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BRIEF REPORT

Emotional inertia contributes to depressive symptoms beyond perseverative thinking

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The autocorrelation or *inertia* of negative affect reflects how much negative emotions carry over from moment to moment and has been associated with increased depressive symptoms. In this study, we posed three challenges to this association by examining: (1) whether emotional inertia is relevant for depressive symptoms when assessed on a longer timescale than usual; (2) whether inertia is uniquely related to depressive symptoms after controlling for perseverative thoughts; and (3) whether inertia is related to depressive symptoms over and above the within-person association between affect and perseverative thoughts. Participants (N = 101) provided ratings of affect and perseverative thoughts for 100 days; depressive symptoms were reported before and after the study, and again after 2.5 years. Day-to-day emotional inertia was related to depressive symptoms over and above trait and state perseverative thoughts. Moreover, inertia predicted depressive symptoms when adjusting for its association with perseverative thoughts. These findings establish the relevance of emotional inertia in depressive symptoms independent of perseverative thoughts.

Keywords: Emotional inertia; Depressive symptoms; Rumination; Perseverative thoughts; Daily diary.

In daily life, feelings may change from happy to sad and back, for example, when hearing the sad news that friends are moving away and enjoying a wonderful dinner afterwards. Such emotional reactions and changes in emotions due to regulation serve very basic functions: they draw attention to

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potential threats and mobilise resources to act, they signal when discomfort dissipates and they indicate progress towards goals (Carver & Scheier, 1999). It is thus not surprising that a lack of emotional flexibility is associated with maladjustment. In particular, emotional inertia, defined as the extent to which emotions carry over from moment to the next (Kuppens, Allen, & Sheeber, 2010), is higher in individuals with comparatively high levels of neuroticism and depressive symptoms, and it prospectively predicts the onset of depression (Kuppens et al., 2012; van de Leemput et al., 2014). Interestingly, a recent study revealed that the relationship between emotional inertia and depressive symptoms cannot be reduced to a cognitive form of perseveration, namely rumination (Koval, Kuppens, Allen, & Sheeber, 2012). This is a highly relevant finding as different forms of perseverative thoughts such as rumination and worry are centrally relevant to depression—they prolong and intensify negative affect (NA) and could thus underlie inertia and its relation with depressive symptoms (Fresco, Frankel, Mennin, Turk, & Heimberg, 2002; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). Hence, demonstrating independence of emotional inertia from perseverative thoughts in terms of predicting depressive symptoms is critically relevant to shed light on the cognitive and affective factors playing in depression.

In this study, we present and empirically evaluate three challenges to the proposed link between emotional inertia and depressive symptoms. First, we examine whether insights on emotional inertia and depressive symptoms generalise when emotions are assessed on a longer timescale than used in previous studies. Second, we evaluate whether emotional inertia is predictive of depressive symptoms when taking not only the *trait* component of perseverative thoughts but also their *state* component into account. With the term *perseverative thoughts*, we refer to the repeated activation of the cognitive representation of a psychological problem (cf. Brosschot, Gerin, & Thayer, 2006). Third, we consider the relative importance of emotional inertia for depressive symptoms in comparison to the within-person interplay between affect and perseverative thoughts. The latter is a core aspect of models of depression that highlight maladaptive cognitions such as rumination as one of its crucial determinants (Beck, Rush, Shaw, & Emery, 1979; Nolen-Hoeksema et al., 2008). Given that dynamics of *negative* emotions are more indicative of psychological maladjustment than those of positive emotions (cf. Houben, van de Noortgate, & Kuppens, 2014), we focus on emotional inertia of NA in this study but provide the results for positive affect (PA) for meta-analytic purposes.

EMOTIONAL INERTIA ON DIFFERENT TIMESCALES

The way emotions evolve over time reflects emotion regulatory capacities and, accordingly, is related to (mal-)adjustment (Bylsma & Rottenberg, 2011). In this context, evidence is growing that emotional inertia, particularly of NA (Houben et al., 2014), is a dynamic correlate and even prospective predictor of depressive symptoms. Such a relationship is theoretically plausible because emotional inertia may indicate (1) emotional insensitivity to contextual variation due to increased preoccupation with the self and decreased environmental engagement, which is common in depression (Rottenberg, Gross, & Gotlib, 2005) and/or (2) a reduced ability to regulate emotions and recover from perturbations (Bylsma & Rottenberg, 2011). Two paradigms have dominated prior research on emotional inertia: real-time behavioural observations during emotional episodes in laboratory settings and experience sampling of emotional experiences on an hourly basis. Findings were consistent across these approaches—inertia of emotional behaviours and experiences across seconds and hours are related to depressive symptoms and low self-esteem (Koval et al., 2012, Koval & Kuppens, 2012; Kuppens et al., 2010). Importantly, emotional inertia also prospectively predicts the onset of depressive disorder (Kuppens et al., 2012), suggesting that inertia may be an early marker for the onset of depression (van de Leemput et al., 2014).

Before drawing more momentous conclusions from these insights, for example, in the sense of establishing early interventions based on the specifics of emotion dynamics in depression, further evidence is required to establish the generalisability of prior findings. In particular, additional and involuntary evidence for the predictive validity of emotional inertia is needed on the timescale of days. Evidence from this timescale is highly relevant because high levels of predictability across changing contexts may further illuminate the kind of difficulties that individuals with high levels of inertia face. Relatedly, it is the day-to-day timescale on which intervention programmes are most likely to be implemented.

Therefore, our first aim in this study was to investigate whether the relationship between emotional inertia and depressive symptoms generalises when inertia is assessed on the timescale of days. It is common for psychological processes to occur on different timescales (e.g., seconds, days, the entire lifespan; Hollenstein, Lichtwarck-Aschoff, & Potworowski, 2013). These timescales are interrelated: dynamic flexibility of emotions within a situation (e.g., in an interpersonal interaction) may determine how flexible a person emotionally responds across different situations (i.e., flexibility across contexts; Hollenstein et al., 2013). However, insights generated on one timescale do not necessarily translate to other timescales. For example, ruminating about a stressor in close proximity to its occurrence may be beneficial, while longer-term rumination hinders active problem-solving and thus is dysfunctional (Lyubomirsky, Tucker, Caldwell, & Berg, 1999). Relationships between variables thus require investigations on multiple timescales.

We expected that emotional inertia, previously investigated on short timescales (seconds, hours), will also be related to depressive symptoms on the timescale of days. Specifically, just as insensitivity to contextual variations likely drives emotional inflexibility at shorter timescales (i.e., within situations), the same tendencies are also likely to be associated with inflexibility across days.

EMOTIONAL INERTIA, STATE PERSEVERATIVE THOUGHTS AND DEPRESSIVE SYMPTOMS

The second aim of this study is to reveal whether emotional inertia is predictive of depressive symptoms when taking *state* aspects of perseverative thoughts into account, in addition to their *trait* aspects. Initial evidence indicates that emotional inertia is uniquely related to depressive symptoms independent of the global tendency to ruminate (i.e., trait rumination; Koval et al., 2012). However, perseverative thoughts, among them rumination, have time-varying components (i.e., state components), and the state components are dynamically interrelated with affect across time. Days that are characterised by high levels of perseverative thoughts such as rumination or cognitive interference are also days with high levels of NA (Brose, Schmiedek, Lövdén, & Lindenberger, 2011; Moberly & Watkins, 2008; Stawski, Mogle, & Sliwinski, 2011). In fact, affective experiences and perseverative thoughts are most likely reciprocally related across time as was exemplified in research on rumination (Moberly & Watkins, 2008). Perseverative thoughts such as rumination and worry increase or prolong NA because these processes interfere with more active problem-solving strategies (Lyubomirsky et al., 1999; Fresco et al., 2002). In turn, NA and its elicitors (e.g., past and anticipated threats in the case of rumination and worry, respectively; Nolen-Hoeksema et al., 2008) may capture attention, possibly leading to more rumination and worry about aversive states. Thus, perseverative thoughts may contribute to emotional inertia—the persistence of affective states across time may result from the perseverative thoughts, and this may account for the association between depression and inertia. Therefore, emotional inertia can only be said to be uniquely related to depressive symptoms over and above more cognitive forms of perseverations if both its global and dynamic aspects are taken into consideration.

EMOTIONAL INERTIA, THE AFFECT–PERSEVERATIVE THOUGHTS ASSOCIATION AND DEPRESSIVE SYMPTOMS

The third aim of this study was to examine the relative importance of emotional inertia for depressive symptoms in comparison to the within-person association between NA and perseverative thoughts across time. This comparison is relevant because an association between NA and perseverative thoughts is central to theories on negative outcomes of the latter. For example, the perseverative cognition hypothesis (Brosschot et al., 2006) proposes that the detrimental effects of stress on health outcomes are mediated by perseverative thinking which, in turn, sustains high NA and physiological arousal. Similarly, rumination, one form of perseverative thoughts, contributes to the aetiology of depression by prolonging NA according to the response style theory of depression (Nolen-Hoeksema et al., 2008). In line with these views, a relatively strong within-person association between affect and rumination was found to be associated with increased depressive symptoms (Moberly & Watkins, 2008; but see Takano & Tanno, 2011). Together, given the link between the association between affect and perseverative thoughts and negative outcomes including depressive symptoms and health more generally, the question arises whether emotional inertia remains relevant for the prediction of depressive symptoms on top of this within-person association between affect and perseverative thoughts. Our third aim in the current study was to empirically evaluate this notion.

In summary, the purpose of this study is to challenge the relevance of emotional inertia for depressive symptoms in three ways: (1) we examine this relationship using a longer timescale to investigate emotional inertia; (2) we examine whether emotional inertia is uniquely related to depression when taking both trait and state aspects of perseverative thoughts into account; and (3) we test the relevance of emotional inertia for depressive symptoms over and above the within-person association between NA and perseverative thoughts.

METHOD

The data presented here were collected as part of the COGITO study conducted at the Max Planck Institute for Human Development Berlin (MPIB). The COGITO study followed a pre-test–post-test control group design, with a phase of 100 days in the experimental group, and a 2-year longitudinal follow-up. The COGITO study was approved by the ethics committee of the MPIB.

Participants and procedure

We analysed data from 101 younger participants (51.5% women, age: 20–31 years, $M = 25.6$). Study participation began and ended in group sessions with 10 days of pre- and post-tests (Time 1, Time 2, 2 hours each). The micro-longitudinal phase (87–107 sessions, $M = 101$) was scheduled on an individual basis. During this phase, participants attended the laboratory each day (from Monday to Saturday, between 8 am and 7:30 pm, 1 hour each) and completed self-reports about their daily experiences (5–7 minutes), followed by 12 cognitive tasks (40–50 minutes) and another self-report on task performance (1–2 minutes; for details, see Brose et al., 2011). Two years later, a follow-up (Time 3) was scheduled in which the participants repeated the post-test and did another 10 sessions similar to those in the 100-day phase. Incentives for participation were €9 per hour plus a bonus which depended on the pace of completing the micro-longitudinal phase of the study. The measures relevant to the current report were administered in the micro-longitudinal phase[1] (affect, perseverative

[1] Affect and perseverative thoughts were also assessed on each of the pre- and post-test days. As these sessions were very intense in terms of work load (i.e., participants spent at least 90 minutes working on cognitive tasks) and as the self-report was not always administered previous to cognitive assessment, we did not include the data on affect and perseverative thoughts from the pre- and post-test in the analyses.

thoughts) and in the pre-test, post-test and follow-up (depressive symptoms).

Measures

Affect

NA was assessed with the NA subscale (10 items) of a German version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988).[2] Individuals were asked to rate how well adjectives (e.g., distressed, nervous) described their momentary mood on a scale ranging from 0 (*does not apply at all*) to 7 (*applies very well*). The average across the items was used for the analyses (Cronbach's α ranged from .85 to .95 across sessions).

Perseverative thoughts

Perseverative thoughts were measured with two items from the Cognitive Rumination (Gedankliche Weiterbeschäftigung) subscale of the Stress Coping Inventory (SVF 78; *Janke & Erdmann, 2002*; 'Today, I keep thinking about something again and again', 'Today, I cannot get certain things out of my mind'). A third item captured self-related thoughts, 'Today, I have difficulties suppressing thoughts about myself'. Responses were made on the same scale as used for affect assessment (Cronbach's α ranged from .82 to .92 across sessions). We operationalised state perseverative thoughts as each individual's daily average across the three items. For our measure of trait perseverative thoughts, we calculated each individual's average state perseverative thoughts score across all days. An analysis of the concurrent validity of this scale indicates that the content of the perseverative thoughts likely was related to negative feelings.[3]

Depressive symptoms

We evaluated depressive symptoms with a German version of the Center for Epidemiologic Studies Depression Scale (CES-D; Hautzinger, 1988). The CES-D measures the degree to which symptoms of depression have occurred during the preceding two weeks. It was administered at Times 1–3. According to a comparison of means and their 95% confidence intervals (CIs), our sample was comparable to a German representative adult sample in terms of depressive symptoms (Hautzinger & Bailer, 1993), M_{rep_sample} = 14.3, M_{this_study} = 15.39, CI_{rep_sample} = 13.74, 14.86, CI_{this_study} = 13.69, 17.09, mean difference: 1.09; the critical value for a significant mean difference is 1.76.

Analytical procedures

The aims of the study were approached with multilevel (ML) models and ordinary least squares (OLS) multiple regression. In the ML models, days were nested in individuals and we adjusted for a linear time trend. ML models were run using SAS PROC MIXED. Level-1 predictor variables were group-mean centred and Level-2 predictors were grand-mean centred. The data's autoregressive structure was modelled with the SPATIAL POWER covariance function in the REPEATED statement, which corrects for unequal intervals between Level-1 observations. Variance components

[2] The results of this study were comparable if only those 5 of the 10 NA items were used for analyses that were used in other publications of the COGITO study.

[3] The COGITO study assessed the general tendency to experience perseverative thoughts by means of the Thought Occurrence Questionnaire (Sarason, Sarason, Keefe, Hayes, & Shearin, 1986), a trait measure of intrusive thoughts. One dimension of this measure captures the tendency to experience thoughts about negative emotions (e.g., 'I think about personal worries'). Thus, this dimension subsumes repetitive thinking about feelings and negative thought content. The correlation between this dimension and an aggregate of the three perseverative thoughts items of this study is .41. It is thus likely that the perseverative thoughts items capture thoughts that are negative in content.

corresponding to fixed effects were tested with likelihood ratio tests. All analyses were repeated for PA for meta-analytical purposes and these results are presented below.[4]

Aim 1: To find out whether emotional inertia was related to depressive symptoms if emotional inertia was observed on the timescale of days, we used a ML model in which the time-varying variable NA(t) was regressed onto the time-varying variable NA(t–1). This autoregressive effect reflects what is referred to as emotional inertia. Additionally, depressive symptoms were added to this model as a Level-2 predictor (an individual differences characteristic) of the within-person slope. This cross-level interaction reveals the relationship between inertia and depressive symptoms.

Aim 2: To reveal whether emotional inertia is a predictor of depression over and above state perseverative thoughts, we ran a ML model in which NA(t) was regressed on NA(t–1) and state perseverative thoughts (t). This analysis provides an estimate of emotional inertia that is statistically independent from state perseverative thoughts as it occurs across days. Additionally, depressive symptoms were added to this model as a Level-2 predictor of the within-person slope reflecting emotional inertia.

Aim 3: To examine the relative importance of emotional inertia regarding depressive symptoms in relation to the association between affect and perseverative thoughts, we used the two random slope effects of the previous model as predictors of depressive symptoms in an OLS multiple regression analysis. That is, we used the person-specific effects of NA(t–1) on NA(t) and of state perseverative thoughts (t) on NA(t) to predict depressive symptoms.

RESULTS

Aim 1: Emotional inertia on the day-to-day timescale

We first examined emotional inertia on the timescale of days and tested whether it is related to depressive symptoms. Emotional inertia was estimated using a ML model that tests the Level-1 autoregressive effect of NA(t–1) on NA(t). Furthermore, depressive symptoms were included in this model as a Level-2 predictor of the Level-1 autoregressive effect (Table 1, ML Model 1). The autoregressive effect reflecting inertia was positive and significant, meaning that, for the average person, NA at occasion (t) was associated with NA at the previous occasion (t–1). This within-person association was indeed moderated by Level-2 depressive symptoms. Individuals with higher levels of depressive symptoms had higher levels of emotional inertia. Thus, prior findings on the association between emotional inertia and depressive symptoms were replicated on the timescale of days.

Given that Kuppens and colleagues (2012) found a prospective relationship between inertia and depression, we ran additional models examining the prospective predictive validity of emotional inertia (i.e., whether *future* depressive symptoms are predictable by the day-to-day affective dynamics). The results partly replicate

[4] PA was measured with 10 items from the PA subscale of the PANAS (Watson et al., 1988) and the analyses for Study Aims 1–3 were repeated with PA as an alternative outcome. Aim 1: PA inertia was not related to depressive symptoms at Time 1 (estimate = 0.05, SE = 0.04, t = 1.06), Time 2 (estimate = 0.14, SE = 0.33, t = 0.67) or Time 3 (estimate = 0.25, SE = 0.32, t = 0.78). Aim 2: PA inertia was not related to depressive symptoms at Time 1 when adjusting for state perseverative thoughts (estimate = 0.06, SE = 0.04, t = 1.39). Aim 3: Neither PA inertia nor the within-person association between PA inertia and perseverative thoughts were related to depressive symptoms at Time 1 (estimate = 0.57, SE = 0.38, t = 1.52; estimate = 0.87, SE = 0.53, t = 1.64). State perseverative thoughts were not related to state PA (estimate = 0.06, SE = 0.01, t = 1.83), but depressive symptoms strengthened this association (estimate = 0.07, SE = 0.03, t = 2.19).

Table 1. *Results of ML autoregressive models predicting NA(t) from NA(t–1), state perseverative thoughts and depressive symptoms*

	Estimate	*SE*	*t*	*p*	*Total*[a] R^2	*Shared* R^2	*Unique* R^2
ML Model 1							
Intercept	.91	.08	11.70	<.0001			
DepSym	.71	.18	3.99	<.0001			
Day	.002	.001	3.72	.001			
NA(*t*–1)	.34	.02	19.72	<.0001	.15		
NA(*t*–1) × DepSym	.13	.04	3.48	.001			
ML Model 2A							
Intercept	.91	.08	11.33	<.0001			
Day	.002	.001	3.35	.001			
NA (*t*–1)	.23	.02	12.93	<.0001			.09
State perseverative thoughts	.20	.01	16.01	<.0001	.31	.06	.16
ML Model 2B							
Intercept	1.24	.09	14.22	<.0001			
DepSym	.65	.18	3.56	.001			
Day	.002	.001	2.71	.01			
NA (*t*–1)	.19	.02	12.03	<.0001			
NA (*t*–1) × DepSym	.26	.02	16.80	<.0001			
State perseverative thoughts	.11	.04	3.20	.001	.31		
ML Model 3							
Intercept	1.19	.09	13.45	<.0001			
DepSym	.77	.20	3.83	<.001			
Day	.003	.001	3.08	.002			
State perseverative thoughts	.28	.02	16.21	<.0001	.22		
State perseverative thoughts × DepSym	.09	.04	2.19	.03			

Note: NA(*t*) was the outcome variable in all models. DepSym = depressive symptoms.

[a]Total refers to the Level-1 predictors (NA and/or perseverative thoughts); not reported are random effects (day, NA [*t*–1], state perseverative thoughts) and residual variance. All analyses were performed adjusting for between-person differences in preferred time of attendance as well as the within-person variation in time of attendance around individuals' preferred times. Between-person differences in timing were included as a grand-mean centred Level-2 predictor of the intercept in affect; within-person variation in timing was included as a group-mean centred Level-1 predictor of affect variation across time. The inclusion of these predictors did not affect the associations relevant for this study.

prior findings. Depression at T2 was positively related to emotional inertia during the micro-longitudinal study phase (Table 2, Model 1), adjusting for depression at Time 1, but this was not the case for depressive symptoms at Time 3 (Model 2).[5]

[5] In addition to predicting T2 and T3 depressive symptoms by emotional inertia while adjusting for T1 depressive symptoms, we tested the effect of emotional inertia on *latent change* by means of *latent change score models* (McArdle, 2009) in the structural equation modelling framework using Mplus. This approach has the advantage that individual differences in change are differentiated from individual differences at T1 by separating true change from measurement error and from occasion-specific influences using latent variables. In these models, latent factors of depressive symptoms were defined at each occasion (T1–T3) using odd- and even-split item composites as manifest indicator variables. Factor loadings, intercepts and residual variances were constrained to be equal across occasions (i.e., we aimed for strict measurement invariance). Our main interest was whether individual differences in change (latent change from T1 to T2, from T1 to T3) were positively related to individual differences in emotional inertia (i.e., whether individuals high in inertia were more likely to have an increase in depressive symptoms). Emotional inertia was modelled as a manifest exogenous variable using the random effect estimates of ML Model 1 (Table 1). It predicted the latent change factors. The model fit of this model was good (root mean square error of approximation (RMSEA) = .04, comparative fit index (CFI) = .99, standardized root mean square residual (SRMR) = .03). The effect of emotional inertia on change in depressive symptoms from T1 to T2 was estimated to be positive (estimate = .98, SE = .35, p = .004); inertia's effect on change from T1 to T3 was not significant (estimate = 0.24, SE = .35, p = .48). Thus, the results are comparable to the results presented in Table 1.

Table 2. *OLS regression (Reg.) models predicting depressive symptoms (CES-D) from emotional inertia and trait perseverative thoughts*

		Results from multiple regression				
Outcome	*Predictors*	*Estimate*	*p*	*Total R^2*	*Shared R^2*	*Unique R^2*
OLS Reg. Model 1						
CES-D Time 2	Inertia	1.07	.002	.39	.13	.06
	CES-D Time 1	.50	<.0001			.20
OLS Reg. Model 2						
CES-D Time 3	Inertia	.32	.35	.25	.06	.01
	CES-D Time 1	.39	<.0001			.18
OLS Reg. Model 3						
CES-D Time 1	Inertia, adjusted[a]	.81	.04	.19	.06	.04
	Trait perseverative thoughts	.10	.002			.09
OLS Reg. Model 4						
CES-D Time 1	Inertia, adjusted[a]	.80	.04	.24	.12	.03
	Trait perseverative thoughts	.08	.02			.05
	Affect–perseverative thoughts association[a]	.42	.02			.04

[a]These predictors are the person-specific/random effects from ML Model 2A (Table 1).

Aim 2: Emotional inertia, state perseverative thoughts and depressive symptoms

To address our second aim, namely to test whether emotional inertia is uniquely related to depressive symptoms after controlling for state perseverative thoughts, we included the latter (t) as an additional time-varying (Level-1) predictor of NA(t) to the previously used ML model (Table 1, ML Model 2A). This model revealed that both NA(t–1) and perseverative thoughts (t) significantly predicted NA(t). That is, how negative the average person felt on a specific day was related to perseverative thoughts on that day and to NA on the previous day. In line with the ideas on transactions between NA and perseverative thoughts, the time series of NA and perseverative thoughts were partly related (note their shared predictive variance, 4.9%).

Importantly, this analysis provides an estimate of emotional inertia that is unrelated to state perseverative thoughts (i.e., the regression coefficient in multiple regression). If this adjusted inertia estimate is related to depressive symptoms, one is safe to say that emotional inertia and depression are related over and above state perseverative thoughts. This was tested by including depressive symptoms as a Level-2 predictor of emotional inertia (Table 1, ML Model 2B). The result indicates that after adjusting for state perseverative thoughts, emotional inertia still was uniquely related to depressive symptoms.

Finally, and to find additional evidence for the partial independence of inertia also from trait perseverative thoughts (Koval et al., 2012), we adjusted for both state and trait perseverative thoughts when examining the relationship between emotional inertia and depressive symptoms. We did so by using an OLS regression model with depressive symptoms as the outcome variable (Table 2, Model 3). In particular, we adjusted for state perseverative thoughts by using the person-level estimates of emotional inertia of ML Model 2A (i.e., random effect estimates that are adjusted for state perseverative thoughts; Table 1); trait perseverative thoughts were adjusted for by including the indicator of the global tendency for perseverative thoughts. We found that emotional inertia was still independently positively related to depressive symptoms after these adjustments. Yet, trait perseverative thoughts and inertia were not entirely independent predictors of

depressive symptoms (see shared R^2 value in Table 2).

Aim 3: Emotional inertia, the affect–perseverative thoughts association and depressive symptoms

Our third aim was to examine the relative importance of emotional inertia for depressive symptoms in comparison to the within-person association between affect and perseverative thoughts across time. For this purpose, we first determined the relationship between depressive symptoms and the within-person association between affect and perseverative thoughts, using ML Model 3 (Table 1) in which NA(t) was predicted by perseverative thoughts (t) and which included depressive symptoms as a Level-2 predictor of the affect–perseverative thoughts association. In line with previous findings (Moberly & Watkins, 2008), individuals with higher levels of depressive symptoms showed a comparatively strong association between NA and perseverative thoughts.

Next, we included emotional inertia and the affect–perseverative thoughts association as predictors of depression in an OLS regression model (Table 2, Model 4). For this purpose, we used the random effects from the two predictors in ML Model 2A (Table 1) which reflect the unique effects of NA(t–1) and perseverative thoughts (t) on NA (t). Although these effects are adjusted for the covariation with the other variable in their prediction of NA(t), they may still share predictive variance regarding depression, to the degree that the relevance of emotional inertia may be undermined—which was that we wanted to find out. The result is that both emotional inertia and the affect–perseverative thoughts association remained significant predictors, pointing to their partly independent roles regarding depressive symptoms (i.e., the relevance of emotional inertia is not undermined). Yet, the two predictors indeed also shared predictive variance which means that individuals with relatively high levels of depressive symptoms are characterised by both high levels of emotional inertia and a relatively strong association between NA and perseverative thoughts.

DISCUSSION

This study examined three challenges to the proposed link between emotional inertia and depressive symptoms: whether it remains (1) when emotional inertia is observed over longer timescales; (2) while taking state aspects of perseverative thoughts into account; and (3) over and above the within-person association between NA and perseverative thoughts. The three challenges were passed. First, the persistence of emotional states across days distinguished between individuals high and low in depressive symptoms, and it prospectively predicted depressive symptoms in close proximity to the period when inertia was observed. That is, previous findings on emotional inertia across seconds and hours were replicated on a longer timescale. Second, findings confirmed that emotional inertia is related to depressive symptoms over and above state perseverative thoughts. This underscores that perseverative tendencies in the affective domain are distinguishable from perseverative tendencies in the cognitive domain when it comes to their role for depressive symptoms (Koval et al., 2012). Although prior research has shown independent predictive validities of emotional inertia and rumination, it was the global level of this type of perseverative thoughts that was assessed (Koval et al., 2012). However, it is crucial to establish the independence of emotional inertia from state aspects of perseverative thoughts given that this could be a possible mechanism linking emotional inertia with depression. Third, this study revealed that individuals with higher levels of depressive symptoms are characterised by both higher levels of inertia and a stronger within-person association between affect and perseverative thoughts than individuals with lower levels. However, emotional inertia also remained a unique predictor of depressive symptoms when taking both aspects of within-person functioning into account.

Our findings on emotional inertia and the state aspects of perseverative thoughts are illuminative in multiple regards. They point to the intricate relationships between state NA and state perseverative thoughts and thereby are in accordance with theoretical accounts of the maladaptive nature of the latter (Brosschot et al., 2006). In particular, the more intense perseverative thoughts are on a particular day, the more affect carries over across occasions (as is indicated by the shared predictive variance of NA[*t*–1] and perseverative thoughts). This is in line with the proposition of transactional relationships between affect and perseverative cognitions that were particularly highlighted in research on rumination (Moberly & Watkins, 2008). Furthermore, these findings are in line with the idea that individuals with high levels of depressive symptoms have a relatively strong relationship between affect and perseverative thoughts, including rumination and worry (Nolen-Hoeksema et al., 2008).

Yet, we showed that these associations only partly explain the relationship between emotional inertia and depressive symptoms. Emotional inertia remained a significant predictor of depressive symptoms when adjusting for its covariation with state perseverative thoughts. Furthermore, we found that while individuals with increased depressive symptoms have both relatively high levels of inertia and strong day-to-day affect–perseverative thoughts associations, emotional inertia remains a relevant predictor of depressive symptoms. In a nutshell, what makes affect dynamics inert beyond perseverative thoughts seems to hold an important key for understanding depressive symptomatology.

It seems highly valuable in this context that future studies closely examine sensitivity to contextual variation and whether it is diminished in individuals with high levels of inertia. Following Hollenstein and colleagues' (2013) recent elaboration on how flexibility can be distinguished on different timescales, such future examinations may include variation in the sense of minor variations within the person (e.g., the degree to which a person can be cheered up by thoughts that come to his or her mind), within situations (e.g., in interpersonal interactions) and across situations (e.g., emotions experienced with different people). The findings of the current study likely point to insensitivity to variation across situations, as changes that occurred between occasions in the COGITO study include differences in weekdays, months and seasons, as well as exposure to different event types (Brose, Scheibe, & Schmiedek, 2013).

The current study is not without limitations: first, the current results may not generalise to individuals with clinical depression because the sample was comparable to a non-clinical representative sample in terms of depression. Thus, it remains to be seen whether emotional inertia and perseverative thoughts more generally and rumination, in particular, are also partly independent in depressed individuals or whether within-person associations between emotional inertia and perseverative thoughts become increasingly tied in depression. A more fine-grained examination of specific types of perseverative thoughts would be highly beneficial in this context (i.e., an explicit examination of rumination and worry). Yet, we think that the results of this study are nevertheless relevant for depression because they may reveal an important mechanism in healthy individuals that renders them vulnerable to depression. Second, while our findings suggest that affect dynamics measured on a timescale of days share fundamental similarities with dynamics on shorter timescales, we could not directly compare affect dynamics on different timescales. Such a comparison requires a multiple timescale design (Ram et al., 2013). Third, in contrast to Kuppens and colleagues (2012), we found no significant prospective association between inertia and depressive symptoms at long-term follow-up. While we cannot conclusively explain this divergence between the two studies, we tentatively suggest that differences in the paradigms used to assess emotional inertia may be at play. Kuppens et al.' s paradigm was known to discriminate particularly well between people's depression status and their participants were teenagers; the onset of depression may have more internal enduring causes at that age as compared to participants in the

mid-twenties, an age when multiple life changes occur which entails a risk for developing depression.

To conclude, this study's findings add to the mounting evidence that the emotional dynamics reflected by emotional inertia are relevant for depressive symptomatology, and this is independent of perseverative thoughts. This is particularly interesting given that NA and state perseverative thoughts co-occur across time. It thus seems high time to find explanations why affective experiences are more inert in some people than in others which may then provide the possibility to intervene at stages before depression emerges.

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