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Repetitive thought as a moderator of the impact of control deprivation on emotional and cognitive functioning

Abstract: *The present research explores the role of repetitive thought (RT) in developing control deprivation deficits. The two main RT theories lead to diverging predictions. The response style theory suggests that RT in reaction to distress leads to negative effects in terms of emotional and cognitive functioning. However, the theory of Marin and Tesser and its elaboration by Watkins, suggest that the effects of RT depend on its form and that individuals who are not depression-prone usually adopt the constructive form of RT that leads to positive effects. To test which of these predictions is true for control deprivation situation, two experimental studies were conducted. Participants after control deprivation were induced RT or distraction, followed by the measurement of their emotional and cognitive functioning. The results suggest that repetitive thought reduces both emotional and cognitive helplessness deficits and has no effect in no control deprivation condition. This supports the theory of Martin and Tesser and its elaboration by Watkins.*

Key words: *control deprivation, repetitive thought, rumination, learned helplessness*

Prior long exposure to control deprivation defined as "an effective or perceived inability to master the environment" (Ric & Scharnitzky, 2003: p. 103), leads to performance impairment (motivational and cognitive deficits) and emotional deficits (e.g., Sędek & Kofta, 1990; McIntosh, Sędek, Fojas, Brzezicka-Rotkiewicz & Kofta, 2006). This phenomenon has been called learned helplessness and is widely considered a model of some aspects of depressive dysfunctions, in terms of emotional (Rosenhan & Seligman, 1989) and cognitive deficits (von Hecker & Sędek, 1999; McIntosh et al., 2006).

Repetitive thought (RT) defined as "process of thinking attentively, repetitively, or frequently about oneself and one's world" (Segerstrom, Stanton, Alden & Shortridge, 2003; p. 909) is a mental process that is commonly engaged by all people (Watkins, 2008). Such way of thinking bridges many topics in psychology: motivation, emotion, self-regulation or psychopathology. One of this psychological phenomenon where RT plays relevant role is depression. Depressive dysfunctions are proven to be strongly associated with maladaptive type of repetitive thought – depressive rumination (Nolen - Hoeksema,Wisco & Lyubomirsky, 2008; Watkins, 2008). Moreover, depressive rumination in conjunction with dysphoric mood or depression leads to negative effects like further exacerbating negative mood or impaired concentration (for review see Nolen - Hoeksema et al., 2008). On the other hand, there is a growing body of evidence that for non-depressive/dysphoric individuals repetitive thought in reaction to distress leads to positive, constructive effects (e.g., Hunt, 1997; Rivkin & Taylor 1999; for review see Watkins, 2008). Such pattern of results leads many researchers to claim that there are both constructive and unconstructive types of repetitive thought (Segerstrom et al., 2003; Watkins, 2008).

Since learned helplessness syndrome is considered a model of some aspects of depression, there is an interesting question - whether the analogies between depression and learned helplessness apply also to the adopted type

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of RT and its consequences. Specifically, whether the repetitive thought in reaction to control deprivation, results in augmenting emotional and cognitive deficits as it can be observed for depression; or, quite the opposite, it reduces these deficits as it can be seen in studies among non-dysphoric participants. The present research tests the predictions based on finding that whereas the depression-prone individuals will preferentially adopt unconstructive form of RT, the majority of individuals tend to adopt constructive type of RT (Watkins, 2008). Therefore it can be expected that in non-clinical group, repetitive thought after exposure to control deprivation will reduce emotional and cognitive helplessness deficits. This is the general hypothesis tested in the present research.

Control deprivation deficits

Originally, it was hypothesized that impaired performance following control deprivation is a result of a decrease in motivation (Maier & Seligman, 1976). According to Seligman's original helplessness theory, this motivation decrement was caused by a generalized expectancy of noncontingency between outcomes and responses that individuals formed when experiencing a control deprivation situation. However, studies by Kofta and Sędek (1989, Sędek & Kofta, 1990), von Hecker and Sędek (1999), Ric and Scharnitzky (2003) and by other cognitively orientated scientists (for review see McIntosh et al., 2006) have proved that a performance decrement after experiencing control deprivation is due to cognitive disruption rather than decreased motivation. The present study is framed within the informational theory of learned helplessness (McIntosh et al., 2006; Sędek & Kofta, 1990), which posits that impaired performance following control deprivation results from an altered psychological state called "cognitive exhaustion", in which individuals are no longer able to engage in costly cognitive activities. People shift to this altered psychological state during prolonged exposure to unsolvable tasks, when they invest effort in order to solve them. If the tasks are solvable, such activities usually allow the individuals to select a specific hypothesis for the best future action program. However, in a control deprivation situation they are confronted with contradictory information, so their effort does not result in any "cognitive gain" - they are unable to select an option for a future action program. This results in shifting to a state called "cognitive exhaustion," which mainly impairs the performance of tasks that require substantial cognitive resources and many simultaneous, flexible mental operations e.g., generative reasoning (McIntosh et al., 2006; Sędek & Kofta, 1990; von Hecker & Sędek, 1999).

Repetitive thought

According to the response style theory (Nolen-Hoeksema et al., 2008) repetitive thought in reaction to stress and failure leads to negative effects like exacerbating negative emotions or impairing concentration. Experimental studies have shown that the induction of repetitive thought among dysphoric and depressed individuals leads to exacerbated negative mood, whereas distraction (thinking about neutral issues that are not associated with the current mood and/or current problem) decreases dysphoric mood (Lyubomirsky, Caldwell & Nolen-Hoeksema, 1998; Lyubomirsky & Nolen-Hoeksema, 1995; Lyubomirsky, Kasri & Zehm, 2003; Lyubomirsky, Tucker, Caldwell & Berg, 1999). Furthermore, repetitive thought in conjunction with dysphoria increases negative thinking (Lyubomirsky & Nolen-Hoeksema, 1995) and impairs concentration (Lyubomirsky et al., 2003), as well as controlled memory retrieval (Hertel, 1998). According to Nolen-Hoeksema and her colleagues (2008) specific type of repetitive thought- depressive rumination- in response to distress causes that people remain fixated on the problems and their feelings about them, without taking action. This leads to exacerbated negative mood and increased negative thinking. Moreover, depressive rumination depletes some cognitive resources and increase the cognitive "load," which, in turn, impairs controlled memory retrieval and concentration.

However, other models emphasize positive implications of repetitive thought as a reaction to distress (for review see Watkins, 2008). For example numerous studies on expressive writing show that writing about difficult emotions, experiences (e.g., vehicle accident, assault or terminal illness) and thoughts related to them, produces better physical and psychological well-being, mood improvement in comparison to writing about emotionally neutral issues (for review see Park, 2010; Pennebaker, 1997). The study conducted by Hunt (1997) with experimentally induced failure, gave similar results in terms of mood improvement.

Watkins (2008) proposed an elaboration of the theory of Martin and Tesser (1996) as an explanation for the contradictory results of these studies. According to Martin and Tesser's (1996) theory, repetitive thought[1] is triggered by a perceived discrepancy in goal progress and is a part of the feedback control process. Repetitive thought produces constructive consequences if it helps to reduce the discrepancy between a desired goal and the actual current state. This can be done by 1) aiding progress toward the goal, 2) modifying the goal in such way that it becomes possible to be met, or 3) abandoning the goal. However, in some cases repetitive thought does not reduce the desired goal-the current state discrepancy and leads to unconstructive consequences, e.g., exacerbated depressive mood, lowered motivation or concentration problems.

According to Watkins, the aspects of repetitive thought in response to distress, failure or negative mood that decide whether it leads to constructive or unconstructive consequences are inter alia: content of repetitive thought (positive vs. negative), individual self-beliefs and the level of construal adopted during repetitive thought. Specifically, repetitive thought with negative content, at too high level of abstraction, associated with very negative self-beliefs

[1] In their original papers Martin and Tesser (1996) used label rumination. However, they defined it very broadly that makes this concept an analogy to repetitive thought. Moreover, the usage of term "rumination" is commonly constrained to unconstructive type of repetitive thought.

is likely to produce unconstructive consequences. On the other hand, more concrete repetitive thought with positive content and associated with positive self-beliefs, is predicted to be usually more effective in reducing the goal-current state discrepancy in stressful situations and, in turn, to produce constructive consequences (for a detailed analysis see Watkins, 2008). Although it must be noticed that in some situations when highly self-relevant goals are severely thwarted, more abstract repetitive thought can be more effective (Watkins, 2008).

There is a growing body of studies that support Watkins' analysis and predictions. First of all, studies of Millar, Tesser and Millar (1988; cited in Martin & Tesser, 1996), Moberly & Watkins (2010), Lassiter, Pezzo & Apple (1993) showed that repetitive thought arise when the progress toward goal is blocked for a longer period - that creates discrepancy in goal progress. Secondly, the studies conducted by Watkins and his collaborators support the predictions concerning level of construal of repetitive thought. For example, the induction of concrete repetitive thought resulted in faster emotional recovery (Ehring, Szeimies & Schaffrick, 2009; Moberly & Watkins, 2006; Watkins, 2004), lower level of negative global self-judgments (Rimes & Watkins, 2005) and more effective solutions to social problems (Watkins & Moulds, 2005), comparing to the induction of abstract repetitive thought. Lastly, the theory of Martin and Tesser (1996) predicts that repetitive thought persists until the perceived discrepancy in goal progress is eliminated. In line with this prediction recent studies show that in a longer period of time, induction of concrete repetitive thought after distress, reduces level of intrusive thoughts about stressful situation, comparing to both induction of abstract repetitive thought (Santa Maria, Reichert, Hummel & Ehring, 2012) and induction of distraction (Ehring et al., 2009). Distraction may reduce the level of intrusive thoughts in a short period time but since the discrepancy in goal progress is not eliminated the level of intrusive thoughts quickly rises (Ehring et al., 2009, Martin, Tesser & McIntosh, 1993; cited in Martin & Tesser, 1996) whereas constructive RT reduces the level of intrusive thoughts more permanently because it reduces discrepancy in goal progress.

Repetitive thought and control deprivation deficits

The basic assumption of the present research is that a long exposure to control deprivation can be interpreted as the situation when progress toward goal of effectively mastering the environment is blocked for a longer period. This, according to Martin and Tesser (1996), triggers repetitive thought that aim is to eliminate the perceived discrepancy in goal progress. Whether the individual adopts constructive or unconstructive type of RT, it should result in reducing or exacerbating control deprivation deficits. However, in the situation where control is not deprived (solvable tasks) there is no blockage of progress toward goal, the induction of repetitive thought should have no significance. This leads to the first specific hypothesis, tested in the present research, that predicts that induction of repetitive thought/distraction should have impact on further emotional and cognitive functioning only in the control deprivation condition and should have no impact in the no control deprivation (cognitive control) condition.

The further hypotheses are based on the finding that individuals that are not depression-prone, tend to adopt constructive type of repetitive thought (Watkins, 2008). That leads to the prediction that in non-clinical sample (as it is in the present research) repetitive thought induced after control deprivation, without experimental manipulation of RT type, should activate constructive type of RT that, in turn, should reduce perceived discrepancy in goal progress. Such discrepancy produces negative emotions (Carver & Scheier, 1990) that is labeled "emotional deficit" in the control deprivation paradigm. Constructive RT through eliminating perceived discrepancy in goal progress, should cause reducing negative emotions, activated by this discrepancy. In line with such prediction, there are studies that show that constructive RT in reaction to failure (Watkins, 2004) or distress (Ehring et al., 2009) reduces negative emotions (facilitates the emotional recovery). The studies on non-dysphoric sample, where failure or distress was followed by induction of repetitive thought/distraction, but without manipulation of RT type, brought the analogous results- better emotional recovery in the repetitive thought condition in comparison to distraction (Hunt, 1997) or no experimental manipulation condition (Rivkin & Taylor, 1999). That allows to make a prediction, tested in the present research, that induction of repetitive thought after exposure to control deprivation will reduce emotional helplessness deficits in comparison to distraction condition.

Furthermore, since constructive repetitive thought persists until the perceived discrepancy in goal progress is eliminated (Martin & Tesser, 1996), it can be expected that the induction of repetitive thought after exposure to control deprivation will eventually lead to lowering the level of intrusive thoughts in comparison with distraction induction; analogically to such effects of induction of constructive RT in response to distress (Ehring et al., 2009) or effects of expressive writing about stressful events (Klein & Boals, 2001). Intrusive thoughts deplete some cognitive resources which, in turn, impairs concentration and aspects of working memory capacity that are responsible for storing and retrieving information (Brzezicka-Rotkiewicz, 2004; Lyubomirsky, Boehm, Kasri & Zehm, 2011; Lyubomirsky et al., 2003). Therefore, lower level of intrusive thoughts means lower cognitive "load" and higher working memory capacity. Such reasoning is in line with the results of Klein & Boals' (2001) study in expressive writing paradigm that suggest that writing about emotions and thoughts related to stressful event reduce level of intrusive thoughts and increase working memory capacity in comparison to writing about neutral issues. Moreover, the improvement of working memory capacity is mediated by decline in intrusive thinking. This leads to the prediction that repetitive thought, through lowering level of intrusive thoughts in a longer period, results in higher working memory capacity that will, at least in part, compensate cognitive control deprivation deficit. Specifically, it is hypothesized that induction of repetitive thought after control deprivation

will reduce cognitive helplessness deficits (better cognitive functioning in terms of memory retrieval) in comparison with induction of distraction after control deprivation. Furthermore, since this positive moderating effect of repetitive thought is postulated to be due to higher working memory, not due to motivational changes, it is hypothesized that it will be particularly visible for more difficult tasks, that require more working memory capacity.

Experiment I

The aim of the experiment 1 was to test the general hypotheses, formulated above, about the moderating role of repetitive thought in developing control deprivation deficits. To achieve this goal two independent variables, control deprivation and induction of repetitive thought or distraction, were experimentally manipulated. Depending on the experimental condition, participants were exposed to 1) control deprivation (unsolvable tasks) followed by repetitive thought, 2) control deprivation followed by distraction (focusing on emotionally neutral issues that are unrelated to the tasks in the control deprivation phase), 3) cognitive control (solvable tasks) followed by repetitive thought, or 4) cognitive control followed by distraction. Subsequently, the participants were given a task involving the construction of linear orders which required memory retrieval and generation of mental models (Sędek & von Hecker, 2004). At the end, they assessed on self-rating scales the cognitive difficulties and emotional states they experienced during the linear orders construction task.

As it was pointed out in detail earlier, induction of repetitive thought after control deprivation is postulated to result in a lower level of negative emotions, a higher level of positive emotions and a better performance in cognitive tasks in comparison to induction of distraction after control deprivation. However, the induction of repetitive thought in no control deprivation condition (cognitive control) is predicted to have no effect on emotional and cognitive functioning.

Method

Participants

The sample consisted of one hundred university students who were recruited for the study through advertisements and volunteered to take part in the experiment. Three persons in the cognitive control groups were excluded because of failing to reach a minimum of 50% of correct answers in solvable tasks[2]. Moreover, two persons in the control deprivation groups were excluded because they figured out that the first task was unsolvable (for details see the Procedure section). The final sample comprised of 95 students (M_{age} = 22,23; SD_{age} = 4,3); 24 in the control deprivation/repetitive thought group (20 women and 4 men), 24 in the control deprivation/distraction group (21 women and 3 men), 24 in the cognitive control/ repetitive thought group (21 women and 3 men), and 23 in the cognitive control/ distraction group (20 women and 3 men).

Materials

Experimental manipulation

Control deprivation. To manipulate control deprivation the method of Informational Helplessness Training of Kofta and Sędek (1999; McIntosh et al., 2006) was used. It consisted of 9 discrimination problems (plus one trial). For each problem, the participants had to find a common target feature within a series of successively presented drawings (8 drawings for each problem). Each drawing was presented for 6 seconds. The drawings could vary on five dimensions, each determining two possible features: (a) size (small or large), (b) shape (triangle or circle), (c) color (dark or bright), (d) position of a horizontal line (at the top or bottom of the drawing), and (e) case of the letter R in the middle of the drawing (upper- or lowercase). Participants were instructed that in order to find the target feature they should inspect a dichotomous verbal cue ("Yes" or "No"), which was presented together with each drawing. A "Yes" cue meant that the target feature was present in a particular drawing, while a "No" cue meant that the target feature was absent. In the control deprivation (helplessness training) condition, the problems were unsolvable. That is, the cues were delivered in such a way that they were contradictory. Each feature was marked twice with a "Yes" cue and twice with a "No" cue. Because of this, whatever hypothesis was formulated, conflicting and inconsistent cues appeared. Immediately after the completion of each problem, participants reported their solution on a computer screen, but were not informed whether they had succeeded or failed. In the cognitive control (solvable tasks), the cues were presented in a fully consistent way, so if the correct hypothesis was formulated, it was consistently supported. This was the only difference between the control deprivation and cognitive control conditions.

Induction of repetitive thought or distraction. In both conditions, participants were asked to fill in three fictitious questionnaires (prepared for the needs of this study). In the repetitive thought condition, the first questionnaire consisted of questions referring to the way participants had functioned in the previous task (e.g., "Was solving the previous task a pleasant activity for you?"). The second questionnaire referred to the affective states they experienced at the time and during the previous week, as well as to the emotions they would like to experience more often or less often (e.g., "To what degree are you experiencing the following emotional states at the moment?"). The third questionnaire concerned general motivation and feeling energetic in everyday situations (e.g., "In comparison to other people, what is the level of your general motivation and your involvement in the attainment of your life goals?; 5- very high, 1- very low"). In the distraction condition, questionnaires referred to emotionally neutral issues, not associated with the current participants' emotions or the

[2] The exclusion was motivated by the fact that although the tasks in the cognitive control groups were solvable, they could be too difficult for some participants. If this was the case, they could actually turn out to provide control deprivation experience. The excessive difficulty criterion for solvable tasks was 50% or less of correct answers.

previous task. Specifically, the first questionnaire solicited opinions about the city of Łódź (e.g "How do you find the city of Łódź a place to live?"), the second one referred to the current social and economic situation in Poland and Europe (e.g., "In your opinion, what are the general economic prospects of Europe, as a whole region, in the next 30 years?"), and finally, the third questionnaire surveyed the participants' opinions on different activities in the field of ecology (e.g., "Ecological actions taken by each individual, e.g., waste segregation in households, are crucial for the effective protection of the natural environment. 5- strongly agree, 1- strongly disagree").

The questionnaires were prepared in such way that a particular questionnaire in one experimental condition was analogous to its counterpart in the other condition in terms of the number of questions, manner of answering and graphical layout. This was intended to ensure that participants spent a similar amount of time and effort on the questionnaires in either experimental conditions.

Using 1–7 Likert scales, 10 independent judges rated all six questionnaires (three in repetitive thought condition and three in distraction condition) as not differing in emotional impact (how filling in the questionnaires make people feel from 1 ''very negative'' through 4 ''neutral'' to 7 ''very positive''), $F(5,54) = 1,12$; $p=0,36$.

Dependent measures

Cognitive functioning - performance. Linear Orders is a cognitive task that requires memory retrieval and generative reasoning (Sędek & von Hecker, 2004; von Hecker, Sędek, Piber-Dąbrowska & Bedyńska, 2006). The task consisted of 6 series of the same structure. Each series was composed of two phases: a learning stage and a test stage. During the learning stage each participant was presented, on a computer screen, three pairs of fictitious people and the relations between them, as it can be seen in an example below. There were six different sets of names (three male and three female) and types of relations between them, each for one series.

Example:

Peter is taller than John.
John is taller than Chris.
Chris is taller than Tom.

Names from these sentences in each series could be ordered in an array. In the example above, it would be the following one: Peter > John > Chris > Tom ("taller than" = ">"). However, the participants were not informed about this feature of the presented pairs.

The sentences were presented separately. Participants were asked to memorize two names and the relation between them. They could study each relation at their own pace, initiating the first relation and moving to the next by pressing the space key. However, they could not come back to the pair they had already studied. After going through three pairs in the way described above, participants immediately moved to the test stage. During the test stage, participants were asked about all six possible relations between the four persons. More specifically, they were presented with sentences like "Chris is taller than Tom" and were supposed to answer whether this sentence is true or false (based on the information gained during the learning stage) by pressing a specific key. Sentences were either in the correct format, conforming to the learned order (e.g., "John is taller than Chris"), or in the false format, that is, contradicting the order (e.g., "Chris is taller than John"). All participants were asked to respond as quickly and as accurately as possible. Referring to the relation between elements in mental model in particular series, two kinds of questions can be distinguished:

- Adjacent questions – they refer to elements that are adjacent in the array (e.g., "Peter is taller than John?"). To answer these questions, it was enough to memorize the pairs presented during the learning stage. Thus, the percentage of correct answers to adjacent questions can be treated as an indicator of memory retrieval.
- Inferred questions – they refer to elements which are not adjacent in the array and were not presented directly during the learning stage (e.g., "Peter is taller than Chris"). To answer these questions in was necessary to go beyond the information presented during the learning stage. More precisely, participants needed to integrate pairwise information into a comprehensive mental model, and then infer the correct answer (Sędek & von Hecker, 2004). Consequently, the percentage of correct answers to inferred questions can be treated as an indicator of generative reasoning function.

There were three adjacent and three inferred questions in each series. Furthermore, time spent on studying the presented phrases during the learning stage was measured (study time). It was treated as an indicator of general motivation.

Cognitive functioning - self-rating measures. Cognitive difficulties scale, consisted of three questions, was used. They were taken from the pool of questions used by Sędek and Kofta (1990) to monitor subjectively perceived functioning during task performance following control deprivation (e.g., "I found it very hard to think"); with the authors' permission (Cronbach's alpha – 0,88). Participants assessed their functioning and subjective cognitive difficulties during task performance on 7-point rating scales *(7 – definitely yes, 1 – definitely not)*.

Emotional functioning - self-rating measures. Emotional states during task performance were assessed by participants on three 7-point rating scales with endpoints of *definitely yes* and *definitely not*. These measures concerned the affective dimensions of irritation, depression and joy.

Procedure

Participants were randomly allocated to one of four experimental conditions. They were told that the whole procedure comprised three unrelated studies, conducted one after another. It was explained that it was easier and more effective to conduct all the studies during one session rather than separately, at different times. The experiment consisted of three phases. Phases 1 and 2 were conducted by Experimenter I and phase 3 was conducted by Experimenter

II. During phase 1 the participants were given a task that was solvable or unsolvable (Informational Helplessness Training). They were informed that the task was about "memorizing and reasoning in terms of abstract materials". After finishing that task, they were told that study 2 would start. During phase 2, repetitive thought or distraction thought was induced with the fictitious questionnaires described in the Materials section. In the repetitive thought condition, participants were instructed that the first questionnaire aimed to measure how they functioned during the previous task and the other two questionnaires were elements of a completely different study whose aim was to create norms for these psychological questionnaires. In the distraction condition, participants were instructed that "these three questionnaires are elements of a completely different study whose aim is to examine people's opinion on different social issues." The experimenter measured the time spent by participants on filling out the questionnaires. After finishing the questionnaires each participant was asked if during phase 2 she/he had been focusing on her/his emotions and current mood. The participants responded on a 5-point scale (5 – *definitely yes*, 3 – *hard to say*, 1 – *definitely not*). This question was asked to check the effectiveness of the experimental manipulation of repetitive/distraction induction. Then, each participant was guided by Experimenter I to another room, where Experimenter II was waiting. Then, the participant was told that the last study would begin. During phase 3, all participants performed a task involving the construction of linear orders using a computer. They were instructed that this task was about learning and recalling rank relations within small groups of fictitious people. Immediately after completing the task, participants were asked to fill out a questionnaire measuring their cognitive difficulties and emotional states during task performance.

Finally, participants were thanked and debriefed gradually. First, the participants from control deprivation were asked whether they had experienced any problems during the "first study". This question was to check if the participants suspected that the task had been unsolvable. Two participants did, so their results were excluded. Secondly, the participants were asked if they thought there were any links between these "three studies" to check if they suspected what the real relationship between the three phases could be, but none of them figured it out. No causal link between repetitive thought/distraction induction or control deprivation training and the third stage of the experiment has been indicated by any participant.

Experimental procedures were conducted individually and lasted about 60 min.

Results

Experimental check

An alpha level of 0,05 was used for all statistical tests. The participants in both repetitive thought groups reported in self-descriptive statements (after repetitive thought induction) a greater focus on their emotions and mood while filling out the questionnaires (phase 2 of the experiment) than the participants in both distraction groups, $t(93) = 6{,}77$; $p < 0{,}001$ ($M_{RT} = 3{,}75$; $SD = 0{,}98$; $M_{DIS} = 2{,}42$; $SD = 0{,}93$; the higher number the greater is focus on her/himself). Moreover, there was no difference between repetitive thought and distraction groups in terms of the time dedicated to questionnaires, $t(93) = 0{,}54$; $p = 0{,}59$ ($M_{RT} = 336{,}08$; $SD = 115{,}16$; $M_{DIS} = 324{,}15$; $SD = 99{,}10$ (time measured in seconds).

Emotional deficits

A 2 (control deprivation vs cognitive control) x 2 (repetitive thought vs. distraction) independent ANOVAs on self-measure emotional scales: irritation, depression and joy, were conducted. They revealed a significant interaction effect for irritation, $F(1,91) = 5{,}0$; $p = 0{,}03$; $\eta^2 = 0{,}052$ and joy $F(1,91) = 6{,}57$; $p = 0{,}01$; $\eta^2 = 0{,}07$ and marginally significant for depression, $F(1,90)$[3] $= 3{,}1$; $p = 0{,}08$; $\eta^2 =$

Table 1. Emotional self-rating measures in each experimental condition

		Control deprivation		Cognitive Control	
		M	SD	M	SD
Irritation	Repetitive thought	1,83	0,96	2,54	1,41
	Distraction	3,21	1,67	2,61	1,56
Depression	Repetitive thought	1,29	0,55	1,62	1,0
	Distraction	2,17	1,05	1,82	1,1
Joy	Repetitive thought	4,37	1,21	3,62	1,21
	Distraction	3,33	1,34	4,00	1,59

[3] Data of one participant was missing for depression scale. This is the reason why the number of degrees of freedom is lower

0,03. A main effect of repetitive thought/distraction for depression was also revealed $F(1,90) = 7,61$; $p = 0,01$. However, the analysis of means in each experimental groups (see Table 1) suggest that the interaction effect explains the results in a better way (Field, 2009). No other effect was revealed. To fully understand the interaction effects, the simple effects analysis was conducted. They indicated that participants from control deprivation/repetitive thought group in comparison to control deprivation/ distraction group were less irritated, $p = 0,001$; less depressed, $p = 0,002$ and felt more joy, $p = 0,009$. There was no significant difference within cognitive control condition (all $p > 0,3$).

Cognitive deficits

Subjective cognitive difficulties.

A 2 (control deprivation vs cognitive control) x 2 (repetitive thought vs. distraction) independent ANOVA on cognitive difficulties scale's results was conducted that revealed a main effect of control deprivation factor, $F(1,91) = 4,24$; $p = 0,042$; $\eta^2 = 0,04$; participants from control deprivation groups ($M = 3,45$; $SD = 1,47$) reported greater cognitive difficulties than participants from cognitive control groups ($M = 2,91$; $SD = 1,22$; the higher number the greater subjective cognitive difficulties). Moreover, a main effect of repetitive thought/distraction factor was revealed, $F(1,91) = 6,62$; $p = 0,012$; $\eta^2 = 0,07$ which meant that participants induced repetitive thought ($M = 2,84$; $SD = 1,24$) experienced less cognitive difficulties than individuals who were induced distraction ($M = 3,53$; $SD = 1,43$). Finally, an interaction effect was found, $F(1,91) = 5,89$; $p = 0,02$; $\eta^2 = 0,06$. The simple effects analysis showed that participants in the control deprivation/distraction group reported greater cognitive difficulties during task performance in comparison with control deprivation/repetitive thought group ($M_{RT} = 2,79$; $SD = 1,26$; $M_{DIS} = 4,11$; $SD = 1,39$; $p = 0,03$). There was no significant difference between cognitive control/ distraction and cognitive control/ repetitive thought groups ($M_{RT} = 2,89$; $SD = 1,25$; $M_{DIS} = 2,92$; $SD = 1,23$; $p = 0,74$).

Performance on the task of constructing linear orders.

For each participant the indicator for average general accuracy (the mean of percentage of correct answers in all series), for adjacent relation accuracy (the mean of percentage of correct answers for adjacent questions in all series) and for inferred relation accuracy (the mean of percentage of correct answers for inferred questions in all series) were calculated.

Then, a 2 (control deprivation vs cognitive control) x 2 (repetitive thought vs. distraction) x 2 relation in mental model (adjacent vs. inferred) mixed ANOVA on performance accuracy revealed a main effect of control deprivation, $F(1,91) = 6,06$; $p = 0,02$; $\eta^2 = 0,06$. Participants exposed to control deprivation performed significantly worse ($M = 83,96$; $SD = 13,28$) than participants who dealt with solvable problems – cognitive control ($M = 90,25$; $SD = 11,80$). An interaction effect was not significant, although it was close to reach significance $F(1,91) = 2, 42$; $p = 0,12$; $\eta^2 = 0,03$. Taking into consideration this result and the fact that for subjective measure of cognitive deficit there was a significant interaction effect (the correlation between subjective cognitive deficit measure and its objective indicator - general accuracy - was moderate, $rho = -0,48$; $p < 0,001$) the author has decided to conduct the simple effects analysis to test more directly the hypothesis concerning the moderating role of repetitive thought in developing cognitive deficit. The simple effects analysis revealed that participants who were induced repetitive thought after exposure to control deprivation performed better than participants who were induced distraction after control deprivation phase ($M_{RT} = 87,5$; $SD = 10,1$; $M_{DIS} = 80,44$; $SD = 18,25$; $p = 0,05$) whereas there was no difference in performance between cognitive control/distraction ($M = 90,70$; $SD = 13,18$) and cognitive control/repetitive thought group ($M = 89,81$; $SD = 10,58$), $p = 0,81$.

A 2 (control deprivation vs cognitive control) x 2 (repetitive thought vs. distraction) independent ANOVA on time study revealed no significant effect.

Discussion

The main objective of the study was to investigate the moderating role of repetitive thought in developing deficits resulted from control deprivation. First of all, as it was predicted the repetitive thought impacts the further emotional and cognitive functioning only in control deprivation situation. The analysis of results revealed, both for emotional and cognitive deficits, interaction effect; with the exception of accuracy measure for which a statistically significant main effect of control deprivation and interaction effect close to significance was found. Crucially, the decomposition of these interactions in terms of simple effects analysis, showed that induction of repetitive thought/distraction plays significant role for further emotional and cognitive functioning only for control deprivation condition. This supports claim of Martin and Tesser (1996) that repetitive thought is triggered when progress toward goal is blocked for a longer period and is a part of the feedback control process.

Moreover, in line with the predictions, the repetitive thought following control deprivation leads to reduction of emotional deficits in terms of reported level of irritation, depression and joy. This is consistent with the results of studies on non-depressive samples, showing that RT in conjunction with stress or failure, leads to reduction of negative emotions (Hunt, 1997; Rivkin & Taylor, 1999).

The support for hypotheses concerning cognitive deficit is more equivocal. As far as subjectively perceived cognitive difficulties are concerned the predictions were fully supported. The induction of repetitive thought after control deprivation made participants report less cognitive difficulties during the test task performance in comparison with participants in control deprivation/distraction group, whereas it had no effect in cognitive control groups. However, the moderating effect of repetitive thought for objective indicator of cognitive functioning (correlated moderately with subjective indicator), although in line with predictions, did not reach a significance level. This remained true also after taking into account the distinction

between two kinds of cognitive functions: memory retrieval and generative reasoning. On the other hand, the direct comparison between groups within control deprivation and cognitive control conditions, gave the results that support the formulated hypothesis. Considering all results concerning both objective and subjective indicators of cognitive functioning, it need to be said that the results of Experiment 1 were not fully conclusive in terms of cognitive deficit. And this is not due to too weak impact of control deprivation on cognitive functions since the main effect of control deprivation on accuracy was found. This issue was addressed in Experiment II.

Experiment II

The results of the previous experiment in terms of objective indicators of cognitive deficit are not entirely conclusive. This study is to address this issue. Specifically, the main purpose of this experiment is to investigate whether the results are more conclusive when another method of induction RT/distraction is used. Moreover, this experiment tests the prediction that the positive, moderating effect of RT following control deprivation for cognitive functioning will be more distinct for more difficult, requiring more cognitive resources, tasks. To test such hypothesis the level of difficulties of final task was manipulated.

Method

Participants

Seventy one students volunteered to take part in the experiment II but two of them were excluded due to exceeding the time limit during the induction of repetitive thought/distraction (for details see Material section). Thus, sixty nine participants were included into the analysis, 52 women and 17 men (M_{age} = 21,74; SD_{age} = 3,23). They were randomly assigned to one of three experimental conditions (23 people in each): control deprivation followed by repetitive thought induction, control deprivation followed by distraction induction and group with no preexposure and no induction of thinking mode (only test task – the same for all groups).

Materials

Experimental manipulation.

Control deprivation. To manipulate control deprivation the method of Informational Helplessness Training of Kofta and Sędek (1999; McIntosh et al., 2006) was used. The materials and manner of use was exactly the same as in Experiment I.

Induction of repetitive thought or distraction. The method was derived from the manipulation used by Watkins (2004). The participants were asked to write two short essays after exposure to control deprivation. The repetitive thought or distraction was induced through different essay instructions. In control deprivation/repetitive thought condition the instructions concerned the thinking process and own emotions during the previous task (exposure to control deprivation). Specifically, participants were presented the following instructions:

"We would like to know what experiences you have had during the last task. Please write about them by following these two instructions, one by one:

1. First, we ask you to focus on your experience from the last task. Next, please describe your thinking process of looking for the right answer during the last task.

2. Now, we ask you to focus on emotions and mood that you felt during the last task. Next, please describe your feelings during the last task and how you feel now"

In control deprivation/distraction the instructions concerned the opinion about the city of Łódź. Specifically, participants were presented the following instructions:

"We would like to know your opinions about the city of Łódź. Please write about them by following these two instructions, one by one:

1. We ask you to express your opinion about the city of Łódź as a place to live, based on your experiences (no matter whether you were born here or you just live/study/work here). Please give reasons for your opinions.

2. We ask you to write about your opinion about the city of Łódź as a place to visit for tourists, based on your experiences (no matter whether you were born here or you just live/study/work here). Please give reasons for your opinions."

The instructions were put on the separated sheets and participants were asked to write second essay just after finishing the first, without any break. The participants in both conditions were asked to try to write their essays in 25 minutes. This time limit was set for two reasons. First, the effects of control deprivation, as they are produced in such experiments, tend to be short-lived (Young i Allin, 1986). Therefore, if the interval between control deprivation and test task would be too long, the effects of control deprivation deficits could disappear. The time limit was set to avoid it. Second reason was to ensure that participants spent similar amount of time and effort in both experimental conditions. Two participants exceeded the limit of 25min (one in RT and one in distraction group); they were not stopped but their results were excluded.

All four essay instructions were rated by 8 independent judges on 1-7 Likert scales (identical as one used in experiment I) in terms of emotional neutrality. The instructions were rated as not differing in emotional impact on participants, $F(3,21) = 0,18$; $p = 0,91$

Cognitive functioning- performance.

To measure cognitive functioning after control deprivation the Linear Orders method was used, the same as in experiment I. However, two changes were introduced. First, the number of series was reduced from six to four. Second, the difficulty level was manipulated. There were two difficulty levels, two series/orders for each level. The difficulty level was operationalized by different ways of presenting pairs during the learning stage. As illustrated in Figure 1, for difficult orders the numbers of operations that participants need to carry out to rearrange the presented pairs into mental array is higher than for easy orders (Sędek & von Hecker, 2004). More specifically, for easy orders elements are presented in such way that a mental array can be

Figure 1.

Abstract notation of presented pairs, ">" = relation (potentially generated model: A>B>C>D)	The material presented to participants (names changed, in original study Polish names were used)	Difficulty level
1. C>D 2. A>B 3. B>C	1) Eve is smarter than Ann, 2) Alice is smarter than Brenda, 3) Brenda is smarter than Eve Model: Alice>Brenda>Eve>Ann	Difficult orders
1. A>B 2. C>D 3. B>C	1) John is faster than Mark, 2) Gregory is faster than Paul, 3) Mark is faster than Gregory Model: John>Mark>Gregory>Paul	
1. B>C 2. A>B 3. C>D	1) Mary is older than Linda, 2) Helen is older than Mary, 3) Linda is older than Susan Model: Helen>Mary>Linda>Susan	Easy orders
1. B>C 2. C>D 3. A>B	1) Robert is taller than Adam, 2) Adam is taller than David, 3) Brian is taller than Robert Model: Brian>Robert>Adam>David	

The presentation patterns in each order in division on difficulty level (the schema of this figure is derived from Sędek & von Hecker, 2004).

constructed by simple adding one pair to another. However, for difficult orders second pair introduces a relation between two new persons, none of whom matches with any person mentioned in the first pair. As a result, participants need to keep in memory both first and second pair until the third pair is presented. The third pair always allows to integrate all four persons into mental array. The more such operations are needed, the more information need to be stored in working memory during learning stage. That leads to conclusion that for difficult series one need more cognitive resources (working memory capacity) to successfully rearrange the presented materials into comprehensive mental model than for easy series.

Procedure

Participants were randomly allocated to one of three experimental conditions: 1) control deprivation followed by repetitive thought induction, 2) control deprivation followed by distraction induction and 3) no preexposure group – no tasks and no thinking mode induction, only test task. They were told that they would participate in two (for repetitive thought condition) or three (for distraction condition) unrelated studies. Persons from no preexposure group was told that there was only one study. The further procedure was very similar to the one adopted in experiment I. However, a few important changes were made. First, in phase 1, only control deprivation condition (unsolvable problems) was established. Second, after control deprivation phase a different method of RT/distraction was used (writing essays). The detailed instructions for both conditions are provided in Material section. During writing the essays participants were left alone in the room and the experimenter measured the time spent on essays. The effectiveness of this experimental manipulation was checked with the following question: "To what degree are you focused on yourself now?" The participants responded on a 7-point scale (7 – *fully focused on myself*, 1 – *not focused on myself at all*). The question was asked just after finishing writing the essays by participants. Third, there were no self-measures of emotional and cognitive functioning during test task. The debriefing procedure was identical as for experiment 1. None of participants figured out neither that the tasks in the first phase were unsolvable nor the real relation between all phases of the experiment.

Experimental procedures were conducted individually and lasted about 75 min.

Results

Experimental check

An alpha level of 0,05 was used for all statistical tests. The participants in repetitive thought condition reported a greater focus on themselves after finishing the essays than the participants in distraction condition, t(44) = 3,30; p = 0,002 (M_{RT} = 5,04; SD = 1,34; M_{DIS} = 3,61; SD = 1,67; the higher number the greater focus on her/himself). Moreover, there was no difference between repetitive thought and distraction group in terms of the time spent on writing essays, t(44) = -1,65; p = 0,11 (M_{RT} = 757,17; SD = 274,78; M_{DIS} = 898,22; SD = 304,18 (time measured in seconds).

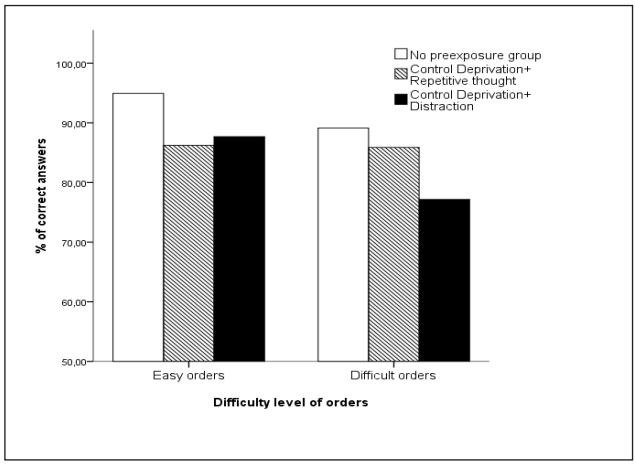
Cognitive deficits - performance on Linear orders task

A 3 experimental group (control deprivation/RT vs. control deprivation/distraction vs. no preexposure group) x 2 relation in mental model (adjacent vs. inferred) mixed ANOVA on performance accuracy revealed a main effect of experimental group, $F(2,66) = 3,32$; $p = 0,04$; $\eta^2 = 0,09$. To interpret this main effect a posteriori Student-Newman-Keuls test with pairwise comparisons was applied. It revealed that no preexposure group (M_{NP}

= 92,03; *SD* =9,8) performed significantly better relative to control deprivation/ distraction group (M_{DIS} = 82,43; *SD* = 13,76), p < 0,05. However, there was no significant difference between no preexposure and control deprivation/ RT group or between control deprivation/RT (M_{RT} = 86,05; *SD* = 14,25) and control deprivation/distraction group (M_{DIS} = 82,43; *SD* =13,76).

The analogical a 3 experimental group (control deprivation/RT vs. control deprivation/distraction vs. no preexposure group) x 2 relation in mental model (adjacent vs. inferred) mixed ANOVA conducted separately on accuracy for difficult and easy orders, revealed no effect for easy orders. However, for difficult orders a significant main effect of experimental group was found, $F(2,66) = 4,44$; $p = 0,02$; $\eta^2 = 0,12$. To interpret this main effect a posteriori Student-Newman-Keuls test was applied which showed that participants who were induced distraction after control deprivation performed significantly worse in comparison with both no preexposure group and control deprivation/ repetitive thought group (all $p < 0,05$). However, there was no statistically significant difference in performance between no preexposure and control deprivation/ RT group (see Figure 2).

Figure 2



Mean accuracy performance for easy and difficult orders in each experimental condition.

A 3 experimental group (control deprivation/ RT vs. control deprivation/distraction vs. no preexposure group) independent ANOVA on time study revealed no significant effect, $F(2,66) = 1,42$; $p = 0,25$. The analogical ANOVAs, conducted separately for time study for easy and difficult orders, revealed no significant differences between experimental groups, neither for easy orders, $F(2,66) = 2,31$; $p = 0,11$; nor for difficult orders, $F(2,66) = 0,46$; $p = 0,63$.

Discussion

The main purpose of this study was to explore more precisely the role of RT after control deprivation for cognitive functioning. As predicted the repetitive thought that follows control deprivation reduces the cognitive helplessness deficit but this effect is limited to difficult tasks that require higher working memory capacity. The direct comparison of performance for difficult tasks between all three experimental conditions supports the prediction that repetitive thought after control deprivation allows to compensate the cognitive deficits (no difference between no preexposure group and control deprivation/RT) whereas distraction in response to control deprivation results in maintenance of impairment of cognitive functioning, both relative to no preexposure and control deprivation/RT group.

Moreover, the fact that the predicted differences in performance between experimental conditions are particularly pronounced for tasks that require more working memory capacity, supports the assumption that positive moderating effect of RT is due to increasing working memory capacity resulted from lower level of intrusive thoughts.

General discussion

The goal of the current studies was to explore the role of repetitive thought following exposure to control deprivation. The results of the first experiment showed that the mode of thinking (repetitive thought vs. distraction) impacts the further emotional and cognitive functioning only in condition of exposure to control deprivation. This is in line with the initial prediction and, more broadly, with Martin and Tesser's (1996) claim that repetitive thought is triggered when progress toward goal is blocked. Moreover, this result suggests that the moderating effects of repetitive thought is due to reducing specific deficits resulted from exposure to control deprivation, not due to general improvement of cognitive and emotional functioning.

The main finding of both studies is that repetitive thought in response to control deprivation leads to reduction of both emotional and cognitive helplessness deficits. However, as far as cognitive functioning is considered, the positive moderating effect of RT was limited to tasks that require more working memory capacity. This is convergent with the assumption that RT should compensate cognitive control deprivation deficit through increasing working memory capacity.

These results are consistent with the research on non-clinical samples that show that repetitive thought following a failure or distress leads to positive effects (Hunt, 1997; Rivkin & Taylor, 1999) and studies that show positive effects of constructive forms of RT in response to failure or distress (e.g., Ehring et al., 2009; Moberly & Watkins, 2006; Watkins, 2004; Watkins & Moulds, 2005; for review see Watkins, 2008). Simultaneously, they are contrary to the results of the studies conducted on depressed or dysphoric individuals that illustrate the negative effects of RT in response to negative mood in terms of emotional and cognitive functioning (e.g., Lyubomirsky et al., 2003, Lyubomirsky & Nolen Hoeksema, 1995; Lyubomirsky et al., 1999, for review see Nolen Hoeksema et al., 2008; Watkins, 2008). Such results, if replicated in further studies, suggest that specific repetitive thought mode –

depressive rumination, naturally adopted by depression-prone individuals (Watkins, 2008; Watkins & Baracaia, 2002), can be limited to depression/dysphoria and is not applied to experimental exposure to control deprivation. The results of present study suggest that in the situation of control deprivation a constructive form of repetitive thought is naturally adopted. In other words, the effects of repetitive thought can be an example of the area where depressive symptoms and, at least experimentally induced, control deprivation are no analogous. It can be speculated that it is more probable that prolonged exposure to control deprivation leads to more permanent depressive dysfunctions when it is associated with negative form of repetitive thought - depressive rumination. Such speculation are in line with the results of longitudinal studies (e.g., Nolen Hoeksema, 2000; Robinson & Alloy, 2003; Spasojevic & Alloy, 2001; for review see Nolen-Hoeksema et al., 2008) that show that people who tend to adopt depressive rumination form of thinking when distress, are more likely to develop depressive symptoms.

One limitation of this research is that it did not test directly what are the effects of different forms (constructive and unconstructive) of repetitive thought after exposure to control deprivation; whether constructive form of RT results in reducing control deprivation deficits, whereas unconstructive form, analogical to depressive rumination, results in exacerbating negative emotions and longer maintenance of cognitive deficits. To test such predictions, it would be necessary to manipulate experimentally the form of repetitive thought (e.g., Ehring et al., 2009; Watkins, 2004). Moreover, the present studies do not test directly the mechanism of reduction of cognitive deficits in control deprivation/repetitive thought condition. More specifically, it was not tested whether the repetitive thought after control deprivation exposure actually results in lowering the level of intrusive thoughts as it was illustrated in study of Ehring and collaborates (2009) and whether this decline of level of intrusive thought mediates the reduction of cognitive deficits in control deprivation/repetitive thought condition. To test it, the level of intrusive thoughts should be measured just after the control deprivation, after RT/distraction induction and/or after completing test task. Lastly, the measurements of working memory capacity before control deprivation and induction of RT and after, should by applied, to test if induction of repetitive thought/distraction affect working memory capacity. Such limitations of the present research are due to the fact that it was designed as a preliminary exploration of the role of repetitive thought in developing helplessness deficits. The studies that apply the above suggestions would help to verify the results of the present studies and their interpretation.

In conclusion, the current studies have provided preliminary evidence for the moderating role of repetitive thought in developing helplessness deficits. Generally, the results suggest that repetitive thought following control deprivation reduces emotional and cognitive helplessness deficits. They provide further evidence that non depression-prone individuals naturally adopt constructive form of RT and support Martin and Tesser's (1996) theory of repetitive thought.

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