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Effects of facial expressions on visual short-term memory in relation to alexithymia traits ☆

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ABSTRACT

We examined dysfunctional memory processing of facial expressions in relation to alexithymia. Individuals with high and low alexithymia, as measured by the Toronto Alexithymia Scale (TAS-20), participated in a visual search task (Experiment 1A) and a change-detection task (Experiments 1B and 2), to assess differences in their visual short-term memory (VSTM). In the visual search task, the participants were asked to judge whether all facial expressions (angry and happy faces) in the search display were the same or different. In the change-detection task, they had to decide whether all facial expressions changed between successive two displays. We found individual differences only in the change-detection task. Individuals with high alexithymia showed lower sensitivity for the happy faces compared to the angry faces, while individuals with low alexithymia showed sufficient recognition for both facial expressions. Experiment 2 examined whether individual differences were observed during early storage or later retrieval stage of the VSTM process using a single-probe paradigm. We found no effect of single-probe, indicating that individual differences occurred at the storage stage. The present results provide new evidence that individuals with high alexithymia show specific impairment in VSTM processes (especially the storage stage) related to happy but not to angry faces.

1. Introduction

Alexithymia is an individual characteristic that is known as a reduced ability to identify and describe one's own feelings and a reduced capacity to engage in fantasy and imagery (Bagby, Parker, & Taylor, 1994a; Bagby, Taylor, & Parker, 1994b; Sifneos, 1973). These difficulties relate to a variety of behavioral disorders, for example, individuals with alexithymia show deficits in communicating emotions to others. Although alexithymia is not included as a diagnostic category in the DSM-IV-TR (American Psychiatric Association., 2000) or DSM-5 (American Psychiatric Association, 2013), it may overlap with various psychiatric and developmental disorders, such as autism or Asperger's syndrome (Fitzgerald & Bellgrove, 2006; Szatmari et al., 2008).

Human beings have developed communication through feelings to maintain the social group. In social communication, we have to guess others' feelings. Specifically, the recognition of others' facial expressions plays an important role in social communication. In order to adapt to the surroundings, there is a great need to retain the identity of angry or happy faces and rapidly and effectively decide whether to approach or avoid these people. However, as described above, individuals with alexithymia generally show impairments to identify and describe feelings. In these situations, we speculate that individuals with alexithymia may have difficulty in communication and experience maladaptation in a social group. Thus, it is necessary to examine the cognitive process of facial expressions in individuals with alexithymia so they can deal with angry or happy faces rapidly and effectively.

Recent studies examined differences in emotional property in alexithymia individuals. The researchers used an experimental method, in which they examined the relationship between alexithymia traits measured by the 20-item Toronto Alexithymia Scale (TAS-20; Bagby et al., 1994a, 1994b) and emotional tasks using facial expressions and emotional words as experimental stimuli (Grynberg, Vermeulen, & Luminet, 2014; McDonald & Prkachin, 1990; Pandey & Mandal, 1997; Parker, Taylor, & Bagby, 1993; Prkachin, Casey, & Prkachin, 2009; Vermeulen & Luminet, 2009; Vermeulen, Luminet, & Corneille, 2006). Other studies have examined the physiological basis of the relationship between the

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TAS-20 and emotional tasks, using event-related potentials (ERP; Franz, Schaefer, Schneider, Sitte, & Bachor, 2004; Vermeulen, Luminet, de Sousa, & Campanella, 2008), functional magnetic resonance imaging (fMRI: Berthoz et al., 2002; Mantani, Okamoto, Shirao, Okada, & Yamawaki, 2005), and positron emission tomography (PET: Kano et al., 2003). Some of these studies have provided evidence of memory deficits in individuals with alexithymia. Using a behavioral approach, for example, Prkachin et al. (2009) examined dysfunctional memory processing of facial expressions in individuals with alexithymia. They used 90 different faces, each displaying one of six basic facial emotions (Ekman & Friesen, 1975) on video recordings. After presentation of the memory stimuli, test faces were presented, and the participants were asked to judge whether the presented faces in the test phase were the same as in the original series. The authors compared high- and low-alexithymia individuals' facial emotion sensitivity and found that individuals with high alexithymia showed less sensitivity to anger, fear, and sadness conditions than individuals with low alexithymia. In contrast, there were no significant differences between high- and low-alexithymia individuals in sensitivity to happy faces. Using a physiological approach, for example, Vermeulen et al. (2008) showed dysfunctional processing of facial expressions in individuals with alexithymia in terms of oddball task with ERP measurements. In the task, they examined the categorical perceptions of facial expressions. Results showed that latencies of N2b and P3a, reflecting the degree of attention devoted to specific information, were delayed among individuals with alexithymia compared with individuals without alexithymia. In this study, they used only negative (angry and disgusted) faces and no positive (happy) faces. These findings suggest that individuals with high alexithymia showed weaker attention levels to deal with faces expressing anger and disgust compared to individuals with low alexithymia.

To the best of our knowledge, basic research of memory for facial expressions in alexithymic individuals is quite limited and are few studies examining memory processes of facial expressions in relation to alexithymia. For example, DiStefano and Koven (2012) showed dysfunctional processing of faces in individuals with alexithymia in terms of visual immediate and delayed memories. In their task, color photographs with human faces (neutral expressions) were presented. Experimental settings consisted of an immediate memory condition (participants responded immediately after the series of test faces were presented) and delayed memory condition (delayed presentation of series of the test faces). The results showed that individuals with alexithymia showed lower memory performance in both conditions. However, this study did not manipulate facial expression. Pandey and Mandal (1997) showed no differences in emotional matching between individuals with and without alexithymia. They used photographic faces (happiness, sadness, fear, anger, surprise, disgust, and neutral) and the participants were asked to match the test photographs with the target. The results showed that there was no difference in matching performance between the two groups. As described above, Prkachin et al. (2009) showed that individuals with high alexithymia showed less sensitivity to anger, fear, and sadness conditions than individuals with low alexithymia, but this study did not strictly manipulate time properties of task. Considering these studies, heterogeneities exist when examining visual short-term memory (VSTM) processes of facial expressions in relation to alexithymia, such as memory properties (including time properties), task (response mode), and stimulus type. To fill this gap, we propose the following adjustments: First, we consider the fact that the findings on memory deficits differ between these previous studies. In other words, it is not obvious what kind of memory impairment was addressed in each of these studies (see also DiStefano & Koven, 2012). Second, in relation to the task, many researchers used free-recall, recognition, or same-different tasks to assess memory. These tasks could not strictly control the memory processing times; thus, we found that many previous studies examined long-term memory processes. Third, many previous studies used photographic faces as experimental stimuli. Since photographs faces include low-level artifacts, such as contrast (Purcell, Stewart, & Skov, 1996), it is not clear whether the alexithymic individuals' deficiencies to memorize facial expressions were caused by the facial expressions themselves (i.e., anger and happiness) or by other low-level perceptual artifacts.

The purpose of the present study was therefore to examine dysfunctions of facial expression memory processes in individuals with alexithymia, by conforming to strict experimental techniques of psychophysics. Considering the first issue, basic research into facial expression among individuals without alexithymia (i.e., individuals with typical development and without psychiatric disorders) has confirmed the threat-advantage (negative) hypothesis in a visual search task (e.g., Öhman, Lundqvist, & Esteves, 2001) and in a change-detection task (e.g., Jackson, Wu, Linden, & Raymond, 2009; however, a positive advantage hypothesis was proposed by D'Argembeau and Van der Linden, 2007). The threat-advantage hypothesis proposes that participants are faster and more accurate in detecting and memorizing angry (or sad) faces among a crowd of happy faces than vice versa. This hypothesis seems to have higher repeatability and robustness in the field of basic facial expression memory. Thus, in the present study, we address dysfunctional processing of facial expressions in individuals with alexithymia in terms of this hypothesis. To examine the second issue, we focused on VSTM, which is an early component of the visual memory process that plays a role in the temporary storage of object representation. The VSTM process consists of 3 stages: encoding, storage, and retrieval (e.g., Xu & Chun, 2006). A visual search task and change-detection task are generally useful in examining the VSTM process. Since many previous studies have used schematic faces as experimental stimuli (e.g., Barratt & Bundesen, 2012; Eastwood, Smilek, & Merikle, 2001; Eastwood, Smilek, & Merikle, 2003), we also used schematic faces.

In the present study, we assessed TAS-20 data from a broader sample and selected participants from the highest and lowest segments of the TAS-20 distribution (High TAS and Low TAS groups, respectively) for the main experiments. In Experiment 1, we assessed whether individual differences were observed in the encoding or storage stages of the VSTM process by utilizing visual search (Experiment 1A) and change-detection (Experiment 1B) tasks, respectively. In Experiment 2, we further examined whether individual differences were observed in storage or retrieval (decision making) stages of the VSTM process by establishing a single-probe paradigm (Wheeler & Treisman, 2002) in the change-detection task. Considering the previous findings (Prkachin et al., 2009), we predict that our High TAS group will show lower performance for the angry and happy faces in the visual search and change-detection tasks.

2. Experiment 1

2.1. Method

2.1.1. Participants

One hundred and thirty-seven Tohoku University students (72 men and 65 women; mean age = 21.20, SD = 2.48) completed the TAS-20 assessment (mean TAS = 53.30, SD = 9.57). Thirty people from the higher and lower portions of the TAS distribution were invited to participate in a measurement of visual ability using Raven's Standard Progressive Matrices (SPM; Raven, Raven, & Court, 1998) and to complete the visual search (Experiment 1A)