Rumination for innovation? Analyzing the longitudinal effects of work-related rumination on creativity at work and off-job recovery

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Abstract

Work-related rumination is not a single construct, but consists of a dimension associated with negative emotions or affect (affective rumination), and a dimension associated with reflective thinking and applying strategies to solve problems (problem-solving pondering). In this three-wave longitudinal study across two years (N = 630) we investigated whether the relationships between work-related rumination, off-job recovery, and creativity at work varied along the two dimensions of work-related rumination. In addition, we tested whether the relationships followed normal, reversed or reciprocal causation. The results showed, first, that in a one-year perspective affective rumination, but not problem-solving pondering, was negatively related to off-job recovery and that problem-solving pondering, but not affective rumination, was positively related to creativity at work. Second, in a two-year perspective reversed effects were detected as creativity at work was negatively related to affective rumination and positively to off-job recovery. Our results suggest that the quality of work-related thoughts determines whether the outcome is beneficial or detrimental. Occupational health interventions that only advise employees to stop thinking about work during off-job time, may therefore be too simplistic.

Rumination for innovation?

Analyzing the longitudinal effects of work-related rumination on creativity at work and off-job recovery

Rumination has been defined as "a class of conscious thoughts that revolve around a common instrumental theme and that recur in the absence of immediate environmental demands requiring the thought" (Martin & Tesser, 1996, p. 7). It is considered a paradoxical phenomenon that has been discussed as being both unconstructive *and* constructive (Watkins, 2008). For example, in the clinical psychology literature rumination is perceived as one potential mechanism explaining the counterintuitive relationship between mood disorders and creativity (Cohen & Ferrari, 2010; Forgeard, 2013; Verhaeghen, Joorman, & Khan, 2005; Verhaeghen, Joormann, & Aikman, 2014), implying that mental health problems, which often co-occur with rumination, may have some positive consequences (e.g., in terms of creativity). It has therefore been suggested that rumination may not be a single construct, but consist of a component associated with negative emotions or affect, and a component associated with reflective thinking and applying strategies to solve problems (Verhaeghen et al., 2014).

In recent years' rumination has also attracted attention in occupational health psychology. Specifically, in the context of the occupational stress literature, *work-related rumination* is typically framed as a negative phenomenon, because it impedes unwinding after work (Cropley, Michalianou, Pravettoni, & Millward, 2012; Vahle-Hinz, Bamberg, Dettmers, Friedrich, & Keller, 2014). Following this increasing interest in work-related rumination, Cropley et al. (2012) recently developed an instrument to measure different dimensions of work-related rumination. They distinguish between affective rumination, which describes the negative emotional experiences evoked by job-related thoughts during off-job time, and problem-solving pondering, which captures a cognitive reflection of work-related issues during free time (Cropley et al., 2012).

As rumination seems to be a multi-faceted phenomenon (Watkins, 2008), it is crucial to investigate whether its antecedents and outcomes vary along its dimensions. Accordingly, in the present study we propose that the different dimensions of work-related rumination may indeed be associated with either positive or negative consequences. To test this proposition, we use a three-wave longitudinal design and test whether the dimensions of work-related rumination (affective rumination and problem-solving pondering) show different associations with off-job recovery and creativity at work. More specifically, building on the conservation of resources theory (COR; Hobfoll, 1998, 2001), we investigate whether different dimensions of rumination can lead to a cycle of resource loss (negatively influencing off-job recovery, and thus leading to less creativity at work), or a cycle of resource gain (positively influencing off-job recovery, and thus enhancing creativity at work). That is, we investigate off-job recovery as a mediator in the relationship between work-related rumination and creativity at work.

Our study makes three contributions. First, the effects of rumination are not entirely clear; as both positive and negative effects have been reported. By simultaneously investigating the positive and negative effects of work-related rumination, we shed new light on the question whether employees should or should not think about work while not actually working. Our findings may therefore be of help in the planning and implementation of tailored interventions in organizations. Second, research on work-related rumination has so far mainly been based on cross-sectional (Berset, Elfering, Lüthy, Lüthi, & Semmer, 2011; Querstret & Cropley, 2012) or diary studies focusing on short-term effects (Cropley & Purvis, 2003; Vahle-Hinz et al., 2014; Wang et al., 2013). In the present study, we use a three-wave longitudinal design to investigate the consequences of work-related rumination for up to two years. Third, we test off-job recovery as a possible mediating mechanism explaining the long-term effects of work-related rumination on creativity at work. This further adds to our

understanding of how work-related rumination may exhibit positive and negative effects over time.

Work-related rumination and creativity at work

There are few characteristics of human performance having as great an impact on our (working) life as creativity (Scott, Leritz, & Mumford, 2004). Indeed, creativity helps employees to cope with and adapt to change and to solve work problems (Cropley, 1990; Runco, 2004). This means that organizational performance and success depend heavily on employees' creativity (Harari, Reaves, & Viswesvaran, 2016). Creativity at work can be defined in various ways, but very often creativity at work has been used to refer to employees' ability and willingness to invent new, innovative, or unconventional ideas in relation to their work (see e.g., Mumford, 2012; Zhou & Hoever, 2014), constituting the definition of creativity in our study as well.

The relationship between rumination and creativity has already been studied in clinical/health psychology, and with interesting findings. Verhaeghen et al. (2014) investigated the relationship between brooding (which is similar to affective rumination) and reflective rumination (which is similar to problem-solving pondering) with depression and creativity in students. Their results showed that brooding, but not reflective rumination, was positively related to depression. Additionally, reflective rumination, but not brooding, was positively associated with creativity (Verhaeghen et al., 2014). Corroborating this finding, Forgeard (2013) showed that deliberate rumination (which is similar to problem-solving pondering), but not intrusive rumination (which is similar to affective rumination), was positively associated with creativity. Finally, a study by Cohen and Ferrari (2010) also reported a positive link between reflective rumination (which is similar to problem-solving pondering) with creativity. Accordingly, studies conducted outside the work context provide preliminary evidence on the positive linkages between problem-solving pondering and creativity.

Some further evidence comes from studies conducted among working populations. A recent study by de Jonge, Spoor, Sonnentag, Dormann, and van den Tooren (2012) used a working sample and investigated the relationship between mental detachment from work and creativity at work. The results of their cross-sectional study showed that *not* mentally detaching oneself from work during off-job time leads to more creativity under the condition of high cognitive resources (e.g., problem-solving skills). Accordingly, not thinking about work is positive for recovery and well-being (Sonnentag & Fritz, 2015), but stopping thinking about work may also lead to poorer performance in terms of less creativity at work.

In this study we suggest that affective rumination is the kind of work-related negative thinking that should be stopped in order to help employees to be more creative at work. This proposition is also congruent with the conservation of resources theory (COR; Hobfoll, 1998; 2001). Negative thoughts about work deplete an employee´s emotional and cognitive resources, thereby also depleting the resources available for generating new ideas. The direct relationship between creativity and affect is actually rather complicated. It seems that positive affect leads to playful, expansive, divergent thinking and new ideas, while negative affect signals problems and causes employees to engage in cautious systematic information processing which may also result in creative insights. Overall, positive affect appears to be more conducive to creativity than negative affect (Amabile, Barsade, Mueller, & Staw, 2005; Hennessey & Amabile, 2010; Isen, Daubman, & Nowicki, 1987). Affective rumination occupies a person´s mind in a negative way, increases cognitive load and may make it more difficult for employees to consider and integrate a wide range of alternative courses of actions and thoughts, which are key to creativity (Gailliot et al., 2007; Van Dyne, Jehn, & Cummings, 2002). Accordingly, we hypothesize:

Hypothesis 1: Affective rumination is negatively related to creativity at work over time.

On the other hand, problem-solving pondering may be conducive to creativity at work, as shown in some earlier studies (de Jonge et al., 2012; Verhaeghen et al., 2014). Continuing to think about a problem outside working hours may help employees to get closer to the solution simply by spending more time thinking about it. During free time, people may also experience activating moods, which have been associated with higher levels of creativity (Baas, De Dreu, & Nijstad, 2008). The new surroundings and context at home may stimulate thinking "outside the box" and making new, unusual connections (see also Martindale, 1999). This proposition is also consistent with the COR theory (Hobfoll, 1998, 2001) as positive cognitive reflection about one's work during off-job time, captured by problem-solving pondering, may start a succession of positive outcomes, for example, being more creative. Accordingly, we hypothesize:

Hypothesis 2: Problem-solving pondering is positively related to creativity at work over time.

Work-related rumination and recovery

Recovery is seen as a crucial resource that enables employees to work optimally throughout their working lives (Hobfoll, 1998; Meijman & Mulder, 1998). Specifically, recovery refers to the process during which an individual's functioning returns to its pre-stressor level and the psychological mechanisms associated with this process (Sonnentag & Zijlstra, 2006). Recovery helps to avoid short-term and long-term negative health consequences (Geurts & Sonnentag, 2006; McEwen, 1998). Additionally, employees who are restored perform better at work (Binnewies, Sonnentag, & Mojza, 2009, 2010). Recovery from work is therefore crucial to both employees and employers.

Thinking about work outside working hours is mainly perceived as detrimental to successful recovery (Sonnentag & Fritz, 2015; Vahle-Hinz et al., 2014), because it translates work demands into the off-work domain, hindering recovery and leading to health impairments in the long run (Brosschot, Gerin, & Thayer, 2006; Verkuil, Brosschot,

Gebhardt, & Thayer, 2010). Detaching oneself from work is therefore seen as a crucial recovery experience, protecting employees against negative health consequences (Sonnentag & Fritz, 2015). However, to stop thinking about work is not always easy, especially when the work demands are high (Sonnentag, Binnewies, & Mojza, 2010). Additionally, to (re-) consider a work-related problem during one's spare time and find a solution for this problem may even be beneficial for health and well-being (Cropley et al., 2012; Querstret & Cropley, 2012). The same may be the case when one reflects positively on one's job outside working hours (Fritz & Sonnentag, 2005). Therefore, the question is whether the quality of rumination – affective rumination or problem-solving pondering – determines whether ruminating about work is detrimental or beneficial to off-job recovery (Cropley et al., 2012; Syrek & Antoni, 2014; Verhaeghen et al., 2014). We suggest that thinking about one's work outside working hours can have both positive and negative effects on recovery.

The negative effects of rumination are based on the perseverative cognition hypothesis (Brosschot et al., 2006). According to this theory, rumination is seen as a cognitive representation of the workplace stressor, that leads to a reliving of the stressful situation, which results in psychological or physiological stress reactions (Pieper & Brosschot, 2005). Importantly, this is true even if the stressor itself is not present (Glynn, Christenfeld, & Gerin, 2007). During times of recovery (outside working hours, at weekends, on holidays) the workplace stressors are typically not present, and thus recovery can occur (Meijman & Mulder, 1998). However, ruminating about work leads to a mental representation of the stressor (even if the stressor is not present), which leads to a prolonged stress reaction and inhibits recovery (Brosschot et al., 2006; Meijman & Mulder, 1998; Sonnentag & Fritz, 2015). Empirical studies support this hypothesis by providing evidence that work-related rumination is related to impaired recovery, for example, in terms of impaired night sleep (e.g., Berset et al., 2011; Pereira & Elfering, 2014; Syrek & Antoni, 2014; Vahle-Hinz et al., 2014). Accordingly, we hypothesize that mentally reliving stressful work experiences while not at

work, combined with negative emotional reactions to this mental representation of stress (typical of affective rumination), leads to poorer off-job recovery across time:

Hypothesis 3: Affective rumination is negatively related to off-job recovery over time.

On the other side, the literature on rumination has emphasized that on some occasions thinking about work can be beneficial rather than detrimental (Brosschot, Van Dijk, & Thayer, 2007; Cropley et al., 2012; Watkins, 2008). For example, if an employee leaves the workplace thinking about the problem not resolved during working hours on the way home or during free time *and* finds a solution that can be applied the following day at work, this may lead to positive emotions and therefore facilitate recovery (Cropley et al., 2012; Syrek, Weigelt, Peifer, & Antoni, 2016). Actually, in their study on the relationship between episodes of repetitive thinking (similar to rumination) and a physiological measure of sleep, Brosschot et al. (2007) showed that duration, but not frequency of repetitive thinking, was negatively related to sleep. They concluded: "when duration is statistically controlled what is left is the number of attempts at problem solving. These by themselves may not have strong physiological consequences and may even be adaptive. One could argue that being aware of one's problems and concerns is healthy and adaptive as long as being aware leads to either productive problem solving or rapid disengagement" (Brosschot et al., 2007, p. 45).

In other words, if one ruminates about a work-related problem during off-job time but finds a solution to this problem or develops a strategy to deal with it, this may lead to positive emotions and a sense of accomplishment, or help to subsequently mentally detach from work (see Syrek et al., 2016). Problem-solving pondering may therefore constitute an act of discovery, which has favorable outcomes for employees (Eschleman, Madsen, Alarcon, & Barelka, 2014). This reasoning is backed up by the COR theory (Hobfoll, 1998). According to the COR theory, stress is reduced and positive emotions induced if resource investment (thinking about a work-related problem during one's free time) leads to resource gain across time (being able to solve this problem and subsequently better detach from work) (Hobfoll,

2001; see also Sonnentag & Fritz, 2007). Accordingly, we hypothesize a positive relationship between problem-solving pondering and recovery.

Hypothesis 4: Problem-solving pondering is positively related to off-job recovery over time.

Recovery as a mediator between rumination and creativity at work

The effort-recovery model (ERM; Meijman & Mulder, 1998) states that adjusting to demands at work requires employees to make an effort, resulting in strain. These strain reactions during work are reversible in the absence of job demands, or when the demands tax different levels of activation (behavioral, physiological, or emotional level). However, if recovery during off-job time is insufficient, these strain reactions develop into long-term health impairments. Importantly, the ERM proposes that the short-term and long-term consequences of workload (i.e., strain reactions of employees) are linked to the work potential of the employee. The work potential determines how much effort an employee is able to make.

According to the ERM, insufficient recovery should be negatively linked to work-related behavioral outcomes such as creativity (Meijman & Mulder, 1998). Insufficient recovery triggers an energy depletion process, which may over time translate into poor performance, including impaired creative performance. Empirical support for the ERM model stems from the literature on work stress recovery, which shows positive relationships between successful recovery and work performance (Binnewies et al., 2009, 2010; Fritz & Sonnentag, 2005, 2006; Sonnentag, 2003). In addition, it has been shown that recovery, in terms of emotional and physical detachment from work, has positive effects on employees' creativity (de Jonge et al., 2012). In accordance with the literature, we propose that successful recovery from work is positively related to creativity at work. In contrast to previous studies, our study uses a longitudinal design to investigate long-term effects of up to two years.

Hypothesis 5: Off-job recovery is positively related to creativity at work over time.

We expect off-job recovery to mediate the relationship between work-related rumination and creativity. On the basis of the COR model (Hobfoll, 1998, 2001) we suggest that being restored is a valuable health-promoting resource as it increases personal health and well-being (Sonnentag & Fritz, 2015; Zijlstra & Sonnentag, 2006). Off-job recovery refers to increasing one's resources during free time and fits well with the COR framework (Hobfoll, 1998, 2001) applied in the present study. Improving off-job recovery through problem-solving pondering (the positive aspect of rumination) should accordingly allow employees to invest their resources in the work context to gain additional creativity boosting resources (e.g., approbation from supervisors/colleagues for creative ideas). However, impairing the recovery process through affective rumination (the negative aspect of rumination), should lead to poorer well-being, and reduce the ability to invest resources in the working context (e.g., being too exhausted to be creative). Accordingly, affective rumination may initiate a cycle of resource loss, meaning that affective rumination about work leads to less creativity at work via less off-job recovery. In contrast, problem-solving pondering about work during free time may initiate a cycle of resource gain that enables employees to be more creative at work, a relationship formed via successful off-job recovery as a health-promoting personal resource.

Past research has already emphasized that recovery may be a key mechanism linking various workplace experiences to employee well-being (Geurts & Sonnentag, 2006; Kinnunen, Feldt, Siltaloppi, & Sonnentag, 2011; Sonnentag, Kuttler, & Fritz, 2010). Furthermore, good recovery has been shown to improve work performance (Binnewies et al., 2009; de Jonge et al., 2012) and the ability to be creative in one's job can be considered a key element of good work performance (see Harari et al., 2016; Koopmans et al., 2011).We hypothesize accordingly:

Hypothesis 6: The relationship between work-related rumination and creativity at work is mediated by off-job recovery over time.

Method

Design and sample

We tested our hypothesis using a three-wave longitudinal design with time lags of one year. Although it is difficult to theoretically determine the right time period as we lack theories of change in general (Kelloway & Francis, 2013), we consider one year an appropriate time lag to test the posited relationships. In earlier studies within the field of occupational health psychology, one year has been the most typical time period in long-term studies on stressor-strain relationships (see Ford et al., 2014, for a review) and recovery studies (e.g., Kinnunen & Feldt, 2013; Rodriguez-Muñoz, Sanz-Vergel, Demerouti, & Bakker, 2012).

We recruited employees mainly working in knowledge-intensive and mentally demanding jobs with the help of an occupational health service provider. Of the 2,824 employees approached in spring 2013 (T1), 1,347 completed the electronic questionnaire after two reminders. In spring 2014 (T2) the electronic questionnaire was sent to those employees' e-mail addresses who responded in 2013 and who were still employed in the same organizations (N = 1,192). Of these, a total of 841 employees returned completed questionnaires. In spring 2015 (T3) the 664 employees who completed the T2 questionnaire also completed the T3 questionnaire. Due to missing data in some variables the final sample consisted of 630 employees on all three measurement occasions. The employees were informed about the goals of the study, assured that responses would be treated confidentially and reminded that participation was voluntary.

At Time 1 of this longitudinal sample, 58% were women. The participants' average age was 47.5 years (range 23–66, SD = 9.9). Of the sample, 38% held an academic degree (master's level or higher), 26% had a polytechnic degree, and the rest (36%) had a vocational school qualification or less. The majority of the sample (62%) were higher white-collar workers (e.g., teachers), 29.5% were lower-white collar workers (e.g., office workers), and

8.5% were blue-collar workers (e.g., cleaners). Most employees had a permanent job (91%), worked full-time (97%) and worked a regular day shift (90%). Average hours worked weekly were 39 (*SD* = 5.9) and 13% had a supervisory position. Of the participants, 54.5% worked in the public sector, and the rest (45.5%) worked in the private sector. Most of the participants (80%) were living with a partner (either married or cohabiting), and 44.2% had children (on average two) living at home.

Sample attrition

In analyzing sample attrition, we compared the characteristics of the respondents in the longitudinal sample with the dropouts (non-respondents either at T2 or at T3). The results indicated that the respondents did not differ from the non-respondents in terms of gender, education, occupational status, weekly working hours, supervisory position, having a partner, or number of children. However, the respondents more often had a permanent employment contract (91% vs. 80%, $p < .001$), worked more often on a regular day shift (90% vs. 85%, $p < .05$) and were older (47.5 vs. 46.2 years, $p < .05$) than the non-respondents.

The attrition analysis for most of the main study variables (problem-solving pondering, off-job recovery and creativity) showed that the longitudinal sample did not differ from the dropouts. However, in the longitudinal sample dropouts engaged more often in affective rumination (2.58 vs. 2.43, $p < .01$) than responders.

Measures

This study was part of a larger project on recovery from work stress. Therefore, the measures for each construct had to be short. We chose items having the highest loadings on each construct in earlier studies. All constructs were measured three times (T1–T3).

Work-related rumination was measured with six items developed and validated by Cropley et al. (2012). Three items measured *affective rumination* (e.g., “I become tense when I think about work related issues in my free time”) and three items assessed *problem-solving pondering* (e.g., “I find solutions to work-related problems in my free time”). The response

scale ranged from 1 (very seldom) to 5 (very often). Cronbach's alphas for affective rumination ranged between .87 at T1 and .89 at T2–T3. For problem-solving pondering, Cronbach's alphas ranged between .68 at T1-T2 and .70 at T3.

Off-job recovery was assessed with an adapted version of the restoration scale developed by Korpela, Ylén, Tyrväinen, and Silvennoinen (2008) in the area of environmental psychology. The adapted scale had six items, which focus on recovery processes employees experience by engaging in free time activities and by which they recover, that is, replenish their resources. Each item starts with "My free time activities…". Three items reflect relaxation and calmness (e.g., "make me feel restored and relaxed"), one reflects attention restoration (e.g., "increase my concentration and alertness"), and two reflect clearing one's thoughts (e.g., "help me clarify my thoughts"). The response scale ranged from 1 (not at all) to 7 (completely). Cronbach's alpha was .93 at T1 and T3, and .92 at T2.

Creativity at work was defined as idea generation behavior and measured with three items ("My head is full of innovative ideas that are related to my work", "I come up with creative solutions to work problems", "I suggest new ways of performing work tasks"), developed and applied by Tierney, Farmer, and Graen (1999). Cronbach's alpha ranged between .84 at T1 and .86 at T2–T3. The responses were rated on a scale from 1 (very seldom or never) to 5 (very often or always).

We used sex (1 = man, 2 = woman), age (a continuous variable), educational background (1 = comprehensive school, 6 = master's degree or higher), and working hours (a continuous variable) as *control variables* in our analyses. We used these controls as they have been shown to be relevant in studying rumination, recovery and creativity (e.g., Fasko, 2001; Geurts, Beckers, & Tucker, 2014; Johnson & Whisman, 2014).

Data analysis

We tested our hypotheses using structural equation modeling (SEM), and focused on cross-lagged effects as well as indirect effects. We conducted our analyses with Mplus 7.1

(Muthén & Muthén, 2010) using the robust maximum likelihood estimator (MLR). Missing data were handled with the Full Information Maximum Likelihood procedure (FIML). In all our analyses, the residuals of the equivalent manifest variables were allowed to correlate between measurement occasions in line with recommendations regarding tests of longitudinal models (Hülsheger, Lang, & Maier, 2010; Little, Preacher, Selig, & Card, 2007; Little, 2013, Vahle-Hinz, 2016). For model evaluation, we relied on CFI, TLI, RMSEA, and SRMR. CFI and TLI values of > .90 are commonly considered to indicate an acceptable fit (Kline, 2005). The recommended boundaries are .06 for RMSEA and .08 for SRMR (Browne & Cudeck, 1993; Hu & Bentler, 1999). Because χ^2 statistics depend on sample size, their significance should not automatically result in a rejection of the model. A value between 2 and 3 for a standardized χ^2 divided by the degrees of freedom (χ^2/df) has been proposed to be acceptable (Moosbrugger & Schermelleh-Engel, 2007; Wheaton, Muthén, Alwin, & Summers, 1977).

Empirical distinctiveness of the scales. We conducted a series of confirmatory factor analyses and investigated whether both dimensions of rumination were different latent factors, and whether a two-factor model with regard to creativity and off-job recovery was confirmed. The results of these analyses supported the empirical distinctiveness of our scales (factor loadings ranged from $\lambda = .49$ to .91, $p < .001$).[i]

Measurement invariance. Measurement invariance is a precondition for making inferences about the relationships between the variables across time (Little et al., 2007). We followed Little's (2013) recommendations and compared a baseline model (a model with identical measurement models on all three measurement occasions) with a weak invariance model (equal loadings across measurement occasions). Next, we compared a weak invariance model with a strong invariance model (equal intercepts of corresponding factors across measurement occasions). The results showed that the fit of the baseline model was comparable to the fit of the weak invariance model (Baseline model: $\chi^2 = 1897.61$, $df = 837$, $p < .001$, $\chi^2/df = 2.27$, CFI = .95, TLI = .94, RMSEA = .04, SRMR = .07; weak invariance

model: $\chi^2 = 1929.90$, $df = 859$, $p < .001$, $\chi^2/df = 2.25$, CFI = .95, TLI = .94, RMSEA = .04, SRMR = .07, $D\chi^2 = 32.03$, $Ddf = 22$, p = ns, $DCFI = .001$)[ii]. However, the comparison in model fit between the strong invariance model and the weak invariance model was significant (strong invariance model: $\chi^2 = 2015.64$, $df = 881$, $p < .001$, $\chi^2/df = 2.29$, CFI = .94, TLI = .94, RMSEA = .04, SRMR = .07, $D\chi^2 = 89.28$, $Ddf = 22$, $p < .001$, $DCFI = .003$). As χ^2 statistics are highly sensitive to sample size, Little (2013) as well as Cheung and Rensvold (2002) recommend using difference in the CFI for model evaluation in larger samples ($N >$ 200). The DCFI between the weak and strong measurement invariance model was .003, and therefore below the threshold of .01 recommended by Cheung and Rensvold (2002), and close to the threshold of .002 suggested by Meade, Johnson, and Braddy (2008). Accordingly, we assumed strong measurement invariance in our sample (see Vahle-Hinz, 2016, for a similar approach). Therefore, our further longitudinal analyses were warranted.

Direct effects. We investigated our hypotheses regarding direct effects between affective rumination at T1 and problem-solving pondering at T1 with recovery at T2/T3 and creativity at T2/T3, using a cross-lagged panel design. Our analytic strategy consisted of five steps: First, we conducted a stability model (T1 variables predicted the same variables at T2, and T2 variables predicted the same variables at T3) as a comparison model for all other models. In this *baseline model* control variables were included, controlling for effects at T1 constructs (Little, 2013). Second, we investigated the proposed normal *causal effects* (affective rumination at T1 and problem-solving pondering at T1 predicting off-job recovery at T2/T3 and creativity at T2/T3; off-job recovery T1 predicting creativity at T2/T3). Third, we investigated *reverse effects* (creativity at T1 predicting affective rumination at T2/T3, problem-solving pondering at T2/T3, and off-job recovery at T2/T3; off-job recovery T1 predicting affective rumination at T2/T3, and problem-solving pondering at T2/T3). Fourth, we tested a *reciprocal effect* model (affective rumination and problem-solving pondering

predicting creativity and off-job recovery over time and vice versa). These models (reversed and reciprocal) were tested to rule out alternative explanations. For model comparisons we only retained significant paths in the models. Fifth, we established a model which included only significant paths no matter whether these were causal, reverse, or reciprocal. This model is termed the *final model*. All models were compared to the baseline stability model. The final model was moreover compared to the best fitting effect model (causal, reverse, or reciprocal effect model). Figure 1 illustrates our analytical design.

[INSERT FIGURE 1 ABOUT HERE]

Mediation. We tested our mediation hypothesis using the different time lags in our sample. We used a full-longitudinal model investigating whether the relationship between affective rumination at T1 and problem-solving pondering at T1 with creativity at T3 is mediated by off-job recovery at T2. As the time lag may determine whether the mediation effect exists or not, we also used a half-longitudinal model using only the lag between T1 and T2 (see Little, 2013). Specifically, we specified a model where we investigated whether the relationship between affective rumination at T1 and problem-solving pondering at T1 with a change in creativity at T2 (controlling for creativity at T1) is mediated by the prediction of affective rumination at T1 and problem-solving pondering at T1 of a change in recovery at T2 (controlling for recovery T1). Figure 2 illustrates the different analytic approaches of these indirect effects. To test for the significance of the indirect effects we used bias-corrected bootstrapping. Additionally, as recommended by Little (2013), we investigated whether the model fit of a model including mediation paths is comparable to the model fit of the final model[iii].

[INSERT FIGURE 2 ABOUT HERE]

Results

Table 1 shows the zero-order correlations, means, standard deviations and reliabilities of all study variables.

[INSERT TABLE 1 ABOUT HERE]

Model testing. Table 2 shows the results concerning the comparison of competing effect models. The results prove that all models showed a good fit to the data. Additionally, the causal, reverse, and reciprocal effect models showed significantly better fit to the data than did the baseline model, which only included stability effects. The model fit of the causal, reverse, and reciprocal models was comparable. Furthermore, the model including only significant paths, regardless of whether these were causal or reverse (see final model in Table 2) showed a good fit to the data. The model fit of the final model was better than that of the baseline model, and comparable to the fit of the competing models, of which the best fitting effect model was the reciprocal effect model. In addition, as the reciprocal model did not improve the model fit compared to the final model, $D\chi^2(4) = 3.16$, ns., we chose the final model to interpret causal and reverse effects.

[INSERT TABLE 2 ABOUT HERE]

Direct effects. Figure 3 summarizes the results of our final model. Hypotheses 1 and 2 proposed a relationship between work-related rumination and creativity at work. Our results showed that affective rumination at T1 was not related to creativity either at T2 or at T3. Therefore, hypothesis 1 was not supported. However, problem-solving pondering at T1 was positively related to creativity at T2. Thus hypothesis 2 was partially supported. Additionally, affective rumination at T1 was negatively related to off-job recovery at T2. This result partially supports hypothesis 3. Problem-solving pondering at T1 was not related to off-job recovery at T2 or at T3, which results in the rejection of hypothesis 4. Although the results partially confirm the relationships between work-related rumination and our outcomes, it should be noted that the effects emerged only regarding a time lag of one year. With regard to the time lag of two years, no significant relationships were found. In contrast to hypothesis 5

our results did not support a positive relationship between off-job recovery at T1 and creativity at T2 or T3.

With regard to reverse causation effects it should be noted that off-job recovery did not predict work-related rumination (neither affective rumination, nor problem-solving pondering) over time. Creativity at T1, on the other hand, was negatively related to affective rumination at T3 and positively related to off-job recovery at T3. It seems that the reversed effects of creativity need considerable time (up to two years) to unfold. Additionally, we detected no reversed effects of creativity at T1 on affective rumination, problem-solving pondering, or off-job recovery at T2.

[INSERT FIGURE 3 ABOUT HERE]

Mediation. In hypothesis 6 we predicted that the relationship between work-related rumination (affective rumination and problem-solving pondering) with creativity at work is mediated by off-job recovery. We used the different time lags in our sample and investigated the mediation effect in a full-longitudinal model (T1 predicts T2, which predicts T3), and a half-longitudinal model (using only the time lag between T1 and T2 to investigate the indirect effect; see Figure 2).

In the full-longitudinal model the results showed that neither the relationship between affective rumination at T1 and creativity at T3, nor the relationship between problem-solving pondering at T1 and creativity at T3 was mediated by off-job recovery at T2 (indirect effect regarding affective rumination: 0.000, 95% CI [-0.006, 0.006]; indirect effect regarding problem-solving pondering: 0.000, 95% CI [-0.002, 0.003]). The results in the half-longitudinal model also showed that neither the relationship between affective rumination at T1 and creativity at T2 nor the relationship between problem-solving pondering at T1 and creativity at T2 was mediated by a change in off-job recovery from T1 to T2 (indirect effect regarding affective rumination: -0.001, 95% CI [-0.002, 0.002]; indirect effect regarding

problem-solving pondering: 0.000, 95% CI [-0.001, 0.005]). Accordingly, hypothesis 6 did not gain support from our results.

Discussion

Our results support the idea that certain types of ruminative thinking can have negative (affective rumination) implications, whereas certain types of ruminative thinking can have positive (problem-solving pondering) implications. Specifically, in this longitudinal study with a sample of 630 employees, we were able to show that problem-solving pondering leads to improved creativity at work over one year, and that affective rumination leads to poorer off-job recovery over the same time-period. However, off-job recovery was not related to creativity at work over time, nor did off-job recovery mediate the relationship between work-related rumination and creativity at work. Viewed theoretically, these finding provided some support for the COR model (Hobfoll, 1989, 2001), arguing that both resource gains and losses are likely to accumulate. Such a resource loss may start with negatively toned affective rumination, whereas a resource gain may start with positively toned problem-based pondering. However, our findings did not support the idea of cycles of loss or gain as the mediator model tested (off-job recovery as a mediator between rumination and creativity) was not supported by our three-wave data. Additionally, we also found reversed effects: creativity at work related to a decrease in affective rumination and an increase in off-job recovery across two years.

Creativity at work is key to organizational success in modern societies characterized by fast, globalized, highly competitive markets (see Harari et al., 2016; Mumford, 2012; Runco, 2004). Successful off-job recovery, in turn, can be considered a crucial resource, which enables employees to work at their best throughout their working lives. Therefore, it is important to identify factors facilitating both creativity at work and recovery outside working hours. Our results show that problem-solving pondering exhibits a positive relationship to creativity at work across one year. Our results further show that experiencing negative affect

due to work-related thoughts hampers recovery outside working hours. Accordingly, we are faced with a paradoxical situation: On the one hand, advising employees to stop thinking about work while not at work can have negative consequences for work-related behaviors. On the other hand, advising employees not to stop thinking about work while at home inhibits recovery outside working hours. Fortunately, our results showed that work-related thinking that reduces recovery outside working hours (affective rumination) was not related to work-related behaviors (creativity at work), while work-related thinking that improved creativity at work (problem-solving pondering) was not related to recovery outside working hours. Helping employees to stop thinking about work in a negative way is therefore important for occupational health interventions (see also Querstret, Cropley, Kruger, & Heron, 2016). However, stopping problem-solving pondering may have negative consequences for organizations. Future research should evaluate in more detail the relationship between problem-solving pondering and different health-related outcomes (e.g., burnout) in order to provide a solid research base, before recommending a certain type of thinking about work during free time.

Our study also contributes to the literature as it provides evidence of a longitudinal effect of work-related rumination on off-job recovery over the course of one year. To the best of our knowledge, our study is the first to report a longitudinal relationship between affective work-related rumination and poor off-job recovery. Importantly, our study design allowed us to investigate causal and reversed effects. With regard to the relationship between affective work-related rumination and off-job recovery, we found no evidence of a reversed effect (e.g., off-job recovery influencing affective work-related rumination over time). Our study therefore advances the existing research by providing evidence of a link between affective work-related rumination and off-job recovery over time.

In our study, off-job recovery was not related to creativity at work over time. This is in contrast to diary studies, which show a positive relationship to work-related outcomes (e.g.,

performance, see Binnewies et al., 2009, 2010). Additionally, we investigated off-job recovery as a mechanism explaining the relationship between work-related rumination and creativity at work. Past cross-sectional research has shown that recovery mediates the relationship between job stressors and well-being (Kinnunen et al., 2011). The results of our longitudinal study do not support the mediating effect of recovery for the relationship between work-related rumination and creativity at work. It may be that the relationship between work-related rumination and work-related outcomes (such as creativity at work) is not explained by off-job recovery but is explained by other recovery measures (e.g., recovery experiences) or by behavioral responses. For example, in the model of employee state paranoia (Chan & McAllister, 2014), it is suggested that the relationship between rumination and poor organizational citizenship behavior is explained by safety behaviors (e.g., avoidance behavior, behavioral withdrawal) of the employee. Future studies might investigate the mechanism linking work-related rumination with behaviors at the workplace in more detail.

The negative and positive effects of work-related rumination in our study were only significant regarding a time lag of one year. It may be that a time lag of two years (between T1 and T3 in the current study) is too long to detect significant effects between work-related rumination and creativity at work or off-job recovery. However, research struggles to identify the ideal time lag for stressor-strain relationships (Ford et al., 2014; Taris & Kompier, 2014). Accordingly, the results of our study suggest that a time lag of two years may not be ideal, whereas a time lag of one year enabled us to detect significant effects. In future studies shorter time lags of less than one year (e.g., three to six months) might be interesting to consider. Nevertheless, the reversed effects were identified in a two-year perspective, which in turn suggests that normal and reverse causation may follow different time courses.

Specifically, we found that creativity at work exhibited a positive reverse causation effect on off-job recovery and a negative reverse causation effect on affective rumination over a time interval of two years. Interpreting these reverse effects, we speculate that being more

creative in one's job at T1 suggests that one is going to be more successful in one's job (Eschleman et al., 2014). When one is successful in one's job, thinking about work is a source of pride and self-confidence. Accordingly, negative feelings about work while thinking about it might be reduced, explaining the negative relationship between creativity at work and affective rumination over time. Additionally, taking the drift hypothesis (see Zapf, Dormann, & Frese, 1996) into account, we suggest that being more successful at work (due to more creativity at work), one is more likely to drift into jobs with better job characteristics and better opportunities to recover. This may explain the positive relationship between creativity at work and off-job recovery. All these effects need considerable time to unfold. For example, being creative in one's job does not lead to greater success in the short run. Therefore these effects unfolded only after two years of measurement. It should be noted, however, that the effect of creativity on off-job recovery loses its significance when the model is run without control variables. It may be that a suppression effect explains the relationship. The results should therefore be interpreted with caution (Spector & Brannick, 2011).

Limitations

Our study has a few notable limitations. First, the time lags between the measurements were not theoretically driven as there is no firm theoretical underpinning to propose the best time-lags between those phenomena we studied. Second, we assessed creativity at work by self-reports, which may have been positively biased. Future studies should measure creativity more objectively. Third, in our study we measured off-job recovery with an adapted version of the restoration scale developed by Korpela et al. (2008). The scale measured improvements in relaxation, attention, and clearness of thought through one's free time activities. It therefore captures the recreation of lost resources very well. As the present study is based on COR theory, this measure of off-job recovery matched well with our theoretical considerations. However, future research might benefit from including such measures of recovery that capture recovery from work more precisely. Our recovery measure did not focus on the processes and

experiences by which one is able to recover especially from work, and this may partially explain why it did not function as a mediator in the work context. Finally, the response rate was quite low, a fact which has to be taken into account when thinking about the generalizability of our results. In addition, attrition occurred based on affective rumination. Nevertheless, the heterogeneity and size of the sample adds to the generalizability of the findings.

Despite these limitations, this is the first study to examine long-term relationships between work-related rumination, off-job recovery, and creativity at work using a full-panel design (all phenomena measured at each wave). The results indicate unequivocally that work-related rumination has its pros and cons and future studies should continue to examine its variable antecedents (e.g., what causes positive/negative rumination), moderators (e.g., when/among whom will rumination most likely result in positive/negative outcomes) as well as other consequences than those studied here.

Practical implications

It might be futile to order employees to stop thinking about work outside working hours, as thinking about work is a common behavior. Importantly, the results of our study suggest that if ruminating about work leads to a solution of the problem or to a strategy for coping with the problem at hand (problem-solving pondering), then work-related rumination enhances creativity at work. However, if thinking about work during one's free time is not accompanied by the development of a solution or a coping strategy, but by negative affect (affective rumination), it results in poorer off-job recovery. The challenge for occupational health interventions therefore is *not* to advise employees to stop thinking about work, but to help employees use problem-solving pondering. It is important to advise employees on how to stop thinking about work if problem-solving pondering is not successful, and thereby to avoid affective rumination. Accordingly, health-promoting interventions need to pay attention to the quality of work-related thoughts. Learning how to think about work, and especially when to

stop thinking about it (e.g., when no solution to the problem or coping strategy is found), is crucial to avoid the negative consequences of work-related rumination, while also benefiting from the positive consequences.

The utilization of stop rules may be one fruitful pathway to develop strategies that help employees to prevent a switch from problem-solving pondering to affective rumination. The literature distinguishes the "as many as can" stop rule, from the "feel like continuing" stop rule (Meeten & Davey, 2011). Ruminating about a problem using the "as many as can" stop rule is associated with more catastrophizing and negative thoughts (Davey, Startup, MacDonald, Jenkins, & Patterson, 2005). However, participants using the "feel like continuing" stop rule abandon ruminative thoughts earlier in the process if rumination is accompanied by negative mood (Martin, Ward, Achee, & Wyer, 1993). Accordingly, complementing cognitive behavioral therapy based workshops that have been shown to prevent affective rumination (Querstret et al., 2016), with elements on how to utilize and develop stop rules, may help employees to prevent a switch from problem-solving pondering to affective rumination.

Another strategy to prevent a switch from problem-solving pondering to affective rumination is to teach employees mindfulness. In mindfulness meditation, people learn to observe their thoughts without making judgements, preventing ruminative reactions to "[…] escalate into self-perpetuating and uncontrollable ruminative cycles" (Raes & Williams, 2010, p. 199). By merely acknowledging feelings, thoughts or sensations, people change their relationship to their thoughts rather than attempting to change the content of their thoughts (Hayes, Strosahl, & Wilson, 1999). This increases their metacognitive awareness or capacity for objectivity, which in turn facilitates adaptive, flexible responses to the environment (Shapiro, 2006).

Finally, our findings suggest that there is a cyclical relation between rumination, off-job recovery, and creativity, implying that one could intervene at any point in the cycle to

disrupt a negative cycle and turn it into a positive one. Therefore, strategies to improve employee creativity may constitute a viable approach to decrease affective rumination and facilitate recovery (see also Eschleman et al., 2014, for the relationship between creative activities, recovery and performance). Techniques which train people how to work with information in a systematic manner (i.e., critical thinking, convergent thinking, constraint identification, and use of analogies) have been shown to be successful strategies to improve creativity (Scott et al., 2004).

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Table 1. *Means, standard deviations, reliabilities, and zero-order correlations between the study variables*

Variable	M	SD	α	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Age	47.59	9.89	-															
2. Sex[1]	1.42	0.49	-	.03														
3. Education[2]	4.68	1.45	-	-.09*	-.03													
4. Working hours	38.82	6.20	-	-.02	.04	.00												
5. Affective rumination T1	2.43	0.88	.87	-.11**	-.16**	.07	.02											
6. Problem-solving pondering T1	2.88	0.77	.71	.04	.04	.21**	.17**	.19**										
7. Off-job recovery T1	5.10	0.94	.93	.06	-.04	.00	-.04	-.20**	-.06									
8. Creativity at work T1	3.46	0.78	.84	.03	.06	.10*	.10**	-.11**	.34**	.24**								
9. Affective rumination T2	2.43	0.89	.89	-.09*	-.13**	.09*	.03	.66**	.14**	-.15**	-.06							
10. Problem-solving pondering T2	2.88	0.74	.68	.00	.03	.18**	.12**	.14**	.69**	.01	.29**	.13**						
11. Off-job recovery T2	5.12	0.86	.92	.04	-.08*	-.02	-.01	-.19**	-.05	.61**	.16**	-.24**	-.02					
12. Creativity at work T2	3.39	0.77	.86	.00	.08*	.14**	.09*	-.07	.37**	.22**	.75**	-.03	.39**	.19**				
13. Affective Rumination T3	2.46	0.90	.89	-.10**	-.15**	.10*	-.02	.56**	.06	-.16**	-.11**	.70**	.03	-.21**	-.10**			
14. Problem-solving pondering T3	2.95	0.76	.70	.04	.02	.23**	.13**	.09*	.70**	.01	.32**	.11**	.72**	-.04	.39**	.07		
15. Off-job recovery T3	5.07	0.88	.93	.03	-.11**	-.00	-.03	-.17**	-.03	.58**	.16**	-.20**	.01	.62**	.17**	-.26**	-.00	
16. Creativity at work T3	3.37	0.78	.86	-.02	.09*	.10**	.10*	-.04	.34**	.22**	.73**	-.03	.35**	.16**	.77**	-.10*	.38**	.20**

Note. [1] 1 = man, 2 = woman. [2] 1 = comprehensive school, 6 = master's degree or higher

** $p < .01$, * $p < .05$, $N = 628$-664

Table 2. *Model comparisons*

Model	χ^2	$\Delta\chi^2$	df	Δdf	*p* model comparison	χ^2/df	CFI	ΔCFI	TLI	RMSEA	RMSEA 90% CI	SRMR
Baseline model	2406.35		1094			2.200	.934		.929	.044	(.041; .046)	.074
Causal effect model	2391.29	15.62	1092	2	.001	2.190	.934	0	.930	.043	(.041; .046)	.073
Reverse effect model	2397.36	8.77	1092	2	.001	2.195	.934	0	.929	.044	(.041; .046)	.072
Reciprocal effect model	2379.20	27.65	1086	8	.000	2.191	.935	-.001	.930	.043	(.041; .046)	.071
Final model	2382.36	23.99	1090	4	.000	2.186	.935	-.001	.930	.043	(.041; .046)	.071
Difference between reciprocal and final model		3.16		4	.531			0				

Note. N = 630; differences in χ^2 between comparative models are based on Satorra & Bentler (1999) scaled chi-square difference as MLR estimator was used. In all models only significant paths were retained for model comparisons. The causal effect model included paths A1 and A2 (see Figure 1), the reverse effect model included paths B1 and B2 (see Figure 1), the reciprocal effect model included paths A1/2 and B1/2 (see Figure 1), and the final model included only significant paths, regardless whether they were causal or reverse (see Figure 3).

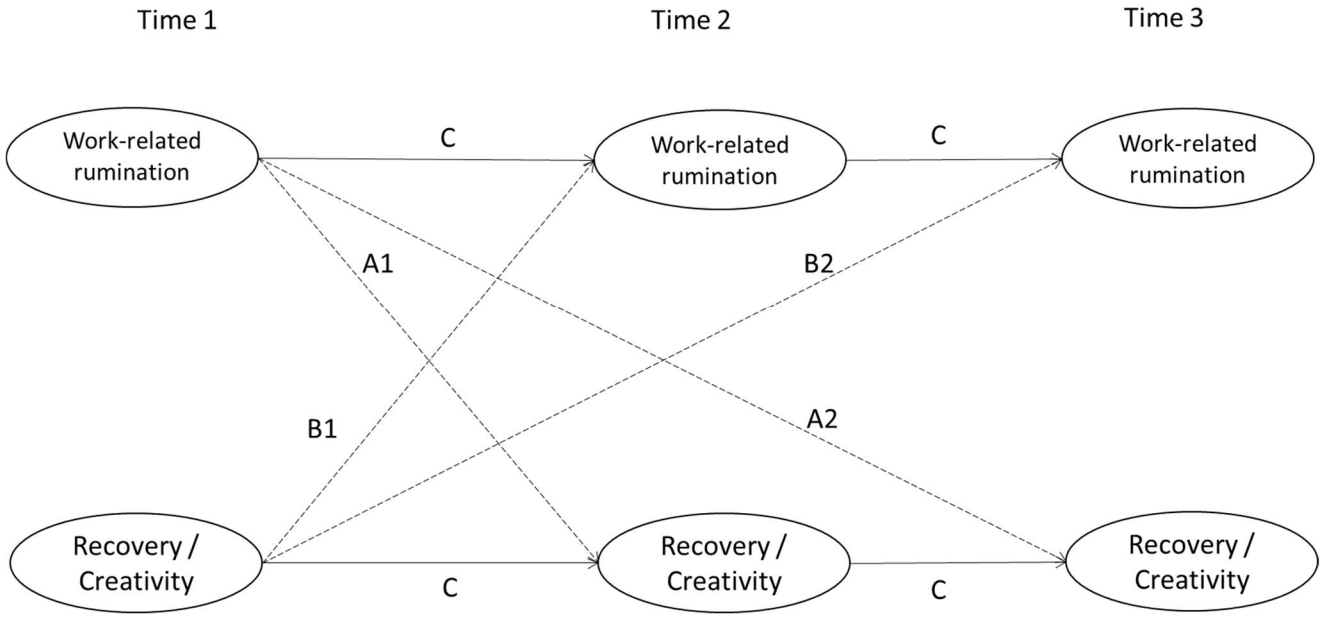

Figure 1. Analytical model. A1 and A2 depict causal paths; B1 and B2 depict reversed paths; C depicts stability paths

Note. Solid lines describe the stability effects and dotted lines describe the cross-lagged effects.

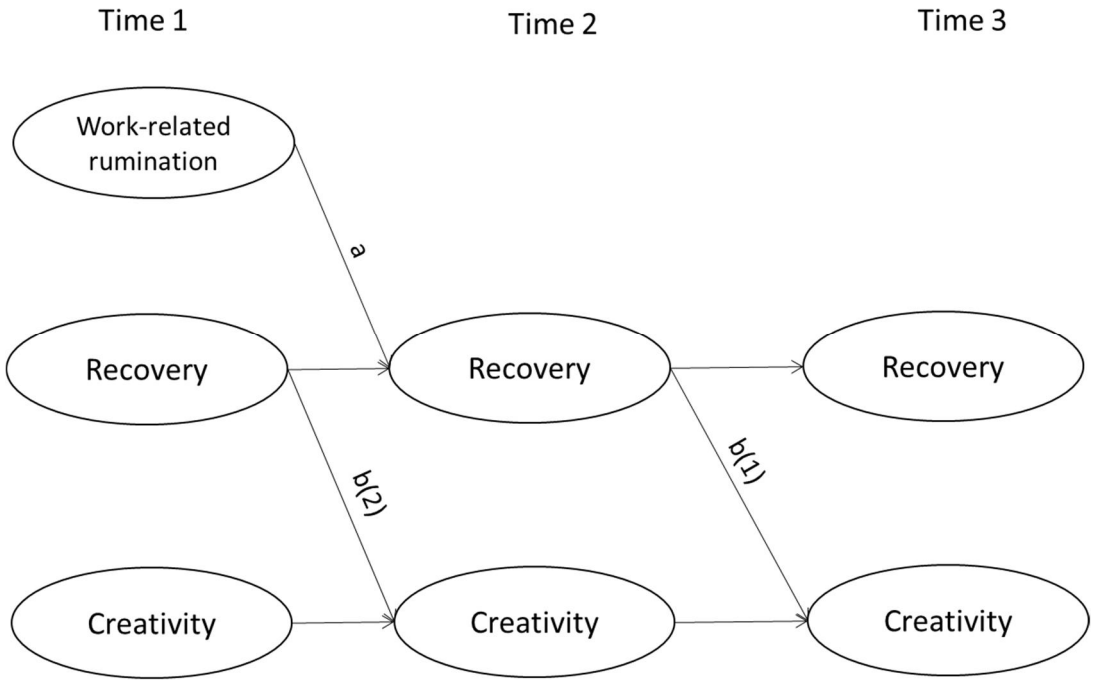

Figure 2. Mediational analyses. Indirect effect using a full-longitudinal model is a*b(1); indirect effect using a half-longitudinal model is a*b(2).

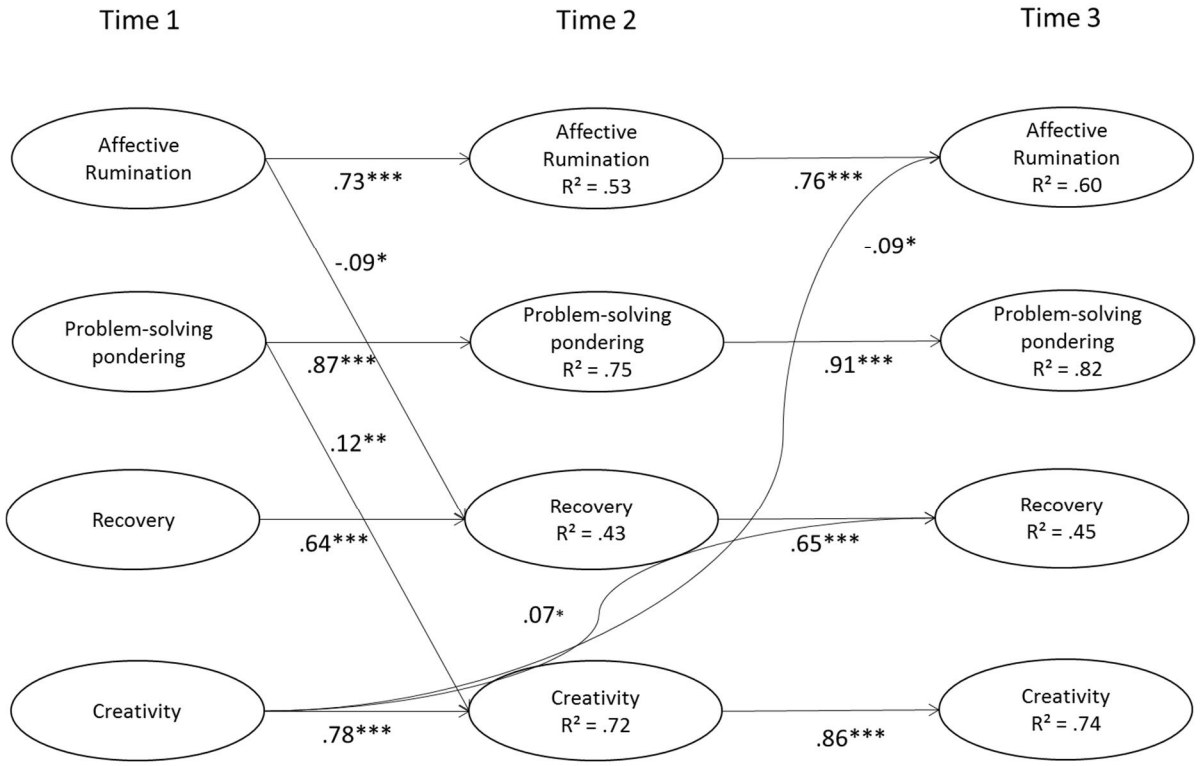

Figure 3. Results of the final model. Please note: Correlations not included in the figure, but latent variables were allowed to correlate within measurement occasions; only significant paths are included in the final model; control variables are not shown, but their effect on T1 constructs was investigated; model fit: : 2382.36, df = 1090, p < .001, χ 2/df = 2.19, CFI = .94, TLI = .93, RMSEA = .04, SRMR = .07; * p <.05, ** p < .01, *** p < .001.

[i] Using CFA, we also confirmed that all scales reported in the present study represent separate constructs. Results are not shown but can be obtained from the corresponding author upon request.

[ii] Differences in χ^2 between comparative models are based on Satorra & Bentler's (1999) scaled chi-square difference because an MLR estimator was used.

[iii] We also compared the fit of this model to that of a measurement model that assumes strong measurement invariance (see Little, 2013). The results showed that both models fitted the data equally well (fit of the measurement model: χ 2 = 2358.99, df = 1060, p < .001, χ^2/df = 2.23 CFI = .94, TLI= .93, RMSEA = .04, SRMR = .07 , CFI = .94, TLI = .93, RMSEA = .04, SRMR = .07, $D\chi^2$ = 21.41, Ddf = 24, p = ns)