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The neutral stimuli detection deficits in delusion-prone individuals

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Summary

Aim. The aim of the study was to investigate whether the delusion-prone individuals tend to select relevant information among distractors in order to examine whether the occurrence of overt delusions could be preceded by specific features of attention functioning.
Methods. Individuals with high and low susceptibility to delusions completed the experimental task relying on the search for the specified signal hidden among distractors.
Results. The delusion-prone individuals did not select emotionally neutral signal more effectively than the non delusion-prone ones. What is more, they made more 'false-alarm' mistakes than the control group, especially at the later stage of the task related to the increased fatigue level.
Conclusion. The delusion-proneness is not related to the excessive information selection ability.

delusion-proneness / signal detection / selective attention

INTRODUCTION

The hypothesis that delusions are distributed in general population as a continuum from the absence of delusional beliefs to the overt delusions has received growing attention in recent years [1, 2, 3, 4]. According to this hypothesis delusional ideations could be observed not only in clinical, but also in non – clinical groups, however in general population these thinking disturbances are not as intense and distressing as delusions being symptoms of pathology. This continuum perspective allows us to examine the development of some psychopathological symptoms by investigating emotional and cognitive phenomenon which could be a basis of unusual conviction.

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Studies examining reasoning disturbances along the continuum of delusions indicated that so called 'delusion-prone' individuals reveal the reasoning bias reflected by hastiness in decision making and the tendency to gather few information concerning the decision, even if the additional data is easily available. What is more, they could also be more convinced than other people that they made the right decisions [5, 6, 7]. This phenomenon, described as 'jumping to conclusion bias', is also observed in individuals with delusions [7, 8, 9, 10] and some authors regard it as a cognitive mechanism being a base of delusion formation [11, 12, 13].

However, one of the most visible feature of delusions is a strong belief that their convictions are appropriate to reality and defies rational counterarguments [14]; thus, delusional thinking seems to demand extraordinary ability to search for information matching the delusional ideation. They should tend to support once formulated beliefs by selecting information rather than present the bizarre, irration-

al thinking. On the one hand, they should be able to capture subjectively valuable information quickly and efficiently; on the other hand, they should protect their cognitive system by ignoring facts which undermine their delusional convictions. It follows that the individuals susceptible to delusions could be characterized by some general attention properties, such as the extended ability to notice previously accepted rules or facts. However, their tendency to make decisions hastily and without sufficient data suggests that they are not interested in searching for additional information, even if they could support their convictions.

The first aim of the current study was to investigate the general ability of delusion-prone individuals to select information, i.e. to select the pre-defined signal among the distractors in order to examine whether the susceptibility to delusions could be related to the extensive ability to search for the relevant information occurring among informational noise. It was predicted that the participants susceptible to delusions would search for suitable information more efficiently than the control group, i.e. more quickly and making less errors.

The second aim of the study was to investigate the ability of the delusional-prone individuals to change the previously accepted and applied rules of information selection. It was assumed that they would reveal more problems than the control group in the assimilation of new rules of information selection since they would perform less efficiently in conditions when they are forced to behave in accordance with the redefined information selection criteria.

SUBJECTS

The sample consisted of 87 healthy Pedagogical University students, 82 women and 5 men. The age of participants ranged from 19 to 29 years old, with mean age 20. 31 (SD=1.31). All participants signed informed consent after being provided with a full description of the task. All participants completed the study voluntarily during the single experimental session.

Participants completed Peters et al. Delusions Inventory [2] (see below), and were divided at the median into two groups: delusion-prone individuals, and non delusion-prone ones. In the current study the median was 13.

The delusion-prone group consisted of 41 students, 38 women and 3 men (mean age 20.38, SD=1.68). Within this group the PDI scores range from 14 to 25. The non-delusion- -prone (control) group was composed of 45 students, 43 women and 2 men (mean age 19.84; SD=2.86) with PDI scores ranging from 2 to 13. The two groups of participants did not differ in terms of age ($t(85) = -0.47$; $p<0.63$).

MATERIALS AND METHODS

Peters' et al. Delusions Inventory (PDI) [2]. PDI is the questionnaire measuring delusional ideation in general population. It consists of 40 items related to unusual experiences. Responses to the PDI are in dichotomous (Yes/No) format. 'Yes' answers are subsequently assessed for the dimensions of 'distress', 'preoccupation', 'conviction' on a 5 – point Likert scales; thus, the PDI provides four separate scores: the Yes/No score, a distress score, a preoccupation score, and the conviction score. The Polish version of PDI has demonstrated good internal consistency (Cronbachs' alpha for the Yes/No score = 0.88 [15]).

The experimental task. At the beginning of the task each participant is given a sheet of paper with 400 clock icons set horizontally (20 lines with 20 icons in each line). The icons present full hours, and one of them – in the current study the icon showing 5.00 p.m. hour – was defined as a signal. Participants were asked to detect as many signals as possible during 2 minute – interval and mark them in any way. When the time was over, participants had to mark the icon which he/she analyzed as the last one in order to indicate how many icons they were able to analyze. There were 40 signals on the sheet of paper. The remaining icons constitute information noise, whereas the 4.00 pm icon, which is most similar to the signal and could be easily mistaken for it, was treated as a distractor. In the current study participants executed the task three times with 2 minute – intervals in between. Later on, in the last execution of the task, the participants

were asked to mark the 4.00 pm icon being a distractor in the previous three tasks. This procedure was invited by Marciusz Moroń, and was described in detail by Szymura and Słabosz [16].

RESULTS

The data were assessed and evaluated by Statistica 10.0 software. Analysis of variance and Student's t-test were employed for statistical analysis. The results were considered as statistically significant with a p value of less than 0.05.

The task provides measures which represent the efficiency of analyzing and selecting information: the number of icons analyzed; the number of errors relies on marking an icon other than a signal (FA), the number of errors relies on missing the correct signal (OM); the total number of errors (D); and the proportion of different types of errors (β=FA/D). All these parameters were measured at each stage of the experimental task.

Regarding the number of icons searched for by participants, the 2 (groups) x 3 (test executions relied on the search for the 5.00 p.m. icon) ANOVA analysis did not reveal the main effect ($F<1$). The between – group comparison showed that the delusion-prone students and the non delusion-prone ones did not differ significantly in the total number of icons analyzed during the three initial executions of the task ($t(87)=0.58$; $p<0.55$). The two groups of participants also did not differ in the first, the second and the third test performance; thus, we could not conclude that individuals susceptible to delusions search for neutral information more quickly than other people.

In terms of the total number of mistakes (D) the 2 (groups) x 3 (number of task executions) also did not reveal the main effect ($F<1$). The total number of errors made by delusion-prone and non delusion-prone individuals also did not yield significant difference ($t(87)=0.57$; $p<0.56$), even if it was counted separately for the first, the second and the third test execution (see Tab.1).

Table 1. The numbers of icons analyzed and the mean numbers of mistakes made in the four executions of the experimental task by the delusion-prone group and non delusion-prone participants.

	Delusion-prone group	Non delusion-prone group		
Numbers of icons analyzed				
	M (SD)	M (SD)	t (87)	p
Test 1	332.69 (68.06)	327.62 (57.54)	0.02	0.98
Test 2	366.70 (50.77)	374.04 (42.64)	0.80	0.42
Test 3	376.71 (37.79)	385.71 (23.38)	0.88	0.30
Test 4	344.66 (53.92)	356.11 (44.36)	1.09	0.25
Total number of mistakes (D)				
	M (SD)	M (SD)	t (87)	p
Test 1	11.66 (7.32)	11.80 (8.37)	- 0.08	0.93
Test 2	10.85 (6.70)	11.75 (6.27)	0.03	0.97
Test 3	10.19 (5.77)	10.60 (5.76)	- 0.49	0.62
Test 4	9.75 (5.90)	7.75 (5.56)	- 1.63	0.10
Omitting mistakes (OM)				
	M (SD)	M (SD)	t (87)	p
Test 1	11.00 (7.14)	11.40 (7.86)	0.02	0.98
Test 2	10.35 (6.32)	11.44 (6.18)	0.25	0.80
Test 3	9.71 (5.64)	10.35 (5.68)	- 0.23	0.81

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Test 4	9.54 (5.93)	7.42 (5.51)	-1.72	0.08
'False alarm' mistakes (FA)				
	M (SD)	M (SD)	t (87)	p
Test 1	0.66 (1.18)	0.4 (1.05)	0.74	0.45
Test 2	0.50 (1.89)	0.31(0.55)	- 1.02	0.30
Test 3	0.47(0.74)	0.24 (0.57)	- 2.38	0.01
Test 4	0.21 (0.41)	0.32 (0.61)	0.94	0.34

The comparison of the number of errors relying on omitting the correct signal (OM) also did not reveal significant differences. The 2 (groups) x 3 (test executions) ANOVA analysis did not reveal the main effect ($F<1$). Neither did the between – groups comparisons of the total number of omitting errors ($t(87)=0.02$; $p<0.97$), and the comparisons made separately for the first, the second and the third executions of the test. Regarding the number of 'false alarm' errors (FA), relying on marking the icon which was not the signal, the 2 x 3 ANOVA also did not show the main effect ($F<1$); however, the between – groups comparisons reveal that the delusion-prone participants made significantly more 'false alarm' mistakes than the non delusion-prone students in the last search for the 5.00 p.m. icon ($t(87)= –2.38$; $p<0.01$). What is more, the comparisons of the total number of 'false alarm' errors reveal that the delusion-prone individuals marked incorrect signals more often than non delusion--prone students; however, this difference did not reach the level of statistical significance ($t(87)= – 1.83$; $p<0.06$) (see Tab. 1). The strategies of test performances measured with the β parameter (β=FA/D) did not differ significantly between the groups ($F<1$).

At the last stage of the task, the participants were asked to search for the icon representing the 4.00 pm hour which was a distractor in the previous three tasks. It was expected that this instruction change would disturb the level of performance in both the delusion-prone and the non delusion-prone groups; however, the participants susceptible to delusions should bear the higher costs of the change of the once accepted rules than those without delusions proneness.

Regarding of the number of icons searched for, the 2 (groups) x 2 (the third and the fourth test executions) ANOVA showed that there was not a significant difference between the number of icons analyzed by delusion-prone and non delusion-prone students between the third and the fourth test performances ($F<1$). In the last execution of the task the two groups of participants found the similar number of icons ($t(87)=0.58$; $p<0.55$).

In terms of errors, the 2 (groups) x 2 (the third and the fourth test executions) ANOVA analysis also did not reveal the main effect of the groups ($F<1$) for both the total number of errors (D), and for the 'omitted mistakes' (OM) ($F[1.174]=1.11$; $p<0.29$). Similarly, in conditions, when the instruction was changed the two groups of participants did not differ in the total number of errors being made ($t(87)= –1.63$; $p<0.10$), and the number of errors relying on omitting the correct signal. However, in the last execution of the task, the delusion prone and non delusion-prone participants differed significantly regarding of 'false alarm' errors (FA): 2 (groups) x 2 ANOVA (the third and the fourth test executions) revealed the main effect for the group ($F[1.174]=5.90$; $p<0.01$, see Fig. 1). Although, the comparison of 'false alarm' showed that when the signal was redefined, the participants susceptible to delusions and the control group once again made similar amount of FA errors (see Tab. 1). Regarding of the proportion of different types of errors (β=FA/D), the 2 (groups) x 2 ANOVA (the third and the fourth test executions) also revealed the effect which approached to the level of significance ($F[1.174]=3.57$; $p<0.06$).

DISCUSSION

The aim of the current study was to investigate whether the individuals with higher score on PDI questionnaire are characterized by the excessive ability to select information relevant to a predefined rule. It was predicted that participants with the high PDI score

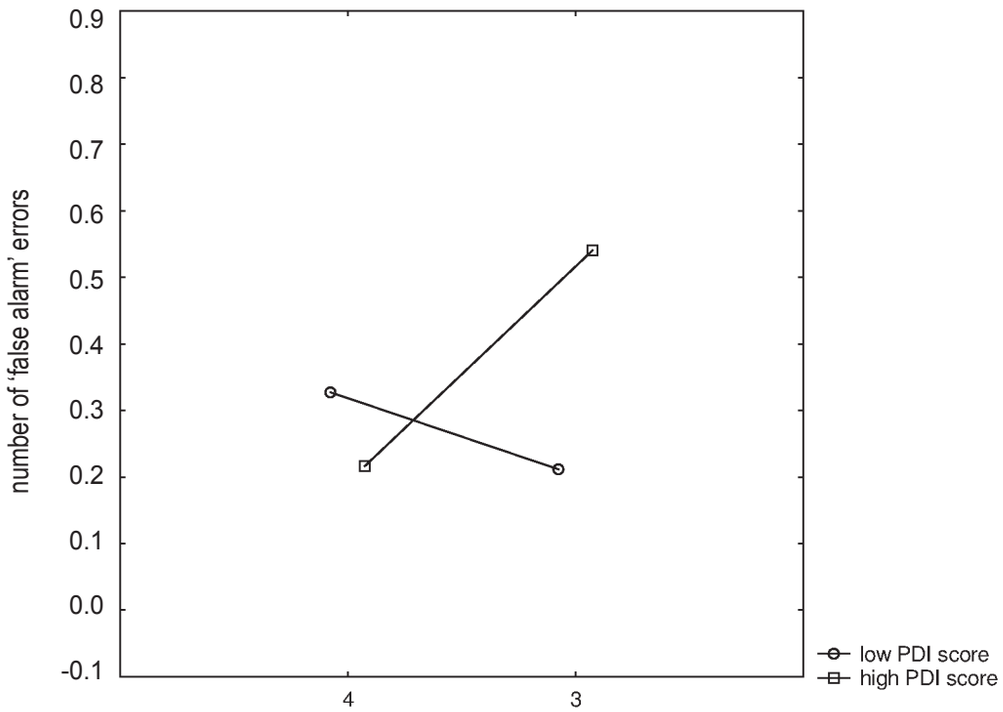

Figure 1. The number of 'false alarm' errors made by the delusion-prone group and the non-delusion-prone participants in the third and the fourth execusion of the task

would search for the signal hidden among information noise and distractors more efficiently than those with the low PDI score, i.e. they would search for more icons, and they would made fewer mistakes than the non-delusion--prone ones.

Contrarily to the prediction, the results showed that the delusion-prone group did not differ from the non delusion-prone one in respect of the speed of performance (i.e. the number of analyzed icons). What is more, they made more 'false alarm' errors. It suggests that they are more impulsive than the individuals not susceptible to delusions: they react quickly and carelessly and prefer marking the incorrect signal rather than omitting the correct one. Although the delusion-prone individuals made more 'false alarm' errors in all test performances relying on the search for the 5.00 pm icon, the tendency to react impulsively was particularly visible in the third execution of the task when the participants were processing the same, undifferentiated material for the third time; thus, the level of fatigue was the highest. These results obtained by the group with the high PDI score contrast with the results occurring typically in this type of research. Participants usually improve their performance subsequently, reaching the best score (i.e. make fewer mistakes) at the last execution of the task [16] since the multiple repetition of behavior is usually related to the skills acquisition. The relation between the delusion--proneness and the duration of the task suggests that in conditions when individuals susceptible to delusions feel tired or notice that the efficiency of their performance is decreasing for some others reasons, they change reaction strategy. They start to react to each stimulus which for them seems to be at least slightly similar to the signal, since they prefer react even if it is not necessary rather than to take a risk meaning that they would mistakenly ignore the important signal. Although this strategy could be associated with the increased effort, for the delusion-prone individuals this more could seem to be safer.

In the delusion-prone group the change of signal caused the sudden reduction of the number of the 'false alarm' errors. In conditions when the new rule of signal detection was introduced, the delusion-prone individuals reacted more correctly than controls. On the one hand, the novelty of the situation could reduce the degree of boredom and weariness, thus improving the performance in partici-

pants who are particularly prone to boredom. On the other hand, in the new circumstances the individuals susceptible to delusions should become more vigilance than in circumstances which seem familiar, since the novelty of the situation could enhance their suspicious attitudes, and cause the decrease of their apprehension level.

CONCLUSIONS

To sum up, the hypothesis that delu sion-proneness is related to enhancing the general ability to select information was not confirmed. In the current study, in which the neutral stimuli were used as experimental material, the delusion-prone group did not search for the signal more efficiently than controls. Contrarily, the results indicate that the individuals with subclinical form of delusions tend to react more impulsively than others. These results are closer to the findings that they are characterized by the tendency to hasty decision making. They do not support the hypothesis of their particular carefulness in information selection. However, these results do not exclude the possibility that in daily functioning, especially in situations related to the delusional ideations, the delusion-prone individuals search for the subjectively valuable information more quickly and correctly than people without subclinical forms of delusions. The second hypothesis saying that the delusion-pone participants should bear the high costs of change the rules of information searching also was not confirmed. Contrarily, the results showed that the individuals with subclinical forms of delusions could adapt to the new instructions more easily than others, since the novelty of situations enhanced their searching skills rather than petrificate the lack of flexibility of their cognitive processes. However, once again it is worth to noting that this finding is related only to the neutral conditions; thus, it does not reflect the delusion-prone individuals behaviors in the situation involving the delusional themes.

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