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The impact of happy and angry faces on working memory in depressed adolescents



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ABSTRACT

Recent cognitive models suggest that the ability to control emotional information in working memory (WM) may be implicated in the etiology and maintenance of depression. However, few studies have examined the effects of processing relevant and irrelevant emotional stimuli on WM performance in depressed adolescents. In the current study, depressed adolescents ($n = 27$) and healthy adolescents ($n = 49$) completed two versions of an emotional n -back task: a low WM load (0-back) task and a high WM load (2-back) task. In the emotion-relevant condition participants were asked to attend to the emotional expression of an angry, happy, or neutral face, whereas in the emotion-irrelevant condition participants were asked to attend to the gender of the face. The results showed a WM improvement for happy faces in the emotion-relevant condition and a WM impairment for happy faces in the emotion-irrelevant condition for healthy adolescents but not for depressed adolescents. No biases toward angry faces were found. These results demonstrate that depressed adolescents do not show a preferential processing of angry faces but rather fail to show a positivity bias as seen in healthy adolescents. This supports the theoretical notion that a depressive disorder is characterized by a blunted reactivity toward positive information and may provide new insights into the underlying mechanisms of youth depression.

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Introduction

Major depressive disorder (MDD) is among the most severe and debilitating mental disorders, constitutes a high economic burden, and increases significantly in prevalence during adolescence (Birmaher, Brent, & American Academy of Child and Adolescent Psychiatry [AACAP] Work Group on Quality Issues, 2007). Previous studies reported recurrence rates of up to 75% (Curry et al., 2011; Fombonne, Wostear, Cooper, Harrington, & Rutter, 2001a) and showed a sixfold higher risk of suicide associated with adolescent depression (Fombonne, Wostear, Cooper, Harrington, & Rutter, 2001b), emphasizing the need for further research on underlying mechanisms of MDD in this age group. The model of Beck (1976) suggests that automatic information processing, driven by “depressogenic” self-referent schemas, is a key mechanism in the development of depressive disorders. Compelling evidence supports the existence of negative biases in different aspects of information processing in (subclinically) depressed youths and demonstrates an attentional bias and an interpretation bias for negative information (for a review, see Platt, Waters, Schulte-Koerne, Engelmann, & Salemink, 2017).

It has been suggested that impaired cognitive control, and an inflexible working memory (WM) regarding the processing of emotional stimuli in particular, alters the effect of processing biases on depression vulnerability (Lonigan & Vasey, 2009; Salemink & Wiers, 2012) and affects one’s capacity to deal with intense emotion (De Raedt & Koster, 2010; Levens & Gotlib, 2010). More specifically, it is stated that updating the contents of WM is essential to reorient attention toward or away from emotional stimuli and to reinterpret emotion-eliciting situations (Joormann & D’Avanzato, 2010). Therefore, flexible WM is hypothesized to affect one’s emotion regulation (ER) abilities and, in turn, the risk of developing MDD (Joormann, Yoon, & Siemer, 2010; Koster, De Lissnyder, Derakshan, & De Raedt, 2011). This is consistent with the conceptualization of WM as the process that allows an individual to briefly store, manipulate, or update information necessary to perform complex cognitive or behavioral tasks (Baddeley, 2010).

In the context of emotional information, WM is often assessed using an emotional variant of an *n*-back task, in which participants are presented with a series of stimuli and are asked to indicate whether the current stimulus matches the stimulus presented *n* trials before. Whereas studies in adults document clear associations between impaired updating of the emotional content of WM and depression (Joormann & Gotlib, 2008; Joormann, Levens, & Gotlib, 2011; Levens & Phelps, 2008; Levens & Gotlib, 2010; Linden, Jackson, Subramanian, Healy, & Linden, 2011), studies on emotional WM in adolescents have been scarce and findings have been mixed (Ladouceur et al., 2005; Tavitian et al., 2014). Using an *n*-back task, Ladouceur et al. (2005) reported slower reaction times (RTs) to neutral target stimuli in the presence of negative background scenes in depressed adolescents and slower RTs in the presence of positive background scenes in healthy adolescents. These results demonstrate that irrelevant negative information interferes with WM performance in depressed adolescents (i.e., *negative bias*), whereas irrelevant positive information hampers WM performance in healthy adolescents (i.e., *positivity bias*). In contrast, regarding accuracy rates, Tavitian et al. (2014) showed that, in comparison with healthy adolescents, depressed adolescents’ WM performance on neutral target stimuli was less accurate in the presence of neutral distractor faces but not in the presence of angry or happy distractor faces. Thus, this study indicates that irrelevant neutral information impairs WM performance in depressed adolescents, whereas irrelevant positive and negative information does not.

It is noteworthy that the emotional stimuli in prior WM studies mostly served as distractors during the performance of a nonemotional task (Joormann & Gotlib, 2008; Kerestes et al., 2012; Ladouceur et al., 2005; Tavitian et al., 2014). Arguably, however, the influence of emotional stimuli on cognitive control processes depends on the task relevance of these stimuli (Kanske, 2012). When emotional stimuli serve as distractors and are irrelevant, performance will be impaired due to their preferential processing. However, when emotional stimuli are relevant and require attention, their automatic and prioritized processing will have beneficial effects on task performance (Cromheeke & Mueller, 2014). Interestingly, Levens and Gotlib (2010) used an emotional *n*-back task to explore depressed individuals’ ability to update WM with new and *relevant* affective information. Depressed participants were faster to integrate relevant negative information in WM (i.e., performance improvement for relevant

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