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Getting stuck in depression: The roles of rumination and emotional inertia

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Like many other mental disorders, depression is characterised by psychological inflexibility. Two instances of such inflexibility are *rumination*: repetitive cognitions focusing on the causes and consequences of depressive symptoms; and *emotional inertia*: the tendency for affective states to be resistant to change. In two studies, we tested the predictions that: (1) rumination and emotional inertia are related; and (2) both independently contribute to depressive symptoms. We examined emotional inertia of subjective affective experiences in daily life among a sample of non-clinical undergraduates (Study 1), and of affective behaviours during a family interaction task in a sample of clinically depressed and non-depressed adolescents (Study 2), and related it to self-reported rumination and depression severity. In both studies, rumination (particularly the brooding facet) and emotional inertia (particularly of sad/dysphoric affect) were positively associated, and both independently predicted depression severity. These findings demonstrate the importance of studying both cognitive and affective inflexibility in depression.

Keywords: Rumination; Emotional inertia; Depression; Psychological flexibility; Perseveration.

Emotional stability has traditionally been considered a key component of psychological health and well-being (Costa & McCrae, 1980; DeNeve & Cooper, 1998; Eysenck, 1967). Although well-adjusted people may appear (even to themselves) to be highly stable, recent research suggests that it is actually their ability to continually modify and adjust their emotional responses to environmental changes that underlies their resilience (e.g., Waugh, Thompson, & Gotlib, 2011). Such adaptability in emotional responding can be seen as a specific instance of *psychological flexibility*, a general capacity for dynamically responding to fluctuating situational demands, which has been identified as a major determinant of mental health (Kashdan & Rottenberg, 2010). The importance of psychological flexibility for mental health is perhaps most evident when it is lacking: many psychological disorders involve perseverative patterns of cognition, affect and behaviour, which

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are rigidly executed in a stereotyped fashion (Gotlib & Joorman, 2010; Hollenstein, Granic, Stoolmiller, & Snyder, 2004; Kashdan & Rottenberg, 2010; Robinson, Wilkowski, Kirkeby, & Meier, 2006). The resulting lack of psychological flexibility serves to maintain these disorders by rendering their sufferers unable to adapt to new situations and changing life circumstances (Robinson et al., 2006).

In the current paper, we focus on two perseverative tendencies that exemplify the psychological inflexibility associated with depression. The first of these is *rumination*: a widely studied form of perseverative cognition that is considered to be a major aetiologic and maintenance factor in depression (Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). The second perseverative tendency, which has been linked with depression more recently, is *emotional inertia*: the propensity for affective states to carry over from one moment to the next (Kuppens, Allen, & Sheeber, 2010). Although rumination and emotional inertia have both been independently associated with depression, no studies have examined whether these two perseverative tendencies are themselves related. Here, we propose that rumination and emotional inertia represent co-occurring, and complementary tendencies to "get stuck" cognitively and affectively. Given the possible link between emotional inertia and rumination, it is also important to examine whether each is independently associated with depression severity. This will help shed light on whether both cognitive and affective perseveration play unique roles in depression, or whether their respective associations with depression derive from some underlying commonality.

Rumination: Getting cognitively stuck

Rumination is a particularly harmful form of perseverative cognition, involving "repetitively and passively focusing on symptoms of distress and on [their] possible causes and consequences" (Nolen-Hoeksema et al., 2008, p. 400). This form of cognitive inflexibility, often labelled depressive rumination, is known to contribute to the development and maintenance of mood disorders, especially depression (Nolen-Hoeksema et al., 2008; Watkins, 2008). A substantial research literature has established that rumination is a stable trait-like vulnerability factor in depression (Bagby, Rector, Bacchiochi, & McBride, 2004), even when controlling for other negative cognitive styles and personality traits such as neuroticism (e.g., Nolen-Hoeksema, Parker & Larson, 1994; Spasojevic, & Alloy, 2001). Although depressive rumination involves inflexible responding to dysphoric affect in particular, it can be seen as a specific instance of a more general inflexible cognitive style. For instance, Davis and Nolen-Hoeksema (2000) showed that individuals who reported engaging in depressive rumination also performed poorly on the Wisconsin Card Sorting Test, a non-affective measure of cognitive flexibility.

Rumination has been subdivided into a maladaptive *brooding* component—comprising negative, abstract, and self-focused thoughts such as "Why can't I handle problems better?"—and a more neutral mode of self-focused cognition labelled *reflection* (e.g., "Write down what you are thinking and analyse it"; Treynor, Gonzalez, & Nolen-Hoeksema, 2003). While both the brooding and reflection components of rumination are associated with depression (Joorman, Dkane, & Gotlib, 2006; Treynor et al., 2003), brooding appears to play a larger role in maintaining and exacerbating depressive symptoms, whereas reflection, to the extent that it is independent of brooding, may be less detrimental (Aldao, Nolen-Hoeksema, & Schweizer, 2010; Treynor et al., 2003).

Emotional inertia: Getting affectively stuck

More recently, depression has also been linked with a perseverative pattern of affective dynamics, known as emotional inertia, wherein affective states carry over from one moment to the next (Koval & Kuppens, 2012; Kuppens, Allen et al., 2010; Kuppens et al., 2012). Following Suls, Green, and Hillis (1998), emotional inertia is operationalised as the autocorrelation of an affective state—the degree to which a person's current

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affect is predicted by their previous affective state—and thus reflects the temporal dependency component of affect dynamics (see also Gottman, Swanson, & Swanson, 2002). Recent studies have shown that, independent of the tonic levels of affect that characterise depression (i.e., higher negative and lower positive affect), under normal conditions depressed individuals display higher levels of inertia of both subjective feelings (Koval & Kuppens, 2012) and emotionally expressive behaviours (Kuppens, Allen et al., 2010). In other words, both the experiential and expressive components of affect are typically more resistant to change over time among depressed individuals. Moreover, emotional inertia prospectively predicts the onset of clinical depression in non-depressed adolescents (Kuppens et al., 2012). Together, these findings show that increased emotional inertia is not merely a concomitant of the mood alterations involved in depression, but may represent an important risk factor for the development of mood disorder.

Associations between rumination and inertia

Affect and cognition are intricately related and, importantly, their links are bidirectional (see, e.g., Forgas, 2008, for a review). Hence, just as negative cognitions can give rise to the experience of negative affect, negative affective states can also trigger negative thoughts. In light of this reciprocal interplay between cognitive and affective processes, it is highly plausible that the tendency to ruminate about negative affective experiences will be related to the propensity for negative affective states to persist over time, and vice versa. Put simply, rumination and emotional inertia should be positively related. Although recent studies have linked rumination to higher average levels of negative affect in daily life (Moberly & Watkins, 2008; Takano & Tanno, 2011), the associations between rumination and the inertia of negative affect remain unexplored.

Rumination and emotional inertia both reflect a tendency for thoughts or affective states to become stuck, suggesting that they may have become disconnected from processes of regulation and control (Nolen-Hoeksema et al., 2008; Kuppens et al., 2012). Given that the same basic psychological abilities and brain systems appear to be involved in the regulation of both cognitive and affective processes (Zelazo & Cunningham, 2007), it follows that deficits in these regulatory capacities may be manifested in complementary patterns of perseverative cognition and affect. Although the relationship between rumination and emotional inertia has not previously been examined, Kuppens, Oravecz, and Tuerlinckx (2010) recently found an inverse relationship between trait rumination and affective *attractor strength*, defined as the strength with which regulatory processes pull an individual's affect back to their normative baseline following affective fluctuations. Given that emotional inertia is defined as the tendency for affective states to carry over in time, which should be inversely related to attractor strength (Hamaker, 2012), we predicted that emotional inertia and rumination would be positively related.

How do rumination and emotional inertia each contribute to depression?

As discussed above, both rumination and emotional inertia have separately been linked with depression. However, if rumination and emotional inertia co-occur, it is important to determine whether each of these perseverative tendencies independently contributes to depression or whether their respective associations with depression are due to shared variance. If both rumination and emotional inertia independently predict depression severity, it would suggest that both cognitive and affective inflexibility each play unique roles in mood disorder. According to prominent cognitive models of depression, the affective disturbances associated with depression result from biased and rigid patterns of cognition (e.g., Disner, Beevers, Haigh, & Beck, 2011; Gotlib & Joorman, 2010). However, affective dysregulation and inflexibility may play a unique role in depression, independent of cognitive factors (Campbell-Sills & Barlow, 2007; Holtzheimer & Mayberg, 2011; Kashdan &

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Rottenberg, 2010). Drawing on these insights, we proposed that cognitive inflexibility (rumination) and affective inflexibility (emotional inertia), although related, likely function as independent vulnerability factors for depression.

The current studies

Our first aim was to examine the prediction that trait rumination and emotional inertia of negative affect are positively associated, such that high ruminators display greater inertia of negative affect. Our second aim was to test the prediction that rumination and emotional inertia are uniquely and independently associated with depression severity. On the basis of previous research (Treynor et al., 2003), we expected that the more maladaptive brooding component of rumination would be more strongly related to emotional inertia and depression severity than would the reflection component. We investigated these research questions using a non-clinical university student sample pre-screened to maximise variability in depression severity (Study 1) and a sample of clinically depressed and non-depressed adolescents (Study 2). In both studies rumination and depression severity were measured using self-report questionnaires. In Study 1, we examined the emotional inertia of participants' negative feelings in daily life, whereas in Study 2 we measured the inertia of participants' observable emotional behaviours during a family interaction in the laboratory.

STUDY 1

Method

Participants

Participants were recruited from a pool of 439 undergraduates who were screened for depression using the Center for Epidemiologic Studies Depression Scale (CES-D; Radloff, 1977; see below) approximately four months prior to the present study. CES-D scores ranged from 0 to 52 ($M = 16.39$, $SD = 10.27$, $\alpha = .92$). To ensure that a wide range of depression severity was represented, we over sampled from the tails of the CES-D distribution and selected 100 participants with a wide range of CES-D scores (range = 0–50, $M = 19.27$, $SD = 12.53$). One participant withdrew early from the study and another four participants were excluded from data analyses (due to equipment malfunction, $n = 3$; poor compliance, i.e., $> 40\%$ missing data, $n = 1$) leaving a final sample of 95 participants (59 women, 36 men), ranging in age from 18 to 24 years ($M = 19.06$, $SD = 1.28$), predominantly of European ethnicity (88%). Participants completed the measures reported here as part of a larger study, for which they received payment of €70.

Materials and procedure

Participants completed the study over seven consecutive days. On the first day, participants came to the laboratory and completed questionnaire measures of depression severity and trait rumination (see below; Table 1 contains descriptive and

Table 1. *Descriptive statistics for dispositional variables in Studies 1 and 2*

	Study 1			*Study 2*					
	(n = 95)			*Depressed (n = 71)*			*Non-Depressed (n = 69)*		
Measure	*M*	*SD*	*α*	*M*	*SD*	*α*	*M*	*SD*	*α*
1. RRS	45.76	10.34	.86	53.66	11.78	.91	37.73	11.80	.94
2. Brooding	10.55	3.08	.64	8.08	2.09	.61	5.88	2.00	.71
3. Reflection	9.98	3.07	.69	12.23	3.58	.78	9.92	3.52	.82
4. CES-D	14.66	9.67	.91	27.54	12.00	.90	7.23	5.52	.80

Notes: RRS = Ruminative Responses Scale. Different versions of the RRS were used in Study 1 (Treynor, Gonzalez, & Nolen-Hoeksema, 2003) and Study 2 (Nolen-Hoeksema & Morrow, 1991). Brooding and Reflection were measured using the (available) items from the RRS (see Treynor et al., 2003). CES-D = Center for Epidemiological Studies Depression scale.

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reliability statistics). Participants then received a Palm Tungsten E2 palmtop, which was used to record their experiences of negative affect in daily life during the following week using the experience sampling method (ESM; Csikszentmihalyi & Larsen, 1987). The ESM data were used to calculate emotional inertia.

Rumination. Participants completed the 22-item Ruminative Responses Scale (RRS; Treynor et al., 2003), which asks participants to rate how often they respond in various ways (e.g., "Think about a recent situation wishing it had gone better") when they feel sad or depressed using a 4-point scale from 1 (*Almost never*) to 4 (*Almost always*). The RRS also contains brooding and reflection subscales each comprising five items. The brooding subscale captures the maladaptive tendency to engage in abstract, negatively valenced and unconstructive self-focused thought (e.g., "Think 'Why can't I handle things better?'"). In contrast, the reflection subscale measures a more adaptive propensity for neutral self-reflection (e.g., "Analyse recent events to try and understand why you are depressed").

Depression severity. Participants once again completed the CES-D (Radloff, 1977), a widely used measure of current depressive symptoms. The CES-D asks participants to indicate how frequently they have experienced a range of depressive symptoms (e.g., "I had crying spells") over the past week, on a 4-point scale ranging from 0 (*Rarely or none of the time*) to 3 (*Most or all of the time*). Participants' scores on the CES-D at the beginning of the study were highly correlated with their pre-screening CES-D scores, measured approximately four months earlier, $r(95) = .71$, $p < .001$.

ESM. Palmtops were programmed to signal ("beep") participants 10 times each day over a 12-hour period during their waking hours, according to a stratified random interval scheme (i.e., each day was divided into 10 equal intervals of 72 minutes with one beep programmed to occur randomly within each interval). The mean time interval between two consecutive beeps was therefore 73.30 minutes ($SD = 29.33$). Compliance with the ESM protocol was high (Mean completed beeps = 91.5%, $SD = 6.2\%$; range = 67–100%) and was not correlated with rumination or depression severity (rs $< .14$, ps $> .20$). At each beep, participants rated their current feelings of anger, sadness, anxiety and dysphoria ("How angry/sad/anxious/depressed do you feel at the moment?"), with responses on a continuous slider scale from 1 (*Not at all angry/sad/anxious/depressed*) to 100 (*Very angry/sad/anxious/depressed*). Item order was randomised at each beep. These four items were also averaged to form a composite negative affect (NA) scale (within-person reliability = .66; between-person reliability = .98).[1] Emotional inertia was calculated by modelling the autocorrelation of each negative emotion and the NA composite using multilevel regression analyses (see below). Following previous studies (e.g., Kuppens, Allen et al., 2010), these autocorrelations represent the lagged effects of affect at one time point predicting affect at the next time point.

Results

We estimated emotional inertia from the ESM data using a series of multilevel models in order to account for their hierarchical structure (i.e., beeps nested within persons; Nezlek, 2012). Specifically, at Level 1 of the models we modelled within-person affect autocorrelations (representing emotional inertia) by predicting each person's current level of affect as a function of a person-specific random intercept, and a random slope of that person's lagged affect score at the previous time point (which was group-mean centred; Enders &

[1] Following Nezlek (2012), within- and between-person reliability estimates for the negative affect scale were obtained from three-level models with items at Level 1, nested within beeps at Level 2, nested within persons at Level 3.

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Tofighi, 2007; Nezlek, 2012). The first value of the lagged predictors for each day was replaced with a missing value such that autocorrelations were only calculated within-days. The autocorrelation slope represents the degree to which the person's current affect was predicted by their affect at the previous time point (controlling for mean level of affect, which is modelled by the intercept), and is thus a direct operationalisation of emotional inertia (Koval & Kuppens, 2012; Kuppens, Allen et al., 2010; Suls et al., 1998). At Level 2, we modelled the between-person relationships of trait rumination with the Level 1 random intercept (representing the mean level of affect) and random slope (representing emotional inertia). Model equations and further details can be found in the appendix.

Associations between rumination and emotional inertia

To address our first research question, we examined the relationships between emotional inertia of both overall NA and each of the separate negative emotions (anxiety, sadness, anger and dysphoria) with trait rumination at Level 2 of the multilevel models. All Level 2 predictors were standardised. Table 2 displays the results of multilevel models predicting emotional inertia from overall rumination scores. As predicted, rumination was associated with higher levels of NA inertia, although this effect was only marginally significant. When the negative emotions were analysed separately, rumination was significantly associated with higher levels of inertia for dysphoria and sadness; associations with anxiety and anger inertia were in the predicted direction but were not statistically significant (see Level 2 slopes in Table 2).

We repeated the above analyses with brooding and reflection scores at Level 2 instead of overall rumination. As predicted, brooding was associated with significantly higher NA inertia ($\beta = 0.06$, $SE = 0.03$, $p = .03$), whereas reflection was not ($\beta = -0.01$, $SE = 0.03$, $p = .76$). For the separate negative emotions, we found that brooding was significantly associated with higher emotional inertia of dysphoria ($\beta = 0.07$, $SE = 0.03$, $p = .01$) and sadness ($\beta = 0.05$, $SE = 0.02$, $p = .03$) and marginally with higher anger inertia ($\beta = 0.05$, $SE = 0.03$, $p = .08$), whereas the relationship between brooding and anxiety inertia was not significant ($\beta = 0.04$, $SE = 0.03$, $p = .13$).

Table 2. *Multilevel models examining the relationship between emotional inertia and rumination in Study 1*

		Level 1		*Level 2 (Rumination)*	
Outcome	*Fixed effect*	*β (SE)*	*p*	*β (SE)*	*p*
Negative affect	Intercept (Mean level)	15.58 (0.98)	<.001	4.87 (0.96)	<.001
	Slope (Inertia)	0.33 (0.02)	<.001	0.04 (0.02)	.078
Dysphoria	Intercept (Mean level)	16.95 (1.32)	<.001	6.93 (1.50)	<.001
	Slope (Inertia)	0.24 (0.03)	<.001	0.07 (0.02)	.008
Sadness	Intercept (Mean level)	17.88 (1.14)	<.001	5.99 (1.15)	<.001
	Slope (Inertia)	0.28 (0.02)	<.001	0.05 (0.02)	.041
Anxiety	Intercept (Mean level)	13.27 (0.99)	<.001	3.57 (1.10)	.002
	Slope (Inertia)	0.17 (0.02)	<.001	0.03 (0.02)	.183
Anger	Intercept (Mean level)	14.23 (0.92)	<.001	3.00 (0.77)	<.001
	Slope (Inertia)	0.19 (0.02)	<.001	0.02 (0.02)	.274

Notes: Lagged predictors at Level 1 were group-mean centred and the first measurement of each day was replaced with a missing value to remove previous day effects. The Level 2 predictor (rumination) was standardised. At Level 1, the intercepts represent mean levels of affect and the slopes represent within-person affect autocorrelations (emotional inertia) on average. At Level 2, the intercepts represent associations between rumination and mean levels of affect across participants, and the slopes represent associations between rumination and emotional inertia levels across participants. Approximate $df = 93$ for all effects.

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In contrast, reflection was not associated with higher levels of emotional inertia in any of the models (all βs = –0.01, all *SE*s = 0.03, all *p*s > .63).[2]

Although not the main focus of the current study, we also note that rumination was related to significantly higher mean levels of all negative feelings (see Level 2 intercepts in Table 2). Similarly, brooding was associated with significantly higher mean levels of negative feelings in all analyses (all βs > 3.17, *SE*s < 1.32, *p*s < .001). In contrast, reflection did not significantly qualify mean levels of NA, dysphoria, sadness, or anger (all βs < |0.81|, *SE*s > 0.75, *p*s > .36), but was related to significantly lower average anxiety (β = –1.87, *SE* = 0.76, *p* = .02).

Predicting depression severity from rumination and emotional inertia

To address our second research question we regressed depression severity simultaneously onto emotional inertia and rumination scores. Individual participant's emotional inertia (autocorrelation) scores were extracted from the slopes from multilevel analyses similar to those described above, but without Level 2 predictors. Next, these inertia scores were entered together with rumination scores as predictors of depression severity in standard regression analyses. We first examined inertia of NA and the separate negative emotions together with overall rumination as predictors of depression severity. We then repeated these analyses with brooding and reflection scores entered simultaneously instead of overall rumination.

As shown in Table 3, rumination was a significant independent predictor of depression severity in every model. Importantly, emotional inertia was also significantly related to depression severity over and above the effect of rumination in three of the five models. Specifically, inertia of NA, dysphoria and sadness were significant independent predictors of depression severity, whereas anger and anxiety inertia were not.

Next, CES-D scores were regressed onto emotional inertia slopes together with brooding and reflection scores. As in the previous analyses, emotional inertia of NA, dysphoria and sadness were significant independent predictors of depression severity (all βs > 0.26, all *p*s < .01). Brooding was also significantly related to depression severity in every model (all βs > 0.38, all *p*s < .001). In contrast, reflection was not a significant independent predictor of depression severity in any of the models (all βs < 0.14, all *p*s > .10).

Discussion

Study 1 demonstrated that emotional inertia and rumination are related, in line with our predictions. Thus, people whose negative feelings in daily life tend to display resistance to change also habitually engage in repetitive, negative, self-focused cognition. Particularly, the brooding component of ruminative thought was strongly

Table 3. *Regression models predicting depression severity from emotional inertia and rumination in Study 1*

Model	R^2	*Predictor*	*β*	*p*
1	.48	NA inertia	0.22	.006
		Rumination	0.59	< .001
2	.53	Dysphoria inertia	0.33	< .001
		Rumination	0.55	< .001
3	.51	Sadness inertia	0.28	.001
		Rumination	0.56	< .001
4	.45	Anxiety inertia	0.12	.144
		Rumination	0.63	< .001
5	.44	Anger inertia	0.08	.312
		Rumination	0.65	< .001

Notes: NA = negative affect. R^2 for all models was significant at *p* < .001. In each model, depression severity was simultaneously regressed onto rumination scores and emotional inertia slopes of NA (Model 1), dysphoria (Model 2), sadness (Model 3), anxiety (Model 4) and anger (Model 5).

[2] To control for possible time-of-day effects, we repeated the multilevel analyses including linear and quadratic effects of time (at Level 1) and their interactions with rumination, brooding and reflection scores (at Level 2). All findings replicated, indicating that the reported associations between emotional inertia and rumination/brooding were independent of time-of-day effects. Additionally, to control for the unequal spacing between successive observations, we repeated the multilevel analyses with the time interval between beeps as a covariate (at Level 1), and replicated all the reported findings.

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associated with higher emotional inertia, whereas the more neutral reflection component of rumination was not. This pattern of results was clearest for the inertia of sadness and dysphoria, suggesting that habitual brooders tend to display slowly changing dysphoric affect. While inertia is theoretically independent of a person's level of affect, we also found that rumination and brooding were associated with higher average levels of negative affect in daily life, replicating previous research (e.g., Moberly & Watkins, 2008). Together, these findings suggest that trait rumination is related to the experience of persistently high levels of dysphoria, which linger on from one moment to the next.

Study 1 also demonstrated that both rumination and emotional inertia are independently associated with depression severity. In particular, inertia of sadness and dysphoria, but not of anxiety or anger, uniquely predicted depression severity controlling for rumination. As hypothesised, the more maladaptive brooding component of rumination was a stronger predictor of depression severity than the reflection component (Treynor et al., 2003).

The findings of Study 1 provide important first evidence of the relationship between emotional inertia and rumination, and suggest that each plays a unique role in depression. However, Study 1 was limited in two important respects. First, because Study 1 used a non-clinical student sample, the generalisability of the findings to a sample that includes clinically depressed individuals may be limited. Second, in Study 1 we measured the inertia of people's subjective feelings in daily life using ESM, and we therefore cannot exclude the possibility that people with higher inertia were simply exposed to fewer situational variations in their daily lives. This could result in less frequent affective changes (i.e., higher inertia) but would not necessarily reflect affective inflexibility.

STUDY 2

In Study 2, we made use of data from a study on family interactions among depressed and non-depressed adolescents (see, e.g., Kuppens, Allen et al., 2010, Study 2; Sheeber et al., 2009). In this study, adolescents' affective behaviours were recorded in a relatively controlled laboratory setting. This allowed us to examine whether rumination was related to the inertia of the behavioural component of negative affect. As in Study 1, we also assessed whether rumination and emotional inertia independently predicted depression severity.

Method

Participants

Participants were 141 adolescents (94 females) ranging in age from 14.5 to 18.5 years (*Mean* = 16.2) and their parents. Depressed adolescents ($n = 72$) met DSM-IV criteria (American Psychiatric Association, 1994) for current major depressive disorder (MDD). MDD duration ranged from 2 to 284 weeks (*Median* = 13.5). Approximately 43% of the depressed adolescents had experienced a previous episode. Exclusion criteria were comorbid psychotic, externalising or substance-dependence disorders, and current usage of medications with known cardiac effects. Non-depressed adolescents ($n = 69$) had no lifetime history of mental disorder or psychiatric treatment, and were matched, to the extent possible, with depressed participants on age, gender, ethnicity, and socioeconomic factors. Detailed recruitment and assessment procedures as well as demographic data are presented in Sheeber et al. (2009). One participant in the depressed group was excluded from analyses due to missing data.

Materials and procedure

Participants' overt behavioural expressions of affect were observed during a series of family interactions conducted in the laboratory. We calculated the emotional inertia of participants' negative affective behaviours using multilevel modelling of these interaction data (see below). As in Study 1, current depressive symptoms and trait rumination were measured by self-report questionnaires obtained

during the lab assessment (see Table 1 for descriptive and reliability statistics).

Rumination. Rumination was measured using the rumination scale of the Response Styles Questionnaire (Nolen-Hoeksema & Morrow, 1991). This scale is the predecessor to the RRS (Treynor et al., 2003) used in Study 1, and does not contain all the same items, however the two versions are highly correlated (Nolen-Hoeksema et al., 2008). Brooding and reflection scores were also calculated using the available items, which meant that brooding scores were based on three items instead of five.

Depression severity. As in Study 1, participants' current depression severity was measured using the 20-item CES-D (Radloff, 1977). The CES-D is suitable for assessing current depression severity among adolescents (Roberts, Andrews, Lewinsohn, & Hops, 1990).

Affective behaviour. Adolescents and their parents completed three interaction tasks, each consisting of two 9-minute discussions, in the laboratory while being video recorded for subsequent behavioural coding. The "positive task" involved first planning a vacation and then discussing a fun time the family had experienced together. The "conflict task" consisted of two problem-solving interactions in which families were asked to discuss and resolve areas of conflict. Finally, in the "reminiscence task" families were first asked to identify and describe the best and most difficult years the adolescent had experienced, and then to discuss the most challenging and most rewarding aspects of parenting the adolescent. Given our focus in the current study on examining the inertia of negative affect, we only analysed data from the conflict and reminiscence tasks, which have been found to elicit more negative affect than the positive task (Sheeber et al., 2011).

Trained observers, blind to diagnostic status and hypotheses, coded the adolescents' nonverbal affective behaviour and verbal content using the Living in Family Environments coding system (LIFE; Hops, Biglan, Tolman, Arthur, & Longoria, 1995). The LIFE is an event-based system in which a new code is entered whenever a participant's nonverbal affect or verbal content changes. Three constructs—angry, dysphoric, and happy—were derived from individual affect and content codes. Angry and dysphoric behaviours were examined for this report. Angry behaviour included aggressive or contemptuous nonverbal behaviour and cruel or provoking statements. Dysphoric behaviour was defined by sad nonverbal behaviour or complaining statements. A composite measure of negative affect (NA) was formed by collapsing across the anger and dysphoria behavioural codes. As in Study 1, emotional inertia was calculated by modelling the autocorrelation of NA, angry and dysphoric behaviour using multilevel regression analyses (see below).

Approximately 25% of videos were coded by a second observer for reliability. Kappas were .73 and .70 for adolescent angry and dysphoric behaviour, respectively. The validity of the LIFE system has been established in numerous studies of adolescent depression (e.g., Katz & Hunter, 2007; Sheeber, Davis, Leve, Hops, & Tildesley, 2007).

Results

The family interaction data consisted of second-by-second binary behavioural codes (e.g., angry/not angry) nested within tasks, nested within persons, and were therefore analysed using three-level logistic regression models. Within-person autocorrelations of negative affective behaviour representing emotional inertia were modelled at Level 1, nested within interaction tasks at Level 2, and the relationships between emotional inertia and rumination were modelled at Level 3. See the appendix for model equations and further details. Specifically, current emotional (e.g., angry) behaviour was predicted by that same behaviour five seconds earlier to obtain estimates of emotional inertia. A time lag of five seconds was chosen because it has been used successfully in previous research (see also, Kuppens, Allen et al., 2010; Kuppens et al., 2012) and because it reflects a

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reasonable time interval in which changes can occur in the context of interpersonal interaction.[3]

Associations between rumination and emotional inertia

As can be seen from the Level 3 slopes in Table 4, overall rumination was related to significantly higher levels of emotional inertia for NA, dysphoria and anger. When we repeated the analyses using the brooding and reflection subscales, we found that brooding was related to significantly higher inertia for NA ($\beta = 0.13$, $SE = 0.06$, $p = .04$), dysphoria ($\beta = 0.13$, $SE = 0.06$, $p = .05$) and anger ($\beta = 0.14$, $SE = 0.07$, $p = .05$), whereas reflection was not related to emotional inertia in any of the models (all βs < 0.06, SEs > 0.06, ps $> .42$).[4]

Rumination was also related to significantly higher mean levels of NA and angry behaviour, but not to mean levels of dysphoric behaviour (see Level 3 intercepts in Table 4). Similarly, brooding predicted significantly higher mean levels of NA ($\beta = 0.35$, $SE = 0.10$, $p < .001$) and dysphoria ($\beta = 0.27$, $SE = 0.11$, $p = .02$), and was positively, although non-significantly, related to mean levels of angry behaviour ($\beta = 0.24$, $SE = 0.15$, $p = .12$). In contrast, reflection was associated with significantly lower mean levels of dysphoria ($\beta = -0.22$, $SE = 0.11$, $p = .05$) and marginally with lower NA ($\beta = -0.19$, $SE = 0.12$, $p = .10$) but was not related to angry behaviour ($\beta = -0.01$, $SE = 0.18$, $p = .95$).

Predicting depression severity from rumination and emotional inertia

Next, we examined the contribution of rumination and emotional inertia to depression severity using the same approach as in Study 1. Person-specific emotional inertia slopes were first obtained from multilevel models and were then entered together with rumination (or brooding and reflection) as predictors of depression severity in regression analyses. Table 5 displays the results

Table 4. *Multilevel models examining the relationship between emotional inertia and rumination in Study 2*

		Level 1		*Level 3 (Rumination)*	
Outcome	*Fixed effect*	*β (SE)*	*p*	*β (SE)*	*p*
Negative affect	Intercept (Mean level)	−1.11 (0.09)	<.001	0.21 (0.09)	.031
	Slope (Inertia)	1.81 (0.05)	<.001	0.13 (0.05)	.006
Dysphoria	Intercept (Mean level)	−1.99 (0.08)	<.001	0.04 (0.08)	.666
	Slope (Inertia)	1.98 (0.05)	<.001	0.15 (0.05)	.005
Anger	Intercept (Mean level)	−3.19 (0.12)	<.001	0.32 (0.13)	.014
	Slope (Inertia)	2.00 (0.06)	<.001	0.17 (0.06)	.003

Notes: Lagged predictors at Level 1 were group-mean centred and the first measurement of each day was replaced with a missing value to remove previous day effects. The Level 3 predictor (rumination) was standardised. At Level 1, the intercepts represent mean levels of affect and the slopes represent within-person affect autocorrelations (emotional inertia) on average. At Level 3, the intercepts represent associations between rumination and mean levels of affect across participants, and the slopes represent associations between rumination and emotional inertia levels across participants. Approximate $df = 138$ for all effects.

[3] All findings replicated using a lag of 10 seconds to calculate affect autocorrelations.

[4] To control for possible time trends, we repeated the multilevel analyses controlling for linear and quadratic effects of time (at Level 1) and their interactions with rumination, brooding and reflection scores (at Level 3). All results replicated, indicating that the reported associations between emotional inertia and rumination/brooding were independent of simple linear or quadratic changes in affective behaviour. We also conducted all multilevel analyses separately for depressed and non-depressed participants. These analyses revealed that neither overall rumination nor brooding or reflection were significantly associated with emotional inertia in either group. Given that depression is known to be strongly associated with both rumination (Nolen-Hoeksema et al., 2008) and emotional inertia (Kuppens, Allen, & Sheeber, 2010), there may not have been sufficient variability in rumination or inertia within each group to detect a relationship between them.

Table 5. *Regression models predicting depression severity from emotional inertia and rumination in Study 2*

Model	R^2	*Predictor*	*β*	*p*
1	.40	NA inertia	0.25	<.001
		Rumination	0.52	<.001
2	.38	Dysphoria inertia	0.22	<.001
		Rumination	0.53	.001
3	.35	Anger inertia	0.11	.127
		Rumination	0.55	<.001

Note: NA = negative affect. R^2 for all models was significant at $p < .001$.
In each Model, depression severity was simultaneously regressed onto rumination scores and emotional inertia slopes of NA (Model 1), dysphoria (Model 2), and anger (Model 3).

of the first models predicting depression severity from emotional inertia and overall rumination.[5] Rumination was a significant independent predictor of depression severity in each model. Emotional inertia of the NA composite and of dysphoric behaviour were also significantly associated with depression severity, controlling for rumination. However, anger inertia did not uniquely predict depression severity.

When depression severity was regressed onto emotional inertia slopes together with brooding and reflection scores, brooding emerged as a significant independent predictor in each model (all $\beta s > 0.32$, $ps < .001$). As in the previous analyses, inertia of NA and dysphoria were also independently related to depression severity when controlling for brooding and reflection ($\beta s > 0.27$, $ps < .001$), whereas the effect of anger inertia was in the same direction but only marginally significant ($\beta = 0.14$, $p = .08$).

Discussion

As in Study 1, and consistent with our predictions, we found that rumination (particularly brooding) and emotional inertia were interrelated. Also in line with our predictions and the findings in Study 1, we found that both rumination (particularly brooding) and emotional inertia (particularly of dysphoric behaviour) both uniquely predicted current depression severity. In short, the results of Study 2 closely replicate the results of Study 1, suggesting that our findings are not limited to non-clinical student populations, and indicating that our findings also extend to inertia of observable affective behaviour.

GENERAL DISCUSSION

The findings of the current studies provide consistent evidence that rumination (especially the maladaptive brooding component) is related to the inertia of dysphoric/sad affect. At a broad level, these results support the notion that cognitive and emotional perseverative tendencies are interrelated. This association cannot be attributed to shared method variance, as our measures of rumination and emotional inertia were highly distinct: rumination was measured using retrospective self-report whereas emotional inertia was operationalised as the autocorrelation of either momentary affective experiences in daily life (Study 1) or observed emotional behaviours during a family interaction (Study 2). Furthermore, the current studies showed that rumination and emotional inertia are both independently associated with depression severity. This underscores the fact that affective inflexibility should be considered as a distinct feature of depression that is related to, but independent of, cognitive inflexibility, rather than simply as a product or antecedent of it (Campbell-Sills & Barlow, 2007; see also, Kashdan & Rottenberg, 2010).

[5] For comparability with Study 1, we report analyses predicting CES-D scores from rumination and emotional inertia. However, we also conducted additional binary logistic regression analyses predicting participants' MDD group status (0 = *Non-depressed*, 1 = *Depressed*) from rumination and emotional inertia, yielding highly similar results to those predicting CES-D scores, with the exception that dysphoria inertia no longer significantly predicted depressive status when controlling for rumination. Furthermore, when we regressed CES-D scores onto rumination and emotional inertia separately for depressed and non-depressed adolescents, we obtained similar results to those for the whole sample, with the exception that brooding scores did not significantly predict depression severity among clinically depressed adolescents when controlling for emotional inertia levels.

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By showing that people who habitually respond to sadness by ruminating also tend to display greater resistance to change in their feelings and behavioural expressions of sadness, the results of the current studies suggest that rumination (especially brooding) may be a maladaptive and ineffective strategy for regulating negative affect (Campbell-Sills & Barlow, 2007; Nolen-Hoeksema et al., 2008). These results contribute to the literature on rumination by showing that, besides its associations with average levels of negative affect, it is linked with characteristics of the temporal dynamics (i.e., autocorrelation) of both the subjective experience and behavioural expressions of negative affect.

The finding that both emotional inertia and rumination displayed independent relationships with current depressive severity indicates that the tendency for negative affective states to display greater resistance to change among depressed individuals is not accounted for by their increased propensity to ruminate or vice versa. These findings not only indicate that emotional inertia and rumination are robust predictors of emotional maladjustment in general, and depression in particular. They also suggest that both cognitive and affective perseverative tendencies play unique roles in depression. This has important implications for psychological treatments of depression. Although the dominant cognitive-behavioural approach to treating depression is highly effective, it tends "to reduce emotion to its associated thoughts and behaviours" (Campbell-Sills & Barlow, 2007, p. 542) and may thus overlook emotional dysregulation and inflexibility as key features of depression alongside depressogenic cognition (Campbell-Sills & Barlow, 2007; Holtzheimer & Mayberg, 2011; Kashdan & Rottenberg, 2010). Our findings suggest that targeting the processes that facilitate flexible affective changes (i.e., effective emotion-regulation strategies) and help to avoid inert emotional responding may be a valuable goal for therapeutic interventions in depression, alongside the treatment of maladaptive patterns of cognition.

Our differential findings for the brooding and reflection subcomponents of rumination are consistent with previous research that has distinguished between adaptive and maladaptive subcomponents of rumination (Armey et al., 2009; Trapnell & Campbell, 1999; Treynor et al., 2003). We found that brooding (i.e., abstract, negatively valenced, self-focus) was consistently related to higher emotional inertia and depression severity, whereas reflection (i.e., neutral, analytical, self-focus) was not significantly associated with either. These findings fit with the view that brooding is associated with a vicious cycle of perseverative negative cognition that serves to maintain and prolong emotional distress by impeding the use of constructive coping strategies, whereas reflection is less detrimental (Nolen-Hoeksema et al., 2008).

We also found distinct results for sad and dysphoric versus angry and anxious affect. Specifically, both rumination and depression severity were more strongly and consistently associated with higher inertia of sadness and dysphoria than with inertia of anger and anxiety. These findings are consistent with the fact that persistent sad mood, in particular, is a core symptom of depression (American Psychiatric Association, 1994). They also fit with recent theorising about depression, which emphasises the inability to effectively regulate and disengage from sad mood as a distinguishing feature of the disorder (Campbell-Sills & Barlow, 2007; Holtzheimer & Mayberg, 2011; Kashdan & Rottenberg, 2010). In relation to rumination, our findings are consistent with previous research showing that rumination is more closely related to sadness than to other kinds of negative affect (Thomsen, 2006). This is perhaps not surprising, given that rumination (at least as measured in the present study) has specifically been conceptualised as a response to the experience of depressed or sad mood (e.g., Nolen-Hoeksema & Morrow, 1991).

We note a number of limitations and directions for future research. First, we operationalised depression as a continuous dimension (measured using the CES-D) rather than a categorical outcome. Although this approach contrasts with most clinical studies, recent evidence suggests that depression may indeed be dimensional rather than categorical (Haslam, Holland, & Kuppens, 2012).

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Moreover, using diagnosed depressive status (based on clinical interview) instead of CES-D scores in Study 2 yielded very similar results (see Footnote 4). Second, we note that the self-report instrument used to measure rumination in the current studies is an indirect measure of cognitive inflexibility, and only assesses habitual responses to emotional distress/dysphoria. Future studies would benefit from using more direct, non-affective, measures of perseverative cognition (e.g., Wisconsin Card Sorting Test; see Davis & Nolen-Hoeksema, 2000) as well as exploring how other forms of rumination are related to affective inflexibility. Third, the current studies focused exclusively on NA, yet recent research indicates that, independently of the tendency to ruminate about negative feelings, people's responses to their positive feelings also play an important role in depression vulnerability (Raes, Smets, Nelis, & Schoofs, 2012). Thus, examining the associations between the dynamics of positive affect and cognitions and how each contributes to depression is an important direction for future research (Kuppens, Allen et al., 2010). Finally, we note that the correlational and cross-sectional nature of the current studies leaves open the question of causal direction. Further research using experimental as well as longitudinal designs is needed to properly elucidate the causal links between rumination, emotional inertia and depression (cf. Kuppens et al., 2012).

Despite these limitations, the current studies provide important insights into the relationships between cognitive and affective perseverative tendencies associated with depression. Taken together, our findings indicate that people who habitually ruminate in response to emotional distress also tend to display higher temporal dependency in their negative affective experiences and behaviours. Furthermore, although rumination and emotional inertia are related, each plays an independent role in depression. Specifically, depression is uniquely related to both the brooding component of rumination and emotional inertia of sad and dysphoric affective experiences and behaviours. These findings highlight the importance of considering both cognitive and affective inflexibility in the development of models and treatments of depression.

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REFERENCES

Aldao, A., Nolen-Hoeksema, S., & Schweizer, S. (2010). Emotion-regulation strategies across psychopathology: A meta-analytic review. *Clinical Psychology Review*, *30*, 217–237.

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Armey, M. F., Fresco, D. M., Moore, M. T., Mennin, D. S., Turk, C. L., Heimberg, R. G., et al. (2009). Brooding and pondering: Isolating the active ingredients of depressive rumination with exploratory factor analysis and structural equation modeling. *Assessment*, *16*, 315–327.

Bagby, R. M., Rector, N. A., Bacchiochi, J. R., & McBride, C. (2004). The stability of the Response Styles Questionnaire rumination scale in a sample of patients with major depression. *Cognitive Therapy and Research*, *28*, 527–538.

Campbell-Sills, L., & Barlow, D. H. (2007). Incorporating emotion regulation into conceptualizations and treatments of anxiety and mood disorders. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 542–559). New York, NY: Guilford Press.

Costa, P. T., & McCrae, R. R. (1980). Influence of extraversion and neuroticism on subjective well-being: Happy and unhappy people. *Journal of Personality and Social Psychology*, *38*, 668–678.

Csikszentmihalyi, M., & Larsen, R. (1987). Validity and reliability of the experience sampling method. *Journal of Nervous and Mental Disease*, *175*, 526–536.

Davis, R. N., & Nolen-Hoeksema, S. (2000). Cognitive inflexibility among ruminators and non-ruminators. *Cognitive Therapy and Research*, *24*, 699–711.

DeNeve, K. M., & Cooper, H. (1998). The happy personality: A meta-analysis of 137 personality traits and subjective well-being. *Psychological Bulletin*, *124*, 197–229.

Disner, S. G., Beevers, C. G., Haigh, E. P., & Beck, A. T. (2011). Neural mechanisms of the cognitive

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model of depression. *Nature Reviews: Neuroscience*, *12*, 467–477.

Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods*, *12*, 121–138.

Eysenck, H. J. (1967). *The biological basis of personality*. Springfield, IL: Charles C. Thomas.

Forgas, J. P. (2008). Affect and cognition. *Perspectives on Psychological Science*, *3*, 94–101.

Gotlib, I. H., & Joormann, J. (2010). Cognition and depression: Current status and future directions. *Annual Review of Clinical Psychology*, *6*, 285–312.

Gottman, J., Swanson, C., & Swanson, K. (2002). A general systems theory of marriage: Nonlinear difference equation modeling of marital interaction. *Personality and Social Psychology Review*, *6*, 326–340.

Hamaker, E. L. (2012). Why researchers should think "within-person": A paradigmatic rationale. In M. R. Mehl & T. S. Conner (Eds.), *Handbook of research methods for studying daily life* (pp. 43–61). New York, NY: Guilford Press.

Haslam, N., Holland, E., & Kuppens, P. (2012). Categories versus dimensions in personality and psychopathology: A quantitative review of taxometric research. *Psychological Medicine*, *42*, 903–920.

Hollenstein, T., Granic, I., Stoolmiller, M., & Snyder, J. (2004). Rigidity in parent–child interactions and the development of externalizing and internalizing behavior in early childhood. *Journal of Abnormal Child Psychology*, *32*, 595–607.

Holtzheimer, P. E., & Mayberg, H. S. (2011). Stuck in a rut: Rethinking depression and its treatment. *Trends in Neurosciences*, *34*, 1–9.

Hops, H., Biglan, A., Tolman, A., Arthur, J., & Longoria, N. (1995). *Living in Family Environments (LIFE) coding system: Reference manual for coders*. Eugene, OR: Oregon Research Institute.

Joormann, J., Dkane, M., & Gotlib, I. H. (2006). Adaptive and maladaptive components of rumination? *Behavior Therapy*, *37*, 269–280.

Kashdan, T. B., & Rottenberg, J. (2010). Psychological flexibility as a fundamental aspect of health. *Clinical Psychology Review*, *30*, 865–878.

Katz, L. F., & Hunter, E. C. (2007). Maternal meta-emotion philosophy and adolescent depressive symptomatology. *Social Development*, *16*, 343–360.

Koval, P., & Kuppens, P. (2012). Changing emotion dynamics: Individual differences in the effect of anticipatory social stress on emotional inertia. *Emotion*, *12*, 256–267.

Kuppens, P., Allen, N. B., & Sheeber, L. B. (2010). Emotional inertia and psychological maladjustment. *Psychological Science*, *21*, 984–991.

Kuppens, P., Oravecz, Z., & Tuerlinckx, F. (2010). Feelings change: Accounting for individual differences in the temporal dynamics of affect. *Journal of Personality and Social Psychology*, *99*, 1042–1060.

Kuppens, P., Sheeber, L. B., Yap, M. B. H., Whittle, S., Simmons, J. G., & Allen, N. B. (2012). Emotional inertia prospectively predicts the onset of depressive disorder in adolescence. *Emotion*, *12*, 283–289.

Moberly, N. J., & Watkins, E. R. (2008). Ruminative self-focus and negative affect: An experience sampling study. *Journal of Abnormal Psychology*, *117*, 314–323.

Nezlek, J. B. (2012). Multilevel modeling analyses of diary-style data. In M. R. Mehl & T. S. Conner (Eds.), *Handbook of research methods for studying daily life* (pp. 357–383). New York, NY: Guilford Press.

Nolen-Hoeksema, S., & Morrow, J. (1991). A prospective study of depression and posttraumatic stress symptoms after a natural disaster: The 1989 Loma Prieta earthquake. *Journal of Personality and Social Psychology*, *61*, 115–121.

Nolen-Hoeksema, S., Parker, L., & Larson, J. (1994). Ruminative coping with depressed mood following loss. *Journal of Personality and Social Psychology*, *67*, 92–104.

Nolen-Hoeksema, S., Wisco, B. E., & Lyubomirsky, S. (2008). Rethinking rumination. *Perspectives on Psychological Science*, *3*, 400–424.

Radloff, L. S. (1977). The CES-D Scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement*, *1*, 385–401.

Raes, F., Smets, J., Nelis, S., & Schoofs, H. (2012). Dampening of positive affect prospectively predicts depressive symptoms in non-clinical samples. *Cognition and Emotion*, *26*, 75–82.

Roberts, R. E., Andrews, J. A., Lewinsohn, P. M., & Hops, H. (1990). Assessment of depression in adolescents using the Center for Epidemiologic Studies Depression scale. *Psychological Assessment*, *2*, 122–128.

Robinson, M. D., Wilkowski, B. M., Kirkeby, B. S., & Meier, B. P. (2006). Stuck in a rut: Perseverative response tendencies and the neuroticism–distress

relationship. *Journal of Experimental Psychology: General*, *135*, 78–91.
Sheeber, L. B., Allen, N. B., Leve, C., Davis, B., Shortt, J. W., & Katz, L. F. (2009). Dynamics of affective experience and behavior in depressed adolescents. *Journal of Child Psychology and Psychiatry*, *50*, 1419–1427.
Sheeber, L. B., Davis, B., Leve, C., Hops, H., & Tildesley, E. (2007). Adolescents' relationships with their mothers and fathers: Associations with depressive disorder and subdiagnostic symptomatology. *Journal of Abnormal Psychology*, *116*, 144–154.
Sheeber, L. B. Kuppens, P. Shortt, J.W., Katz, L. F. Davis, B. & Allen, N. B. (2011). Depression is associated with escalation of adolescents' dysphoric behavior during interactions with parents. *Emotion*. Advance online publication. doi: 10.1037/a0025784.
Spasojevic, J., & Alloy, L. B. (2001). Rumination as a common mechanism relating depressive risk to depression. *Emotion*, *1*, 25–37.
Suls, J., Green, P., & Hillis, S. (1998). Emotional reactivity to everyday problems, affective inertia, and neuroticism. *Personality and Social Psychology Bulletin*, *24*, 127–136.
Takano, K., & Tanno, Y. (2011). Diurnal variation in rumination. *Emotion*, *11*, 1046–1058.
Thomsen, D. K. (2006). The association between rumination and negative affect: A review. *Cognition and Emotion*, *20*, 1216–1235.
Trapnell, P. D., & Campbell, J. D. (1999). Private self-consciousness and the five-factor model of personality: Distinguishing rumination from reflection. *Journal of Personality and Social Psychology*, *76*, 284–304.
Treynor, W., Gonzalez, R., & Nolen-Hoeksema, S. (2003). Rumination reconsidered: A psychometric analysis. *Cognitive Therapy and Research*, *27*, 247–259.
Watkins, E. R. (2008). Constructive and unconstructive repetitive thought. *Psychological Bulletin*, *134*, 163–206.
Waugh, C., Thompson, R., & Gotlib, I. (2011). Flexible emotional responsiveness in trait resilience. *Emotion*, *11*, 1059–1067.
Zelazo, P. D., & Cunningham, W. A. (2007). Executive function: Mechanisms underlying emotion regulation. In J. J. Gross (Ed.), *Handbook of emotion regulation* (pp. 542–559). New York, NY: Guilford Press.

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APPENDIX

Multilevel model equations for Study 1

Level 1:

$$NA_{tj} = \pi_{0j} + \pi_{1j}\left(NA_{t-1j}\right) + e_{tj}$$

Level 2:

$$\pi_{0j} = \beta_{00+}\beta_{01}\left(zRRS_j\right) + r_{0j}$$
$$\pi_{1j} = \beta_{10}+\beta_{11}\left(zRRS_j\right) + r_{1j}$$

At Level 1, the outcome (NA_{tj}) represents person *j*'s level of Negative Affect (NA) at time *t*. This outcome was modelled as a function of a random intercept (π_{0j}) representing person *j*'s mean level of NA, and a random slope (π_{1j}) representing the degree to which person *j*'s level of NA at the previous time point (NA_{t-1}) predicts their current level of NA. To allow for an interpretation of within-person effects, the Level 1 lagged predictor (NA_{t-1}) was person-mean centred, thus removing between-person differences from the Level 1 parameter estimates (Enders & Tofighi, 2007; Nezlek, 2012). At Level 2, the Level 1 random intercept (π_{0j}) and slope (π_{1j}) were modelled as a function of each person *j*'s standardised rumination score ($zRRS_j$). Thus, the slope β_{01} represents the relationship between rumination and NA mean level, while the slope β_{11} represents the relationship between rumination and NA autocorrelation (inertia). Due to standardisation of RRS scores at Level 2, the intercepts β_{00} and β_{10} represent the mean level and autocorrelation of NA for a person with an average rumination score, respectively.

Multilevel model equations for Study 2

Level 1:

$$\text{Prob}\left(NA_{tij} = 1|\pi_{ij}\right) = \pi_{tij}$$
$$\log\left[\pi_{tij}/\left(1-\pi_{tij}\right)\right] = \eta_{tij}$$
$$\eta_{tij} = \pi_{0ij} + \pi_{1ij}\left(NA_{t-1ij}\right)$$

Level 2:

$$\pi_{0ij} = \beta_{00j} + r_{0ij}$$
$$\pi_{1ij} = \beta_{10j} + r_{1ij}$$

Level 3:

$$\beta_{00j} = \gamma_{000} + \gamma_{001}\left(zRRS_j\right) + u_{00j}$$
$$\beta_{10j} = \gamma_{100} + \gamma_{101}\left(zRRS_j\right) + u_{10j}$$

The multilevel models used in Study 2 were identical to those used in Study 1, with the following two exceptions: First, we used three-level models where second-by-second behavioural codes (Level 1) were nested within tasks (Level 2), which were nested within participants (Level 3); second, because the outcome variable at Level 1 was binary (affective behaviour was coded as either present or absent) the Level 1 equation included a log-link function (see above). As in Study 1, we modelled each person *j*'s NA during each task *i*, at time *t*, as a function of a random intercept (π_{0ij}) representing person *j*'s mean level of NA in each task *i*, and a random slope (π_{1ij}) representing degree to which person *j*'s level of NA at the previous time point (NA_{t-1}) in task *i*, predicts their current level of NA in each task. At Level 2, we allowed the Level 1 random slope and random intercept to vary across tasks. Finally, at Level 3, we modelled the relationship between standardised rumination scores (*zRRS*) and the mean level and autocorrelation (inertia) of NA.

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