Research Article

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Social Psychological Bulletin
Psychologia Społeczna

The Effects of Stability of Uncontrollability Experiences on Cognitive Exhaustion

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Handling editor: Marcin Bukowski (Jagiellonian University, Cracow, Poland)

Received: 28 March 2016 • **Accepted:** 14 October 2016 • **Published:** 11 April 2018

Citation: Józefczyk, A. (2018). The effects of stability of uncontrollability experiences on cognitive exhaustion. *Social Psychological Bulletin*, *13*(1), Article e25498. https://doi.org/10.5964/spb.v13i1.25498

Abstract

The present study investigates whether stability of the uncontrollability experience is an important factor in causing cognitive exhaustion syndrome. In the first phase, participants experienced different types of deprivation of personal control in terms of trying to find a solution to solvable and unsolvable tasks based on the procedure of Informational Helplessness Training. The Linear Orders Task was used to evaluate the efficiency of generative reasoning. The results revealed the greatest deficits in the group with random uncontrollability experience, with the first solvable and the last unsolvable task. Mechanisms underlying the effects of various uncontrollability experiences on cognitive exhaustion are discussed.

Keywords

deprivation of control, personal control, generative reasoning, learned helplessness

The issues of personal control over one's own activity and human functioning when control is lost have held psychologists' interest for almost half a century (Bandura, 1977; Bukowski, Asanowicz, Marzecová, & Lupiáñez, 2015; Kofta & Sędek, 1999; Langer, 1975; Maier & Seligman, 1976; Overmier & Seligman, 1967). Effects of an individual's contact with an uncontrollable situation were defined as *learned helplessness* (Maier & Seligman, 1976). According to the Informational Model of Helplessness (Kofta & Sędek, 1993; Sędek

& Kofta, 1990; Sędek, Kofta, & Tyszka, 1993), the mechanism of the syndrome's genesis lies in an ineffective cognitive effort made by an individual who faces a problem situation. The authors assume that people tend to become engaged in a systematic mental activity when they face problem solving situations. Such an activity consists mainly of generating hypotheses regarding effective activities and testing these hypotheses in the light of incoming data. When a situation is controllable, one reduces the initial uncertainty about its solution while coping with it, and he or she finds an adequate solution by means of eliminating subsequent hypotheses. In a situation of no control, when finding a solution is impossible, this activity is in vain and an individual experiences non-reducible cognitive entropy. A prolonged cognitive effort that does not lead to real progress in problem solving results in a transition to a new psychological state that is defined as *cognitive exhaustion* (Sędek & Kofta, 1990). The basic feature of this state lies in the deterioration of constructive and integrative mental processing. To put it differently, in subsequent controllable tasks, an individual displays deficits in generative reasoning, a typical example of which is the ability to create mental models (Halford, 1993; Johnson-Laird, 1983). Creating a mental representation of a problem situation requires systematic integration of the incoming data, and this ability appears to be impaired after having experienced helplessness training (Sędek & von Hecker, 2004; von Hecker & Sędek, 1999). It is related to a gradual decrease in cognitive resources while an uncontrollable situation is lasting (Kofta, Narkiewicz-Jodko, & Kobylinski, 2011; McIntosh, Sędek, Fojas, Brzezicka-Rotkiewicz, & Kofta, 2005). The state of cognitive exhaustion does not mean a total inability to cope with any type of problems. The deficits become apparent only in new and difficult situations that demand nonstandard and flexible ways of coping (Sędek & Kofta, 1990). The so called "plan B", which is used by persons who have experienced helplessness training and which consists of using activity procedures that were acquired and established earlier, guarantees efficiency in simple tasks. This is confirmed by results of studies in which syllogisms, the double task paradigm, or Oberauer's task were used (McIntosh et al., 2005). Apart from the described cognitive deficits, a motivational deficit also accompanies cognitive exhaustion. What occurs after helplessness training is cognitive demobilization, i.e., lowered motivation to mental effort (Kofta & Sędek, 1993).

Studies to date have indicated that the state of cognitive exhaustion is a result of a long-lasting and stable uncontrollability experience. In most cases, helplessness training is referred to as the constant contact of an individual with an uncontrollable situation, which is realized in experimental studies as the procedure in which an examinee is given unsolvable tasks only (Kofta & Sędek, 1993; Maier & Seligman, 1976; von Hecker & Sędek, 1999). Thus, the situation subjected to analysis is the one in which the experiences of an individual are only the sum of totally ineffective reactions. It seems, however, that in everyday functioning, people's contact with uncontrollable situations is not always so unambiguous and does not consist exclusively of experiencing the inefficiency of their activities. Therefore, the question arises of whether an unstable experience of uncontrollability leads to a state of cognitive exhaustion as well. It may be hypothesized that a situation in which a person experiences solvable and unsolvable tasks alternately, and thus forms a conviction about the efficiency of his/her activities, but soon after this conviction is negated with no objective reason, and the process is repeated several times, leads to dynamic fluctuations in a sense of self-efficacy. An intriguing question refers to a relation between the lack of conviction about the efficiency of one's cognitive effort, which occurs in the classic helplessness training, and a total instability of this conviction. The relations between the stability and uncontrollability have been explored in the context of the moderating effect of attributions on learning helplessness syndrome (Abramson, Seligman, & Teasdale, 1978). It is assumed that attributing helplessness to stable factors leads to chronic deficits and expectancy of a lack of any control in the future, whereas making unstable attributions may not necessarily have detrimental effects on subsequent tasks (Mikulincer, 1988). In line with this perspective, it seems plausible to hypothesize that coping with alternately solvable and unsolvable tasks will enhance the tendency to form unstable attributions and as a result lead to less severe – in comparison to the classic helplessness training – effects of experiencing uncontrollability.

From a different perspective, the situation of random controllability may be interpreted as a source of a high level of self-efficacy uncertainty. Informational Helplessness Training (Kofta & Sędek, 1993) is arranged in such a way that each possible hypothesis formulated to solve the problem received 50% of confirmatory and 50% of disconfirmatory evidence and, as a result, a person is not able to reduce the number of possible solutions and make a distinction between good and bad ideas. Interestingly, when we consider random controllability training from the perspective of the whole task, not just separate series, we can observe a very similar process: coping with solvable series may lead to the conviction that an effective strategy has been found but the same strategy in the subsequent, identically arranged series turns out to be ineffective. What should be taken into consideration is the level of cognitive entropy experienced in such conditions. Sędek and Kofta (1990) used this concept in terms of a degree of uncertainty experienced by a person during a single series in the learning helplessness and from this perspective the classic helplessness training leads to the maximum level of possible entropy. On the other hand, reflecting the entropy from a more systemic view, as was originally defined by Clausius (1865) as the amount of energy within a system, may lead to an assumption that the level of cognitive entropy after the whole helplessness training should not be considered a sum of independent elements, but rather a dynamic interaction between them. As a result, it may be possible that in comparison with the classic procedure, training consisting of both solvable and unsolvable tasks enhances the experience of uncontrollability and results in a higher cognitive entropy, which is perceived as the main determinant of the learned helplessness state (Kofta & Sędek, 1993; Sędek & Kofta, 1990). What may be seen as a less speculative theoretical assumption is that the crucial element of random uncontrollability is the high uncertainty which – according to the entropy model of uncertainty (Hirsh, Mar, & Peterson, 2012) – may be subjectively experienced as anxiety. Studies devoted to the interrelatedness between anxiety and cognitive performance demonstrate the detrimental effect of anxiety on processing efficiency defined as the relationship between performance effectiveness and use of processing resources (Eysenck & Calvo, 1992; Eysenck, Derakshan, Santos, & Calvo, 2007). Derakshan and Eysenck (2009) made an additional assumption that anxiety does not necessarily impair performance effectiveness because of enhanced motivation in anxious individuals to compensate for the adverse effects of anxiety. In terms of cognitive exhaustion, we may expect that random uncontrollability will lead to cognitive deficits with an accompanying higher level of motivation. Taking the approaches presented above together, in the present study we explore the idea that an unstable lack of personal control in comparison with stable deprivation can lead to higher deficits in one's efficiency of generative reasoning.

Moreover, the phenomenon of random uncontrollability experience is worth analyzing in a more detailed way, taking into account conflicting results from the learned helplessness literature on the effects of the presentation order. One strand of research has shown that beginning with a controllable experience leads to proactive interference at the time of subsequent exposure to unsolvable problems and thus it protects against learned helplessness deficits (Seligman & Maier, 1967). Results that confirm the possibility of immunization, as this phenomenon is called, were observed in a wide range of studies (Douglas & Anisman, 1975; Jones, Nation, & Massad, 1977; Seligman, Rosellini, & Kozak, 1975; Warren, Rosellini, Plonsky, & DeCola, 1985). It should be noted that all of these studies were conducted according to the Classic Theory of Helplessness (Maier & Seligman, 1976; Overmier & Seligman, 1967), in which it is assumed that the deficits are caused by noticing during the helplessness training that there is no relation between reaction and reinforcement and by generalizing this expectation to subsequent tasks. According to the Informational Model of Helplessness (Sędek & Kofta, 1990), we may interpret the process of immunization as a sudden loss of control, which due to unknown reasons comes after earlier efficient functioning. In line with this perspective, immunization can lead to cognitive chaos and thus to more severe effects than those observed for a sole uncontrollability experience. Such an effect was obtained in the studies by Wróblewska and Brzezicka (2011), in which the group that had been immunized according to the informational helplessness training procedure scored lower on the test task than the group subjected to the classic helplessness training. Thus, it seems that the mechanism underlying the immunization procedure may not be a proactive interference, as indicated by Seligman and Maier (1967), but rather a retroactive one manifested as problems with the recall of previously learned information due to some newly learned data (e.g., Eakin & Smith, 2012; Unsworth, Brewer, & Spillers, 2013). Those effects are connected with a serial position effect, which was first coined by Herman Ebbinghaus (1885/1964) and which shows the tendency of a person to recall the first (*the primacy effect*) and last (*the recency effect*) items in a series best.

If a delay between the study and test phase is not long, the primacy effect is reduced in favor of the recency one (Knoedler, Hellwig, & Neath, 1999). Such results in terms of helplessness training enhance the importance of the character of the last series that a person has to deal with. Concerning the immunization procedure, ending the training with an unsolvable task may contribute to a lower sense of self-efficacy and therefore result in a higher performance deficit in subsequent tasks. Studies that demonstrate people's belief that they have a higher level of control in an uncontrollability success than in an uncontrollability failure condition (Griffith, 1977; Tiggemann, 1981) give support to this hypothesis. What is more, this idea seems to be consistent with a different strand of research which has suggested that control restoration, operationalized as an initial contact with an unsolvable task and final contact with a solvable one, may have positive effects on individuals' cognitive efficiency (Bukowski et al., 2015). Research results indicate that a short-term deprivation of control stimulates motivation to restore control and is related to systematic information processing, using more precise strategies of problem solving, and efficiency of attentional control (Pittman & D'Agostino, 1989; Pittman & Pittman, 1980; Wortman & Brehm, 1975). Therefore, it may be predicted that the group that is regaining control in the test task will be characterized by lower cognitive deficits as compared to the group subjected to the classic procedure.

The conclusions presented above should be referred to as the two possible variants of the random procedure: when an individual initially gains a conviction about the efficiency of his/her activity but finally loses it, or when we face the reverse situation. According to the hypothesis that underlies the importance of the recency effect during helplessness training, it may be assumed that if random experience of control is additionally linked to the immunization procedure, the detrimental effects on generative reasoning will be multiplied. Taking into consideration that the uncontrollability factor is predicted to be more important than the effect of control restoration, we expected a random procedure finished by unsolvable series to diminish the positive effect of control restoration and result in greater cognitive deficits in the random restoration group as compared to the restoration group.

We should emphasize that, to date, there has not been any research that directly compares the effects of individual experience with different types of unstable contact with uncontrollability. First, we expected greater deficits in the full deprivation group as compared to the baseline group (Hypothesis 1). Secondly, we assumed that random experiencing of uncontrollability would cause greater deficits than those displayed in the group after the classic helplessness training (Hypothesis 2). We predicted that this rule would apply to both the random immunization group (Hypothesis 3) and the random restoration group (Hypothesis 4). Moreover, some evidence contained in the results of the described studies show that the random immunization group will display a greater performance deficit as compared to the immunization group (Hypothesis 5), and that the random restoration group will display a greater performance deficit as compared to the restoration group (Hypothesis 6). We also decided to examine the efficiency of the immunization and restoration procedures by means of comparing results in these groups with those obtained in the group subjected to the classic helplessness training. We predicted that the immunization group will display greater deficits (Hypothesis 7) and the restoration group will display lower deficits (Hypothesis 8) as compared to the classic helplessness training group. In order to evoke the experience of different types of personal control deprivation, a differentiation between the configuration of solvable and unsolvable series in the Informational Helplessness Training was made (Kofta & Sędek, 1993). The intensity of cognitive and motivational deficits, meant in terms of the state of cognitive exhaustion, was measured with the Linear Orders Task (Sędek & von Hecker, 2004), which is designed to examine the skill of creating mental models.

Method

Participants

One hundred and fifty-nine students from the University of Lodz (118 women and 41 men; M_{age} = 20.92 years, *SD* = 1.85) took part in the study. They were randomly assigned to one of six experimental conditions: (1) full control deprivation (*n* = 27); (2) random immunization (*n* = 27); (3) immunization (*n* = 27); (4) random restoration (*n* = 27); (5) restoration (*n* = 26); (6) baseline (*n* = 25). No participant was excluded due to the results of the manipulation procedure (see the Method Section).

Procedure

Upon participants' arrival to the laboratory, the experimenter informed them that the study would concern "memory and reasoning skills" and was made up of two separate tasks. All measures and stimuli materials were presented via computer. Having read the instructions, participants were asked to perform the first task, which was the Informational Helplessness Training (IHT). On the basis of the experimental condition that participants were randomly assigned to, they were given a different configuration of solvable and unsolvable problems. After uncontrollability manipulation, the Linear Orders Task was presented. Finally, participants were asked a set of questions regarding the efficiency of the manipulation. Experimental procedures lasted about 45 min.

Materials

Informational Helplessness Training (IHT)

To induce uncontrollability, we used a task based on the procedure developed by Sędek and Kofta (1990). It consisted of eight discrimination series composed of eight trials each. On each trial one figure was presented. The figures varied on five dimensions, each determining two possible features: (a) size (small or large), (b) shape (triangle or circle), (c) surface (plain or striped), (d) position of a line (at the top or bottom of the figure) and (e) size of the letter 'r' in the middle of the figure (small or large). In each series one of ten figure features was chosen. The participants' task was to identify it by inspecting the information 'Yes' or 'No' presented at the bottom of the figure. In a given trial, 'Yes' means presence, whereas 'No' means lack of the target feature. By manipulation of the piece of information that accompanied the figure presented on screen, each series was either solvable or unsolvable. In the solvable series, the feedback was truthful – 'Yes' indicated that the target feature was present in the figure and 'No' that it was absent. Thus, the problem was potentially solvable and the exposure of each image allowed for gradual reduction in the number of potentially correct answers. In unsolvable trials, identifying the target feature was impossible as the sequence of 'Yes' and 'No' appeared in such a way that each potential problem solution was equally confirmed and negated. Each series was completed with a list of ten features on which participants appointed the solution.

Every participant was instructed that all series were solvable but in fact each experimental condition was made up of a different configuration of solvable and unsolvable series. In the full deprivation condition all eight tasks were unsolvable. In the immunization group, the first four series were solvable, and the last four were unsolvable. The restoration group experienced the inverse order: first unsolvable tasks and then the solvable ones. Random groups experienced partial uncontrollability by coping with both solvable and unsolvable series presented in a random way. The order of the controllable and uncontrollable series was not entirely convertible so as to avoid repeatability and thus stability of the experience. The difference between the first and the second group concerned the first and the last presented series – in the random immunization group the first series was solvable, and the last one was unsolvable; in the random restoration group, the solvability of the first and last series was reversed. In the control condition all tasks were solvable. The configuration of solvable and unsolvable series in each experimental condition is presented in Table 1.

Table 1
The Configuration of Solvable and Unsolvable Series Presented in Each Experimental Condition

The experimental condition	The configuration of series in the Linear Orders Task
Full deprivation	U U U U U U U U
Random immunization	S U U S U S S U
Immunization	S S S S U U U U
Random restoration	U S S U S U U S
Restoration	U U U U S S S S
Baseline	S S S S S S S S

Note. S = solvable series; U = unsolvable series.

At the end of the study all the participants were asked how difficult they found the task and if they faced any problems during solving it. No participant reported unsolvability-notification about the task. Answers obtained from the participants from the immunization and the control groups were pre-analysed as to ensure that results of the second task springs from the experimental manipulation, not misunderstanding instructions – participants should have reached a level of 50% correct answers (two correct answers in the immunization group and four correct answers in the control group). No participant was excluded from further analyses.

Linear Orders Task

The efficiency of the generative reasoning, defined in terms of the ability to construct mental models, was measured using the Linear Orders Task (Sędek & von Hecker, 2004). It consisted of eight series of three phases each:

(1) Learning – three pairs describing relations between four people were presented. Participants were asked to try to remember them. There was no time constraint, but returning to the previous relation when the next one was presented on screen was impossible. There were six different name sets (three women and three men) and each name set consisted of four names. As an operationalization of difficulty level, three different types of pair orderings proposed by Smith and Foos (1975) were presented. In the simplest problems, each consecutive pair contained a matching element that facilitated the construction of a mental array (AB BC CD and CD BC AB). In order to resolve moderate problems participants had to shift the presented pairs before matching a common element (BC CD AB and BC AB CD). At the most difficult level, two pairs presented before could not be integrated in the linear order until the third pair was presented. Thus, participants had to hold both pairs in memory until the third pair was presented (AB CD BC and CD AB BC). The difficulty variable refers to the level of cognitive resources needed to resolve the problem.

Study times in each series for each presented pair were measured. It is hypothesized that participants do not simply store the presented pairs during the learning stage but they rather try to integrate them into a linear model. Studying the third pair longer than the first and the second pairs indicates a spontaneous generative mental model construction (Sędek & von Hecker, 2004).

(2) Test – in the second phase, participants were asked to classify six statements concerning people presented during the learning stage. Three types of pairs were queried: a) adjacent pairs as an indicator of memory retrieval, b) two-step pairs not presented during a learning phase and demand constructive reasoning across two steps on the mental model, c) end-point pair which also involves constructive reasoning but is directed the maximum array distance of the hypothetical model (see Table 2). In fact, in the test phase participants are queried about previously presented relations (adjacent pairs) and about relations that should be inferred (two-step and end-point pairs). Since the two-step and end-point pairs relate to the same process of generative reasoning, in analyses they were considered together as “inferred pairs”. As dependent measures, response times for correct answers and accuracy in responding to the two types of queries (adjacent and inferred) were measured for each order difficulty.

(3) Maths – this phase is made up of four simple mathematical equations in order to clear memory of the previously presented verbal material.

Table 2
The Pair Distance Variable in the Linear Orders Task

Name of the relation	Number of question	Set of pairs that is concerned in the question
Adjacent pairs		
	1	A > B
	2	B > C
	3	C > D
Two-step pairs		
	4	A > C
	5	B > D
End-point pair		
	6	A > D

Note. The potentially generated mental array: A > B > C > D.

Results

Study Times

First, we analyzed the relation between the stability of the uncontrollability experience and study times during the learning stage in the Linear Orders Task. The results were compared at three levels of difficulty and for three subsequently presented pairs. A 6 (helplessness training: full control deprivation vs. random immunization vs. immunization vs. random restoration vs. restoration vs. baseline) × 3 (order difficulty: simple vs. moderate vs. difficult) × 3 (presented pair: first vs. second vs. third) mixed-model ANOVA, with helplessness training as a between-subjects factor and order difficulty and presented pair as within-subjects factors, revealed a significant main effect of helplessness training, $F(5, 153) = 2.56$, $p = .029$, $\eta^2_p = .080$. Planned contrast comparisons revealed that, as predicted, study times in the full deprivation condition were longer than in the baseline condition, $t(153) = 2.31$, $p = .022$, $r = .18$[1]. Most importantly, differences between the full deprivation group and both random groups did not reach the significance level and it concerns the comparison with random groups considered first together ($t(153) = 0.59$, $p = .556$, $r = .05$) and then separately (with random immunization group: $t(153) = 0.91$, $p = .365$, $r = .07$; with random restoration group $t(153) = 0.11$, $p = .910$, $r = .01$). No differences were found for the random immunization versus immunization group as well, $t(153) = -1.02$, $p = .311$, $r = .08$, but study times in the random restoration group were significantly longer than in the restoration group, $t(153) = 2.31$, $p = .022$, $r = .18$. With regard to the last two hypotheses, the comparison between the full deprivation condition and the immunization condition was not significant, $t(153) = -0.11$, $p = .915$, $r < .001$, in contrast to the comparison between the full deprivation condition and the restoration condition, $t(153) = 2.32$, $p = .022$, $r = .18$. The mean study times and standard deviations are shown in Table 3.

1 We used r contrast as an effect size measure for planned contrasts (Field, 2009).

Table 3

Study Times (in Seconds) in the Linear Orders Task as a Function of Helplessness Training, Order Difficulty and Presented Pair

Order difficulty	Presented pair	Full deprivation		Random immunization		Immunization		Random restoration		Restoriation		Baseline		Overall	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Simple															
	1	10.21	1.12	8.44	1.12	10.32	1.12	10.35	1.12	8.15	1.14	8.47	1.16	9.32	1.13
	2	8.16	0.89	6.61	0.89	9.14	0.89	7.75	0.89	6.70	0.90	6.86	0.92	7.54	0.89
	3	9.54	0.92	9.37	0.92	9.84	0.92	8.65	0.92	6.72	0.93	7.34	0.95	8.57	0.92
Moderate															
	1	11.92	1.06	10.57	1.06	12.18	1.06	11.00	1.06	9.85	1.08	10.03	1.10	10.93	1.07
	2	12.20	1.16	9.29	1.16	12.34	1.16	11.41	1.16	10.49	1.18	8.95	1.21	10.78	1.17
	3	10.58	1.24	11.25	1.24	10.82	1.24	9.37	1.24	7.41	1.27	9.15	1.29	9.76	1.25
Difficult															
	1	15.29	1.35	15.38	1.35	16.53	1.35	16.73	1.35	12.82	1.37	13.08	1.40	14.97	1.36
	2	25.33	2.71	23.91	2.71	23.55	2.71	27.00	2.71	17.87	2.76	17.01	2.82	22.44	2.74
	3	15.13	1.23	13.30	1.23	14.83	1.23	14.82	1.23	12.00	1.26	10.90	1.28	13.50	1.24
Overall		13.15	1.30	12.01	1.30	13.28	1.30	13.01	1.30	10.22	1.32	10.20	1.35		

The analysis also revealed significant main effects of order difficulty $F(2, 306) = 205.56$, $p < .001$, $\eta_p^2 = .573$, and presented pairs, $F(2, 306) = 38.99$, $p < .001$, $\eta_p^2 = .203$. These effects were qualified by an order difficulty × presented pairs interaction, $F(4, 612) = 32.71$, $p < .001$, $\eta_p^2 = .176$, showing interesting result that third pairs were studied not longer but shorter than both first and second pairs in moderate, $t(153) = 2.41$, $p = .017$, $r = .19$, and difficult orders, $t(153) = 9.06$, $p < .001$, $r = .59$), there were no significant differences in the simple ones, $t(153) = -0.47$, $p = .638$, $r = .04$ (for descriptive statistics see Table 3). The interaction of helplessness training with order difficulty ($F(10, 306) = 1.58$, $p = .111$, $\eta_p^2 = .049$) and presented pairs ($F < 1$, *ns*) did not reach the significance level. The three-way interaction was not significant as well ($F < 1$, *ns*).

Reaction Times for Correct Answers

We also examined differences between experimental conditions in terms of reaction times for correct answers. A 6 (helplessness training: full control deprivation vs. random immunization vs. immunization vs. random restoration vs. restoration vs. baseline) × 3 (order difficulty: simple vs. moderate vs. difficult) × 2 (pair distance: adjacent vs. inferred) mixed-model ANOVA with helplessness training as a between-subjects factor and order difficulty and presented pair as within-subjects factors, was conducted. The analysis revealed a significant main effect of helplessness training, $F(5, 153) = 2.37$, $p = .042$, $\eta_p^2 = .072$. Differences between the full deprivation group and the control group were nonsignificant, $t(153) = 0.29$, $p = .769$, $r = .023$. Similar to the previously presented analysis, the comparison between the full deprivation group and both random groups did not reach the significance level, $t(153) = -1.53$, $p = .128$, $r = .123$ but when we consider random groups separately we can observe that participants from the random immunization group responded significantly more slowly in comparison to participants from the full deprivation group $t(153) = -2.54$, $p = .012$, $r = .020$, whereas there were no significant differences in reaction times between participants from the random restoration group and the full deprivation group $t(153) = -0.11$, $p = .914$, $r = .008$. What is more, reaction times in the random immunization condition were longer than in the immunization condition $t(153) = 2.40$, $p = .018$, $r = .190$, whereas the comparison between the random restoration group and restoration group was not significant, $t(153) = 0.48$, $p = .632$, $r = .039$. There were no significant differences in reaction times between the full deprivation group and both the immunization group $t(153) = -0.14$, $p = .889$, $r = .011$ and the restoration group $t(153) = 0.37$, $p = .710$, $r = .029$.

The analysis also revealed significant main effects of order difficulty, $F(2, 306) = 56.70$, $p < .001$, $\eta_p^2 = .270$, pair distance, $F(1, 153) = 22.83$, $p < .001$, $\eta_p^2 = .130$, and an interaction between these factors, $F(2, 306) = 19.06$, $p < .001$, $\eta_p^2 = .111$. Reaction times for inferred pairs were longer than for adjacent pairs but only for moderate, $t(153) = -4.17$, $p < .001$, $r = .25$, and difficult orders, $t(153) = -4.84$, $p < .001$, $r = .36$. No significant differences were detected for simple orders, $t(153) = -0.97$, $p = .334$, $r = .08$

Table 4

Reaction Times for Correct Answers (in Seconds) in the Linear Orders Task as a Function of Helplessness Training, Order Difficulty and Pair Distance

Order difficulty	Pair distance	Full deprivation		Random immunization		Immunization		Random restoration		Restoriation		Baseline		Overall	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Simple															
	Adjacent	4.39	0.27	4.36	0.27	3.76	0.27	3.56	0.27	3.21	0.27	3.96	0.28	3.87	0.27
	Inferred	4.24	0.66	5.41	0.66	4.12	0.66	3.46	0.66	3.17	0.67	4.35	0.69	4.13	0.67
Moderate															
	Adjacent	4.28	0.31	4.70	0.31	4.02	0.31	4.06	0.31	3.88	0.31	4.01	0.32	4.16	0.31
	Inferred	4.91	0.82	6.90	0.82	5.29	0.82	4.35	0.82	4.45	0.83	5.06	0.85	5.16	0.83
Difficult															
	Adjacent	5.57	0.70	7.01	0.70	5.66	0.70	6.89	0.70	4.89	0.71	4.24	0.73	5.71	0.71
	Inferred	8.11	2.43	16.94	2.43	9.41	2.43	9.76	2.43	9.87	2.48	8.27	2.53	10.39	2.46
Overall		5.25	0.87	7.55	0.87	5.38	0.87	5.35	0.87	4.91	0.88	4.98	0.90		

We also obtained a significant interaction between the order difficulty and the helplessness training, $F(10, 306) = 1.96$, $p = .037$, $\eta_p^2 = .060$, showing that reaction times in difficult orders were longer in comparison to simple orders for random immunization, $t(153) = -5.74$, $p < .001$, $r = .42$, immunization, $t(153) = -2.91$, $p = .004$, $r = .23$, random restoration $t(153) = -3.90$, $p < .001$, $r = .30$, and restoration condition $t(153) = -3.32$, $p = .001$, $r = .26$. The comparison for full deprivation, $t(153) = -0.97$, $p = .334$, $r = .08$, and baseline condition $t(153) = 1.17$, $p = .244$, $r = .09$, did not reach the significance level. No other interaction effect was found (pair distance × helplessness training: $F(5, 153) = 1.54$, $p = .181$, $\eta_p^2 = .048$; order difficulty × pair distance × helplessness training: $F < 1$, *ns).* All descriptive statistics for reaction times are presented in Table 4.

Reasoning Accuracy

Finally, to assess the proportion of correct answers to queries for the two levels of pair distance for each order and for the three levels of difficulty we ran a 6 (helplessness training: full control deprivation vs. random immunization vs. immunization vs. random restoration vs. restoration vs. baseline) × 3 (order difficulty: simple vs. moderate vs. difficult) × 2 (pair distance: adjacent vs. inferred) mixed-model ANOVA, with helplessness training as a between-subjects factor and order difficulty and presented pair as within-subjects factors. Most importantly, the main effect of helplessness training did not reach the significance level, $F < 1$, *ns*. The analysis revealed significant main effects of order difficulty, $F(2, 306) = 29.00$, $p < .001$, $\eta_p^2 = .160$, and pair distance, $F(1, 153) = 9.86$, $p = .002$, $\eta_p^2 = .061$. These effects were qualified by an order difficulty × presented pairs interaction, $F(2, 306) = 4.34$, $p = .014$, $\eta_p^2 = .028$, showing that the proportion of correct answers was significantly higher for adjacent than for inferred pairs but only for moderate, $t(153) = -3.17$, $p = .002$, $r = .25$, and difficult orders, $t(153) = -4.84$, $p < .001$, $r = .36$, not for the simple ones, $t(153) = -0.98$, $p = .330$, $r = .08$. The interaction of helplessness training with order difficulty ($F < 1$, *ns*) and presented pairs ($F < 1$, *ns*) did not reach the significance level, similarly the three-way interaction ($F < 1$, *ns*). Accuracy means and standard deviations are shown in Table 5. As to make more clear differences between experimental conditions for all the dependent variables, accuracy means are shown in Figure 1.

Discussion

We conducted the present study in order to verify whether different types of personal control deprivation differentiate learned helplessness deficits. In general, the results confirm the assumption that what significantly modifies the consequences of uncontrollability experience is the stability of this experience. A high level of uncertainty, and on a more speculative note cognitive entropy, experienced by a person struggling with unsolvable problems intermixed with solvable problems, seems to result in generative reasoning deficits comparable or even greater than those experienced after the classic procedure. Such findings are in opposition to the assumption that formulating unstable

Table 5

Reasoning Accuracy in the Linear Orders Task as a Function of Helplessness Training, Order Difficulty and Pair Distance

Order difficulty	Pair distance	Full deprivation		Random immunization		Immunization		Random restoration		Restoriation		Baseline		Overall	
		M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
Simple															
	Adjacent	0.98	0.02	0.94	0.02	0.94	0.02	0.93	0.02	0.89	0.02	0.95	0.02	0.94	0.02
	Inferred	0.96	0.03	0.90	0.03	0.94	0.03	0.94	0.03	0.88	0.03	0.96	0.03	0.93	0.03
Moderate															
	Adjacent	0.93	0.03	0.94	0.03	0.93	0.03	0.94	0.03	0.92	0.03	0.95	0.03	0.94	0.03
	Inferred	0.93	0.03	0.94	0.03	0.90	0.03	0.95	0.03	0.88	0.03	0.93	0.03	0.92	0.03
Difficult															
	Adjacent	0.84	0.03	0.91	0.03	0.90	0.03	0.89	0.03	0.85	0.03	0.89	0.03	0.88	0.03
	Inferred	0.81	0.04	0.79	0.04	0.84	0.04	0.85	0.04	0.79	0.04	0.86	0.04	0.82	0.04
Overall		0.91	0.03	0.90	0.03	0.91	0.03	0.92	0.03	0.87	0.03	0.92	0.03		

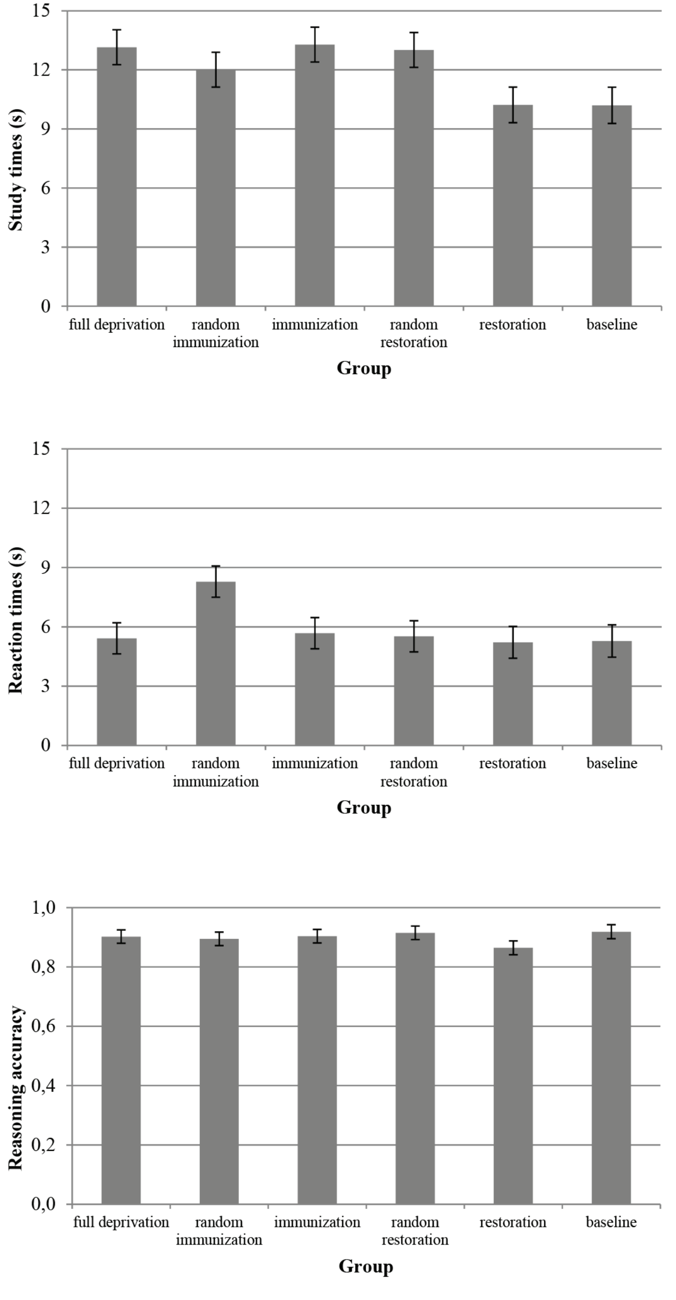

Figure 1. Cognitive exhaustion in terms of study times, reaction times for correct answers and reasoning accuracy in the Linear Orders Task for six groups: full deprivation, random immunization, immunization, random restoration, restoration, and control group. Error bars represent standard deviation.

attributions after helplessness training may protect a person against learned helplessness deficits (Abramson et al., 1978). However, it should be noted that researchers presumed that the stability dimension is responsible for the chronicity of the deficits, not their size. Mechanisms of those effects need to be further explored, but it may be hypothesized that instability of personal control deprivation leads to a cognitive exhaustion state but it is limited in time.

The observed effects of randomness, however, did not concern the reasoning accuracy in the Linear Orders Task, which appeared to be too easy for the participants. The percentage of correct answers for all the groups, which fluctuates around 90, seems to confirm one of the major assumptions of the Informational Model of Helplessness that the deficits of learned helplessness become apparent only in difficult and complex tasks (Kofta & Sędek, 1993; Sędek & Kofta, 1990). In the present study, the task was found not to be a sufficiently sensitive measure of the efficiency of generative reasoning, so no significant effects of helplessness training were obtained. However, some other measures revealed several valuable findings.

First, an interesting pattern emerged for study times in the learning phase of the Linear Orders Task. It was found that for all groups with uncontrollable pre-exposure, with the exception of the restoration group, the study times were longer than for the control group. Taking this measure as an indicator of an experienced difficulty in integrative processes, we may conclude that they needed more time to achieve the level of performance comparable to baseline participants. Such a finding concerns both random groups and indicates that an unstable controllability experience may result in constructive processes problems comparable to those after the classic procedure. This clearly supports the idea that the level of cognitive exhaustion syndrome is not only a function of the duration of learned helplessness training as was previously assumed (e.g., Wortman & Brehm, 1975), and shorter but unstable contact with unsolvable tasks may lead to deficits as well. Concerning the immunization process, it seems that initial contact with solvable series was insufficient to reduce negative effects of subsequent unsolvable tasks and the effect of a loss of control was so strong that it diminished the effect of randomness. Taking into account that, to date, the efficiency of the immunization procedure has been evidenced only with the use of Behavioral Helplessness Training, followed by a task that demanded a behavioral activity, for example, pressing an adequate button in order to avoid an unpleasant sound, it seems plausible to hypothesize that the immunization process requires a social context understood as a behavioral activity evaluated by others. Results obtained for the control restoration process were in line with our hypothesis, which predicts that the random procedure will diminish the positive effect of control restoration and result in greater cognitive deficits in the random restoration group as compared to the restoration group. The positive effect of control restoration seems to emerge only when there is a systematic shift from uncontrollable to controllable series and this pattern of results resembles that obtained by Bukowski et al. (2015). It seems, however, that it is an oversimplification to assume that moderate levels of control deprivation lead to cognitive mobilization effects, because such an effect was obtained only when loss of control was preceded by solvable tasks. What is more, results suggest that in the light of the Informational Model of Helplessness, immunization to the learned helplessness may be possible but with the reverse procedure than the one assumed by Seligman and Maier (1967), which is consistent with the idea of the dominance of the retroactive interference during helplessness training.

Another interesting finding emerged for the reaction times for correct answers in the testing phase of the Linear Orders Task, which may be interpreted in terms of processing efficiency. It appeared that the random immunization group showed significantly longer times of responding for correct answers in comparison to all other groups. These results are congruent with the assumption that instability of control experience may, indeed, be a factor contributing to cognitive impairment after prolonged exposure to non-contingency. However, this effect emerges only for the immunization sequence, not the restoration one. Taking into account the significant differences between the random immunization group and immunization group, it should be noted that it was the random procedure, and not loss of control itself, that caused the transition to the state of learned helplessness. This result becomes especially important in the situation of no significant differences between the group with the classic helplessness training and the control group. If the test task was so simple that it did not display cognitive deficits in the group in which such deficits were observed in many other studies, it seems that the process of random immunization must have a special influence upon generative reasoning. Such results are in line with the hypothesis that an instability of control experience results in cognitive deficits similar to those experienced upon anxiety and may not impair performance effectiveness (quality of performance) when it leads to the use of compensatory strategies, for example, increased use of processing resources. What is more, it seems that the last series in the helplessness training may significantly differentiate consequences of random uncontrollability experience because the presented effects do not concern a random restoration group. In contrast to the result of study times, it seems that a positive trajectory of control experience totally eliminates the effects of an instability experience on generative reasoning.

Apart from the intergroup differences, general regularities in the process of solving the Linear Orders Task were observed. Results obtained for study times in the learning phase demonstrated an interesting effect that in moderate and difficult orders the third premises were studied more briefly than both the first and the second ones. It seems that in simple tasks participants do not simply store the presented pairs but rather try to integrate them into a mental model, whereas in more difficult series a spontaneous generative, constructive mental activity was diminished. This effect may underlie longer reaction times and lower reasoning accuracy in more difficult series for inferred questions as compared to the adjacent ones. Presumably, in the testing phase of linear orders participants did not only recollect adequate pairs on the basis of previously generated mental models, but rather had to invest an additional effort to reach the high level of performance. In particular, this concerned participants from immunization and restoration groups, both random and stable, who needed significantly more time to give correct answers in difficult tasks in comparison with simple tasks. Therefore, it seems plausible to hypothesize that the function impaired by uncontrollability pre-exposure was not memory retrieval but generative reasoning.

The results of the presented work indicate that an experience of personal control deprivation is a process the consequences of which are differentiated by two factors: the stability of control experience and the character of the first and the last series in helplessness training. We expected the first factor to prevail over the second one but our findings show different patterns of results for experienced difficulty in integrative processes in comparison to processing efficiency, and thus demonstrate that such an assumption would be an oversimplification. For the first indicator of a cognitive exhaustion state, the effect of randomness seems to be dominant as participants from both groups exposed to instability of control experience needed more time to learn the presented pairs in comparison to participants who underwent the classic procedure. What is more, the effect of instability was so strong that it seems to even diminish the positive effect of control restoration. Results obtained for processing efficiency present a converse pattern. For regaining control it does not make any difference whether this happens as an effect of unstable or stable deprivation of control – both variants seem to reduce negative effects of previously experienced lack of personal control and result in processing efficiency comparable to control condition. However, this interpretation should be taken with caution since, as reported earlier, there were no significant differences between the participants from the full deprivation and the baseline condition. Nevertheless, it can be observed that the combination of two factors expected to cause the most severe deficits in generative reasoning, that is, the instability of control experience and loss of control, results in the most decreased processing efficiency. In other words, the results demonstrated an interesting interactional pattern: with regard to control restoration, the effect of randomness results in difficulties in integrative processing, but not decreased processing efficiency, whereas with regard to the loss of control, the inverse is true. Therefore, it seems legitimate to assume that experiencing dynamic fluctuations in perceived control may highlight the importance of the recency effect and lead to formulating the final conviction about the sense of control on the basis of the last series in the helplessness training. Ending random training with a solvable task may contribute to the higher sense of self-efficacy and as a consequence result in a higher processing efficiency, whereas a final unsolvable task may be related to a lower perceived sense of control and result in a lower processing efficiency.

Different patterns of results obtained for study times and for reaction times should lead to a more careful reflection on the nature of cognitive exhaustion syndrome in terms of motivational and cognitive deficits. The study times in the Linear Orders Task was interpreted by Sedek and von Hecker (2004) as a measure of the motivational level of cognitive involvement. Kofta and Sędek (1993) assume that contact with uncontrollability causes symptoms of internal motivation loss, which are displayed in such subjective feelings as a decrease in interest in a task or lack of pleasure in undertaking an activity. Yet, results of studies in which learning times in test tasks for groups with the experience of control deprivation and the control groups were compared, mostly show that there are no significant differences as for an undertaken cognitive effort (Sędek & von Hecker, 2004; von Hecker & Sędek, 1999). While comparing the means obtained in this study, the results are even higher for the majority of experimental groups as compared to the control group. Such results seem to be consistent with the research demonstrating that experiencing anxiety may enhance motivation to undertake mental effort (Derakshan & Eysenck, 2009) and that control deprivation can heighten motivation and, at the same time, reduce cognitive resources (Ric & Scharnitzky, 2003). Thus, objective and subjective indicators of internal motivation seem not to be coincidental and the nature of motivational deficits in learning helplessness syndrome needs to be further explored. A hypothesis worth verification in subsequent empirical studies regards the fact that persons who experience control deprivation, despite feeling unwillingness to undertake a mental effort, finally do it and it turns out effective or not depending on the task's difficulty level. An intriguing question also refers to the importance of emotional deficits, which to date have been considered rather marginally in cognitive exhaustion syndrome. The results of the presented experiment also shed some light on the role of the level of task difficulty in learning helplessness deficits. In contrast to the assumption of the Informational Model of Helplessness (Kofta & Sędek, 1993; Sędek & Kofta, 1990), it seems that the cognitive exhaustion syndrome is not limited to difficult tasks only, but it has varied symptoms depending on the task's difficulty level. It seems plausible that in difficult tasks it is connected with effectiveness, whereas in simple tasks it is connected with processing efficiency and a motivation to undertake a cognitive effort.

There are at least two limitations of the presented study. First, the Linear Orders Task appeared to be too easy to reveal performance deterioration after Informational Helplessness Training. It may be a matter of participants, as in the research that concerned the functioning of people with depression (Brzezicka, Kamiński, Kamińska, Wołyńczyk-Gmaj, & Sędek, 2017) or subclinical depression (Sedek & von Hecker, 2004), significant differences in comparison to the control group were found. Future studies may benefit from making the task more difficult and it may be a good idea to use capital letters as stimuli instead of names in order to avoid linguistic connotations (see: Brzezicka et al., 2017). Second, our experimental design does not allow differentiation of the effect of the first series from the effect of the last series in the random procedure of helplessness training. Although there are theoretical premises which allow us to assume that the effect of the last series plays a more important role in triggering the cognitive exhaustion state, it would be worth verifying this in further studies.

To conclude, the results of the presented study indicate that deprivation of cognitive control is a process, and stability of this experience differentiates learned helplessness deficits. Instability of control experience leads to difficulties in integrative processes and – if combined with the loss of control – it results in a lower processing efficiency. Additionally, we demonstrated that immunization against a cognitive exhaustion state may be a consequence of a stable restoration of control process. The present study opens a relatively new and unexplored topic of the effects of stability of uncontrollability experiences on cognitive exhaustion and needs to be further explored, with special attention given to distinguishing cognitive and motivational deficits in cognitive exhaustion syndrome. Studying this issue seems particularly significant for the applicative character of research on the phenomenon of learned helplessness.

Supplementary Materials

Data for this article are available at PsychArchives: https://doi.org/10.23668/psycharchives.784

Funding

The authors have no funding to report.

Competing Interests

The authors have declared that no competing interests exist.

Acknowledgments

The authors have no support to report.

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