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Attentional biases in patients suffering from unipolar depression: results of a dot probe task investigation

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ABSTRACT

Cognitive models of depression emphasize the relevance of cognitive biases for development, onset and maintenance of major depressive disorder (MDD). Attentional biases consisting of increased attention to negative, mood congruent stimuli and reduced attention to positive, mood-incongruent stimuli are postulated but have rarely been tested for early attentional processing. Furthermore, the role of concurrent depressive mood as a moderating factor has not been studied to date. Participants comprised 30 patients suffering from MDD and 30 healthy control subjects. All participants performed a dot-probe task with pictorial stimuli displaying affective facial expressions, presented either for 100 ms or for 500 ms. Attentional biases towards faces displaying joy in both MDD patients and control subjects and towards faces displaying pain in MDD subjects were found at presentation times of 100 ms. In the MDD sample, the bias indices at 100 ms were correlated with concurrent depressive mood. In patients with pronounced depressive mood, significant biases towards happy and angry faces were observed that exceed the biases obtained in control subjects and patients with less depressive mood. The results provide first evidence that MDD patients with pronounced depressive mood show an increased early attentional engagement towards emotional salient stimuli, independent from valence.

1. Introduction

Unipolar depression is a disorder that also affects cognition. In current classification systems, cognitive deficits, especially attentional problems, are listed as diagnostic criteria. And indeed, it could be shown that depressed persons suffer from cognitive impairments persisting beyond acute depressive episodes (Bora et al., 2013; Lee et al., 2012). However, the magnitude of these impairments is comparably smaller than in patients suffering from bipolar disorder, schizoaffective disorder or schizophrenia (Harvey, 2011).

Instead of focusing on pure cognitive functioning, cognitive models of depression like Beck's schema theory (Beck et al., 1987; Beck, 2008) or associative network models (Bower, 1981) predict that dysfunctional cognitive structures and cognitive biases affecting perception, attention, memory and reasoning play a major role in development, onset and maintenance of affective disorders.

Thus, deviations in information processing of emotionally relevant stimuli would be expected for depressive patients and indeed, for several cognitive domains, MDD patients performed differently compared to healthy controls in so-called "hot cognition" tasks using emotionally relevant stimuli (Roiser and Sahakian, 2013). For example, stimuli related to depression are better recalled by depressive patients than neutral and happy stimuli (Moritz et al., 2005; Matt et al., 1992), and there is evidence that altered "hot cognition" might not only be a state marker of depression but might also function as a vulnerability factor (Wells and Beevers, 2009; Baert et al., 2010).

Given the crucial role of attention for other cognitive domains as well as for emotion processing and regulation, the investigation of attentional engagement to and disengagement from emotionally relevant stimuli during early stages of information processing in depressive patients is an interesting topic (see de Raedt et al., 2010). One widely used paradigm to investigate such attentional biases is the dot probe task, which was first introduced by MacLeod et al. (1986). Based on the assumption that subjects respond faster to probes presented at the spatial location that was previously attended, pairs of stimuli (usually one neutral and one emotional) are presented, while the primary task is to detect a probe (usually a dot) as fast as possible. The probe appears at the position of either the emotional or the neutral stimulus immediately after both stimuli have disappeared. If the emotional stimulus was attended, then reaction time should be shorter when the dot appears at the position of the emotional stimulus. Recently, emotional faces have been preferred as stimuli over emotional words, as faces represent

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social situations better than words (Mogg and Bradley, 2002), are more salient (Segrin, 2000) and seem to have privileged access to brain structures responsible for rapid and automatic processing of emotional contents (Le Doux, 1995).

For depressive patients, past research has found contradicting results using the DPT, yielding attentional biases in some studies but not in others. However, most reviewers (e.g. De Raedt and Koster, 2010) agree that if emotional stimuli are presented for one second or longer, there is stronger evidence of mood congruent biases (faster reaction to dots at the spatial position where sad faces were presented immediately before) and weaker evidence of an absence of attentional biases towards positive stimuli, which usually can be found in non-depressed persons (Fritzsche et al., 2010; Hankin et al., 2010; Joormann and Gotlib, 2007; Gotlib et al., 2004a, 2004b). These results are commonly interpreted by the authors as a difficulty to disengage from affective salient information (see also Bradley et al., 1997a, 1997b). For shorter presentation times, especially relevant for early engagement processes, there is no clear evidence of any biases in depressive patients (see for example Donaldson et al., 2007; Neshat-Doost et al., 2000). These results could be interpreted as in line with the emotion context insensitivity theory (see for example Rottenberg and Cowden Hindash, 2015), which suggests a generalized loss of emotional reactivity and would predict no favour towards any emotion.

Given these findings, several further questions could be raised. First, in concordance with Beck' s cognitive model, if presentation times of 1000 ms or longer are used, several series of top-down driven engagement and disengagement processes could have taken place and finally resulted in enduring engagement. Thus, it is unclear whether initial attentional biases bound to bottom-up mechanisms responsible for the instantiation of negative perceptions are being captured at all. Second, to complicate this situation even further, attentional biases seem to be influenced by current depressive mood. For example, the depletion of tryptophan (a precursor to serotonine) seems to reduce biases towards happy faces in healthy subjects, while administration of SSRIs or a single nasal dose of oxytocin (Zhou et al., 2015; Domes et al., 2016) reduces biases toward sad faces in depressive patients (see for example the review of Merens et al., 2007). Similar results can be found when current mood is considered in healthy and depressed subjects (Bradley et al., 1997a, 1997b; Shane and Peterson, 2007). Third, there is substantial evidence of elevated autonomic arousal following stimuli of any emotional valence (Guinjoan et al., 1995; Falkenberg et al., 2012; Schneider et al., 2012), which makes it even thinkable that immediate attentional responses are independent from emotional content.

In the present study we therefore administered a dot-probe task that uses stimulus presentation times of 100 ms and 500 ms in a sample of patients suffering from major depressive disorder (MDD) with no comorbidity of anxiety as well as in a control sample without history of psychiatric illness. Furthermore, we used faces expressing joy, anger and pain as pictorial stimuli in our DPT study, because all of these pictures have been used by our workgroup in previous studies investigating pain-related processing (see for example Scheel et al., 2017; Dimova et al., 2013; Baum et al., 2013a, 2013b) and represent distinct positive and negative states that are at the same time distant to sadness, which is the mood congruent emotion for depression. By that procedure, we tried to avoid unfavourable top down effects created by primes for depressive mood which cannot be offset by later presentations of other emotions. These primes might confound perception of later stimuli, as repeated sad mood inductions may – especially in individuals with a vulnerability for depression – result in emotional sensitization, which is difficult to counterbalance (Mata et al., 2013).

We hypothesized that during initial engagement (at a presentation time of 100 ms) the fact that stimuli contain emotional content of any kind might be more important than the specific emotional content during early bottom-up instantiation of negative perceptions for the depressive group. Thus, we expected enhanced early attentional engagement for all emotional stimuli, independent from their emotional content. As depressive mood might influence attentional biases, we supposed that attentional engagement even in depressed subjects might be stronger for participants suffering from more severely depressed mood. In contrast, presentation times of 500 ms might reveal later engagement or early disengagement, which could already be under the control of top-down processes after the emotional stimulus content has been recognized. Thus, for the control group, joy faces should lead to more engagement whereas pain and anger faces should lead to more disengagement. On the other hand, patients with depression may be more likely to display attention biases toward pain and anger faces and away from joy faces.

2. Methods

2.1. Participants

Thirty inpatients of a psychiatric hospital in Bamberg, Germany were included. All of them fulfilled the International Classification of Diseases-10 (ICD-10) as well as the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) criteria for a current major depressive disorder and were diagnosed based on the Structured Clinical Interview for the DSM-IV (SCID, First et al., 1997). Exclusion criteria were other medical diagnoses associated with neurocognitive impairment, prior or concurrent diagnosis of anxiety disorders and uncorrectable deficits in vision or hearing that would prevent performing the tests. Furthermore, 30 control subjects matched by age, educational level and gender from a larger sample that had been recruited for a former study of our research group (Baum et al., 2013) via announcement in local newspapers and amongst university students in Bamberg took part. Participants of the control group were without any history of psychiatric or neurological disorders. None of the participants (of either group) took analgesics or reported any acute or chronic pain conditions or previous major surgical intervention.

After a complete description of the study, written informed consent was obtained from all subjects. The study adhered to the principles of Good Clinical Practice of the International Conference on Harmonization and the Declaration of Helsinki and was approved by the local ethics board (University of Bamberg).

2.2. Measures

2.2.1. Dot-probe task

The dot-probe paradigm used in this study is described in further detail in Baum et al. (2013a). Monochrome photographs of affective facial expressions (pain, anger, joy, neutral faces; displayed by three male and three female actors) extracted from the Montreal Pain and Affective Face Clips (Simon et al., 2008) served as stimulus material. There were 24 pictures for each category. Affective pictures were always paired with pictures displaying neutral faces. Additionally, neutral-neutral picture pairs served as control items. Only pictorial emotions where joy, pain and anger were expressed very distinctly by the actors were included in the dot-probe task. Additionally, the displays were FACS coded to guarantee that they indeed matched typical basic emotions and that the intensities of displays were similar. Furthermore, we tested whether the most similar facial expressions, namely those of anger and pain, were still clearly distinguishable in our set of pictures and obtained a positive result (Baum et al., 2013b).

In each trial, first a fixation cross was presented for 500 ms in the centre of a computer screen. Next, two pictures (either a neutral picture paired with an affective picture, or two neutral pictures) were presented concurrently, left and right of the central fixation point. Each pair of pictures was presented twice, at 100 ms and 500 ms. Immediately after the concurrent presentation of the two pictures, a dot appeared in the same position as one of the two pictures. The participants were instructed to indicate as quickly as possible the side the dot had appeared, using a response box with a three button response panel.

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