Task Unrelated Thoughts (TUT) affecting mood in ecological settings: from adaptive mind-wandering to maladaptive repetitive negative thinking.

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Abstract

The literature suggests several hypotheses explaining adaptive vs. maladaptive character of task unrelated thoughts (TUT). However, it is still not clear what particular features can differentiate adaptive TUT from its maladaptive form. The main aim of the present study was to test the content and the context regulation hypothesis using daily sampling, that is to verify how TUT and task features are linked to momentary mood. 214 participants assessed their trait TUT through self-reported questionnaires and underwent a 7-day ecological momentary assessment of mood, TUT and task characteristics measured 7 times by day. The results suggest that TUT particular features (i.e. lack of control, delay from the present moment, valence) are linked to both, lower mood valence and higher anxiety. Moreover control over the thoughts moderates the link between task characteristic (effort required by the task) and participants' mood. Thus, from the clinical perspective, it seems more justified to take into account the particular TUT features instead of distinguishing specific TUT type (e.g. mind-wandering or rumination).

Keywords: mind-wandering; daydreaming; repetitive negative thinking; rumination; emotional regulation; daily sampling

Introduction

Mind-wandering (MW) is an overarching construct that encompasses a variety of phenomena e.g., daydreaming, repetitive negative thinking (RNT), unintentional thoughts, stimulus-independent thoughts, unguided thoughts and meandering (Seli et al., 2018). In the context of inclusive family resemblance perspective proposed by Seli et al. (2018), MW can be defined as an engagement in mentation that occurs unintentionally, and which is unrelated to one's current activity and surroundings (Marcusson-Clavertz, Cardeña, & Terhune, 2016). Even though MW is considered as a normal, everyday life, mental by default activity, some studies suggest that, under its maladaptive form (Schimmenti, Somer, & Regis, 2019), MW might be related to negative affect, lower life satisfaction, and it represents a risk factor for psychological disorders such as depression (e.g. Marchetti, Van de Putte, & Koster, 2014). By engaging in maladaptive task unrelated thoughts (TUT) individuals tend to neglect ongoing activities and social relations (Mar, Mason, & Litvack, 2012). Moreover, under certain circumstances, TUT might take a form of maladaptive RNT, i.e. repetitive dwelling on one or more negative concerns that is perceived as difficult to control (Ehring & Watkins, 2008). An important question remains: why for some people TUT might be maladaptive and lead to increased risk of depression (Marchetti, Koster, Klinger, & Alloy, 2016), while for others, it is a normal activity not leading to negative consequences in terms of impaired emotional regulation (Gorgolewski et al., 2014). The aim of the present study was to test which characteristics of TUT lead to an increased negative mood in participants' everyday life. This goal seems to be particularly relevant in the perspective of disentangling maladaptive MW (Schimmenti et al., 2019) and RNT (Watkins, 2008) and determining whether they are two ends of the same continuum or two separate, independent processes.

Mind-Wandering and Repetitive Negative Thinking: end-points of the same continuum or distinct concepts?

The link between MW and RNT, e.g. rumination and worry, remains unclear. Some authors suggest that MW is a subtype of RNT (Watkins, 2008). Conversely, others suggest that RNT is the same construct as mind-wandering, but in a maladaptive form, because the two processes share the same main characteristics, i.e. difficulties in controlling the thoughts stream (Marchetti et al., 2016; Ottaviani, Shapiro, & Couyoumdjian, 2013). In line, Ottaviani et al. (2013)

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indicate that RNT and MW might be the end-points of the same process (maladaptive and adaptive, respectively).

Therefore, instead of using the term MW to describe all the task unrelated thoughts types included in the family resemblance perspective, in the present paper, we use a more general term - the TUT (Seli et al., 2018). This inclusive nomenclature encompasses both concepts (MW and RNT) and enables to avoid the confusion already present in the current literature, i.e. the theoretical validity of distinguishing maladaptive MW from RNT (Stawarczyk, Majerus, Maj, Van der Linden, & D'Argembeau, 2011).

The literature on MW and RNT is largely separated, composing two distinct lines of research (Ottaviani et al., 2013). However, this cleavage seems to be based not on theoretically founded differences between the two processes, but mainly on different approaches to measure MW and RNT.

Task Unrelated Thoughts: adaptive vs. maladaptive consequences and underlying features

The consequences of TUT in terms of cognitive functioning and emotional regulation have been described over the past two decades. Among identified adaptive outcomes, it has been shown that MW would enhance the creative process (Baird et al., 2012); planning and anticipating the future (Stawarczyk et al., 2011). MW also provides a mental break, allowing recovery from boring or stressful tasks (Ruby, Smallwood, Engen, & Singer, 2013). Concurrently, a body of research has shown that MW can also lead to dysfunctional consequences in a variety of tasks and activities, e.g. reading or driving (Seli et al., 2018). Moreover, MW can be involved as a risk factor for psychological disorders (Marchetti et al., 2014, 2016).

The concept of maladaptive MW raised two important theoretical questions. First, what factors are responsible for switching from an adaptive, naturally occurring process of MW into its maladaptive form? Second, what is the difference between maladaptive MW and RNT (if there is one), as the two processes can be described as task unrelated thoughts, they share main common characteristics and might both lead to maladaptive consequences on emotional regulation?

The maladaptive consequences of RNT are also well documented in the literature. RNT can be considered as a transdiagnostic process involved not only in depression or generalized anxiety but also in other psychological disorders linked to impaired emotional regulation, e.g., eating disorders, addictions or social anxiety (Watkins, 2008). RNT is also linked to increased cognitive and attentional biases (e.g. Koster, De Lissnyder, Derakshan, & De Raedt, 2011).

Several hypotheses have been put forward to explain those adaptive and maladaptive consequences of TUT. To date, the Content Regulation Hypothesis (Andrews-Hanna et al., 2013) and the Context Regulation Hypothesis (Kane & Mcvay, 2012) represent the most convincing theoretical frameworks for reconciling the opposite effects of the TUT. It is important to underline that those two hypotheses on TUT mechanisms are neither independent nor exclusive.

The Content Regulation Hypothesis suggests that the form and content of TUT affect their associated functional outcomes (Andrews-Hanna et al., 2013). The main characteristics influencing the adaptive vs. maladaptive TUT character are: personal significance, valence, level of construal (concreteness) and temporal orientation (Andrews-Hanna, Smallwood, & Spreng, 2014). While enumerating TUT characteristics, it seems important to note that in the RNT literature, some additional features can be identified, for example, repetitiveness and verbal form (Watkins, 2008).

The impact of concreteness and temporal orientation of repetitive negative thinking was tested in several experiments, including laboratory (e.g., Kornacka, Krejtz, & Douilliez, 2019) and ecological assessments (e.g., Moberly & Watkins, 2006). The results suggest that those two factors might play a crucial role in adaptive vs. maladaptive RNT impact on emotional regulation with the concrete and present-focused thoughts enhancing negative affect regulation (Behar, Zuelling, Borkovec, 2005; Watkins, Moberly, & Moulds, 2008). However, the research focusing on MW tend to suggest that adaptive MW is linked to focus on the future while MW focused on the past will be linked to negative mood (Ruby et al., 2013; Smallwood et al., 2009; Smallwood & O'Connor, 2011). Thus, it seems important to disentangle whether the maladaptive feature of TUT is linked to the past vs. future thoughts orientation as suggested by MW research (e.g. Ruby et al., 2013) or to the delay from the present moment as suggested by the RNT research (e.g. Watkins, 2008)

The Context Regulation Hypothesis (Kane & McVay, 2012) posits that individuals with good cognitive control limit their MW when ongoing task is demanding and requires more cognitive resources. At the same time, they tend to produce more TUT when the environment is non-demanding (Unsworth & McMillan, 2013). In this view, the role of executive control varies as a function of the external task demands (Kane & McVay, 2014). Moreover, McVay and Kane (2010) postulated that mind-wandering represents a failure of executive control, particularly an incapacity to deal with the interfering stimuli.

Results supporting the context regulation hypothesis were mostly obtained in laboratory studies, and they suggest that task characteristics and executive resources are linked to the ongoing task performance and not necessarily to the subjective experience of TUT (Kane & McVay, 2012). There are fewer studies using experience sampling. For example, Kane et al. (2007) supported the role of interaction between task cognitive-demands and working memory. In a similar vein, Ottaviani et al. (2013) suggest the existence of a MW–RNT continuum where the RNT can be viewed as systemic inflexibility resulting from poor executive control. It is worth underlining that also RNT is often seen as an executive control failure (e.g., Zetsche, D'Avanzato, & Joormann, 2012)

To sum up, the existing literature on RNT and MW is largely separated (Ottaviani et al., 2013). These two processes, RNT and MW, are defined as task-unrelated

thoughts (Seli et al., 2018), often perceived as unintentional and difficult to control; thus, both might reflect a failure in self-control (Zetsche et al., 2012). In the present study, we merge these two lines of research to examine which TUT and task characteristics affect mood in ecological settings.

Using ecological momentary assessment (EMA) to empirically verify the content regulation hypothesis (Andrews-Hanna et al., 2013), we tested the main features of TUT that might be responsible for maladaptive or adaptive outcomes of TUT. We expect that concreteness, control over thoughts and positive valence would be linked to less negative mood. In contrast, the delay from the present moment, repetitiveness and verbal feature will be linked to more negative mood in momentary measures. Additionally, in order to examine the context regulation hypothesis (Kane & McVay, 2012), we controlled for the ongoing task characteristics: its stressfulness, and participants' interest, motivation and effort to complete it. We hypothesize that task characteristics, and particularly the effort required by the task will be linked to less TUT. Moreover, this relation can be moderated by the control over one's thoughts. Finally, we aimed at testing whether the tendency to use MW or RNT at the trait level is linked to momentary TUT or mood. The graphic outline of tested models can be found in the supplementary materials: https://osf.io/fw78r/.

Method

Participants

415 healthy volunteers took part in the first part of the study (trait evaluation); among them, 279 started the EMA part of the study. Sixty-five participants drop-out during the study or filled in less than 60% of EMA questions (the drop-out rate was 23%). The final sample was composed of 214 participants (mean age = 29.17, *SD* = 8.93; 169 females, 43 males, 2 participants did not want to provide their gender). The compliance rate in the EMA part of the study was 80 % resulting in 8108 momentary observations.

Procedure

Participants were invited through social networks to take part in a study on daydreaming. Prior to their participation, volunteers received information about the aim of the study, trait and EMA evaluation procedure; they also signed a consent form. First, the participants filled in an online trait evaluation through Qualtrics platform. Next, they were contacted by an experimenter in order to explain the rules and technical aspects of EMA. All EMA measures were provided through Movisens application. Participants installed the application on their personal smartphones. The EMA assessment lasted for 7 days. Participants received one signal randomly in each 2h period, 7 times per day in a 14h activity window (e.g from 8a.m. to 10p.m.). Application sent an auditory signal and a visual pop-up asking participants to answer a series of questions (see EMA measures). Participants had 20 minutes to complete the assessment. Participants received financial compensation for their participation (around 20$). The protocol was approved by a local ethical committee (WKEB69/03/2021).

Measures

EMA measures.

TUT. Participants were asked two questions assessing their consciousness of ongoing thoughts and the task-unrelated character of their thoughts: "Just before the bip, to what extent [1] you were conscious of your own thoughts" (not at all conscious – totally conscious); [2] "your thoughts were task related – unrelated" They provided answers on a visual analog scale (VAS) from 0 to 100.

Content - TUT characteristics. The questionnaire was based on the TUT characteristics identified in the literature as crucial in determining the TUT impact on emotional regulation. Participants were asked to respond to the following questions by using a VAS from 0 to 100 *"*Just before the bip, to what extent your thoughts were:" [1] focused on past-future; middle point indicated as "here and now" (temporal orientation); [2] possible to visualize (concreteness); [3] repetitive (repetitive feature); [4] in the form of inner speech (verbal feature); [5] negative-positive (valence)*;* [6] possible to control (control). Higher scores indicate more concrete thoughts, higher repetitiveness, form of inner speech, higher control and more positive valence.

Context – task characteristics *(adapted from Granholm et al., 2020).* Participants are asked to choose from the scroll-down list an answer to the question: "What kind of task are you performing at the moment:" Vocational (e.g., going to work/university)*;* At home leisure (e.g., reading)*;* Outside leisure (e.g. cinema)*;* Homecare (e.g., cleaning)*;* Self-care (e.g., shower). Moreover, participants were asked to characterize their ongoing task by answering the following questions: "Is the task you currently performing": [1] stressing; [2] interesting, [3] motivating; [4] requiring control. They provided answers on the VAS from 0 - not at all to 100- totally.

Mood *(adapted from Koster et al., 2015).* Mood was measured using two dichotomous VAS from 0 to 100 assessing mood valence and anxiety, where participants are asked to assess: "At the present moment do you feel:" [1] (discontent-content; higher score indicates positive valence); [2] anxious-calm (higher score indicates less anxiety).

Trait measures.

Mind-wandering. Trait MW was evaluated through Daydreaming Frequency Scale (DDFS; Giambra, 1993), which assess the general frequency of stimulus-independent and task unrelated thoughts.

Repetitive Negative Thinking. Trait RNT was evaluated from two self-reported questionnaires. First, the transdiagnostic Perseverative Thinking Questionnaire (PTQ; Ehring et al., 2011) assessing the main features of RNT (unproductiveness, repetitive feature and mental capacity captured by RNT) and, second, the Ruminative Response Scale assessing depressive rumination (RRS; Treynor, Gonzalez, & Nolen-Hoeksema, 2003).

Results

Statistical analysis plan

Taking into account the nested structure of the data, we computed multilevel analysis using HLM 8.0. Level 1 variables (data collected through EMA measures) were nested in participants (Level 2). Trait level variables were also introduced at Level 2. Although it was possible to consider the data as a 3-level model (observations nested in days, nested in participants), taking into account that most of the previous EMA studies on TUT are based on the two-level models (even if they used multiple observations by day, e.g. Kane et al., 2007; Pe et al., 2013), we decided to keep the 2-level structure. Level 1 variables were entered to the model group mean centered, Level 2 variables were grand mean centered. All the coefficients reported above were computed with the robust standard error and based on a random model as estimations of variance component for each tested variable was significant ($p < .05$).

In the first part of the analysis, we run an unconditional model for each of level 1 variables. The example of null model equation for mood valence is as follow:

Level 1 (within-person): $Mood\ valence_{ij} = \beta_{0j} + r_{ij}$

Level 2 (between-person): $\beta_{0j} = \gamma_{00} + u_{0j}$

The descriptive statistics and reliability coefficients are presented in Table 1 for Level 1 and Level 2 variables.

Additionally, following the recommendations by Garson (2013), we computed, for each model with predictors, the likelihood ratio test for the random coefficient regression model and deviance drop compared to the null model (reported in Table 2).

Table 1: Descriptive statistics and reliability of variables.

Variable	***Mean (SD)***	***Reliability***
Level 1 variables		
Consciousness of thoughts	62.39 (29.07)	.961
Task unrelated thoughts	41.54 (30.11)	.856
Main feature of TUT		
Temporal orientation	55.02(16.42)	.877
Concreteness	59.28(26.33)	.934
Repetitive feature	60.13(25.54)	.867
Verbal feature	46.93(28.76)	.948
Valence	59.10(23.53)	.927
Control	57.53(25.71)	.948
Delay form the present	11.02(13.17)	.895
Mood		
Valence	60.51(23.46)	.939
Anxiety	62.06 (25.31)	.927
Level 2 variables		
PTQ	46.66 (11.96)	.951
RRS	50.56 (12.96)	.921
DDFS	38.04 (9.15)	.915

Note. PTQ - Perseverative Thinking Questionnaire; RRS - Ruminative Response Scale Revised; DDFS – Daydreaming Frequency Scale.

TUT and mood in momentary measures

Next, in order to test the link of TUT level and mood in participant's everyday life, we tested how consciousness of thoughts and TUT predicted cross sectional mood using following equation:

Level 1 (within-person): $Mood\ valence_{ij} = \beta_{0j} + \beta_{1j}\,(Consciousness_{ij}) + \beta_{2j}\,(Task\ unrelated\ thoughts_{ij}) + r_{ij}$

Level 2 (between-person): $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

Both momentary consciousness of thoughts and task unrelated thoughts were significant predictors of momentary mood (valence and anxiety, see Model 1B and 1C in Table 2, respectively). A higher level of TUT predicted more anxiety and more negative valence of mood.

Main features of TUT

In order to test how TUT features predicted TUT level and mood (the content regulation hypothesis), we introduced the TUT characteristics simultaneously in the model at level 1 and TUT (2A), mood valence (2B) and anxiety (2C) as outcomes (see Table 2).

The variable "delay from the present moment" was computed as the absolute value of participants' answers to the temporal orientation question minus 50 (i.e. 0 in the new variable indicating full focus on "here and now" and 50 an extreme focus on the future or on the past).

The results suggest that more positive, concrete, and controlled thoughts were related to positive mood valence (see model 2B in Table 2). The verbal features of TUT and the delay from the present moment were associated with less positive mood. Surprisingly, the repetitive character of TUT was not related to mood valence. TUT valence and control over TUT were also associated with less anxiety reported by participants in EMA, while higher anxiety was predicted by verbal features, delay from the present moment and repetitiveness. The concreteness of TUT was not a significant predictor of anxiety (see Model 2C in Table 2).

Additionally, in order to disentangle the impact of the temporal orientation (postulated as a key factor in the MW literature) form the delay from the present moment (postulated by the RNT literature) we computed a model with temporal orientation (past-future) and delay from the present as Level 1 predictors. For the mood valence as the outcome, both predictors were significant, the mean temporal orientation slope (γ_{10}) was .13 (p <.001), and the mean delay from the present slope (γ_{20}) was -.41 (p <.001). For anxiety as an outcome, only the delay from the present moment, but not temporal orientation was a significant predictor with the mean temporal orientation slope (γ_{10}) of .04 (p =.127), and the mean delay from the present slope (γ_{20}) was -.36 (p <.001).

Task characteristics

In order to test the context regulation hypothesis (Kane & McVay, 2012), we verified whether task features and particularly effort required by the task is linked to decreased

TUT. Model 3A in the Table 2 showed that effort, but also stressfulness, interest and motivation to execute the ongoing task are all significant predictors of lower TUT. Additionally, following the procedure described by Nezlek (Nezlek, 2011; Nezlek & Plesko, 2003), we tested level 1 interaction between effort in the ongoing task and control of TUT in order to test the prediction of the Context Regulation Hypothesis, as follows:

Level 1 (within-person) : $TUT_{ij} = \beta_{0j} + \beta_{1j}\,(Effort_{ij}) + \beta_{2j}(Control_{ij}) + \beta_{3j}(Effort\ x\ Control_{ij}) + r_{ij}$

Level 2 (between-person): $\beta_{0j} = \gamma_{00} + u_{0j}$

$\beta_{1j} = \gamma_{10} + u_{1j}$

$\beta_{2j} = \gamma_{20} + u_{2j}$

$\beta_{3j} = \gamma_{30} + u_{3j}$

The level 1 interaction term was created by multiplying centered around the mean control by similarly centered effort variable. The interaction term was introduced to the model uncentered. It appears that, consistent with the context regulation hypothesis, control of TUT, the effort put in the ongoing task, and the interaction between them, were all significant predictors of lower TUT level. The mean effort slope (γ_{10}) was -.013 (p <.001), the mean control slope (γ_{20}) was -.48 (p <.001) and the mean interaction slope (γ_{30}) -.001 (p = 004). The examination of interaction effect based on within-level +/- 1 SD values suggested that the level of TUT decreases with the task demands, but only for participants with high control of thoughts.

Trait tendencies and TUT

Finally, in order to test the relation between the trait tendency to use TUT (daydreaming and RNT) and TUT level in daily life and mood, we computed the models with EMA of mood and TUT measure as the outcome and trait variables introduced as predictors at Level 2 of the model, as follow:

Level 1 (within-person): $Mood\ valence_{ij} = \beta_{0j} + r_{ij}$

Level 2 (between-person): $\beta_{0j} = \gamma_{00} + \gamma_{01}\,(DDFS_j) + \gamma_{02}\,(PTQ_j) + \gamma_{03}\,(RRS_j) + u_{0j}$

The analysis of the Level 2 predictors (see Model 4 in Table 2) suggest that only the tendency to use RNT (measured through PTQ) was linked to a higher level of TUT, the lower valence of mood and higher anxiety in momentary measures.

Discussion

The link between mind-wandering (MW) or repetitive

Table 2: Testing Level 1 and 2 predictors' link to TUT, mood valence and anxiety.

	Outcome								
	A. Task unrelated thoughts			B. Mood valence			C. Mood anxiety		
	Coeff.	*SE*	*t-ratio*	*Coeff.*	*SE*	*t-ratio*	*Coeff.*	*SE*	*t-ratio*
Model 1: Consciousness and TUT									
Consciousness of thoughts				0.13	0.02	7.77***	0.05	0.02	2.96**
Task unrelated thoughts				-0.12	0.01	-8.73***	-0.08	0.02	4.43***
Deviance drop comparing to null model						817.91			439.60
Significance of likelihood ratio test						< .001			< .001
Model 2: TUT features									
Concreteness	-0.13	0.02	6.58***	0.03	0.01	2.83**	0.02	0.01	1.17
Repetitive feature	-0.30	0.02	16.12***	-0.01	0.01	0.27	-0.09	0.01	8.15***
Verbal feature	0.07	0.02	4.45***	-0.02	0.01	2.72**	-0.01	0.01	1.19
Valence	-0.07	0.02	3.33**	0.65	0.02	43.66***	0.63	0.02	36.78***
Control	-0.22	0.02	11.49***	0.07	0.01	5.77***	0.08	0.01	6.47***
Delay from the present	0.61	0.04	16.45***	-0.03	0.01	2.24*	-0.05	0.02	2.13*
Deviance drop comparing to null model			3620.80			65515.49			4738.26
Significance of likelihood ratio test			< .001			< .001			< .001
Model 3: Task features									
Stressfulness	-0.04	0.02	2.14*	-0.15	0.01	11.23***	-0.34	0.02	20.91***
Interest	-0.18	0.02	8.89***	0.19	0.01	15.34***	0.15	0.01	11.55***
Motivation	-0.25	0.02	12.14***	0.15	0.01	10.99***	0.09	0.01	6.38***
Effort	-0.13	0.02	6.18***	-0.05	0.03	4.36***	-0.07	0.01	5.42***
Deviance drop comparing to null model			598.75			1919.11			2542.64
Significance of likelihood ratio test			< .001			< .001			< .001
Model 4: Trait variable									
DDFS	0.03	0.11	0.29	0.01	0.11	0.05	-0.02	0.11	0.22
PTQ	0.18	0.09	2.00*	-0.22	0.09	2.53*	-.025	0.09	2.78**
RRS	0.12	0.09	1.49	-0.28	0.09	3.03**	-0.18	0.10	1.91+
Deviance drop comparing to null model			9.92			35.00			22.80
Significance of likelihood ratio test			.002			< .001			< .001

Note. *** < .001; ** < .01; * < .05; + < .10; TUT – task unrelated thoughts.

negative thinking (RNT) and lower mood in participants daily life was already shown in some ecological momentary assessment studies (e.g. Killingsworth & Gilbert, 2010; Moberly & Watkins, 2008). The literature offers several hypotheses on the mechanisms and characteristics involved in the maladaptive outcome of this kind of TUT. However, most of them were evaluated in laboratory or experience sampling studies testing a single feature of TUT. To our knowledge, the present study is the first to test various TUT characteristics that, according to the content (Andrews-Hanna et al., 2013) and context regulation hypothesis (Kane & McVay, 2012), along with RNT theory (Watkins, 2008; Watkins & Roberts, 2020), could affect TUT's impact on mood.

The results of the present study suggest that, in general, TUT are linked to more negative valence of mood and to more anxiety in momentary measures. However, it seems that above the fact that one's mind wander, the key factors to take into account in the context of emotional regulation are TUT's particular features. In one of the first EMA studies assessing simultaneously MW and rumination, Kuehner, Welz, Reinhard, and Alpers (2017) showed that TUT characteristics measured (e.g. having a sense of control over one's thoughts) might affect mood through the mediating role of rumination. However, in their study TUT characteristics were assessed only in the laboratory conditions. The present study extends those results by suggesting that independently of the TUT precise definition (MW or RNT) the control component plays a crucial role in TUT impact on mood. This role of control over thoughts might also potentially explain why PTQ (measuring also control resources captured by RNT) was the only trait predictor affecting momentary TUT. The role of executive control was already described in both RNT and MW literature (e.g., Ottaviani et al., 2013; Zetsche et al., 2012); however, in those studies, control of thoughts was rather considered from the perspective of individual differences without taking into account the within-person variability. The results of our study seem to support the idea that the maladaptive outcome of TUT in terms of lower mood might be due to a failure of control over one's thoughts (e.g. Ottaviani et al., 2013).

Another TUT feature worth having a closer look at is the repetitiveness of thoughts. In the present study, the repetitive feature of TUT was linked to increased anxiety, but not to mood valence. It also seems that this feature is characteristic for RNT and not necessary for MW, which should be characterized by a freely moving mind (Seli et al., 2018). Thus, it seems that repetitiveness might be one of the key elements in the switch between adaptive and maladaptive TUT. According to literature, it could be also essential in distinguishing MW from RNT (Christoff et al., 2018). It is also important to note that this repetitive feature might be dependent on self-control failure and thus strongly correlated with the control factor described above.

It is also interesting to take into account the interaction between the effort put into the ongoing task and the control of the thoughts supporting the crucial role of the control in maladaptive outcomes of TUT. The context regulation hypothesis (Kane & McVay, 2012) states that during a demanding task one's self-control resources should enable to inhibit task unrelated thoughts and focus on the ongoing task. Momentary data from the present study suggest that this mechanism works only for those who reported having high subjective control over their thoughts.

The present study might also help to understand the role of the temporal orientation of TUT. MW literature suggests that negative affect is linked to focusing the attention on the past (e.g. Ruby et al., 2013), while the processing mode theory of RNT suggests it is the delay from the present moment and abstract thinking that might have a deleterious impact on emotional regulation (Watkins, 2008). It seems that both focusing on the past and the delay from the present moment might affect participants' mood. Nevertheless, only the delay from the present moment is linked to anxiety. Moreover, in line with the processing mode theory (Watkins, 2008) also, the concreteness of TUT is related to mood valence. However, it is necessary to underline that those two characteristics might be interrelated, as events more distant in time might also be considered as less concrete.

Several challenges need to be addressed by future studies. First, to further explore the potential distinction between maladaptive MW and RNT (or the lack of it), it seems necessary to emphasize the freely moving feature of MW suggested as a necessary element to define MW by the dynamic framework of MW, strongly critical toward the family resemblance perspective (Christoff et al., 2018).

Moreover, it is still unclear how to operationalize the control component, a crucial feature for TUT's impact on emotional regulation. It is necessary to disentangle the role of attention, working memory and inhibitory processes previously shown in laboratory studies (Kane & Mcvay, 2012) and the subjective perception of having control over thoughts (Kuehner et al., 2017). Additionally, particularly in EMA studies, context measures should include not only task, but also the environment characteristics. Moreover, the present study focused on the processual characteristics of TUT that should be further examined in the perspective of TUT function. It seems also necessary to take into account how this function and TUT features interaction might affect emotional regulation. Finally, it seems indispensable while assessing TUT function to go beyond its context and the content by examining motivational factors (Klinger & Cox, 2011).

In sum, the present study sheds some light on the main features involved in maladaptive TUT. More specifically, it brings arguments in favor of considering MW and RNT as a continuum of TUT, which might become maladaptive when TUT are characterized by particular features (i.e. lack of control, particular temporal orientation, repetitiveness, lack of concreteness). This integrative approach might be interesting from the perspective of process-based therapies addressing a particular psychological mechanism across various psychological disorders and not necessarily a disorder-specific type of cognition.

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