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Rumination prospectively predicts executive functioning impairments in adolescents



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ABSTRACT

Background and objectives: The current study tested the resource allocation hypothesis, examining whether baseline rumination or depressive symptom levels prospectively predicted deficits in executive functioning in an adolescent sample. The alternative to this hypothesis was also evaluated by testing whether lower initial levels of executive functioning predicted increases in rumination or depressive symptoms at follow-up.

Methods: A community sample of 200 adolescents (ages 12–13) completed measures of depressive symptoms, rumination, and executive functioning at baseline and at a follow-up session approximately 15 months later.

Results: Adolescents with higher levels of baseline rumination displayed decreases in selective attention and attentional switching at follow-up. Rumination did not predict changes in working memory or sustained and divided attention. Depressive symptoms were not found to predict significant changes in executive functioning scores at follow-up. Baseline executive functioning was not associated with change in rumination or depression over time.

Conclusions: Findings partially support the resource allocation hypothesis that engaging in ruminative thoughts consumes cognitive resources that would otherwise be allocated towards difficult tests of executive functioning. Support was not found for the alternative hypothesis that lower levels of initial executive functioning would predict increased rumination or depressive symptoms at follow-up. Our study is the first to find support for the resource allocation hypothesis using a longitudinal design and an adolescent sample. Findings highlight the potentially detrimental effects of rumination on executive functioning during early adolescence.

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1. Introduction

Major depressive disorder (MDD) is a common and debilitating mental illness with an estimated lifetime prevalence in the United States of 16.2% (Kessler, Merikangas, & Wang, 2007). It is particularly important to study the onset of depression during adolescence as the majority of adults with MDD experience their first depressive episode during this critical period of development (Kim-Cohen et al., 2003). Although rates of depression may be as low as 1% in children up to age 11, a dramatic spike in onset occurs during

adolescence, with lifetime prevalence rising to an estimated 5% by age 15 and 20% by age 18 (Hankin et al., 1998).

Individuals with depression often report decreased concentration and memory, and cognitive difficulties are an established symptom of MDD (American Psychiatric Association [DSM-IV-TR], 2000; Gotlib & Joormann, 2010). Indeed, depression has been linked to impaired performance on cognitive tasks involving non-emotionally-valenced stimuli; deficits have been found in samples of depressed adults across all domains of executive functioning (EF) including attentional switching, updating and monitoring working memory, and selective attention (Castaneda, Tuulio-Henriksson, Marttunen, Suvisaari, & Lonnqvist, 2008; Gotlib & Joormann, 2010; Miyake, Friedman, Emerson, Witzki, & Howerter, 2000; Wagner, Doering, Helmreich, & Lieb, 2011). Findings in adolescent samples have been mixed. Unipolar depression in adolescence has been linked to poorer performance on neutral tests

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of sustained attention (Maalouf et al., 2011; Wilkinson & Goodyer, 2006), selective attention (Wilkinson & Goodyer, 2006), and attentional switching (Gunther, Konrad, De Brito, Herpertz-Dahlmann, & Vloet, 2011; Wilkinson & Goodyer, 2006), as well as working memory (Klimkeit, Tonge, Bradshaw, Melvin, & Gould, 2011; Matthews, Coghill, & Rhodes, 2008). However, some studies of EF in depressed adolescents have found no difference between depressed and non-depressed youth (Favre et al., 2009; Gunther, Holtkamp, Jolles, Herpertz-Dahlmann, & Konrad, 2004), suggesting that further research is necessary.

Cognitive impairments observed in depressed individuals may be related to cognitive vulnerabilities. Rumination, a cognitive vulnerability for depression, is characterized by recurring, perseverative thoughts about the symptoms, causes, and future repercussions of one's depression (Nolen-Hoeksema, 1991; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008; Smith & Alloy, 2009). Rumination has been found to predict the onset (Just & Alloy, 1997), duration (Roberts, Gilboa, & Gotlib, 1998), and number (Spasojevic & Alloy, 2001) of depressive episodes in adult samples. Rumination was also a significant predictor of depressive symptoms (Abela & Hankin, 2011; Nolen-Hoeksema et al., 2008; Roelofs et al., 2009) and episodes (Abela & Hankin, 2011) in studies of adolescents and children.

Rumination also has been linked to impaired cognitive processing on neutral tasks (Wisco & Nolen-Hoeksema, 2008). Dysphoric adults instructed to ruminate displayed inhibition impairments on the Stroop task (Philippot & Brutoux, 2008), as well as poorer short-term problem-solving abilities and impaired concentration (Lyubomirsky, Kasri, & Zehm, 2003; Lyubomirsky & Nolen-Hoeksema, 1995); the latter two effects did not emerge in nondysphoric participants, or when dysphoric participants were instructed to engage in distraction techniques. In addition to studies of rumination induction, trait rumination also has been associated with cognitive impairments on neutral tasks. Adults scoring higher in rumination were worse at inhibiting a previous task's instructions when presented with a new task; this result was independent of depression score (Whitmer & Banich, 2007). In addition, rumination has been linked to difficulties in attentional switching and mental flexibility in studies examining depressive symptoms in adults (Altamirano, Miyake, & Whitmer, 2010; Davis & Nolen-Hoeksema, 2000; De Lissnyder, Koster, Derakshan, & De Raedt, 2010). Findings of switching deficits complement the conceptualization of rumination as involving difficulties disengaging from depressive cognitions, resulting in repetitive, maladaptive thought patterns (Davis & Nolen-Hoeksema, 2000). In addition, tasks requiring attentional switching and inhibition may be particularly cognitively demanding, in accord with hypotheses that the detrimental effects of rumination on EF may only emerge when under significant cognitive load (Levens, Muhtadie, & Gotlib, 2009). Rumination also has been associated with working memory deficits (Berman et al., 2011; Meiran, Diamond, Toder, & Nemets, 2011). Only one study has examined the relationship between trait rumination, depression and EF in an adolescent sample; whereas attentional switching impairments were linked to MDD, there was no significant relationship between switching and trait rumination (Wilkinson & Goodyer, 2006). In sum, findings from adult and adolescent studies suggest a link between depression and cognitive impairment, particularly with regards to attentional processes and working memory on neutral tasks. Rumination has been associated with similar EF impairments in adults in domains such as attentional switching, inhibition, and working memory, and may in part be responsible for the deficits observed in relation to depression (Gotlib & Joormann, 2010; Hertel, 1998; Levens et al., 2009; Watkins & Brown, 2002).

However, the nature of the relationship between depression, rumination, and executive functioning is not well understood.

Resource allocation theory posits that the negative thoughts of depression and rumination deplete limited cognitive abilities that would otherwise be directed towards task-relevant processes (Gotlib & Joormann, 2010; Levens et al., 2009; Watkins & Brown, 2002). According to this theory, valuable cognitive resources are allocated towards irrelevant depressive and ruminative thought processes. Indeed, depression and rumination have been associated with increased attention towards, and difficulty disengaging from, negative information, as put forward in the affective interference hypothesis (Gotlib & Joormann, 2010; Siegle, Ingram, & Matt, 2002). In line with this hypothesis, EF deficits observed in depressed and ruminative individuals may be more indicative of difficulties in cognitive control and attentional redirection than of global processing deficits (Gotlib & Joormann, 2010; Siegle et al., 2002). At the same time, although engaging in depressive and ruminative thoughts may deplete cognitive resources that would otherwise be directed towards relevant tasks, it is also possible that underlying cognitive impairments could be the cause of depressive and ruminative styles, or that these negative thought patterns and EF impairments interact (Gotlib & Joormann, 2010; Koster, De Lissnyder, Derakshan, & De Raedt, 2011; Levens et al., 2009).

Unfortunately, there is a lack of longitudinal research attempting to better understand the direction of the relationship between rumination, depression, and EF impairment. Zetsche and Joormann (2011) found that impaired inhibition of negatively-valenced stimuli predicted increased rumination and depressive symptoms in adults at six-month follow-up; however, this study did not include non-emotional stimuli. De Lissnyder et al. (2012) utilized both emotional and non-emotional stimuli in a longitudinal study examining the relationship between EF, stress, and rumination in college students. They found that baseline emotional set-switching impairments moderated the effect of a stressful life event on subsequent brooding rumination, with higher levels of initial set-switching impairment resulting in higher rumination levels following the experience of a stressor. Interestingly, only emotional set-switching impairments significantly moderated the effect of stress on rumination; non-emotional switching impairments did not. Although these findings tentatively suggest that impaired processing of emotional information may play a role in the development of rumination, the relationship between rumination and non-emotional cognitive processing remains unclear.

Several prospective studies have linked rumination and depression in adolescence to lower levels of effortful control (EC), an aspect of temperament encompassing overall self-regulatory and attentional abilities (Hilt, Armstrong, & Essex, 2012; Verstraeten, Vasey, Raes, & Bijttebier, 2009). Associations have been found between low EC, rumination, and depressive symptoms both concurrently (Verstraeten et al., 2009) and prospectively (Hilt et al., 2012; Verstraeten et al., 2009), suggesting that lower levels of EC may predict greater rumination and that higher EC may serve as a protective factor against depressive symptoms, although null results also have been reported (Mezulis, Simonson, McCauley, & Vander Stoep, 2011). Findings from studies of EC suggest that the direction of the relationship between underlying cognitive abilities and rumination may be opposite to that proposed by the resource allocation hypothesis, underlining the need for additional longitudinal research. Additionally, the temperamental construct of effortful control in these studies is often measured by self-report, and does not address specific domains of executive functioning, which may be best examined using behavioural methods. To our knowledge, no prospective studies of rumination, depression, and behavioural indices of executive functioning have been conducted in an adolescent sample.

From a developmental perspective, it is particularly important to investigate the relationship between rumination, depression,

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