*riented *T*hinking or a preoccupation with the details of external events (EOT), can be differentiated. There is growing empirical evidence that these facets probably refer to different aspects of emotional processing (Coffey et al., 2003; Luminet et al., 2006; de Timary et al., 2008; Gohm and Clore, 2000) with high intercorrelations between the DIF and DDF subscales and low intercorrelations of the DIF and DDF subscales with the EOT subscale (Gohm and Clore, 2000; de Timary et al., 2008; Parker et al., 2003). In addition, these facets might be differentially linked to observed abnormalities in the processing of stress and negative emotions (de Timary et al., 2008).

Several authors hypothesized that hampered regulation of emotion in alexithymia might be based on deficits in the perception and further processing of emotional stimuli (Aleman, 2005; Lane et al., 2000) which was empirically supported by imaging data (Berthoz et al., 2002; Kano et al., 2003; Lane et al., 1997; Mantani et al., 2005; Moriguchi et al., 2006a,b). Berthoz et al. (2002) emphasized that deficits in emotion processing in alexithymia are characterized by abnormalities during the appraisal of emotional stimulus content whereas perceptual aspects of stimulus processing remain unaffected. While imaging approaches (e.g., fMRI, PET) allow for identifying brain areas involved in emotional processing with high spatial accuracy, they lack the fine temporal resolution to investigate the time course of emotional stimulus processing.

Some studies provide evidence that alexithymia is associated with impaired processing of emotional stimuli, supporting the view that mainly aspects of stimulus appraisal are affected in alexithymia. Franz et al. (2004) provided evidence that alexithymia might be characterized by a processing deficit to emotional aversive stimuli. Using a modified odd-ball paradigm with three different stimulus categories (aversive probes and affective neutral pictures serving as nontargets and instructed targets) they demonstrated that subjects with alexithymia displayed increased positive deflections (especially of the P2 component) of the visual event-related potential after probe presentation as compared to subjects without alexithymia. The authors concluded that subjects with alexithymia do not express difficulties in perceptual aspects of emotional stimuli but may need more effort and cognitive resources to process emotional information. Results from Aftanas and co-workers

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(Aftanas et al., 2003; Aftanas and Varlamov, 2004, 2007) confirm the importance of appraisal processes for emotional processing in alexithymia. The authors showed that alexithymics revealed enhanced event-related theta synchronization over right anterior cortical regions in response to negative stimuli or to negative and positive film clips.

Furthermore, very few studies indicate that also early perceptual-related processes are altered in alexithymia. Schaefer et al. (2007) demonstrated that high alexithymic participants exhibited higher P1–N1 amplitudes when confronted with acoustic stimuli of increasing intensity. The authors argued that alexithymia may be associated with a general stimulus augmentation to prevent individuals from ignoring stimuli that might be dangerous. Further evidence for perceptual differences in alexithymia stems from research on anhedonia, a personality trait associated with a decrease in the ability to feel pleasure. Anhedonia is conceptualized as linked to alexithymia, an assumption which was partly supported empirically (e.g., Deborde et al., 2006; Loas et al., 1997, 1998). Franken et al. (2006) used a visual oddball paradigm and found that both early, middle and late ERP components of subjects with low levels of hedonic tone were attenuated compared with ERPs of subjects with high levels of hedonic tone. The authors suggested that decreased hedonic tone is associated with reductions in both automatic and effortful cognitive processing of relevant stimuli. In accordance to this finding Rey et al. (2010) reported that anhedonics experience less positive feelings when confronted with positive pictures differing in luminance which might be associated with the perceptual encoding and emotional processing in anhedonia.

In summary, previous research suggests emotion processing abnormalities in alexithymia that might be investigated by means of event-related potentials (ERP). There is converging empirical evidence that late potentials such as the P3 associated with higher order aspects of cognitive information processing are reduced in alexithymia (Hajcak and Olvet, 2008). As the P3 is positively related to experienced intensity of feelings (Hamm et al., 2003; Polich and Kok, 1995; Pollatos et al., 2007) this hypothesis is in accordance to numerous empirical studies showing reduced self-reported arousal in alexithymia, e.g. demonstrating reduced arousal in participants with high degrees of alexithymia (Pollatos et al., 2008b; Roedema and Simons, 1999), less pronounced arousal increases after exposure to negative film clips (Stone and Nielson, 2001) or a trend towards lower self-rated intensity during emotional imagery (Mantani et al., 2005). Importantly, there is also some evidence that early components of the ERP like the P1 and N2 could be affected in alexithymia (Franken et al., 2006; Schaefer et al., 2007). This is relevant because early deficits in perceptual encoding could account for later processing abnormalities.

In the present study we focused on participants within a non-clinical range of alexithymia to obtain a sample contrasting high vs. low scores in alexithymia in order to have a representative selection of individuals without psychiatric or neurological problems and without reported drug intake or currently received medication. The present study aimed to investigate the time course of brain dynamics accompanying emotion inducing stimulation in response to affective pictures (Cuthbert et al., 2000; Keil et al., 2002; Pollatos et al., 2005; Schupp et al., 2000; Waldstein et al., 2000) in alexithymia by the use of event-related potentials technique. We hypothesized that a reduced P3 in alexithymia is accompanied by a modulation of the P1 component reflecting perceptual difficulties in processing of emotional information. With respect to the N2 it is known that N2 amplitudes are more pronounced when stimuli are difficult to encode (Nittono et al., 2007). This could be a consequence of processing abnormalities on a prior perceptual level as assumed in alexithymia. We therefore hypothesized this component to be increased in alexithymia reflecting a consecutive higher cognitive demand to encode emotional information. Taking previous work on the different facets of alexithymia into account (e.g. de Timary et al., 2008; Luminet et al., 2006; Pollatos et al., 2008a,b; Vermeulen et al., 2006), we hypothesized that the emotional aspects of alexithymia as reflected in the DDF and DIF subscales would interact with the processing of emotional stimuli while the cognitive aspects as reflected in the EOT scale would not interfere with emotion processing.

2. Methods

Fifty subjects were screened for alexithymia using the Toronto Alexithymia Scale (TAS; Taylor and Doody, 1985). The TAS-20 is the most psychometrically valid and commonly used self-report measurement of alexithymia (Bagby et al., 1994; Mantani et al., 2005) consisting of 20 items rated on a 5-point scale with total scores ranging from 20 to 100. All selected subjects were confirmed right-handed by means of the Handedness Questionnaire (Oldfield, 1971). None of the participants had a history of neurological or psychiatric disorders, reported about drug intake (except of alcohol within a normal consumption range) or currently received any medication (except of contraceptives).

Based on the total TAS sum score the first and the last quartile of the participants were chosen and categorized as having either high (HDA) or low (LDA) degrees of alexithymia. Two experimental groups were formed in a manner that each group consisted of 10 (5 male) age- and gender-matched participants. The participants in the HDA and LDA groups were aged 28.3 ± 4.3 years and 28.4 ± 5.4 years, respectively (mean ± SD). In the HDA group the mean total TAS score was 55.3 (SD 5.8), in the LDA group 26.6 (SD 1.4). This procedure is comparable to previous studies using, e.g. the 33rd percentile and the 66th percentile or the first vs. last quartile as cutoffs for categorizing participants in having either high or low degrees of alexithymia (Franz et al., 2004; Moriguchi et al., 2006a), e.g. yielding into mean sum scores of 34 in the LDA vs. 59 in the HDA group (Franz et al., 2004). Concerning the German version of the TAS no standardized threshold exists for identifying clinically relevant degrees of alexithymia. Using the English version, the common international cutoff refers to a sum score of >61 to assess clinically relevant degrees of alexithymia, e.g. in psychosomatic patients (Franz et al., 2004). Referring to the healthy population, the obtained groups of HDA vs. LDA represent both ends of alexithymia as extreme groups in a non-clinical population thus justifying the chosen categorization. In accordance to the chosen selection method, both groups differed significantly in the total TAS score ($F(1,18) = 231.3$, $p < .001$, $\eta^2 = .93$; $\varepsilon = 1.00$) as well as in the TAS subscores “difficulties in identifying feelings (DIF)” (TAS 1: *HDA* 17.4 vs. *LDA* 8.3, $F(1,18) = 39.7$, $p < .001$, $\eta^2 = .69$; $\varepsilon = 1.00$) and “difficulties in describing feelings (DDF)” (TAS 2: *HDA* 18.4 vs. *LDA* 6.1, $F(1,18) = 86.2$, $p < .001$, $\eta^2 = .82$, $\varepsilon = 1.00$). For the subscore “externally oriented thinking or a preoccupation with the details of external events (EOT)” only a trend towards group differences was observed (TAS 3: *HDA* 19.5 vs. *LDA* 12.2, $F(1,18) = 3.26$, $p = .09$). In order to further elucidate the effects of the three facets of alexithymia, regression analyses were conducted when the overall group effect alexithymia was significant.

All participants had normal or corrected to normal visual acuity and gave their written informed consent. Experiments were conducted in accordance with the Declaration of Helsinki with the approval of the local ethics committee.

2.1. Stimulus material

420 pictures (140 pleasant, 140 neutral, 140 unpleasant) from the IAPS served as emotional stimuli. The IAPS is a standardized and well-characterized collection of visual images designed to evoke either neutral, positive, or negative emotional states (Lang et al., 1999). Pictures in the IAPS vary with respect to two primary dimensions: affective valence, ranging from unpleasant to pleasant (1–9); and arousal, ranging from calm to excited (1–9). The valence and arousal level of each picture have been quantified in the IAPS. Negative pictures included such images as frightening animals and mutilated human bodies, while neutral pictures depicted daily necessities such as tableware and books.

The task was administered on a personal-computer-controlled 22-in. color display (refreshment rate, 100 Hz), using Presentation software (Neurobehavioral Systems, Inc.) to control the presentation and timing of all stimuli. Each picture was displayed in color and occupied the entirety of the 22-in. monitor (aspect ratio 4:3). At a viewing distance of approximately 100 cm, each picture occupied a visual angle of nearly 17° in the vertical plane, and 27° in the horizontal plane.

According to the normative ratings of the IAPS, the three emotion contents differed significantly regarding pleasantness (mean_{pos} 7.4, mean_{neu} 5.2 and mean_{neg} 3.0, respectively; $F(2,417) = 285.1$; $p < .001$), while pleasant and unpleasant pictures yielded higher arousal scores than neutral ones (mean_{pos} 6.1, mean_{neg} 6.5, mean_{neu} 3.1; $F(2,417) = 182.4$; $p < .001$; post hoc LSD tests, $p < .001$), but did not differ significantly regarding their normative arousal ratings (post hoc LSD tests, p = n.s.).