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Sitting Posture Makes a Difference—Embodiment Effects on Depressive Memory Bias

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Basic research has shown that the motoric system (i.e., motor actions or stable postures) can strongly affect emotional processes. The present study sought to investigate the effects of sitting posture on the tendency of depressed individuals to recall a higher proportion of negative self-referent material. Thirty currently depressed inpatients either sat in a slumped (depressed) or in an upright (non-depressed) posture while imagining a visual scene of themselves in connection with positive or depression related words presented to them on a computer screen. An incidental recall test of these words was conducted after a distraction task. Results of a mixed ANOVA showed a significant posture x word type interaction, with upright-sitting patients showing unbiased recall of positive and negative words but slumped patients showing recall biased towards more negative words. The findings indicate that relatively minor changes in the motoric system can affect one of the best-documented cognitive biases in depression. Practical implications of the findings are discussed. **Copyright © 2014 John Wiley & Sons, Ltd.**

Key Practitioner Message:
- Features of patients' motoric system (i.e., habitual movement patterns or body postures) might be relevant for individual case conceptualization.
- Training patients to change habitual motoric patterns (e.g., dysfunctional posture or movement patterns) might attenuate negatively biased information processing in depressed patients.
- Training patients in mindful body awareness might be useful because it fosters an intuitive understanding of the interplay of bodily and emotional processes.

Keywords: Embodiment, Depression, Body, Memory

During the past decade, a flourishing field of basic research has focused on the interrelationship between bodily and emotional processes (Niedenthal, 2007; Niedenthal et al., 2005). According to these embodiment theories of emotion, experiencing emotional states affects the somatovisceral and motoric systems (e.g., mood affects posture). Moreover, embodiment theories postulate that somatovisceral and motoric systems influence how emotional information is processed. Several studies have found empirical support for a bidirectional influence of the motoric system and emotional processes. Studies on the effects of mood on the motoric system have shown that experimentally induced mood states such as sadness, happiness and pride had effects on posture (Oosterwijk, Rotteveel, Fischer, & Hess, 2009) or gait (Michalak et al., 2009). Moreover, several studies have gathered evidence for a reversed directed causal mechanism in which the motoric system had effects on emotional processes. In a seminal study, Strack, Martin and Stepper (1988), for instance, found that participants who were asked to contract the zygomaticus major muscle, which is involved in the production of a human smile, by having a pen between their teeth, enjoyed cartoons more than those who were prevented from contracting the zygomaticus. In another study by Riskind (1983), while recalling pleasant or unpleasant experiences from their lives, participants in one condition were instructed to have a smile on their face while being in an upright position or a downcast expression with head and neck bowed and body slumped in another condition. Access to pleasant or unpleasant life experiences improved when participants were positioned in postures and facial expressions congruent with the emotional valence of these life experiences as opposed to when postures and facial expressions were incongruent. Moreover, a more recent study by Carney, Cuddy and Yap (2010) has shown that experimentally induced high-power poses caused power related physiological changes (i.e., elevations in testosterone) in addition to psychological and behavioural changes.

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Although basic research on the embodiment of emotions is flourishing, research on embodiment in clinical psychology is largely lacking. A clinical theory that supposes the relevance of the body in depression is the Interacting Cognitive Subsystems (ICS) approach (Teasdale & Barnard, 1993). The ICS approach proposes that proprioceptive and kinesthetic input from the body (e.g., the motoric system) makes a direct and important contribution to emotional states, which distinguish them from more intellectual and rational processes. Only when cognitive (e.g., the thematic semantic context of a situation; 'Other people dislike me') and proprioceptive informations ('gut feelings' or proprioceptive information from posture and movement) are interlocked, a person will feel, e.g., sad or hopeless. When information is processed only semantically without resonance of the body, the person will simply think about sadness or hopelessness without actually *feeling* the emotion. According to the ICS approach in the so-called depressive interlock configuration, bodily and cognitive feedback loops can become established and 'lock' subsystems into a self-perpetuating configuration that maintains depression.

Only a few studies have empirically investigated associations between depression and the motoric system. Most studies have focused on gait in depression and have shown that depression is related to specific gait characteristics such as reduced speed, a slumped posture, reduced vertical movements of the upper body and swaying lateral movements (e.g., Lemke et al., 2000; Michalak et al., 2009; Sloman et al., 1982). However, on the basis of these studies, it is not possible to determine whether depressive mood affects gait or, in addition, that the motoric system causally influences the psychological processes relevant in depression. Therefore, in a recent study, Michalak, Rohde, and Troje (2014) directly tested whether changes in gait can affect depression related processes in a non-clinical sample. They gave undergraduates computer-based feedback to change their gait patterns. One group of participants received gait feedback that changed their gait into a more depressed pattern, and the other group of participants received gait feedback that changed their gait into a more positive pattern. Participants in the depressed gait feedback condition recalled a higher rate of negative self-relevant material than participants in the happy gait feedback condition.

The aim of the present study was to test whether the motoric system can also affect etiologically relevant processes in clinically depressed individuals. In contrast to the study of Michalak, Rohde, and Troje, we manipulated posture instead of gait: depressed participants sat either in an upright (non-depressed) or slumped (depressed) posture. In parallel with the study of Michalak, Rohde, and Troje, we investigated the effects of the different postures on biased processing of self-referent material, one of the most intensively studied cognitive-affective correlates of depression. A large body of research has found that depression affects how information about oneself is processed, as evidenced by enhanced encoding and recall of negative self-referent material and by a reduced processing of positive information (Mathews & MacLeod, 2005; Matt, Vázquez, & Campbell, 1992; Williams, Watts, MacLeod, & Mathews, 1997). A meta-analysis of studies on recall performance found that individuals with major depression remembered 10% more negative words than positive words (Matt et al., 1992). In contrast, non-depressed controls exhibited a memory bias for positive information in 20 of 25 studies. Several cognitive models of depression propose that biased memory is one of the key maintaining factors in depressive disorders (e.g., Beck, 1987; Rehm & Naus, 1990), and empirical studies have shown that biased memory predicts the course of depression symptoms (Beeney & Arnett, 2008).

Our present research tested the hypothesis that posture affects memory bias. We expected that depressed patients sitting slumped would tend to be biased towards recalling more negative than positive words, whereas depressed patients sitting upright would recall a more evenly balanced number of negative and positive words.

METHOD

Participants and Overview of Procedure

The participants were 30 psychiatric inpatients suffering from major depression disorder (MDD). The inpatients were recruited from adult psychiatric units at two university-affiliated hospitals. To verify the diagnosis of the psychiatrists of the inpatient units, a trained rater conducted the German version of the Structured Clinical Interview for Diagnostic and Statistical Manual of Mental Disorder Fourth Edition (Wittchen, Wunderlich, Gruschwitz, & Zaudig, 1997). Patients were included in our study if they met the criteria of the Diagnostic and Statistical Manual of Mental Disorder Fourth Text Revision Edition (American Psychiatric Association, 2000) for a principal diagnosis of current MDD. To further ensure the validity of MDD diagnoses, each participant also completed the Beck Depression Inventory-II (Beck, Steer, & Brown, 1996; German version Hautzinger, Keller, & Kühner, 2006). Only patients who scored 14 or more on the Beck Depression Inventory-II were included in our study. We excluded patients with psychotic disorders, bipolar disorders, current substance related disorders or chronic back pain. Most patients (80%) had comorbid diagnoses [especially anxiety disorders ($n = 14$ panic disorder, $n = 2$ agoraphobia without history of panic disorder, $n = 5$ social phobia, $n = 7$ specific phobia, $n = 4$ obsessive-compulsive disorder, $n = 4$ posttraumatic stress disorder and $n = 1$ anxiety disorder not otherwise specified) or somatoform disorders ($n = 2$

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pain disorder, $n=1$ hypochondriasis and $n=1$ body dysmorphic disorder)]. All patients were treated with antidepressant medication (mostly with selective serotonin reuptake inhibitors [$n=14$] or serotonin noradrenalin reuptake inhibitors [$n=11$]). The study was conducted in accordance with the Declaration of Helsinki and was approved by the local Ethics Committee of Ruhr-Universität Bochum, Germany.

The participants were randomly assigned to the slumped ($n=15$) or upright ($n=15$) sitting position conditions. They believed that the study dealt with the effects of different relaxation positions on physiological stress reactions. To support this cover story, participants were asked to collect saliva samples with a salivette from their mouths (analyses of these samples were not intended). After manipulation of the posture, a word imagination task was used as the incidental learning procedure for the free-recall task. The imagination task was followed by a 5-min distraction task that prevented participants from further elaborating the material. This distraction task presented participants with two letters per trial. Their task was to mentally rotate the letters and to judge whether they were mirror-reversed or not (performance on this task was not monitored). Finally, a free-recall task was conducted to assess participants' memory for the words used during the imagination task (for details see below). The experiment lasted approximately 20 min during which the participants stayed either in the slumped or upright position. After the position was dissolved, participants rated their comfort in sitting during the task on a seven-point scale (1 'very uncomfortable' to 7 'very comfortable'). After the end of the experiment, a positive imagined scenario was induced in all participants to counteract possible negative mood effects of the posture induction.

Posture Modification

To manipulate the posture (Figure 1) of our participants, we used a slightly modified version of the instructions of Riskind (1984) and Duclos *et al*. (1989). The instructions were modified to make sure that the position of the feet and the degree of tension was identical in both conditions so that group differences in memory bias could unambiguously be attributed to differences in the posture of the upper body. The experimenter gave the following instructions:

Slumped Posture

Sit back in your chair. (Pause) Plant your feet flat on the floor underneath your knees, shoulders' width apart. (Pause) You should feel no tension in your legs or feet. (Pause) Now fold your hands in your lap, just sort of loosely cupping one hand in the other. (Pause) Now please drop your head, letting your rib cage fall and letting the rest of your body go limp. (Pause) You should feel just a slight tension up the back of your neck and across your shoulder blades.

Upright Posture

Sit back in your chair. (Pause) Plant your feet flat on the floor underneath your knees, shoulders' width apart. (Pause) You should feel no tension in your legs or feet. (Pause) Lift up the upper part of your body. (Pause) Bring your shoulders back slightly. (Pause) Elevate your chin. (Pause) You should feel just a slight tension up the back of your neck and across your shoulder blades.

To ensure that both groups of participants had a clear view of the computer screen, it was placed on the floor for patients in the slumped posture position and at eye level

Figure 1. Slumped and upright posture used in this study

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for patients in the upright position. The words were 1.4 cm high and 2.8–13 cm wide, and the distance to the computer screen was 1.20 m resulting in a good visibility of words in both conditions.

Assessment of Memory Bias

We assessed memory biases with an explicit memory task developed by Rinck and Becker (2005). Participants were shown 16 positive (e.g., beauty and enjoyable) and 16 depression related (e.g., exhaustion and dejected) words on a computer screen. Positive and depression related words were matched for length, frequency and word class (noun, verb and adjective). The positive words selected were about as intensely positive as the depression related words were negative, as determined by the valence ratings collected in a pilot test (for details see Rinck & Becker, 2005). We asked the participants to create a visual scene for each word by imagining themselves in connection with the presented word (e.g., a scene in which they felt dejected). The words were presented one by one on the computer screen for 10 sec. After each word, the patients were asked to rate how well they had been able to imagine the scene (scale ranging from 1 'very difficult' to 5 'very easy'). The complete imagination task lasted for approximately 10 min. The 5-min distractor task followed in which participants mentally rotated letters. Next, participants were asked to orally name the words presented to them during the imagination task (5 min). The experimenter wrote down all words recalled by the patients. Participants were not aware that their memory capacity of the words in the imagination task would be tested later. Affective biases in memory recall were then measured as the difference between the number of recalled positive words and the number of recalled negative words.

Statistical Analyses

We used *t*-tests and Chi-square tests for categorical variables to compare the pre-experimental characteristics of the two experimental groups. We tested our hypothesis with a 2 × 2 mixed-factors ANOVA with posture as a between-subjects factor and number of positive versus negative words recalled as the within-subjects factor. The critical effect was the interaction between these two factors. Because our hypothesis on effect of posture on memory bias is strongly theory-driven and directional in character (i.e., predicting a more evenly balanced number of negative and positive words in the upright condition), we used a directional interpretation of the *F*-test.

RESULTS

Descriptive statistics of our sample are displayed in Table 1. Independent *t*-tests and Chi-squared tests for categorical variables showed no significant pre-test differences between participants of the slumped and upright posture conditions (all p's > 0.05).

The mixed ANOVA revealed a significant interaction between posture and number of positive versus negative words recalled $F(1, 28) = 3.78$, directional $p = 0.031$, $\eta^2 = 0.119$, indicating that patients sitting in an upright posture showed a more balanced recall of positive and negative words, whereas patients sitting in a slumped posture showed a greater recall of the negative words (Figure 2).

An independent *t*-test revealed no group difference in ratings of comfort between conditions (slumped posture: M = 3.27, standard deviation (SD) = 1.28; upright position: M = 3.67, SD = 1.05, t (28) = 0.26, *NS*). Including comfort as

Table 1. Descriptive statistics

	Slumped posture (*n* = 15)	Upright posture (*n* = 15)
Age in years: M (range) SD	42.1 (28–59) 9.60	42.00 (20–58) 13.40
Female/male	9/6	9/6
Current pharmacological treatment (%)	100	100
BDI: M (range) SD	29.93 (16–40) 7.18	24.87 (15–43) 8.32
Number of past episodes M (range) SD	3.88 (1–15) 4.29	3.11 (1–11) 3.06
Number of patients treated with SSRI/SNRI	9/3	5/8

Note.
BDI = Beck Depression Inventory. SSRI = serotonin reuptake inhibitors. SNRI = serotonin noradrenalin reuptake inhibitors. SD = standard deviation.

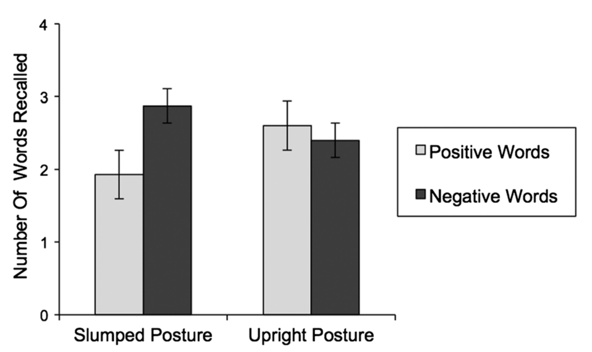

Figure 2. Means of positive and negative words recalled in a slumped or upright posture. Error bars represent 1 standard error

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a covariate (analysis of covariance) did not alter the obtained results ($F(1,28) = 3.034$, directional $p = 0.046$, $\eta^2 = 0.101$). Correspondingly, the intergroup difference in memory bias cannot be attributed to the comfort associated with the groups' different postures. We found no significant group differences in the ability to imagine positive (slumped posture: M = 2.99, SD = 0.75; upright position: M = 3.37, SD = 0.65, t (28) = 1.49, NS) or negative words (slumped posture: M = 3.85, SD = 0.50; upright position: M = 3.80, SD = 0.55, t (28) = 0.26, NS).

DISCUSSION

The present study found that depressed patients in a slumped posture recalled more negative than positive words in comparison with upright-sitting patients. An enhanced recall of negative material is a robust finding in studies on biased explicit memory in depressed people (Matt et al., 1992). In contrast, depressed patients in an upright posture showed a balanced recall of positive and negative words. Correspondingly, our results indicate that a relatively short and simple bodily manipulation can attenuate memory bias in depression and lead to a balanced recall of positive and negative self-referent material. As Figure 2 indicates, this result is not attributable to a mere reduced recall of negative material in the upright posture, but instead, the upright posture especially affects the difference between positive and negative material recalled.

To our knowledge, this is the first study in clinically depressed individuals showing that changes in the gross motor system affect processes that are relevant in the aetiology of depression. Our findings might have implications on a theoretical as well as on a therapeutic level. On a theoretical level, they suggest that interactions between the body and emotional process that are well-documented in basic research might also be of relevance for our understanding of clinical phenomena. Bodily aspects such as posture or movement patterns (e.g., gait characteristics) might be more than epiphenomena of psychopathology but also might contribute to an escalation of distorted process in psychological disorders. Dysfunctional motoric patterns in MDD (i.e., posture or gait) might bias information processing in a negative direction. As the ICS approach (Teasdale & Barnard, 1993) supposes, this might lead in the long run to a 'depressive interlock configuration', in which bodily and cognitive feedback loops 'lock' subsystems into a self-perpetuating configuration that maintains depression.

Our results might have practical implications as well. If motoric processes are relevant for the aetiology of depression (and other psychological disorders), the motoric system might also be a promising focus of therapeutic interventions. Training patients to change habitual motoric patterns (e.g., dysfunctional posture or gait patterns) might, in the long run, have effects on depressive symptoms and on the course of MDD by changing processing biases of emotional material. These changes could be attained by direct motoric feedback. Moreover, one might speculate that an alternative way to change motoric patterns might be to enhance body awareness by interventions like Mindfulness-based Cognitive Therapy (Segal, Williams, & Teasdale, 2002). If patients are intensively trained in mindful body awareness, they might develop an intuitive understanding of the interplay of bodily and emotional processes (for a detailed discussion see Michalak, Burg, & Heidenreich, 2012) and change depressogenic motoric patterns (Michalak, Troje, & Heidenreich, 2010, 2011). Of course, it should be noted that further longitudinal studies are needed to determine whether changes in the motoric system have a long lasting impact on memory bias and clinical significant effects on the course of MDDs.

One limitation of the present study is the small sample size. Therefore, future studies should investigate embodiment effects on depression with larger samples. More statistical power would allow determining more clearly whether the more balanced recall of positive and negative words in the upright posture is attributable to a higher rate of positive words recalled or to a reduced rate of negative words recall.

Moreover, future research should elucidate the mechanisms responsible for the effect of posture on memory bias. For example, it would be of interest to find out whether body posture affects the encoding, decoding or consolidation of self-referent emotional material. In addition, future studies could profit from including a condition in which the body is not manipulated. This would allow a comparison of the memory bias of participants in their habitual posture with participants whose motor system is intentionally manipulated. Moreover, including a matched control group of non-depressed individuals would help to elucidate whether comparable effects of posture on memory bias can be observed in people who are not depressed. This could be expected on the basis of basic research of embodiment effects in emotion. As described above, Riskind (1983), e.g., found in a non-clinical sample that access to pleasant and unpleasant life experiences was affected by sitting postures and facial expressions. Alternatively, effects of posture on affective memory might be specific or more pronounced in depressed patients. Depressed patients have repeatedly experienced situations in which slumped posture, depressive mood and thinking patterns were present simultaneously. One might speculate that this has resulted in strong associations between posture, depressive mood and thinking patterns, thus leading to easy and rapid activation of depressive information processing by a slumped posture.

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In summary, the present study offers evidence that a relatively minor and simple change in the motoric system can change a negatively biased memory to a more balanced memory for self-referent material in depressed individuals. According to cognitive theories, biased memory is one of the key etiological factors in MDD. Correspondingly, balancing this dysfunctional process through the motoric system might offer new treatment options for this debilitating condition.

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