**SUPPLEMENTARY MATERIAL**

**1. Details on inpatient/outpatient status and medication**

The majority of BPD patients were inpatients (N = 31); 8 BPD patients were outpatients. All ADHD patients were outpatients.

BPD: 17 patients were unmedicated; 22 patients were taking various psychiatric medications at the time of their participation in the study. Eight patients were medicated with antidepressants, 7 patients with antipsychotics, 6 patients with a combination of antidepressants and antipsychotics, and 1 patient with a combination of antipsychotic and mood stabilizer.

ADHD: 8 patients were unmedicated; 17 patients were taking various psychiatric medications at the time of their participation in the study. Seven patients were medicated with atomoxetine, 3 patients with methylphenidate, 1 patient with a combination of atomoxetine and methylphenidate, 2 patients with antidepressants, 2 patients with antipsychotics, 1 patient with a combination of antidepressants and antipsychotics, and 1 patient with a combination of atomoxetine and antipsychotics.

We provide exploratory analysis of the differences in impulsivity and cognitive tests between patients without psychiatric medication and patients under psychiatric medication across the two patient groups. Table S1 presents descriptive statistics and results of independent samples t-tests, p values are provided without correction. No difference reached significance (with or without correction more multiple comparisons).

**2. Order of tests**

The test battery was presented in a fixed order to all participants. Because of high number of tests, the order could not have been counterbalanced. However, self-reported, behavioral, and cognitive tests were interleaved so that the participants did not engage in one type of task for too long. Participants did not require breaks due to fatigue during the session. The order of tests was as follows: Zung Self-Rating Anxiety Scale, Go/NoGo task, delay discounting, MADRS, d2, Iowa Gambling task, stop signal task, UPPS-P, Tower of London, and digit span.

**Table S1. Descriptive statistics and differences in impulsivity and cognition variables between medicated and unmedicated patients**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Variable | Medication | *N* | *M* | *SD* | *t(df)* | *p* | η2 |
| PRE | no | 25 | 27.08 | 6.41 | -0.75 (62) | .455 | -0.19 |
| yes | 39 | 28.23 | 5.69 |
| PER | no | 24 | 25.17 | 4.96 | -1.38 (61) | .172 | -0.36 |
| yes | 39 | 27.13 | 5.76 |
| SS | no | 25 | 33.04 | 6.76 | 0.81 (61) | .421 | 0.21 |
| yes | 38 | 31.53 | 7.57 |
| NU | no | 24 | 37.13 | 5.14 | 0.47 (59) | .462 | 0.12 |
| yes | 37 | 36.41 | 6.29 |
| PU | no | 25 | 36.12 | 9.39 | -0.68 (60) | .502 | -0.17 |
| yes | 37 | 37.81 | 9.85 |
| Go omissions | no | 25 | 0.14 | 0.19 | 1.13 (62) | .263 | 0.29 |
| yes | 39 | 0.11 | 0.06 |
| Go RT | no | 24 | 349.72 | 39.20 | 1.44 (61) | .156 | 0.37 |
| yes | 39 | 338.43 | 23.29 |
| NoGo commissions | no | 25 | 0.30 | 0.22 | -0.60 (62) | .549 | -0.15 |
| yes | 39 | 0.33 | 0.15 |
| SSRT | no | 25 | 281.90 | 93.43 | -0.06 (62) | .955 | -0.01 |
| yes | 39 | 283.16 | 80.63 |
| AUC low | no | 25 | 0.27 | 0.22 | -1.09 (62) | .281 | -0.28 |
| yes | 39 | 0.34 | 0.15 |
| AUC high | no | 25 | 0.49 | 0.27 | -0.85 (62) | .401 | -0.22 |
| yes | 39 | 0.56 | 0.30 |
| IGT net score 1st half | no | 25 | 5.92 | 33.90 | -0.42 (62) | .674 | -0.11 |
| yes | 39 | 9.64 | 34.67 |
| IGT net score 2nd half | no | 25 | 16.08 | 43.15 | -0.69 (62) | .494 | -0.18 |
| yes | 39 | 24.87 | 53.61 |
| Digit span | no | 25 | 16.32 | 4.11 | -1.14 (62) | .258 | -0.29 |
| yes | 39 | 17.59 | 4.49 |
| d2 (accuracy) | no | 24 | 10.92 | 10.34 | 1.80 (32.35) | .081 | 0.53 |
| yes | 39 | 6.75 | 5.90 |
| d2 (speed) | no | 24 | 171.63 | 33.00 | -0.13 (61) | .900 | -0.03 |
| yes | 39 | 172.87 | 40.64 |
| ToL move score | no | 25 | 32.24 | 22.93 | 1.93 (61) | .058 | 0.50 |
| yes | 38 | 22.45 | 17.26 |
| ToL init. time | no | 25 | 77.61 | 57.34 | -1.12 (60) | .269 | -0.29 |
| yes | 37 | 97.69 | 76.53 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ToL exec. time | no | 25 | 224.08 | 99.16 | 1.59 (60) | .116 | 0.41 |
| yes | 37 | 186.78 | 84.11 |

*Note.* BPD = borderline personality disorder, ADHD = attention-deficit/hyperactivity disorder, HC = healthy controls, PRE = lack of premeditation, PER = lack of perseverance, SS = sensation seeking, NU = negative urgency, PU = positive urgency, Go omissions = Go omissions percentage, Go RT = Go reaction time, NoGo commissions % = NoGo commissions percentage, SSRT = stop signal reaction time, AUC = area under the curve, IGT = Iowa gambling taks, ToL = Tower of London, init. time = initiation time, exec. time = execution time

**3. Details on behavioral tests of impulsivity**

The Go/NoGo task used white letters A and B on a black background as stimuli. Participants were asked to press the space key on the computer keyboard whenever a Go stimulus (the letter “A”) appeared and suppress that action whenever a NoGo stimulus (the letter “B”) appeared. Go stimuli were highly prevalent (83%) to make action suppression less automatic and thus encourage more NoGo commissions (Nieuwenhuis *et al*., 2003). Stimuli duration was 0.4 seconds, and each stimulus was preceded by a fixation cross with a variable duration between 1.1 and 2.6 seconds. The task was divided into four blocks, each with 48 trials.

The stop signal task used white left and right arrows on a black background as the Go stimuli. Participants were asked to press the left or right arrow key when the respective Go stimulus appeared, except when the Go stimulus was followed by a Stop signal: a change in the arrow color from white to red. The time between the Go stimulus and the appearance of the Stop signal - the stop signal delay (SSD) - was initially set to 200 milliseconds. It increased by 45 milliseconds whenever action suppression was successful, and decreased by 45 milliseconds otherwise ("horse race procedure"; Verbruggen & Logan, 2009). The stop signal frequency was 25%. Each trial ended either after the participant’s response or, in the absence of a response, one second after the appearance of the stimulus. Each trial was preceded by a fixation cross of variable duration between 1.1 and 2.6 seconds. The task again involved four 48-trial blocks.

In the delay discounting task, participants were asked to answer a set of questions requiring a choice between a smaller but immediate reward (IR) and a higher but delayed reward (DR; e.g. *Would you rather receive CZK 500*[[1]](#footnote-1) *now, or CZK 900 in a month?*). For each combination of a DR amount and a delay period (D), different immediate reward amounts were displayed until an “indifference point” (IP) could be determined for the combination. The IP is the immediate reward amount that has the same subjective value as the higher delayed reward. Questions regarding different Ds and DRs were presented in random order, with the IR being selected according to a procedure described by Richards et al. (1999). The Ds and DRs were determined based on pilot studies. Chosen Ds were 1 day, 1 week, 1 month, 3 months, and 6 months. Two DRs were chosen: a smaller amount of CZK 990 (approx. EUR 40), and a higher amount approximately equivalent to the median monthly salary in the Czech Republic (CZK 24,900; approx. EUR 980). The IR amounts varied in CZK 20 increments in questions about the smaller DR and in CZK 500 increments in questions about the higher DR.

A computerized version of Iowa gambling task (IGT) based on the IGT version by Odum *et al*. (2011) was used and adapted using CZK. The task ended after 200 cards. The IGT design is summarized in Table S2.

**Table S2. The Iowa Gambling Task design**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Deck A | Deck B | Deck C | Deck D |
| Gain | CZK 1000 | CZK 1000 | CZK 500 | CZK 500 |
| Loss | CZK 1500  to CZK 3500 | CZK 12500 | CZK 500 | CZK 2500 |
| Gains to losses ratio  (in 10 cards) | 5:5 | 9:1 | 5:5 | 9:1 |
| Net losses  (in 10 cards) | 5 | 1 | 0 | 1 |
| Long-term outcome  (in 10 cards) | CZK -2500 | CZK -2500 | CZK 2500 | CZK 2500 |

**4. Details on the cognitive tests**

Working memory was assessed with the digit span subtest from Wechsler Adult Intelligence Scale-III (Wechsler, 1997). In the test, the examiner reads aloud a list of number sequences in an increasing degree of difficulty and the participant is asked to repeat the sequence in the original order (forward condition) or reverse order (backward condition). Each difficulty level consisted of two trials with the same number of digits. Two points were assigned if the participant responded correctly on both trials. One point was assigned if the participant recalled only one trial correctly and zero points were assigned if both trials were incorrect. The maximum score was 16 for the forward condition and 14 for the backward condition. The total score was created by adding both sub-scores together.

Executive functioning was measured by the Tower of London (ToL), Drexel University, Second Edition (Culbertson & Zillmer, 2005). The test consisted of two boards with three different sized bars and three beads of different colors. The examiner used one of the boards to present a pattern from beads placed differently on the bars. The participants were instructed to complete the same arrangement of beads on their board in as few moves as possible under predetermined rules (only one bead can be moved at the same time and each bar has a maximum of beads that can be placed on it). Ten tasks with increasing degrees of difficulty were presented to each participant, with a two-minute limit for completing each task. The following scores were recorded: *move score* represents the number of moves that the participant needed to achieve the given configuration that exceeded the minimum number of required moves. The *move score* gives information about theoverall efficiency of the participant’s problem solving, requiring planning and correct execution of the plan. *Initiation* *time* represents the time between the reception of instruction andinitiation of action; in other words, it is the time spent thinking about a plan before acting. *Execution time* represents the time that participant needed to solve the task.

Attention was assessed by a paper-and-pencil cancellation test d2-R (Brickenkamp *et al*., 2014) The test consisted of 14 rows with 47 characters. Each character was either a letter “p” or “d” and one to four dashes were placed above or below each letter (or both). The participant’s task was to scan the rows and cancel out as many “d” characters with two dashes above as possible while ignoring all other characters. The time limit for each line was set to 20 seconds and no pauses were allowed between the rows. The following scores were recorded: *speed* (represents total number of items worked through) and *accuracy* (represents percentage of omission and commission errors).

**REFERENCES**

**Brickenkamp R, Schmidt-Atzert L, Liepmann D, Hoskovcová S, Černochová D** (2014). *d2 attention test revised (Czech version)*. Prague: Hogrefe - Testcentrum.

**Culbertson W, Zillmer E** (2005). *Tower of London - Drexel University* (2nd ed.). Toronto: Multi-Health Systems.

**Nieuwenhuis S, Yeung N, van den Wildenberg W, Ridderinkhof KR** (2003). Electrophysiological correlates of anterior cingulate function in a go/no-go task: effects of response conflict and trial type frequency. *Cognitive, Affective & Behavioral Neuroscience* **3**, 17–26.

**Odum AL** (2011). Delay Discounting: I’m a k, You’re a k. *Journal of the Experimental Analysis of Behavior* **96**, 427–439.

**Richards JB, Zhang L, Mitchell SH, de Wit H** (1999). Delay or probability discounting in a model of impulsive behavior: effect of alcohol. *Journal of the Experimental Analysis of Behavior* **71**, 121–143.

**Verbruggen F, Logan GD** (2009). Models of response inhibition in the stop-signal and stop-change paradigms. *Neuroscience and Biobehavioral Reviews* **33**, 647–61.

**Wechsler D** (1997). *Wechsler Adult Intelligence Scale – Third Edition Manual* (3rd ed.). San Antonio: The Psychological Corporation.

1. CZK: Czech koruna [↑](#footnote-ref-1)