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Conference Paper

The Relationship Between Measures of Impulsivity and Clinical Characteristics of Patients With Alcohol Use Disorder

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Abstract

The current article presents findings on the interaction between impulsivity features and clinical characteristics of patients with alcohol use disorders (AUD). Patients (*n* = 88), who were completing detoxification program for the symptoms of AUD, were recruited for the study. They completed biographical questionnaire, Penn Craving Scale (PACS), self-report screening measure of the symptoms of adult ADHD (ASRS v.1.1) and underwent a series of experimental tasks (Delay Discounting Task (DDT), Stroop Task, Continuous Performance Test-Identical Pairs (CPT-IP), Tower of London (ToL)). Two distinct groups of impulsivity features were identified using cluster analysis. One group, which was comprised of DDT and ToL measures, described the level of impulsivity during the decision-making process. The second group included Stroop task and CPT-IP measures and expressed the level of response inhibition and interference control. In addition, the model of interaction between measures of impulsivity and clinical characteristics of patients was developed. The self-report measure of inattention and hyperactivity had significant effect on the level of craving and the duration of remission. No significant relationships were observed between DDT clinical characteristics.

Keywords: impulsivity, alcohol use disorder, delay discounting, stroop task, Tower of London, CPT-IP, craving, ASRS

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1. Introduction

Impulsivity is a multidimensional concept that encompasses physiological, behavioral, cognitive, and personality aspects and constitutes a key feature in many psychiatric disorders [7, 25]. Impulsivity can be categorized into three factors – impulsive choices, impulsive actions, and impulsive personality traits [24] and further operationalized

through such constructs as poor inhibitory control [1, 21], difficulties delaying gratification and increased discounting of delays [27, 34], poor planning and altered sensitivity to rewards and punishment [11, 39, 40], emotion dysregulation in the form of positive and negative urgency [5, 32, 39], the lack of perseverance and proneness to sensation seeking and risk taking [1, 29, 39], etc. Due to the complex nature of the concept of impulsivity, multiple attempts to develop models of impulsivity have been made (for example, Whiteside et al., 2005, [37]); at the same time, some authors [6, 23, 35] observed that measures of impulsivity do not necessarily correlate with each other and, thus, their exact contribution to the development and maintenance of psychopathology is still unclear.

Despite the lack of the shared agreement on what defines impulsivity, multiple studies established connections between impulsivity features and substance use and abuse. In non-clinical populations, greater risk-taking and non-planning characteristics [4, 8, 23], increased discounting of delays [8, 12], diminished inhibitory control [8, 22], increased urgency and sensation seeking [31], and reduced cognitive control [13] were associated with greater alcohol and other substances use. In clinical populations, the cross sectional comparisons of patients with substance use disorders (SUD) with healthy control groups observed higher levels of impulsivity in patients with SUD; in addition, the higher incidence of SUD was observed in individuals with impulse control disorders [25]. In addition, higher levels of impulsivity, including impaired decision-making, poor planning, reduced inhibitory control, etc., were deemed both the predictors and consequences of alcohol and other substance use disorders ([33], Jentsch et al., 2015, [19]). It was also observed that the relationship between the measures of impulsivity and the symptoms of SUD is not straightforward. Thus, MacKillop et al., (2007) and Field et al. (2007) reported that the levels of impulsivity is associated with symptoms of alcohol use disorder, levels of alcohol consumption, and craving, while Robles et al (2011) found that the impulsivity features don't covary with the severity of substance use disorder.

The goal of the current study is to explore how multiple measures of impulsivity, more specifically, response inhibition, impulsive decision-making, delay discounting, difficulties maintaining sustained attention, and results of self-report on inattention and hyperactivity and might be related to the clinical characteristics of patients with alcohol use disorders (AUD) (i.e., duration of AUD, average duration of past remissions, maximum duration of past remissions, type of alcohol consumption, and the level of craving).

Table 1: Psychosocial and clinical characteristics of the study participants.

Patients' characteristics (M ± SD)	
Age	42 ± 8.6 y.o.
Age of onset of AUD	31 ± 7.6 y.o.
Duration of AUD	11 ± 7.6 years
Average number of remissions	1.1 ± 1.4
Average duration of remissions	8 ± 15 months
Maximum duration of remissions	10 ± 17 months
Type of alcohol consumption (%(*n*)):	
Daily	58 (51)
Binge-drinking	28 (25)
Mixed	14 (12)

2. Methodology

2.1. Participants

In the present study, we recruited patients (n = 88), who were undergoing treatment for AUD (F10.2) at the Department of Addictions at V.M. Bekhterev National Research Medical Center for Psychiatry and Neurology (St. Petersburg, Russia). The patients were assessed prior to their discharge from the hospital. Psychosocial and clinical characteristics of the study participants are presented in Table 1.

2.2. Methods

For the purpose of this study we used the following measures – biographical questionnaire, experimental tasks (Tower of London (ToL), Continuous Performance Test-Identical Pairs (CPT-IP), Delay Discounting task with monetary rewards (DDT), Stroop task with neutral, emotional, and alcohol stimuli), Penn Alcohol Craving Scale (PACS), and Adult ADHD self-report scale (ASRS-v.1.1).

Biographical questionnaire, which was developed by the authors of this study, contained questions inquiring about patients' demographic characteristics (i.e., age, sex, etc.) as well as clinical characteristics of AUD (i.e., diagnosis, age of onset of AUD, duration of AUD, average number of remissions, average duration of remissions, maximum duration of remissions, etc.).

ToL is a subtest of Brief Assessment of Cognitions – Affective Disorders [14, 16]. The ToL is aimed at assessing spatial problem-solving abilities [30]. The participants are presented with two images of three pegs of unequal length with colored balls on

them; the aim of the task is to identify the number of balls that should be moved in order to make two images look alike. For the purpose of this study, we used the characteristic of impulsive decision-making, which was calculated as a logarithm of the ratio of correct to erroneous choices made within 20 sec.

CPT-IP is aimed to measure inhibition control [2]. We used the computerized version of the CPT-IP, which was developed using free software PEBL [26]. In this task, the participants are presented with two-, three-, and four-digit numbers and are asked to press the space bar, when two identical numbers are shown consequently. The numbers are shown for 50 ms followed by 950 ms of dark time. The response inhibition index is calculated as the mean of d-prime values for each session.

DDT is aimed at measuring temporal discounting (Kirby & Marakovic, 1996). The participants are presented with a set of hypothetical choices, asking to choose a smaller monetary reward now or greater reward later. The k index was used as a discounting of the delays characteristics in the current study.

Stroop task with neutral, emotional, and alcohol stimuli [36] is aimed at measuring response interference control. The participants are presented with the sheets of paper each containing four columns of names of colors printed in different colored ink (red, green, and blue). The participants are instructed to name the color of the ink of the printed words during the period of 30 sec. In addition, the authors of the current study used Stroop task with emotion stimuli and Stroop task with alcohol stimuli. The former one was derived from the BAC-A and the latter one was developed by the authors of the study.

ASRS v.1.1 [17] is a 6-item self-report instrument, which is developed for using with adults in order to screen for the main symptoms of attention deficits and hyperactivity. Each item is rated on the scale from 'never' to 'very often'; four or more marks on the shaded area of the instruments' form suggests the presence of adult ADHD symptoms.

PACS [10] is a five item self-report scale that measures the level of craving. The items inquire about the frequency, intensity, duration of craving and the ability to resist it over the previous week; each item is rated from 0 to 6.

2.3. Statistical analysis

The mean and the median were calculated for demographic data, clinical characteristics, and self-report measures. Further statistical analysis was done in two steps. The goal of the first step was to identify latent variables. In order to do that, the cluster analysis of variables that are typically associated with impulsiveness, was done using

bootstrapping (the null hypothesis was that absence of cluster). Next, the Principal Component Analysis (PCA) with variables' standardization was done for identifying the significant information within the clusters. After PCA, the Bayesian networks with the use of Hill Climbing algorithm (score-based structure learning algorithms) were constructed; in the results, greater negative values refer to stronger effect of the variable. In all calculations, null hypotheses were rejected at the level of $p < 0.05$.

3. Results

Cluster analysis yielded two distinct groups of impulsivity parameters. The first cluster is comprised of delay discounting and impulsive decision-making indices. The measures of impulsivity in the 1st cluster reflect individual tendency for rush decision-making. The second cluster is comprised of interference control and response inhibition control. The interaction of the parameters within the 2nd cluster suggests that decrease of the first component might result in decrease of the second one and vice versa.

Next, the model of interaction between the parameters of impulsivity and clinical characteristics of the participants was developed (Figure 1).

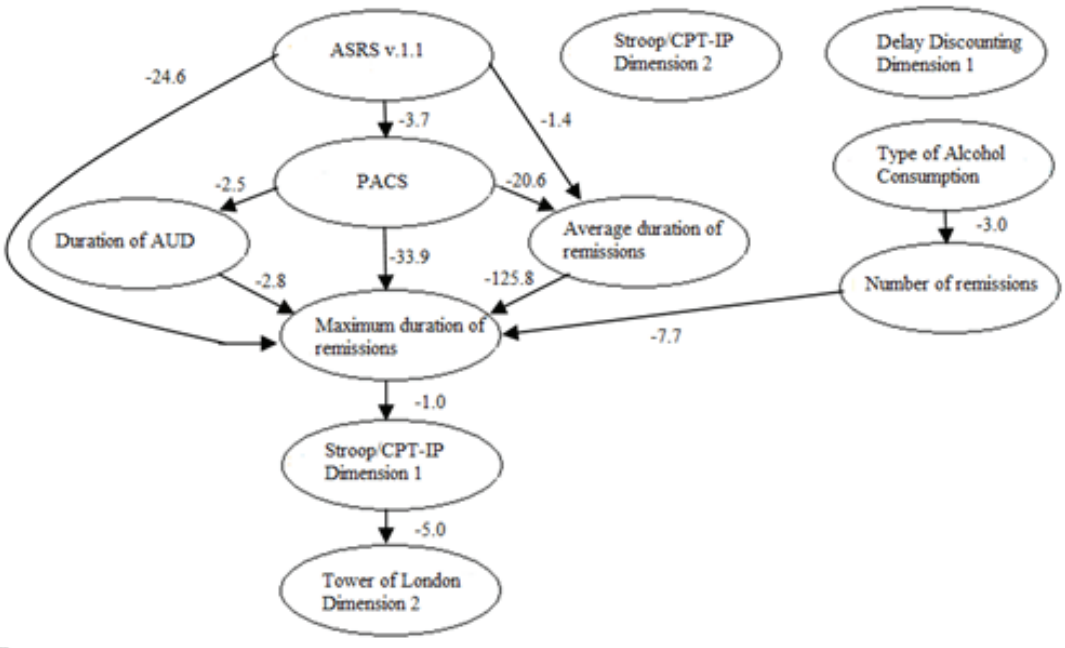

Figure 1: Relationship between measures of impulsivity and clinical characteristics of the participants.

The model suggests that self-reported symptoms of inattention and hyperactivity had significant effects on the level of craving and the duration of remissions. Maximum

duration of remission significantly affected the interference and inhibition control, as measured by Stroop tasks and CPT-IP. The maximum length of remission also affected the level of impulsive decision-making via interference and inhibition control. Surprisingly, no relationships were observed between the temporal discounting as measured by DDT and the reviewed clinical characteristics.

4. Discussion

Heightened impulsivity have long been linked to the development of substance use disorders and associated with the continued use and abuse of the psychoactive substances. Impulsivity is a complex phenomenon and, thus, there is still the lack of unified agreement on the definition, classification, and models of impulsive features. Due to theoretical differences in conceptualizing this construct, the findings on the role of impulsivity in development and maintenance of SUD vary as well.

In the article, we presented the results of the study exploring the relationship between multiple measures of impulsivity, namely temporal discounting (DDT), response inhibition (CPT-IP), interference control (Stroop tasks), impulsive decision-making (ToL), and self-report screening instrument for the symptoms of inattention and hyperactivity (ASRS v1.1). Using cluster analysis, we were able to identify two distinct groups of impulsivity features. One group is comprised of DDT and ToL measures, which generally describe the level of impulsivity in decision-making. Another group is comprised of response inhibition and interference control. Next, we've built a model of relationship between measures of impulsivity and clinical characteristics of participants (namely, duration of AUD, duration and the number of remission, and the type of alcohol consumption). Although the constructed model seemed to differ from the previous reports exploring the multidimensional impulsivity in relation to AUD symptoms (for instance, [4]), the structure of the relationship definitely points out at the effect of impulsivity on the clinical characteristics. Surprisingly, DDT didn't have any significant relationship with any of the clinical parameters. We might hypothesize that some impulsivity features might be the premorbid condition and are not significantly affected by continued substance use, which was observed in our previous studies (Trusova et al., 2018, [18]), as well as reported by other authors (Robles et al., 2012).

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References

[1] Bari, A. and Robbins, T. W. (2013). Inhibition and impulsivity: Behavioral and neural basis of response control. *Progress in Neurobiology*, vol. 108, pp. 44–79.

[2] Cornblatt, B. A., Lenzenweger, M. F., and Erlenmeyerkimling, L. (1989). The Continuous Performance-Test, Identical Pairs Version.2. Contrasting Attentional Profiles in Schizophrenic and Depressed-Patients. *Psychiatry Research*, vol. 29, no. 1, pp. 65–85.

[3] Cornblatt, B. A., Lenzenweger, M. F., and Erlenmeyer-Kimling, L. (1989). The continuous performance test, identical pairs version: II. Contrasting attentional profiles in schizophrenic and depressed patients. *Psychiatry Research*, vol. 29, no. 1, pp. 65–85.

[4] Courtney, K. E., Arellano, R., Barkley-Levenson, E., et al. (2012). The relationship between measures of impulsivity and alcohol misuse: an integrative structural equation modeling approach. *Alcoholism: Clinical and Experimental Research*, vol. 36, no. 6, pp. 923–931.

[5] Cyders, M. A., and Smith, G. T. (2008). Emotion-based Dispositions to Rash Action: Positive and Negative Urgency. *Psychological Bulletin*, vol. 134, no. 6, pp. 807–828. DOI: http://doi.org/10.1037/a0013341

[6] Dick, D. M., Smith, G., Olausson, P., et al. (2010). Understanding the construct of impulsivity and its relationship to alcohol use disorders. *Addiction Biology*, vol. 15, no. 2, pp. 217–226.

[7] Evenden, J. L. (1999). Varieties of impulsivity. *Psychopharmacology*, vol. 146, no. 4, pp. 348–361.

[8] Fernie, G., Peeters, M., Gullo, M. J., et al. (2013). Multiple behavioural impulsivity tasks predict prospective alcohol involvement in adolescents. *Addiction*, vol. 108, no. 11, pp. 1916–1923.

[9] Field, M., Christiansen, P., Cole, J., et al. (2007). Delay discounting and the alcohol Stroop in heavy drinking adolescents. *Addiction*, vol. 102, no. 4, pp. 579–586.

[10] Flannery, B. A., Volpicelli, J. R., and Pettinati, H. M. (1999). Psychometric properties of the Penn alcohol craving scale. *Alcoholism: Clinical and Experimental Research*, vol. 23, no. 8, pp. 1289–1295.

[11] Franken, I. H., van Strien, J. W., Nijs, I., et al. (2008). Impulsivity is associated with behavioral decision-making deficits. *Psychiatry Research*, vol. 158, no. 2, pp. 155–163.

[12] Gowin, J. L., Sloan, M. E., Stangl, B. L., et al. (2017). Vulnerability for alcohol use disorder and rate of alcohol consumption. *American Journal of Psychiatry*, vol. 174, no. 11, pp. 1094–1101.

[13] Holmes, A. J., Hollinshead, M. O., Roffman, J. L., et al. (2016). Individual differences in cognitive control circuit anatomy link sensation seeking, impulsivity, and substance use. *Journal of Neuroscience*, vol. 36, no. 14, pp. 4038–4049.

[14] Janushko, M. G., Shamanina, M. V., Aristova, T. A., et al. (2015). Standartizacija shkaly «Kratkaja ocenka kognitivnyh funkcij u pacientov s affektivnymi rasstrojstvami»(BAC-A) na osnove normativnyh dannyh rossijskoj populjacii. *Rossijskij psihiatricheskij zhurnal*, no. 2, pp. 68–75.

[15] Jentsch, J. D., Ashenhurst, J. R., Cervantes, M. C., et al. (2014). Dissecting impulsivity and its relationships to drug addictions. *Annals of the New York Academy of Sciences*, vol. 1327, no. 1, pp. 1–26.

[16] Keefe, R. S., Fox, K. H., Davis, V. G., et al. (2014). The Brief Assessment of Cognition In Affective Disorders (BAC-A): Performance of patients with bipolar depression and healthy controls. *Journal of Affective Disorders*, vol. 166, pp. 86–92.

[17] Kessler, R. C., Adler, L., Ames, M., et al. (2005). The World Health Organization Adult ADHD Self-Report Scale (ASRS). *Psychological Medicine*, vol. 35, no. 2, pp. 245–256.

[18] Klimanova, S. G., Trusova, A. V., Berezina, A. A., et al. (2017). Vremennoe diskontirovanie i pokazateli interferencii metodiki Strupa u pacientov s alkogol'noj zavisimost'yu. *Lurievskij podxod v mirovoj psixologicheskoj nauke: tezisy' dokladov*, c. 86. Ekaterinburg : Izd-vo Ural. un-ta.

[19] Lejuez, C. W., Magidson, J. F., Mitchell, S. H., et al. (2010). Behavioral and biological indicators of impulsivity in the development of alcohol use, problems, and disorders. *Alcoholism: Clinical and Experimental Research*, vol. 34, no. 8, pp. 1334–1345.

[20] Lejuez, C. W., Magidson, J. F., Mitchell, S. H., et al. (2010). Behavioral and biological indicators of impulsivity in the development of alcohol use, problems, and disorders. *Alcoholism: Clinical and Experimental Research*, vol. 34, no. 8, pp. 1334–1345.

[21] Logan, G. D., Schachar, R. J., and Tannock, R. (1997). Impulsivity and inhibitory control. *Psychological Science*, vol. 8, no. 1, pp. 60–64.

[22] López-Caneda, E., Rodríguez Holguín, S., Cadaveira, F., et al. (2013). Impact of alcohol use on inhibitory control (and vice versa) during adolescence and young adulthood: a review. *Alcohol and Alcoholism*, vol. 49, no. 2, pp. 173–181.

[23] MacKillop, J., Mattson, R. E., Anderson MacKillop, E. J., et al. (2007). Multidimensional assessment of impulsivity in undergraduate hazardous drinkers and controls. *Journal of Studies on Alcohol and Drugs*, vol. 68, no. 6, pp. 785–788.

[24] MacKillop, J., Weafer, J., Gray, J. C., et al. (2016). The latent structure of impulsivity: Impulsive choice, impulsive action, and impulsive personality traits. *Psychopharmacology*, vol. 233, no. 18, pp. 3361–3370.

[25] Moeller, F. G., Barratt, E. S., Dougherty, D. M., et al. (2001). Psychiatric aspects of impulsivity. *American Journal of Psychiatry*, vol. 158, no. 11, pp. 1783–1793.

[26] Mueller, S. T. and Piper, B. J. (2014). The psychology experiment building language (PEBL) and PEBL test battery. *Journal of Neuroscience Methods*, vol. 222, pp. 250–259.

[27] Reynolds, B. and Schiffbauer, R. (2005). Delay of gratification and delay discounting: A unifying feedback model of delay-related impulsive behavior. *The Psychological Record*, vol. 55, no. 3, pp. 439–460.

[28] Robles, E., Huang, B. E., Simpson, P. M., et al. (2011). Delay discounting, impulsiveness, and addiction severity in opioid-dependent patients. *Journal of Substance Abuse Treatment*, vol. 41, no. 4, pp. 354–362.

[29] Ryb, G. E., Dischinger, P. C., Kufera, J. A., et al. (2006). Risk perception and impulsivity: Association with risky behaviors and substance abuse disorders. *Accident Analysis & Prevention*, vol. 38, no. 3, pp. 567–573.

[30] Shallice, T. (1982). Specific impairments of planning. *Philosophical Transactions of the Royal Society of London B*, vol. 298, no. 1089, pp. 199–209.

[31] Shin, S. H., Hong, H. G., and Jeon, S. M. (2012). Personality and alcohol use: the role of impulsivity. *Addictive Behaviors*, vol. 37, no. 1, pp. 102–107.

[32] Smith, G. T. and Cyders, M. A. (2016). Integrating affect and impulsivity: The role of positive and negative urgency in substance use risk. *Drug and Alcohol Dependence*, vol. 163, no. 1, S3–S12.

[33] Stephan, R. A., Alhassoon, O. M., Allen, K. E., et al. (2017). Meta-analyses of clinical neuropsychological tests of executive dysfunction and impulsivity in alcohol use disorder. *The American Journal of Drug and Alcohol Abuse*, vol. 43, no. 1, pp. 24–43.

[34] Steward, T., Mestre-Bach, G., Fernández-Aranda, F., et al. (2017). Delay discounting and impulsivity traits in young and older gambling disorder patients. *Addictive Behaviors*, vol. 71, pp. 96–103.

[35] Strasser, E. S., Haffner, P., Fiebig, J., et al. (2016). Behavioral measures and self-report of impulsivity in bipolar disorder: no association between Stroop test and Barratt Impulsiveness Scale. *International Journal of Bipolar Disorders*, vol. 4, p. 16. Retrieved from http://doi.org/10.1186/s40345-016-0057-1

[36] Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of Experimental Psychology*, vol. 18, no. 6, p. 643.

[37] Swann, A. C., Bjork, J. M., Moeller, F. G., et al. (2002). Two models of impulsivity: Relationship to personality traits and psychopathology. *Biological Psychiatry*, vol. 51, no. 12, pp. 988–994.

[38] Trusova, A. V., Berezina, A. A., Klimanova, S. G., et al. (2015). Cognitive control in patients with alcohol use disorder: testing three function model. *Archives of Psychiatry and Psychotherapy* (in press).

[39] Whiteside, S. P. and Lynam, D. R. (2001). The five factor model and impulsivity: Using a structural model of personality to understand impulsivity. *Personality and Individual Differences*, vol. 30, no. 4, pp. 669–689.

[40] Zermatten, A., Van der Linden, M., d'Acremont, M., et al. (2005). Impulsivity and decision making. *The Journal of Nervous and Mental Disease*, vol. 193, no. 10, pp. 647–650.