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Attentional bias and childhood maltreatment in clinical depression - An eye-tracking study

Charlott Maria Bodenschatz, Marija Skopinceva, Theresa Ruß, Thomas Suslow*

Department of Psychosomatic Medicine and Psychotherapy, University of Leipzig, Semmelweisstr. 10, 04103, Leipzig, Germany

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ABSTRACT

Major depressive disorder (MDD) has been found to be associated with biased attention to emotional stimuli: increased attention for dysphoric information and/or decreased attention for positive information compared to healthy individuals. A history of childhood maltreatment (CM) has been discussed as a factor that might have an impact on the occurrence and extent of biased attention in depression. The present study examined the association between CM and attention for facial emotions in currently depressed patients using eye-tracking methodology. In a free viewing paradigm, 31 individuals with MDD and 31 healthy subjects viewed images of four facial expressions (happy, sad, angry, and neutral). Dwell time on each facial expression was used as an indicator of attention allocation. Childhood maltreatment was assessed using the German version of the Childhood Trauma Questionnaire. Depressed patients showed shorter gaze durations for happy faces compared to healthy controls. This result is in line with the assumption that depression goes along with a loss of elaborative processing of positive stimuli. No group differences were observed concerning dwell times on negative faces. However, CM was associated with reduced attention for angry and sad facial expressions in the depressed sample. Depressed individuals with a history of CM seem to avoid processing of threatening or burdensome stimuli. Early life adversity appears to impact attention allocation in depressed individuals and might help to explain discordant results in the literature regarding biased attention to negative facial expressions in depression.

1. Introduction

Biased attention to emotional information has been discussed as an important factor influencing the onset, maintenance, and recurrence of depression (Gotlib and Joormann, 2010). With selective attention, some stimuli in the environment are given priority, while processing of others is inhibited or reduced (Posner et al., 1980). In contrast to healthy individuals, who orient their attention preferentially to positive information, depressed individuals have been found to be characterized by either a tendency of selective attention to negative information and/or inattention for positive information (Armstrong and Olatunji, 2012). It has been suggested, that biased attention to emotional information supports the maladaptive patterns of information processing that are typical for depression (Gotlib and Krasnoperova, 1998).

Early stressful life events such as childhood maltreatment (CM) could be a variable affecting attentional biases. CM has been discussed to influence not only the incidence of major depressive disorder (MDD) but also characteristics such as course of illness and treatment response (Nelson et al., 2017). Maltreated individuals have been found to be twice as likely to develop both recurrent and persistent depressive episodes compared to those without a history of CM (Nanni et al., 2012). Importantly, research revealed that there are differential effects of CM subtypes associated with MDD. Compared with physical and sexual abuse, emotional abuse in childhood has been shown to be especially associated with internalizing symptoms and the development of MDD (Shapero et al., 2014). However, the exact mechanisms through which emotional maltreatment enhances the vulnerability to depression remain largely unknown.

To examine attention to emotional stimuli, the eye-tracking technology has proven to be especially promising. Eye-tracking provides a relatively direct measure of attention allocation, as the direction of the gaze and the focus of attention are thought to be tightly coupled (Wright and Ward, 2008). Moreover, through the assessment of eye gaze it is possible to analyze attentional processes continuously over a long period of time.

* Corresponding author.
E-mail addresses: charlott.bodenschatz@medizin.uni-leipzig.de (C.M. Bodenschatz), skopinceva@gmx.de (M. Skopinceva), suslow@medizin.uni-leipzig.de (T. Suslow).

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1.1. Biased attention in depression

Previous eye-tracking studies investigating biased attention in clinical depression came to partly inconsistent results. Mogg et al. (2000) recorded eye movements from currently depressed and healthy controls while viewing slides of two facial expressions presented for 1 s, one emotional (threatening, sad, or happy) and one neutral. In this study, no orienting bias to emotional information was found suggesting that depressed individuals are not characterized by biases in early attentional processes. However, analyzing gaze data over a longer period of time (3.5 s), Duque and Vázquez (2015) revealed that clinically depressed individuals spend significantly more time viewing sad facial expressions compared to healthy controls. Biases in maintained attention to dysphoric information in depressed individuals have also been found in two eye-tracking studies using presentation durations longer than 10 s and pictures of emotional scenes as stimulus material (Eizenman et al., 2003; Kellough et al., 2008). Soltani et al. (2015) exposed currently depressed and healthy individuals for 8 s to images of happy, sad, threatening and neutral facial expressions. They found an attentional bias for sad faces and reduced attention for happy faces in the depressed sample. Using a comparable method, Isaac et al. (2014) observed decreased attention to happy facial expressions but not heightened attention to sad faces in depressed patients compared to healthy individuals.

Against this background, it can be concluded that depressed individuals are characterized by an attentional bias in late stages of information processing. This is consistent with the idea that depression goes along with deficits and biases in elaborative processing (Mogg and Bradley, 2005). However, while those eye-tracking studies investigating late stages of information processing consistently found attentional biases in depressed individuals, the findings are somewhat discordant regarding type and extent of this bias. Clinical depression is characterized by an increased attention to dysphoric stimuli and/or reduced attention to positive stimuli. One reason for the inconsistent eye-tracking results could be the small samples (*N*s vary between 8 and 16 depressed participants) examined in the aforementioned studies. Depression is a heterogeneous disorder, with considerable variations in etiology, symptom severity or symptom patterns. This heterogeneity has been found to influence the course of the disorder (Carter et al., 2012). Therefore, it is important to identify variables that might have an impact on the occurrence and extent of attentional biases in depressed individuals.

1.2. Biased attention in childhood maltreatment

In recent years, several studies have investigated the effects of CM on attention orientation to emotional information using response latency tasks like the dot probe or the emotional stroop task. Those studies proposed a link between CM and altered attention orientation to emotional stimuli. For instance, depressed patients and healthy young adults with a history of CM showed faster attention orientation to negative faces compared to those without a history of CM (Gibb et al., 2009; Günther et al., 2015). In contrast to these findings, Pine et al. (2005) found that maltreated children with concurrent post-traumatic stress disorder displayed attention avoidance of threatening faces. Postpartum women with a history of early life adversity also showed decreased attention to negative stimuli (England-Mason et al., 2018). It can be argued that decreased attendance to negative cues reflects a tendency in CM to avoid processing of stimuli that are perceived as threatening or burdensome because of deficits in emotion regulation. Early life adversity has been found to be associated with a lack of adaptive emotion regulation strategies (Carvalho Fernando et al., 2014). None of the aforementioned studies used eye-tracking methodology to investigate the association between CM and attentional bias.

1.3. The present study

In the present study, we examined the association of CM with allocation of attention to facial emotions in currently depressed patients using eye-tracking methodology. To our knowledge, no prior work explored the relationship between CM and biased attention in clinical depression based on gaze behavior. We used emotional (happy, sad, and angry) and neutral facial expressions as stimulus material. Facial expressions signal the emotional states of others and are therefore of high interpersonal relevance (Gilboa-Schechtman et al., 2004). We administered a free viewing paradigm with a presentation duration of 10 s to assess preferential attention allocation in late stages of information processing. Based on previous research, we predicted to find attentional bias in depressed compared to healthy individuals. We assumed that depressed individuals demonstrate increased attention towards sad facial expressions (i.e. longer dwell times) compared to healthy controls. Moreover, we hypothesized to find reduced attention to happy faces in the depressed sample (i.e. shorter dwell times) compared to healthy controls. Regarding CM, we expected that a history of maltreatment impacts attention allocation in depressed individuals. More precisely, we predicted that in the clinical sample experiences of early life adversity go along with reduced attention allocation to negative (sad and angry) faces.

2. Method

2.1. Participants

All participants in this study were between 19 and 46 years old, native speakers of German and had normal vision (tested with a Snellen eye chart). Each participant was screened for various exclusion criteria including neurological disorders, head injury with possible negative impact on cognitive functioning, alcohol or other substances abuse within the past 6 months as well as the wearing of eyeglasses or contact lenses. The study's procedure was approved by the ethics committee of the University of Leipzig, Medical School, and in accordance with the Declaration of Helsinki. The procedure of the study was explained before the experiment, all participants gave written consent to participate, and were financially compensated upon completion of the study.

Depressed patients were recruited from the Department of Psychosomatic Medicine and Psychotherapy at the University of Leipzig. MDD patients were invited to participate in a clinical interview to determine their study eligibility. Two trained interviewers administrated the Structured Clinical Interview for the DSM-IV Axis I (SCID; German version, Wittchen et al., 1997) to 64 depressed inpatients and those with a primary diagnosis of MDD were included in the study. Individuals with other present or past psychiatric conditions such as a bipolar disorder or psychotic symptoms and those with distinct symptoms of an anxiety disorder were excluded. Patients who met inclusion criteria were scheduled for the second experimental session.

The final sample consisted of 31 (19 female) patients who met SCID criteria for current major depression and scored 14 or higher on the revised version of the Beck Depression Inventory (BDI-II; German version, Hautzinger et al., 2006). Participants mean number of lifetime episodes of major depression was 9.09 (SD = 8.60), the mean duration of actual hospitalization was 4.90 (SD = 1.83) weeks and 55% of the sample was medicated (of these, 53% with selective serotonin reuptake inhibitors). Sixty-five percent of the sample exhibited emotional abuse in their childhood, 29% physical abuse, 23% sexual abuse, 61% emotional neglect and 58% physical neglect.

Thirty-one healthy controls (HC; 19 female) were selected to match the MDD patients for gender. The HC group was recruited via online advertisements and public notices posted in the city. The Mini International Neuropsychiatric Interview (M.I.N.I., Ackenheil et al., 1999) was conducted by a trained psychologist to exclude participants

Table 1
Demographic, affective, cognitive and maltreatment characteristics of study groups.

	MDD (N = 31)			HC (N = 31)			
	M	SD	Range	M	SD	Range	
Age	31.13	7.16	19–46	29.48	5.56	19–44	
Level of education [a]	3.19	1.14	1–5	3.55	1.03	2–5	
BDI-II	23.97	6.63	14–38	3.26	3.01	0–9	**
STAI-T	57.77	8.65	35–69	32.58	5.75	21–44	**
TMT-B	63.02	21.43	37–120	60.52	17.66	39–121	
CTQ	50.94	16.66	26–101	34.90	8.09	25–61	**
CTQ emotional abuse	12.10	5.65	5–24	6.65	2.04	5–12	**
CTQ physical abuse	7.06	3.62	5–19	5.35	1.20	5–11	*
CTQ sexual abuse	7.97	6.20	5–25	5.48	1.57	5–13	*
CTQ emotional neglect	15.42	4.19	5–24	10.87	5.10	5–23	**
CTQ physical neglect	8.39	2.68	5–16	6.54	1.86	5–11	**

Note: MDD = Major depressive disorder; HC = Healthy controls; M = Mean; SD = Standard Deviation; Significant group differences denoted by: *$p < .05$ and **$p < .01$; [a] Coding of level of education = 0 = no degree, 1 = 9th grade, 2 = 10th grade, 3 = 11th/12th grade, 4 = university bachelor degree, 5 = university master degree; BDI-II = Beck Depression Inventory-II; STAI-T = State – Trait Anxiety Inventory, trait version; TMT-B = Trail Making Test Part B; CTQ = Childhood Trauma Questionnaire.

with potential symptoms of depression or other past or present mental disorders. The HC group consisted of individuals who were free from any life-time history of psychiatric disorders and scored 9 or less on the BDI-II. Thirteen percent of the sample exhibited emotional abuse in their childhood, 6% physical or sexual abuse, 29% emotional neglect and 29% physical neglect. The descriptive statistics for each group are shown in Table 1.

2.2. Measures and materials

To assess severity of depressive symptoms, all participants completed the revised version of the BDI-II, a 21-item self-report measure. Participants indicate on a four-point scale the severity of their experience for each depressive symptom. Total scores of the BDI-II range from 0 to 63, with higher scores indicating more severe symptoms. Childhood maltreatment was measured with the Childhood Trauma Questionnaire (CTQ; German version, Bader et al., 2009), a retrospective self-report measure consisting of 28 items. The CTQ has five subscales assessing emotional, physical and sexual abuse as well as emotional and physical neglect. Scores on the total scale range from 25 to 125, and scores on the subscales from 5 to 25, with higher scores indicating more severe abuse or neglect. To determine the presence of the different types of child maltreatment on a dichotomous basis, empirically determined and validated threshold values were applied (as reported by Walker et al., 1999). To control for trait anxiety levels, the trait version of the State-Trait Anxiety Inventory (STAI; German version, Laux et al., 1981) was included in this study. The STAI is a 20 item self-report questionnaire. Respondents are asked to rate how much they agree with each of the statements on a four-point scale. Total scores range from 20 to 80 points, with higher scores indicating higher levels of anxiety. To assess cognitive flexibility, the Trail Making Test Part B (TMT-B; Reitan and Wolfson, 1985) was administered. In this paper-and-pencil test, participants are asked to connect numbers and letters in ascending order (i.e., 1 – A – 2 – B – 3 – C …). Twenty-five items have to be connected and the total time to complete this task is measured. Higher scores indicate slower switching between letters and numbers, therefore, poorer attention switching control. Table 1 lists the questionnaire data of the study groups.

2.3. Eye-tracking task

2.3.1. Stimuli and procedure

A free-viewing paradigm was administered to assess participants' preferential attention allocation to emotional faces (Fig. 1). For this purpose, 80 photographs of 20 actors (10 female) were selected from the validated Lifespan Database of Adult Emotional Facial Stimuli

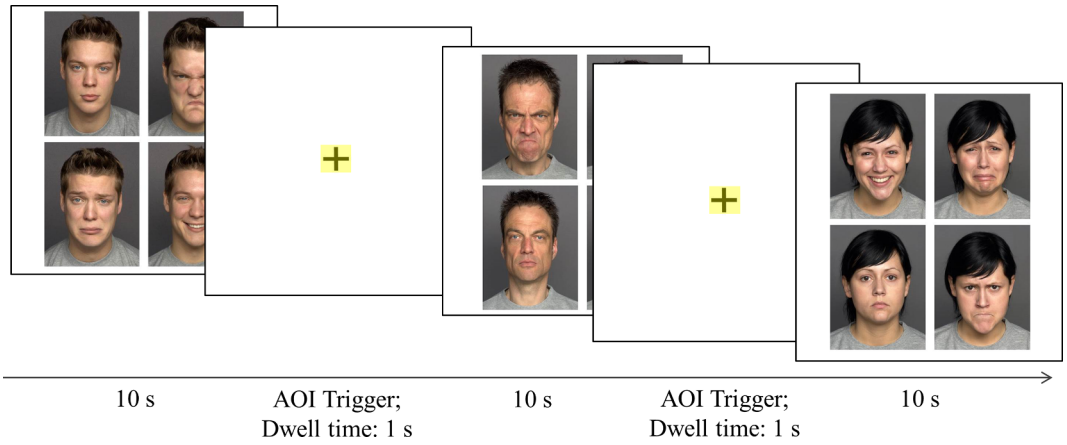

Fig. 1. Example of three trials in the free viewing task (AOI = Area of interest).

(Ebner et al., 2010).[1] Each actor clearly expressed four different emotional facial expressions: happiness, sadness, anger, and a neutral expression. All four facial expressions of a given actor were arrayed in a 2 × 2 matrix and presented simultaneously on a computer screen. The display size of each facial expression was 13 cm high × 11 cm wide.

Participants were instructed via the computer screen that they would be shown photographs of faces and should view them naturally. Each trial of the task started with a fixation cross (gray cross against a white background), shown until a fixation of 1000 ms. Subsequently, the four facial expressions were presented for 10 s. Each of the four emotional categories appeared equally likely in each corner and each actor was presented only once. The experimental setup consisted of 20 trials and lasted for approximately 4 min.

2.3.2. Apparatus

All stimuli were presented in their original color against a white background on a 22-inch TFT widescreen monitor (resolution:

[1] Stimuli included pictures from the following actors: 006, 008, 010, 014, 020, 022, 028, 029, 031, 032, 035, 038, 041, 043, 045, 048, 050, 056, 057, and 062.

1680 × 1050) running with an SMI-customized Dell laptop (IView X laptop). Eye movements were continuously recorded using an IView X RED250 remote system by SensoMotoric Instruments (SMI), an infrared video-based eye-tracking device sampling eye movements every 4 ms (250 Hz) with a gaze position accuracy of 0.4°. The SMI RED250 tracker is capable of compensating for changes in head position, therefore no head-resting device was required. SMIs Experiment Center software was used to present stimuli and to synchronize with recorded eye movements.

2.3.3. Eye movement parameter

Eye-tracking data were computed using a velocity-based algorithm with a minimum fixation duration of 100 ms, a minimum saccade duration of 22 ms and a peak velocity threshold of 40°/s. BeGaze 3.0 software was used to define four areas of interest (AOI) in each trial; corresponding to each facial expression. We used the eye-tracking parameter *dwell time* as an indicator for attention allocation. Dwell time was defined as the extent of time a participant's gaze remains fixated within the boundaries of a particular AOI, taking into account the number of attentional shifts. This measure was calculated by summing up the durations from all fixations and saccades that hit the AOI in ms. Dwell times were calculated for each AOI and each trial and then averaged for each participant. The parameter *entry time* was used as an indicator for initial orientation. Entry time was defined as the time between stimulus onset and the first fixation on the AOI in ms. The entry time was calculated for each AOI and each trial and then averaged for each participant.

2.4. General procedure

All participants were invited to the laboratory individually, read written instructions about the purpose and procedure of the experiment and gave their informed consent. On the day of administration of the visual scanning protocol, subjects were seated at approximately 70 cm in front of a computer screen in a sound-attenuated room shielded from sunlight. Ceiling lighting produced stable illuminance conditions. We used a Mavolux 5032B luxmeter (Gossen, Nuremberg, Germany) to measure horizontal (sensor placed on the desk in front of the screen) and vertical (sensor placed at about the position where the participant's eyes were located) lighting. Horizontal and vertical lighting were approximately 570 and 250 lux, respectively. Camera adjustments were made to best capture participants' eyes and a nine-point grid was used for calibration, followed by a separate validation using the IViewX software. The calibration procedure was repeated if visual deviation was above 0.7° on the X or Y axis. All participants were instructed to minimize body and head movements as much as possible. Once calibration was successful, the free-viewing task started. After the eye-tracking experiment, participants completed the BDI-II, the CTQ, the trait version of the STAI and the TMT-B.

2.5. Statistical analyses

A 2 (group: MDD, HC) x 4 (emotional category: happiness, sadness, anger, and neutral expression) mixed-model analysis of variance was calculated to test whether clinically depressed patients differed from HC in their dwell times. Greenhouse-Geisser correction (Greenhouse and Geisser, 1959) was applied to adjust the degrees of freedom of the F-ratios when the assumption of sphericity was violated. Bonferroni-corrected pairwise comparisons were conducted (alpha threshold set at 0.05/4 = 0.0125). Information about effect sizes is provided.

Correlation analyses were conducted to examine the association between dwell times on the four emotional facial expressions and the CTQ total scale (alpha threshold set at 0.05/4 = 0.0125). To control for the possibility that the correlation between attentional bias scores and childhood traumata were due to depression severity or trait anxiety, partial correlation analyses were conducted. To clarify the impact of CM on early gaze behavior, we performed additional correlation analyses between the CTQ total scale and the entry time data. All correlations are two-tailed tests unless hypothesized, in which case one-tailed probability is reported.

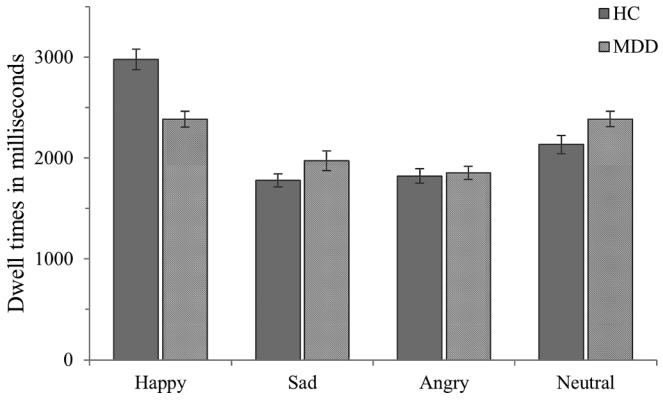

Fig. 2. Dwell times in ms for happy, sad, angry and neutral facial expressions. Participants with major depressive disorder (MDD) and healthy controls (HC) are compared. Error bars represent standard error.

3. Results

3.1. Group characteristics

As shown in Table 1, participants in the MDD group reported more symptoms of depression, $t(41.87) = -15.83$, $p < .001$, $r = 0.926$, higher anxiety levels, $t(60) = -13.50$, $p < .001$, $r = 0.867$ and higher scores on the total CTQ scale, $t(43.40) = -4.82$, $p < .001$, $r = 0.590$, as well as on each subscale ($ps \leq .035$). Groups did not differ regarding gender, age, education and cognitive flexibility ($ps > .2$).

Paired t-tests revealed no differences in medicated and unmedicated participants in dwell times on happy faces ($t(29) = 0.16$, $p > .5$, $r = 0.029$), sad faces ($t(29) = -0.40$, $p > .5$, $r = 0.074$), neutral faces ($t(20) = -0.01$, $p > .5$, $r = 0.002$) and angry faces ($t(25.82) = 0.95$, $p > .1$, $r = 0.174$). Correlation analyses revealed that the duration of actual hospitalization as well as the numbers of lifetime episodes of MDD did not have a significant impact on dwell times and CTQ values ($ps \geq .33$).

3.2. Attention allocation: between-group comparison

The dwell time analyses yielded a significant main effect of AOI, $F(2.42, 145.47) = 37.94$, $p < .001$, partial $\eta^2 = 0.387$ and a significant interaction between AOI and group, $F(2.42, 145.47) = 9.17$, $p < .001$, partial $\eta^2 = 0.133$. The interaction effect indicated that dwell times differed between study groups only for specific expression conditions. Bonferroni-corrected pairwise comparisons revealed that dwell time on happy faces was significantly shorter for the MDD group compared to the HC group, $t(60) = 4.63$, $p < .001$, $r = 0.513$. Dwell times on neutral faces, $t(58.66) = -2.18$, $p < .05$, $r = 0.274$, as well as on sad faces, $t(60) = -1.73$, $p > .05$, $r = 0.218$, were longer for the MDD group compared to the HC group but both failed to reach significance. The groups did not differ in their dwell times on angry faces, $t(60) = -0.34$, $p > .5$, $r = 0.044$, see Fig. 2.

Table 2
Bivariate correlations between attentional bias scores and childhood trauma scales.

Dwell time	CTQ-total	EA	PA	SA	EN	PN
Happy	.273	.275	.067	.128	.295	.268
Sad	-.403*	-.333	-.198	-.212	-.430	-.375
Angry	-.471**	-.350	-.323	-.374	-.370	-.312
Neutral	.391	.310	.415	.278	.127	.374

Note: *$p \leq .0125$; **$p \leq .005$.
To control for multiple testing, level of significance was set to an alpha of .0125 for the correlations between the *CTQ-total* score and the dwell time data. CTQ = Childhood Trauma Questionnaire; EA = Emotional abuse; PA = Physical abuse; SA = Sexual abuse; EN = Emotional neglect; PN = Physical neglect.

3.3. Relations between attention allocation and childhood maltreatment

A series of bivariate correlation analyses was conducted to explore whether the dwell time data of the MDD group was associated with the CTQ total scale. Table 2 shows the zero-order correlation coefficients.[2] Analyses revealed significant negative correlations between the CTQ total scale and sad facial expressions ($p = .012$, one-tailed) as well as on angry facial expressions ($p = .004$, one-tailed). There was also a positive correlation between the CTQ total scale and dwell times on neutral facial expressions ($p = .30$, two-tailed). However, after controlling for multiple comparisons, this correlation failed to reach significance.

There was no significant correlation between gaze behavior and the affect measures, BDI-II and STAI ($ps \geq .07$) and between the CTQ total scale and the affect measures ($ps \geq .24$). Partial correlations were calculated to determine the relationship between dwell time data and the CTQ total scale controlling for depressive symptom severity and trait anxiety. There were still significant negative correlations between the CTQ total scale and attention to negative facial expressions ($r = -.40$, $p = .03$ for sad faces; $r = -0.45$, $p = .01$ for angry faces).

The correlation analysis between the entry time to the different emotional facial expressions of the MDD group and the CTQ revealed no significant correlation ($ps \geq .35$).[3]

4. Discussion

Despite a growing body of literature investigating the association between attentional bias for emotional information and MDD, little is known about factors that might impact this relationship. Because CM has been shown to contribute to the incidence, course of illness and treatment response of MDD, it is worth examining the association between CM and attentional bias in currently depressed patients.

In our study, reduced attention to positive facial expressions was observed in currently depressed participants compared to healthy controls. This finding is consistent with results from Isaac et al. (2014) and Soltani et al. (2015). Both studies demonstrated that depressed individuals spend less time attending to positive facial expressions compared to healthy people. Further research found that non-depressed individuals preferentially process and recall positive information, while depressed individuals fail to display such a *protective bias* (Armstrong and Olatunji, 2012; Soltani et al., 2015). The absence of a protective bias is believed to support the maladaptive patterns of information processing that are typical for depression (Gotlib and Krasnoperova, 1998). Thus, the present work contributes to a growing body of evidence that depression goes along with decreased attention to positive information.

Comparable to the study of Isaac et al. (2014), the present work did not find increased attention to sad facial expressions in depressed individuals. This result was unexpected as several other eye-tracking studies observed an attentional bias for sad faces (e.g. Eizenman et al., 2003; Kellough et al., 2008; Soltani et al., 2015). For instance, Duque et al. (2015) demonstrated that clinically depressed individuals spend more time viewing sad facial expressions compared to healthy controls, pointing to a negative attentional bias in depression. The present study did not find such a negative bias, even though we carefully diagnosed our depressed sample including only individuals with a medium to high level of depression and excluding participants with comorbid disorders. Moreover, compared to previous eye-tracking studies in this field, we included a larger sample of depressed individuals. Our data suggest that depressed compared to healthy individuals are characterized by a missing protective (or positive) bias rather than a negative attentional bias.

Inconsistency of results in the literature might be due to variables that influence the association between attention allocation and MDD. Previous eye-tracking studies did not consider the effect of early life adversity on this association. Our data suggest a substantial influence of CM on gaze behavior to negative facial expressions in currently depressed patients. Specifically, early life adversity was significantly associated with reduced attention to negative facial expressions in the depressed sample. There was no evidence for confounding effects of depression severity or trait anxiety.

According to our data, depressed individuals with a history of CM seem to avoid processing of threatening or burdensome stimuli. This result is in line with recent data from England-Mason et al. (2018) who found decreased attention to negative stimuli in women with a history of CM. Regarding early gaze behavior, the present work found no association between CM and entry time to the different emotional facial expressions. This result is somewhat surprising as previous research found faster attention orientation to negative faces in individuals with a history of CM (Gibb et al., 2009; Günther et al., 2015). According to those studies, it could be assumed that early heightened sensitivity to threatening facial expressions serves to protect maltreated individuals against additional aversive situations by rapidly identifying negative cues and preparing defensive responses such as attentional avoidance. However, in the long run, decreased attention to negative cues seems to reflect a maladaptive emotion regulation strategy, which could contribute to the development and maintenance of depression. The present work did not find early vigilance for negative facial expressions in the MDD (and maltreated) sample. The inconsistencies in the findings might be due to methodological differences as previous research used reaction time tasks (e.g. dot probe tasks) to assess attention allocation, rather than a direct measure such as the registration of gaze.

Recent research demonstrated that attention bias in depressed participants is associated with, and in part dependent on, the existence of other cognitive biases. For instance, Sanchez et al. (2017) investigated the interplay of attention, interpretation and memory biases in depressed individuals and found that attention to negative information was associated with a greater tendency to remember more negative experiences (from the last two years). According to this study, it could be assumed that depressed individuals not only show a negative attention bias but also remember negative information more often. In contrast to this finding, the present work found that higher CTQ scores (which indicate heightened memory for traumatic experiences in childhood) were associated with reduced attention to negative facial expressions. Hence, CM seems to influence the direction of attention bias for unpleasant social signals in depressed individuals.

The present work provides a first insight into the effects of CM on attention to emotional facial expressions in depression. However, further research is needed to improve our understanding of the exact mechanisms how maltreatment experiences lead to an avoidance of negative social information in depression. Furthermore, as depression is

[2] Even though we had no specific predictions for the CTQ subscales, we report the correlation coefficients of the CTQ subscales in the correlation analysis in an explorative manner.

[3] All correlation analyses were also conducted for the healthy sample. No correlation reached statistical significance ($ps \geq .1$).

a complex phenomenon, with considerable variations in symptom patterns, forthcoming studies should consider the interplay of different emotional and cognitive biases.

Certain limitations should be acknowledged. The present work examined only a small sample of patients with mild to medium levels of CM. The extent of CM was even smaller in the HC sample. Studies with larger samples and participants characterized by greater severity of CM could reveal stronger effects in attentional biases concerning emotional information. Furthermore, Blanco et al. (2017) demonstrated in an eye tracking study that the processing advantage of happy faces could be partly due to confounding effects related to salience of physical characteristics such as the visibility of teeth. As the present study used happy facial expressions with open mouths and visible teeth as stimulus material, we cannot exclude the possibility that the observed processing advantage of happy faces in the HC group is due to such salient features. However, participants in the MDD group oriented their attention away from happy facial expressions. In this sample, there was no difference in dwell times on happy and neutral facial expressions even though the teeth were covered in the neutral faces.

In sum, the present work provides evidence that CM is associated with altered attention to negative social information in clinically depressed individuals. Depressed patients with a history of CM manifest reduced attention to angry and sad facial expressions. Early life adversity appears to impact attention allocation in depressed individuals and might help to understand inconsistent findings in the literature regarding biased attention to negative facial expression in depression.

Conflicts of interest

All authors declare that they have no conflicts of interest.

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