PHONOLOGICAL WORKING MEMORY AND IMPULSIVITY IN DRUGS USERS TREATED IN AN INTEGRATED CENTER FOR MENTAL HEALTH CARE

Avaliação da memória operacional fonológica e impulsividade de usuários de drogas atendidos em um centro de atenção integrada à saúde mental

Luciana Lopes Silva Costa [1], **Ana Luiza Gomes Pinto Navas** [2], **Christian Cesar Cândido Oliveira** [3], **Lilian Ribeiro Caldas Ratto** [4], **Kamila Helena Prior de Carvalho** [5], **Helio Rodrigues da Silva** [6], **Cristiane Lopes** [7], **Carla Andréa Tieppo** [8]

ABSTRACT

Purpose: to evaluate the phonological working memory abilities and check possible influences of impulsivity in patients just included in treatment at the program for Alcohol and Drug users at the Center for Integrated Mental Health Care of Irmandade da Santa Casa de Misericordia de São Paulo (ISCMSP –CAISM-SP, Portuguese initials). **Method:** 29 patients: 21 males and 8 females, drug users, 37,9 ± 10.5 years old, 10.59 ± 3.53 years of schooling; And 30 volunteers: 19 males and 11 female, 32,4 ± 11,9 years old and 11.07 ± 3.29 years of schooling, without psychiatric history or substance abuse participated freely. The individuals were asked to attend the specific evaluation, aiming to assess: 1) phonological working memory for words and pseudowords, 2) impulsivity in its second order factors (attentional impulsiveness, motor and non-planning). **Results:** performance in the evaluation of phonological working memory of the individuals of drug users group compared to the control group showed a reduction in both, auditory word and pseudowords span , as well as the total number of correct words and pseudowords recall. In the evaluation of impulsivity, the group of drug users showed higher scores comparing to control individuals in all subtypes of impulsivity, including the total score of impulsivity. There were no correlations between impulsivity scores and word and/or pseudowords span. **Conclusion:** this pattern of responses indicates impairment in verbal working memory processing and high level of impulsivity in this population of chronic drug users. The poor performance of chronic drug users on tests of phonological working memory is probably not due to increased impulsivity observed. The present results could helptreatment strategies planning focused on the detected changes.

KEYWORDS: Memory, Short-Term; Impulsive Behavior; Substance-Related Disorders; Street Drugs

(1) Graduate Student, Department of Speech Pathology, School of Medical Sciences of Santa Casa of São Paulo, Brazil.

(2) PhD, Adjunct Professor, Department of Speech Pathology, School of Medical Sciences of Santa Casa of São Paulo, President Director of ABCD Institute, Brazil.

(3) PhD, Department of Speech Pathology of School of Medicine, University of São Paulo, Brazil.

(4) Psychiatrist; Attending Physician of Irmandade da Santa Casa de Misericordia de São Paulo; Member of the Medical Staff of the Center for Integrated Mental Health Care of Santa Casa of Mercy of São Paulo, Brazil.

(5) Psychiatrist;Specialist in chemical addiction program at Counseling and Treatment of Addiction – PROAD Federal University of São Paulo – UNIFESP; Member of the medical staff of the Center for Integrated Health Care Mental of Santa Casa of Mercy of São Paulo, Brazil.

(6) Graduate student in Health Sciences; Specialist in Clinical Analysis; School of Medical Sciences of Santa Casa de São Paulo, Brazil.

(7) PhD, Molecular Scientist; Assistant Professor Department of Physiological Sciences, School of Medical Sciences of Santa Casa of São Paulo, Brazil.

(8) PhD Neuroscientist; Adjunct Professor Department of Physiological Sciences, School of Medical Sciences of Santa Casa of São Paulo; Teaching Assistant Department of Developmental Psychology, Catholic University of São Paulo, Brazil.

Conflict of interest: non-existent

INTRODUCTION

The consumption of psychoactive substances has always existed in human history since its inception, varying in amount, type and manner of drug use[1]. If there is a supremacy on one or another type of drug at one time, this is due to specific factors and characteristics of the historical moment in which we live[2].

Psychoactive substances have different aims and very different pharmacological effects, although they all have the potential to cause addiction. The addiction of these substances or simply addiction can be defined as the loss of control over drug use or the compulsive seeking and use despite adverse consequences[3].

The essential feature of substance addiction, according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV)[4] and International Classification of Diseases[5], is the presence of a cluster of symptoms of cognitive, behavioral and physiological processes indicating that the individual continues to use a substance despite significant problems related to it.

The substance abuse is associated with neuropsychological deficits related to emotion, memory and executive functions[6]. The impairment in cognitive performance of drug users not only interferes with the general aspects such as quality of life, but also the inefficiency of these cognitive functions is directly related to the central aspect of addiction: the behavior and tendency to use drugs despite negative consequences[7].

In a longitudinal study characterizing cognitive change, the authors found poor performance in verbal learning, verbal working memory and attention skills involved in adolescent drug users[8]. Improvements in development were observed in learning a word list after two weeks of abstinence and verbal working memory, after three weeks. While the attention deficits persisted even during the withdrawal period of three weeks[8].

Working memory is the memory responsible for the temporary storage of information to perform a series of cognitive tasks[9]. The ability to maintain relevant information to the active processing is considered a crucial aspect of cognitive function. Working memory can be understood as a system of maintenance and temporary storage of information required to perform complex cognitive tasks involving reading, comprehension and reasoning[10].

The verbal working memory system is particularly important given its role in linguistic processes involved in cognitive mechanisms. According to the literature, span tasks were designed to measure if the capacity of this memory is highly predictive of the performance in high-level cognitive activities such as understanding, reasoning and problem solving[11].

The difficulty in working memory span is explained by the fact that the information to be retained is susceptible to decline over time. Thus, the performance of the individual on recall depends on the duration of the procedure, which then determines the retention period of the stimulus in memory. The longer the duration of the retention, the greater the span[11].

Some authors[12,13] investigated the possibility of storage in working memory capacity observing that maintenance and durability is fragile and limited. Phonological memory is influenced by the extent and frequency of verbal material and starts its development from the age of six. In order to assess the phonological component of working memory tasks it is widely used a task of digits and non-words or pseudowords repetition. The repetition of pseudowords assesses more accurately the phonological component since it is not influenced by semantics or syntax.

The executive processing is related to the human ability to obtain information by different brain systems, verbal or nonverbal, and act to produce new responses[14]. Working memory and inhibitory control are two cognitive processes that underlie the executive function. The first, refers to the ability to maintain and manipulate information in short-term to generate an action in the near future; and the latter, refers to a process that aims to suppress internal or external influences that might interfere with ongoing behavioral sequence[14].

Losses in the executive control system of working memory may explain some of the cognitive and behavioral problems displayed by individuals who use multiple drugs, identified as more impulsive than the control group[15].

Impulsive behavior can be defined from various viewpoints, including biological phenomenon, sociological and psychological[16]. Studies suggest a correlation between three factors: general verbal learning, impulsivity and attentional executive processing, emphasizing the importance of mnemonic aspects of impulsive behavior[16].

Impulsive disorders are also characterized by a working memory decrease and impulsive personality correlates with low cognitive performance[17]. Impulsivity can also be defined as behavior characterized by a high level of anticipatory responses, held in a faster reaction time, compared to situations that require a decision[18]. Studies show impulsivity as the main feature for understanding vulnerability to impulse control disorders, such as drug

addiction and associated with a higher sensitivity to the effects of dopaminergic drugs[19].

The association between impulsiveness and the use and/or substance abuse has been investigated in animal models and in humans. In animal models of impulsivity, it was shown that mice with high levels of anticipatory responses on tasks of sustained visual attention (5-CSRT Five-choice serial reaction time) showed an increase in self-administration of cocaine[20]. In humans, this association has been demonstrated in studies with individuals addicted on alcohol, tobacco, marijuana and heroin, whose impulsive behavior scale measured by BIS-11 was higher than the control group[21].

Chronic drug use produces deficits in general neuropsychological mechanisms, however, it is difficult to differentiate what effects are caused by each substance in users of polydrugs. The specific effects of a substance (eg. stimulant) and those produced by other substances (eg. depressor) may be superimposed even though the pharmacological effects are different[7].

The aims of this study were to characterize and correlate the expression of phonological working memory and impulsivity in a group of drug users who seek care in a psychiatric clinic.

METHOD

This was a quantitative, prospective and transversal study. We included 29 drug users for over 1 year, with no hearing problems, which spontaneously sought outpatient care in the Integrated Care Center of Mental Health of Santa Casa of Mercy of São Paulo (drug user group) and 30 individuals who had no history of drug use and no hearing problems (control group). The control group was selected among the students, trainees and employees of the School of Medical Sciences of Santa Casa of São Paulo.

The drug user group was characterized by: age 37.9 ± 10.5 years old; 10.59 ± 3.53 years of schooling: 7 with higher education, 8 had incomplete college, 8 with complete medium education, 2 with primary complete education and 4 with incomplete primary education. The demographic profile of the samples is shown in table 1. The profile of psychoactive substance use is: 6 individuals had used only alcohol, 7 had used two psychoactive substances, 5 had used three substances and 11 had used more than three substances concomitantly. Regarding the type of substance used: 26 individuals were alcohol users, 20 cocaine users, 19 marijuana users, 10 crack users, 3 lysergic acid users and 2 amphetamine users, as shown in Figure 1.

The exclusion criteria were individuals: 1) under 18 years old: 2) under imminent risk of violent behavior or violent tendencies detected by the psychiatrist, 3) with a history of hearing disorders, visual and/or fluency of speech, 4) with personality disorders detected by the psychiatrist. The individuals included were submitted to the specific tests described below, and then the data categorized according to type of addiction, age and education.

Each individual was assessed individually in two phases for a total of one hour duration. First, we assessed phonological working memory and then we completed the questionnaire on impulsivity.

Procedures

Phonological working memory assessment

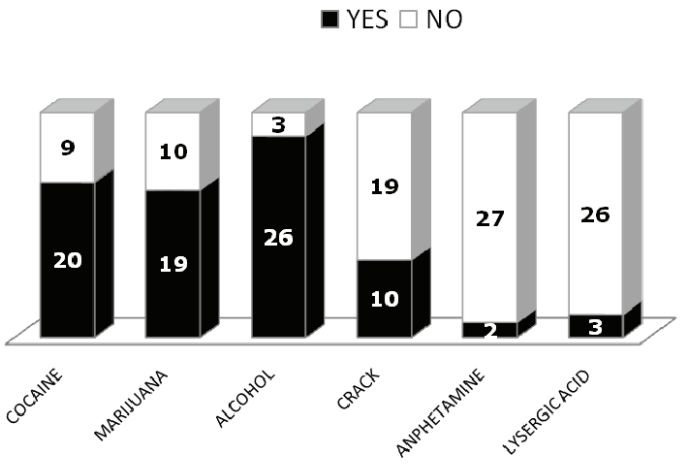
For the assessment of phonological working memory, tests were used to evaluate verbal memory capacity. More specifically, tests evaluated auditory sequential memory of words and pseudowords[22.23]. The memory test contains a sequence of 60 words and 42 pseudowords, which are the auditory stimuli. They are read to the research individual separately. All stimuli are disyllabic with the accent on the first syllable, and with a consonant-vowel-consonant-vowel (CVCV) pattern. These are considered the most frequent structure in Brazilian Portuguese. Five lists were presented with three blocks of stimuli with two, three, four, five and six sequences of words and four lists with three blocks of stimuli with two, three, four and five sequences of pseudowords.

The inter stimuli interval was one second for the two lists. The presentation took place by means of a recording software with speakers attached to a computer and the answers recorded on digital

Table 1 – Demographic profile of the observed samples

	DRUG USER GROUP (N=29)		CONTROL GROUP (N=30)	
GENDER	**M**	**F**	**M**	**F**
	21	**8**	**19**	**11**
AGE (years)	**37,9±10,5**		**32,4±11,9**	
SCHOOLING (years)	**10,59±3,53**		**11,07±3,29**	

A



B

No of substances	No of subjects
One drug	6
Two drugs	7
Three drugs	5
More than three drugs	11

Figure 1 – Number of users of psychoactive substances. A) Number of subjects for psychoactive substance use. B) Number of subjects who use polydrugs: one, two, three, or more than three drugs simultaneously

recorder. The volunteer was requested to hear the sequence of stimuli of a block and the end to repeat them in the correct order.

Impulsivity

Barratt Impulsiveness Scale was used to assess impulsivity[24]. The version 11 was validated for use in Brazilian adults[25]. The BIS-11 is one of the most widely used instruments to measure impulsivity, with translation and validation for different languages. It consists of an instrument of 30 self-report items designed to assess personality and behavioral construction of impulsivity[26,27]. Generated total score of impulsivity ranging from 30 to 120, plus three other sub-scores: attentional, motor and not planning. Depending to the concept of components that range attentional impulsiveness is to make decisions faster. Cognitive, motor impulsivity involves acting without thinking, and impulsivity is not a lack of planning "vision of the future "or planning[25].

This research was approved by the Ethics Committee of Irmandade da Santa Casa de Misericordia de São Paulo (ISCMSP), protocol number 143/08 and the individuals involved signed an informed consent form.

For auditory memory analysis we used Student t test and for the impulsivity analysis, we used the nonparametric Mann-Whitney test. Correlation analysis was performed between the results obtained in phonological working memory task with the scores presented in the impulsivity questionnaire. Correlation was evaluated by linear regression test, placing one of correlation factors to be tested on the abscissa and the other on the ordinate. The slope of the line was taken as the correlation factor.

We considered statistically significant result when $p<0.05$, for all comparisons performed .

RESULTS

After the evaluation of phonological working memory and impulsivity in chronic users of psychoactive substances (drug user group), legal or illegal, who sought outpatient treatment spontaneously in CAISM, some important deficits were detected when compared with control individuals (control group – not drug users) and are described below.

In the assessment of phonological working memory it was evaluated four parameters: word span, pseudowords span, total recall of words and total recall of pseudowords. Compared with the control group, drug users had lower efficiency on auditory word span (3.8 ± 0.75 vs 3.3 ± 0.93 respectively, $p = 0.0069$*) and pseudowords (2.7 ± 2.2 vs

0.43 ± 0.78 respectively, p = 0.0024*). This reduction in efficiency of phonological working memory was also detected when comparing the total number of hits in the recall of words (41.6 ± 6.5 vs 34.3 ± 12.4, p = 0.0168*) and pseudowords (21.8 ± 4.8 vs 16.5 ± 6,9,08, p = 0.0071*), control groups and drug users, respectively. These data are presented in Figure 2. These results indicate that drug users are less efficient on the expression of phonological working memory.

In impulsivity, measured by the Barratt Impulsiveness Scale, the group of drug users had high scores in contrast to control individuals in all subtypes of impulsivity: no planning, motor and attention; including the total score of impulsivity, according to data presented in Figure 3. These results indicate that chronic users of psychoactive substances are more impulsive than controls.

After the analysis of phonological working memory and impulsivity of drug users and controls, we raised the possibility of a correlation between performance on tests of phonological working memory and impulsivity in the group of users. No correlation was found between these two parameters, as shown in Table 2. These results indicate that the decreased efficiency of phonological working memory is not due to greater impulsivity showed by drug users.

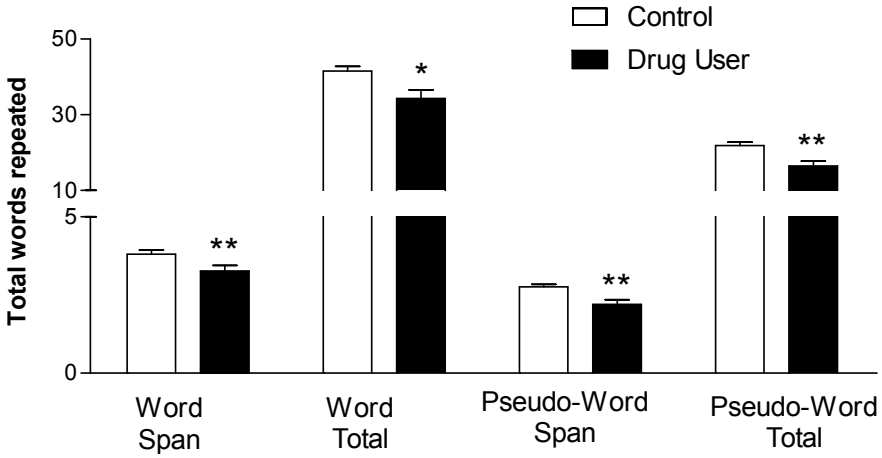


Figure 2 – Assessment of phonological working memory to the test of repetition of words and pseudowords. Data presented are mean ± SD .* p <0.05 and ** p <0.01

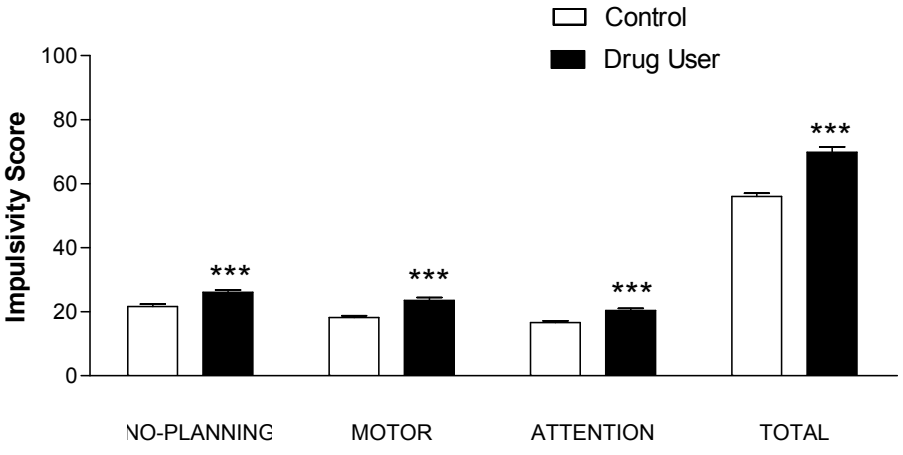


Figure 3 – Impulsiveness scale by Barratt (BIS-11). The scores were obtained from responses to the questionnaire and classified in different sub-items and total score of impulsivity. Data presented are mean ± SD. *** p <0.001

Table 2 – Correlation coefficient and p value of regression analysis between elements of phonological working memory and impulsivity scores: No Planning (NP), Motor (M) and Attentional (A)

	NP	M	A	Total
WORD SPAN	r = 0,05878	r = 0,2011	r = 0,06804	r = 0,1262
	p = 0,7664	p = 0,3049	p = 0,7360	p = 0,5221
WORD TOTAL	r = - 0,03	r = 0,1936	r = 0,06804	r = 0,1010
	p = 0,8556	p = 0,3236	p = 0,7308	p = 0,6091
PSEUDO-WORD SPAN	r = 0,2766	r = 0,2344	r = 0,1628	r = 0,3199
	p = 0,1543	p = 0,2299	p = 0,4080	p = 0,0971
PSEUDO-WORD TOTAL	r = 0,1025	r = 0,2537	r = 0,1607	r = 0,2342
	p = 0,6039	p = 0,1926	p = 0,4140	p = 0,2303

DISCUSSION

Assistance to users of alcohol and other drugs is under public health policy discussion, given the impact that this issue brings to the national public health in all countries. According to the Report on World Health[28] (2001), from the 20 diseases in the age group between 15 and 44 years old for males, disorders due to alcohol intake are in second place, with 10%, and disorders due to the use of illicit drugs are in ninth position, with 3%. According to the report of the United Nations Office on Drugs and Crime [29] (UNODC) released in 2010, it is estimated that the number of drug users is around 155 and 250 million (or 3.5 to 5.7% of world population between 15 and 64) with 2.9% to 4.3% of marijuana users, 0.6% using derivatives of amphetamines and 0.4% of cocaine users. From the total, 40 million were identified as regular users.

The psychoactive substances regular use is associated with neuropsychological deficits related to emotion, memory and executive functions[30]. The impairment in cognitive performance of drug users not only interferes with the general aspects such as quality of life, working conditions and student life, but is also directly related to the central aspect of addiction: the behavior and tendency to use drugs despite the negative consequences[7]. Several experimental models have been applied to better understand the phenomenon of compulsive drug use. This behavior can be described as a condition associated with dysfunction of brain mechanisms responsible for decision-making capacity[31].

The polydrug use is another hallmark of the current pattern of compulsive use, gradually replaced by exclusive use. This study characterized as all-inclusive, as it considered the inclusion of patients with chronic use of psychoactive substances varied licit, illicit and therapeutic drugs[7,32] corroborating several studies that emphasize the difficulty with this population that makes use of many different substances in a short period of time, and often simultaneously.

In this study, the individuals from the group of drug users presented a significant reduction in the capacity of phonological working memory performance compared to ones of the control group, either on tests of auditory sequential memory for words or pseudowords. From these results, we concluded that there is an impairment in working memory ability in drug users of this study.

It was also observed the increase in scores of impulsivity in drug users. The results support studies showing that drug users have lower scores than controls in tasks involving attention, verbal learning and memory[33,34], cognitive flexibility, impulse control[35,36]and selective processing [37]. Studies also point to the fact that adult chronic users of drugs have impaired performance in tasks involving selective attention, suggesting a slowdown in information processing and difficulty in maintaining attention to relevant stimuli[34].

The performance on tasks requiring this kind of memory is directly related to aspects of attention, motivation and cognition. It is described in the literature that drug users have increased levels of impulsivity[38,39].

Studies with a population that use psychoactive substances chronically, such as tobacco, marijuana, cocaine and alcohol, showed impairments in cognitive functions involving self-control, and point to the fact that chronic drug users compared with nonusers, have decreased ability to inhibit responses, they were worse in the performance of tasks involving mental flexibility, control of visual attention and decision making[40].

In this sense, it was found in the sample of individuals studied, which are drug users, increased impulsivity scores according to the BIS-11 in all sub-items: attentional, motor and non-planning impulsiveness.

To analyze the impact of increased impulsivity in the drug user group on words and pseudowords span, linear regression analysis was calculated, with the results obtained in phonological working memory and impulsivity sub-scores (Table 2). The lack of correlation found could mean that the working memory deficit observed is not directly related to impulsive behavior.

The fact that the individual drug users have high levels of impulsivity, does not mean that they necessarily must have a reduced ability to repeat words and pseudowords in the applied assessment of phonological working memory. However, the results show that besides the increased impulsivity, the sample population involved in this work also has important deficits in phonological working memory.

Considering the enormous impact that drug addiction causes to society, with a deep burden in education, health, economics, among others areas, it is absolutely pertinent investment in intellectual and economic efforts in order to characterize the drug user, to describe difficulties and cognitive inefficiency, and to find solutions to intervene in the process efficiently and positively, in order to help in rehabilitation.

CONCLUSION

The pattern of responses found in this study indicates involvement in the processing of phonological working memory and high level of impulsivity in a population of chronic users of psychoactive substances compared with controls not drug users.

The poor performance of drug users in the trials involving phonological working memory was not due to increased impulsivity observed.

More studies are needed to verify the nature and severity of phonological working memory deficits associated with the use of psychoactive substances, and its direct implication in clinical treatment. These analyses could help to suggest treatment strategies directed at the detected deficits.

ACKNOWLEDGEMENTS

To Irmandade da Santa Casa de Misericórdia de São Paulo and Fundação Arnaldo Vieira de Carvalho for their support in developing this study.

RESUMO

Objetivo: avaliar a memória operacional fonológica e relacionar com a impulsividade de pacientes em tratamento no Centro de Atenção Integrada à Saúde Mental. **Método:** 29 usuários: 21 do gênero masculino e 8 do feminino, usuários de substâncias psicoativas, com 37,9±10,5 anos de idade e 10,59±3,53 anos de escolaridade; e 30 voluntários: 19 do gênero masculino e 11 do feminino, com 32,4±11,9 anos de idade e 11,07±3,29 anos de escolaridade, sem histórico psiquiátrico ou de dependência química foram convocados à avaliação de: 1) memória operacional para palavras e pseudopalavras; 2) impulsividade em seus fatores de segunda ordem (impulsividade atencional, motora e de não planejamento). **Resultados:** o desempenho dos usuários de substâncias psicoativas na avaliação da memória em comparação ao grupo controle foi pior tanto no *span* auditivo de palavras e pseudo-palavras como também no número total de recordação de palavras e pseudo-palavras. Na avaliação da impulsividade, os usuários apresentaram escores elevados em contraposição aos sujeitos controle em todos os subtipos de impulsividade, inclusive no total. Na análise de correlação dos dados não foram encontradas relações entre os escores de impulsividade e memória. **Conclusão**: este padrão de respostas indica comprometimento da memória operacional fonológica provavelmente independente do alto nível de impulsividade apresentado pelos usuários de drogas. Estas análises contribuem para propor estratégias de tratamento direcionadas às alterações detectadas.

DESCRITORES: Memória de Curto Prazo; Comportamento Impulsivo; Transtornos Relacionados ao Uso de Substâncias; Drogas Ilícitas

REFERENCES

1. Moreira CS, Barbosa NR, Vieira RCPA, Carvalho MR, Marangon PB, Santos PLC, Teixeira Jr ML. Análise retrospectiva das intoxicações admitidas no hospital universitário da UFRJ no período de 2000-2004. Ciênc. Saúde coletiva. 2010; 15(3):879-88.

2. Horta RL, Horta BL, Pinheiro RT, Morales B, Strey MN. Tobacco, alcohol, and drug use by teenagers in Pelotas, Rio Grande do Sul State, Brazil: a gender approach. Cad Saúde Pública. 2007; 23(4):775-83.

3. Li CY, Mao X, Wei L. Genes and (common) pathways underlying drug addiction. Plos Comput Biol. 2008; 4(1):28-34.

4. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders, Text Revision., Washington, DC: American Psychiatric Association. 2000.

5. World Health Organization (WHO). International Statistical Classification of Diseases and Related Health Problems. Tenth Revision. Geneva: WHO; 1993. Available from: http://www.who.int/classifications/icd/en/GRNBOOK.pdf

6. Vieira RMT, Serafim AP, Saffi F. Prejuízos neurocognitivos na dependência alcoólica: um estudo de caso. Rev. Psiquiatr. Clín. 2007; 34(5):246-50.

7. Fernández-Serrano MJ, Pérez-García M, Verdejo-García A. What are the specific vs. generalized effects of drugs of abuse on neuropsychological performance? Neurosci Biobehav Rev. 2011; 35(3):377-406.

8. Hanson KL, Winward JL, Schweinsburg AD, Medina KL, Brown SA. Longitudinal study of cognition among adolescent marijuana users over three weeks of abstinence. Addictive Behaviors. 2010; 35(11):970-6.

9. Rodrigues A, Befi-Lopes DM. Memória operacional fonológica e suas relações com o desenvolvimento da linguagem infantil. *Pró-Fono R. Atual. Cient.* 2009; 21(1):63-8.

10. Baddeley AD. Working Memory. Current Biology. 2010; 20(4):136-40.

11. Barrouillet P, Gavens N, Vergauwe E, Gaillard V, Camos V. Working memory span development: a time-based resource-sharing model account. Dev Psychol. 2009; 45(2):477-90.

12. Gindri G, Keske-Soares M, Mota HB. Working memory, phonological awareness and spelling hypothesis. Pró-Fono. 2007; 19(3):313-22.

13. Anderson JD, Wagovich AS. Relationships among linguistic processing speed, phonological working memory, and attention in children who stutter. *J. Fluency Disord.* 2010; 35(3):216-34.

14. Almeida PP, Novaes MAFP, Bressan RA, Lacerda ALT. Revisão: funcionamento executivo e uso de maconha. Rev. Bras. Psiquiatr. 2008; 30(1):69-76.

15. Verdejo-Garcia A, Del Mar Sánchez-Fernández M, Alonso-Maroto LM, Fernández-Calderón F, Perales JC, Lozano O, Pérez-Garcia M. Impulsivity and executive functions in polysubstance-using rave attenders. Psychopharmacology (Berl). 2010; 210(3):377-92

16. Kockler TR, Stanford MS. Using a clinically aggressive sample to examine the association between impulsivity, executive functioning, and verbal learning and memory. Arch Clin Neuropsychol. 2008; 23(2):165-73.

17. Roiser JP, Rogers RD, Sahakian BJ. Neuropsychological function in ecstasy users: a study controlling for polydrug use. Psychopharmacology. 2007; 189(4):505-16.

18. Duva SM, Silverstein SM, Spiga R. Impulsivity and risk-taking in co-occurring psychotic disorders and substance abuse. Psychiatry Rs. 2010; 24.

19. Cumming P, Caprioli D, Dalley JW. What have PET and 'Zippy' told us about the neuropharmacology of drug addiction? Br J Pharmacol. 2010; 1476-5381.

20. Dalley JW, Fryer TD, Brichard L, Robinson ES, Theobald DE, Laane K, Pena Y, Murphy ER, Shah Y, Probst K, Abakumova I, Aigbirhio FI, Richards HK, Hong Y, Baron JC, Everitt BJ, Robbins TW. Nucleus accumbens D2/3 receptors predict trait impulsivity and cocaine reinforcement. Science. 2007; 315(5816):1267-70.

21. von Diemen VL, Bassani DG, Fuchs SC, Szobot CM, Pechansky F. Impulsivity, age of first alcohol use and substance use disorders among male adolescents: a population based case–control study. Addiction. 2008; 103(7):1198-205.

22. Navas ALPG, Ferraz EC, Giangiacomo MCPB, Satake TKR. Efeito de lexicalidade e de intervalo de apresentação em uma tarefa de *span* de palavras e pseudo-palavras. In: Anais do VIII Congresso Brasileiro de Fonoaudiologia. Santos, 2005.

23. Giangiacomo MCPB, Navas ALGP. A influência da memória operacional nas habilidades de compreensão de leitura em escolares de 4ª série. Rev. Soc. Bras. Fonoaudiol. 2008; 13(1):69-74.

24. Patton JH, Stanford MS, Barratt ES. Factor structure of the Barratt impulsiveness scale. Journal of Clinical Psychology. 1995; 51:768-74.

25. Malloy-Diniz LF, Mattos P, Leite WB, Abreu N, Coutinho G, de Paula JJ, Tavares H, Vasconcelos AG, Fuentes D. Tradução e adaptação cultural da Barratt Impulsiveness Scale (BIS-11) para aplicação em adultos brasileiros. J. Bras. Psiquiatr. 2010; 59(2):99-105.

26. Stanford MS, Mathias CW, Dougherty DM, Lake SL, Anderson NE, Patton JH. Fifty years of the

Barratt Impulsiveness Scale: An update and review. 2009; 47(5):385-95.
27. Spinella M. Normative data and a short form of the Barratt Impulsiveness Scale. Int J Neurosci. 2007;117(3):359-68.
28. OMS. Relatório Mundial da Saúde. Saúde Mental: nova concepção, nova esperança. 2001. Lisboa, 2002. Available from: http://www.who.int /whr/2001/en/whr01_djmessage_po.pdf
29. ONU. Relatório Mundial sobre drogas, 2010. Available from: www.unodc.org/...//2010/06/wdr2010/World_Drug_Report_2010_lo-res.pdf
30. Oliveira CCC, Scheuer CI, Scivoletto S. Autobiographical and semantic memory of adolescent drug users. Rev. Psiquiatr. Clín. 2007; 34(6):260-5.
31. Verdejo-García A, Bechara A. A somatic-marker theory of addiction. Neuropharmacology. 2009; 56(1):48–62.
32. Oliveira LG, Nappo AS. Caracterização da cultura de crack na cidade de São Paulo: padrão de uso controlado. Rev Saúde Pública. 2008; 42(4):664-71.
33. Kolling NM, Silva CR, Carvalho JCN, Cunha SM, Kristensen CH. Avaliação neuropsicológica em alcoolistas e dependentes de cocaína. Aval. Psicol. 2007; 6(2):127-37.
34. Schweinsburg AD, Brown AS, Tapert SF. The influence of marijuana use on neurocognitive functioning in adolescents. Curr Drug Abuse Rev. 2008; 1(1):9-111.
35. Reis AD, Castro LA, Faria R, Laranjeira R. Craving decrease with topiramate in outpatient treatment for cocaine dependence: an open label trial. Rev. Bras. Psiquiatr. 2008; 30(2):132-5.
36. Salgado JV, Malloy-Diniz LF, Campos VR, Abrantes SSC, Fuentes D, Bechara A, Correa H. Neuropsychological assessment of impulsive behavior in abstinent alcohol-dependent subjects. Rev. Bras. Psiquiatr. 2009; 31(1): 4-9.
37. Angelucci F, Ricci V, Pomponi M, Conte G, Mathe AA, Tonali P, Bria P. Chronic heroin and cocaine abuse is associated with decreased serum concentrations of the nerve growth factor and brain-derived neurotrophic factor. J Psychopharmacol. 2007; 21(8):820-5.
38. Wan L, Baldridge RM, Colby AM, Stanford MS. Association of P3 amplitude to treatment completion in substance dependent individuals. Psychiatry Res. 2010; 177(1-2):223-7.
39. Balodis IM, Potenza MN, Olmstead MC. Binge drinking in undergraduates: Relationships with gender, drinking behaviors, impulsivity and the perceived effects of alcohol. Behav Pharmacol. 2009; 20(5-6): 518–26.
40. Colzato LS, Huizinga M, Hommel B. Recreational cocaine polydrug use impairs cognitive flexibility but not working memory. Psychopharmacology (Berl). 2009; 207(2): 225–34.

RECEIVED IN: 11/21/2010
ACCEPTED IN: 02/15/2011

Mailing Address:
Luciana Lopes Silva Costa
Rua Dr. Cesário Motta Jr., 61
São Paulo – SP – Brazil
CEP: 01221-020
E-mail: llscosta@hotmail.com