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PREFRONTAL SYMPTOMS INVENTORY IN CHILE: PRELIMINARY ANALYSIS

Inventario de síntomas prefrontales en Chile: análisis preliminar

Inventário de sintomas pré-frontais no Chile: análise preliminar

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Keywords: Prefrontal Symptoms Inventory, cognitive and emotional deficits, executive functions.

Palabras Clave: Inventario de síntomas prefrontales, déficits cognitivos y emocionales, funciones ejecutivas.

Palavras-chave: Inventário de sintomas pré-frontais, déficits cognitivos e emocionais, funções executivas

A B S T R A C T

Introduction. Executive functions (EF) are important variables in interrelationships of cognitive processes. Therefore, it is relevant to understand the way in which these are articulated in the execution of certain behaviors and in the appearance of certain deficits. Their adequate detection requires valid and reliable instruments that are also useful for prevention and treatment. **Objective.** To evaluate the psychometric properties of the Prefrontal Symptoms Inventory. **Method.** It was studied the factorial structure and internal consistency in a sample of Chilean university students from the Metropolitan Region (n = 211) with ages between 18 and 30 years (*M* = 23; *SD* = 2.81). **Results.** The factorial solution of three factors was consistent with the original questionnaire regarding the main alterations that interrogate the questionnaire (cognitive, emotional and behavioral). **Discussion**. The internal consistency indexes were good for the general scale, being a reliable and valid scale for the detection of cognitive, emotional and behavioral deficits, associated with the executive functions (EF).

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R E S U M E N

Introducción. Las funciones ejecutivas (FE) son variables importantes en las interrelaciones de los procesos cognitivos. Por lo tanto, es relevante comprender la forma en que se articulan en la ejecución de ciertos comportamientos y en la aparición de ciertos déficits. Su detección adecuada requiere instrumentos válidos y confiables que también sean útiles para la prevención y el tratamiento. **Objetivo**. Evaluar las propiedades psicométricas del Inventario de síntomas prefrontales (ISP-20). **Método.** Se estudió la estructura factorial y la consistencia interna en una muestra de estudiantes universitarios chilenos de la Región Metropolitana (n = 211) con edades entre 18 y 30 años (M = 23; DE = 2.81). **Resultados.** La solución factorial de tres factores resultó coherente con el cuestionario original respecto a las principales alteraciones que interroga el cuestionario (cognitivas, emocionales y comportamentales). **Discusión.** Los índices de consistencia interna fueron buenos para la escala general, resultando ser una escala fiable y válida para la detección de déficits de los procesos cognitivos, emocionales y conductuales asociados con las funciones ejecutivas (FE).

R E S U M O

Introdução: As funções executivas (FE) são variáveis importantes nas inter-relações dos processos cognitivos. Portanto, é relevante compreender a forma em que se articulam na execução de certos comportamentos e na aparição de certos déficits. Sua detecção adequada requer instrumentos válidos e confiáveis que também sejam úteis para a prevenção e o tratamento. **Objetivo**: Avaliar as propriedades psicométricas do Inventário de Sintomas Pré-frontais (ISP-20). **Método:** Analisou-se a estrutura fatorial e a consistência interna em uma mostra de estudantes chilenos da Região Metropolitana (n = 211) com idades entre 18 e 30 anos (M = 23; DE = 281). **Resultados:** A solução fatorial de três fatores se mostrou coerente com o questionário original a respeito das principais alterações que perguntava o questionário (cognitivas, emocionais e comportamentais). **Discussão:** Os índices de consistência interna foram bons para a escala geral, resultando ser uma escala fiável e válida para a detecção de déficits dos processos cognitivos, emocionais e comportamentais associados com as funções executivas (FE).

Introduction

Executive functions (EF) are important variables in interrelationships of cognitive processes that involve attention, perception, problem solving, task change, but also regulation of emotions and behavior modification (Hall, Crossley & D'Arcy, 2010; Solberg- Nes et al., 2009). Therefore, the effect of these variables on health could be indirect, as it is seen as a moderator of the adverse effects of stress on physical health (Shields, Moons & Slavich, 2017).

These variables seem to influence the selection of the type of coping that is deployed. For example, a person who perceives greater control over a stressor is more likely to use the problem-centered approach; conversely, if he / she perceived less control, he / she would be more likely to be more passive, using avoidant coping strategies (Carver, Scheier & Weintraub 1989). Consequently, understanding the concept of EF is particularly important since it would participate in the evaluation process not only of a possibly stressful situation, but also of how to deal with it (Maes & Karoly, 2005; Williams & Thayer, 2009).

Currently, there are different definitions of EF, which have also been modified over time (Diamond & Lee, 2011). It was Muriel Lezak (1982) who first used the term EF, defining it as regulatory functions of human behavior, necessary to formulate goals, plan how to achieve them, and effectively fulfill the plan. Subsequently, he defines them as mental capacities that are fundamental for executing creative and socially accepted behavior (Lezak, 1987). And finally, as capacities that allow us to enjoy intentional and self-regulated behavior (Lezak, et al., 2004).

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Other researchers argue that EF refers to all aspects of thinking associated with solving a problem. Funahashi (2001) defined them as the processes necessary to meet a specific objective, calling them "executive control systems". Tirapu, Pérez, Erekatxo & Pelegrín (2007), propose that when a novel problem appears, the processes involved in the EF are those that evaluate the consequences of possible actions.

Regardless of the definition assumed, there is consensus among researchers that EF are a system of complex cognitive operations that participate in emotional and behavioral control (Diamond, 2013; Diamond & Ling, 2016; Miyake & Friedman, 2012). The search for a specific determination of the phenomena or subdomains EF encompass has derived a long list of functions, which has led to the limits of their concept being even more imprecise (Dajani & Uddin, 2015).

For Lezak (1987, 2004), EF were organized into different components that make up the cognitive processes related to the selection of objectives, as well as the ability to plan and monitor strategies so that the person achieves the goals set and adapts to their environment. The key elements recognized in EF are: (1) anticipation and development of attention, (2) inhibitory control and self-regulation, (3) cognitive flexibility and use of feedback, (4) planning and organization, (5) effective selection of problem-solving strategies and (6) monitoring (Anderson, 2002).

Several models have been proposed to explain EF, although none have been universally adopted (Diamond & Lee, 2011). The first models proposed conceptualizing EF from a unitary perspective, such as the Central Executive model proposed by Baddeley (1986), or the Active Supervision System model by Norman & Shallice (1986). These models have been too simple for some researchers, given that EF incorporate different components or interrelated dimensions (Alexander & Stuss, 2000; Hosenbocus & Chahal, 2012; Shallice & Bruguess, 1996). Other models emerged, including the one proposed by Miyake et al. (2000), in which they raised three independent core factors: inhibitory control, cognitive flexibility and working memory. These authors focused on these three factors since: (1) they are easily operationalized, (2) they can be studied using common tasks, (3) they influence the performance of complex tasks (Bausela, 2014). They also suggest that their degree of unity and independence can change throughout the different stages of development (Miyake et al., 2000). Concluding that these functions are distinguishable, but also correlated (Miyake & Friedman, 2012).

EF are clearly different and consist of different processes, which could be interrelated and could lead to conceptualizing the EF as a unit. However, this is still a matter under discussion since: (1) patients with frontal lobe damage rarely exhibit global executive dysfunction (Godefroy, 2003; Hosenbocus & Chahal, 2012); (2) measures of executive processes may poorly correlate (Miyaket et al., 2000); (3) the tasks or tests to evaluate the EF, can lead to errors, when evaluating a single indicator, which prevents obtaining sufficient evidence of the general construct of FE (Bausela, 2014; Chan, Shum, Toulopoulou & Chen, 2008).

In conclusion, the processes associated with these skills are diverse and of a different nature (Diamond, 2013). Therefore, it is relevant to understand the way in which these are articulated in the execution of certain behaviors and in the appearance of certain deficits that in the clinic are important to treat; but especially, in identifying what measures can be used for its evaluation.

Due to the above, there are different instruments that can be used to detect cognitive deficits in daily activities. It is necessary to have a questionnaire that asks about daily functioning, given that these include a quantitative assessment of the interrelationships of cognition with aspects emotional and behavioral in daily life (Ruiz et al., 2012); however, most of them were created in the English-speaking context, and only a few have been used in the Spanish-speaking population.

There are two classical instruments aimed at evaluating prefrontal symptoms. On the one hand, the dysexecutive questionnaire (DEX) includes the behavioral evaluation of the dysexecutive syndrome, which consists of 20 items that are scored on a 5-point Likert-type scale, between 'never' and 'very frequently'. n the other hand, we have the frontal systems behavior scale (FrSBe), with 46 items, which are answered in a scale similar to the previous one,

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and which includes both a global measure of frontal alteration and partial measures associated with three frontal syndromes: dysexecutive syndrome, apathy and disinhibition.

Both inventories have been validated in Spain, not only in addicts but also in the general population, confirming the existence of these same subscales, although it also suggested a possible unidimensionality of the questionnaires.

There is also the Prefrontal Symptoms Inventory (PSI-20) (Ruiz et al., 2012). The authors recruited 1,624 participants from Spain (445 addicts and 1,179 from the general population) to whom an inventory of 100 items based on the three spheres of human activity (cognition, emotion and behavior) was applied in relation to the three prefrontal syndromes. They administered the dysexecutive questionnaire (DEX-Sp) and the perceived stress scale (PSS) to study their convergent validity. The data showed a trifactorial structure of the questionnaire: problems in executive control (with three sub-factors; motivational, control and attentional problems), problems in social behavior and problems in emotional control (Ruiz et al., 2012).

The PSI-20 has proven its reliability and validity in samples from: (1) the general population; (2) people with addictions under treatment; (3) people with acquired brain damage; (4) as well as its concurrent validity with classic neuropsychological evaluation tests (Rojo, Pedrero, Huertas, Merritt, & MacKenzie, 2016).

In the case of the Chilean context, there are no standardized questionnaires or scales that allow measuring the cognitive and emotional deficits of daily activities. In accordance with the foregoing, in this work the main psychometric properties are disclosed the PSI-20, which is proposed as a tool that allows to measure the main symptoms of malfunction in activities of daily living that can be related to these deficits and prefrontal problems at the brain level.

Method

Design of the study

Descriptive, transversal, and instrumental study.

Participants

The sample used was non-probabilistic, intentional, and included 211 students from the Pontificia Universidad Catolica de Chile (PUC), aged between 18 and 30 years (*M*= 23, *SD* = 2.81) (see Table 1), who accepted under informed consent, participate in the study.

Table 1.
Demographic characteristics of participants

Gender	*N*	*%*
Men	86	40.76
Women	125	59.24
Age (years)	*M ± SD*	*%*
18-20		54.3
21-25	23±2.81	43.1
26-30		2.6

Procedure

To obtain the sample, the different schools / faculties of the PUC were approached to ask for their collaboration to invite the students who were taking their programs. Subsequently, those students who were interested in

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participating were briefly explained the objectives of the research. The confidentiality and anonymity of their data was guaranteed, and they were asked to sign the informed consent, read the instructions, and respond to the scale.

Place

The data collection was carried out at PUC headquarters between August 2017 and July 2018.

Data availability statement

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Instrument

The original version of Prefrontal Symptom Inventory (PSI) was used: this is a self-reported questionnaire developed by Ruiz, et al. (2012), that explores symptoms of poor everyday functioning related with neuropsychological alterations that can be attributed to the prefrontal cortex. It contains three factors: a) Executive problems, which in turn comprise three sub-factors (motivational, attentional and executive control problems); b) Emotional control problems, and c) Social behavior problems. The questionnaire consists of 20 items, with a Likert-type response system (0: never or hardly ever; 1: rarely; 2: sometimes; 3: often; 4: almost always or always). For its correction, the proposal by Rojo, et al. (2016), where the existence of cognitive and executive deficits is determined based on the percentile in which the person is located with the score obtained on the scale.

Ethical considerations

This study was approved by the Humanities and Social Sciences Research Ethics Committee (PUC), and was conducted following the ethical standards of the Helsinki Declaration. All participants provided their written informed consent to participate in this study.

Statistical analyses

The correlation coefficients of each item in the questionnaire were analyzed with the total test. The sample adequacy was evaluated by calculating the KMO index, the Bartlett test of sphericity, and the determinant of the correlation matrix. An exploratory factor analysis was conducted with the principal axis factor method with promax rotation. In addition, the internal consistency of the scale was evaluated using the Cronbach's Alpha statistic, considering those values equal to or greater than 0.7 to be acceptable (Cohen & Manion, 1990).

Results

Prior to the exploratory factor analysis that was carried out, the inventory was applied to an intentional sample of 10 PUC students, aged between 22 and 25 years (M = 23.60; SD = 1.43). The pilot confirmed the compression and writing of each of the items in the inventory. The results of the pilot study showed that no modification was necessary.

The results of the analyses carried out are presented below:

Analysis of the item / total correlation coefficient

The correlation coefficients of each item in the questionnaire were analyzed with the total test. The result showed that the coefficients are significant and most of them are greater than 0.50, this means that the items correspond

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to the factors that the inventory differentially evaluates. It should be mentioned that only "item 3" did not present a significant correlation coefficient with the total test (see Table 2).

Correlation matrix estimation

Before carrying out the exploratory factor analysis, the correlation matrix between the variables was estimated (see Table 3).

Exploratory Factor Analysis

After estimating the correlation matrix, an exploratory factor analysis was performed with the principal axis factorization method and oblique rotation with the promax method, sample adequacy tests with KMO (Kaiser-Meyer-Olkin) and Bartlett's sphericity, as well as the sedimentation graph was used as a criterion to select the number of factors.

The results of this factor analysis were as follows: the Kaiser-Meyer-Olkin sample adequacy index, which yielded an acceptable value (0.794). On the other hand, the Barlett sphericity test was significant (X^2 = 657.44, df = 180, p <0.001). From these results, it was established that the data was adequate to carry out an exploratory factor analysis.

It was decided to replicate the structure of the original version of the questionnaire, which has three factors. This was due to the fact that using the Kaisser-Guttman rule and the sedimentation graph (see Figure 1), this graph yielded a possible solution of three factors, which also satisfied the theoretical definition of the dimensions of the instrument.

From the above, the main axis factorization extraction method was used, with three factors. According to the literature (Fabrigar, Wegener, MacCallum & Strahan, 1999), this method provides more precise results about the commonality of the variables (shared variance) and is therefore highly recommended. Using this procedure allows us to identify the underlying (latent) factors or the dimensions that reflect the commonality of the variables (shared variance), without ruling out the single variance (error).

In Table 4, the loads of the unrotated factors for each variable on each factor (F1, F2, F3) are presented.

Given the difficulty in interpreting the item loads for each factor without rotating the result, a promax rotation of the model was performed (see Table 5).

The solutions found after rotation confirmed that the three-factor model is plausible. Obtaining that this explains 48.67% of the total variance.

The first factor was related to problems in executive / behavioral control (planning / attention / motivation), made up of nine questions (items 1, 2, 8, 9,10, 11, 12, 15, 16), which had the highest load was: I find it difficult to plan things in advance (0.817). The second factor related to problems in the control of social behavior or to others, was made up of four questions (items 14, 17, 18, 20), among which the one with the greatest burden was: I make inappropriate jokes / jokes in inappropriate situations (0.887), and the third factor, was related to problems in emotional control, was made up of four questions (items 4, 5, 13, 19), among which: I can easily go from laughing to crying, it was the one with the highest load (0.798).

Question 3 (I cannot do two things at the same time), question 6 (I have trouble changing the subject in conversations) and question 7 (I am like lethargic or sleepy), did not have factor loads above or equal to 0.4 Therefore, they were not grouped with any of the factors.

Reliability analysis for internal consistency

To demonstrate that the instrument has the psychometric property of reliability, internal consistency was evaluated using the Cronbach's Alpha statistic, considering those values equal to or greater than 0.7 to be acceptable.

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In the sample studied, the internal consistency of the total scale using Cronbach's alpha was 0.799, including the 20 original items, however, given that the three of the items, as they did not seem sensitive or representative for any of the three factors, they decided to exclude, obtaining that reliability continued to be high and had an increase (0.816). The final version of the inventory appears in Table 6.

Comparative analysis by gender of the participants

Regarding the gender variable, there were no differences between the scores according to the sex of the study participants (t = 1.13, p <.05).

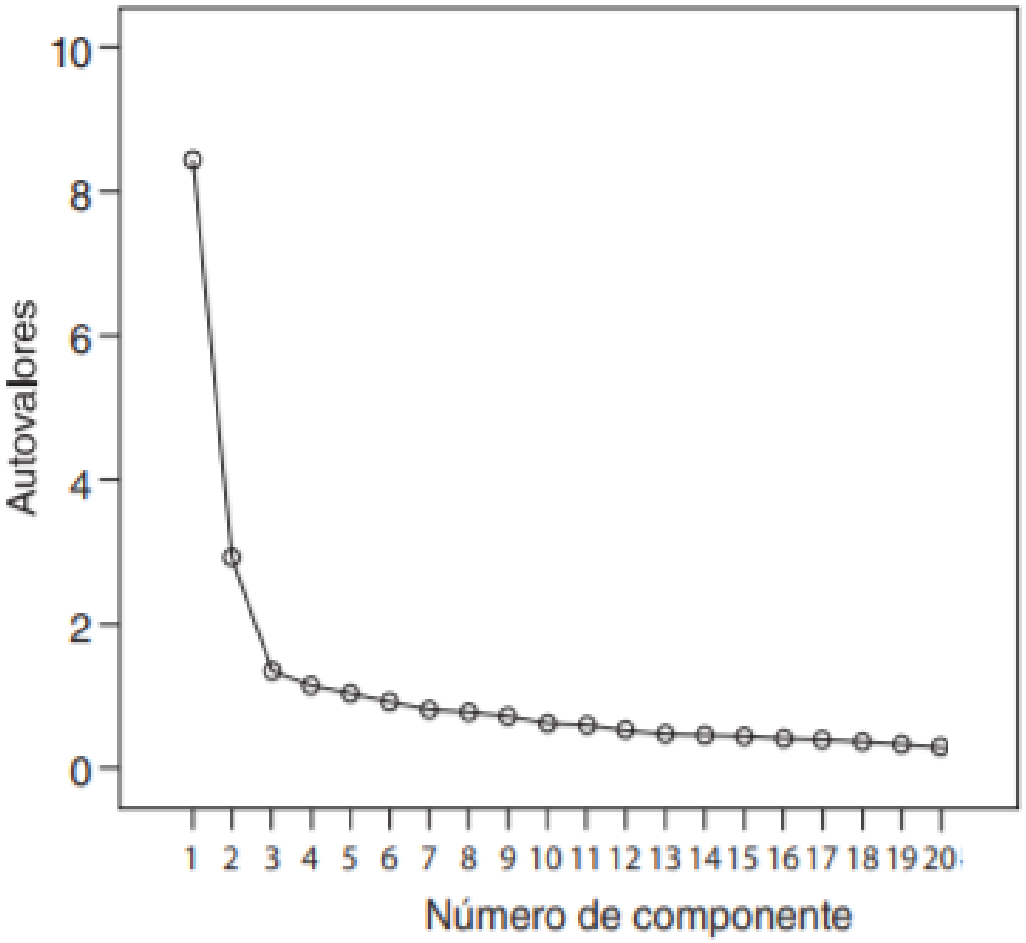

Figure 1. Sedimentation Graph

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Table 2

Correlation matrix between the items and the total test

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18	Item 19	Item 20
Total Test	.460**	.701**	.105	.404**	.364**	.266*	.472**	.643**	.550**	.539**	.510**	.449**	.449**	.306**	.587**	.552**	.462**	.516**	.536**	.235*

** p < 0.01
* p < 0.05

Table 3

Matrix of correlations between the items

	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9	Item 10	Item 11	Item 12	Item 13	Item 14	Item 15	Item 16	Item 17	Item 18	Item 19	Item 20
Item 1	1										.									
Item 2	.406**	1																		
Item 3	-.080	.118	1																	
Item 4	.057	.225*	-.187	1																
Item 5	.139	.313**	-.175	.297**	1															
Item 6	.180	.268*	.256*	.086	.097	1														
Item 7	.420**	.302**	-.212	-.068	.323**	-.057	1													
Item 8	.260*	.344**	.015	.222*	.140	.046	.274*	1												
Item 9	.194	.258*	.299**	.050	-.107	.145	.255*	.375**	1											
Item 10	.200	.345**	.045	.190	-.090	-.017	.106	.569**	.447**	1										
Item 11	.009	.447**	.132	.112	.054	.009	.144	.213	.265*	.296**	1									
Item 12	.252*	.125	.070	.007	.009	.101	.228*	.411**	.321**	.243*	.312**	1								
Item 13	.123	.274*	-.187	.479**	.377**	.225*	.111	.221*	.141	.159	.069	.035	1							
Item 14	.030	.208	-.003	-.159	.037	-.072	.223*	.081	.086	.093	.258*	.037	-.161	1						
Item 15	.575**	.446**	-.134	.090	.290**	.058	.534**	.468**	.162	.261*	.181	.280*	.110	.164	1					
Item 16	.304**	.276*	.183	.256*	-.044	.133	.083	.355**	.428**	.293**	.288**	.456**	.101	-.048	.179	1				
Item 17	.148	.311**	-.045	.098	.207	-.075	.213	.124	.149	.270*	.313**	.039	.131	.408**	.140	.140	1			
Item 18	.044	.289**	-.055	.180	.047	.149	.229*	.223*	.221*	.253*	.246*	.088	.108	.518**	.242*	.174	.491**	1		
Item 19	.116	.395**	-.108	.420**	.290**	-.054	.160	.440**	.155	.244*	.232*	.165	.520**	-.092	.296**	.417**	.005	.012	1	
Item 20	-.184	.069	-.139	.280*	.160	.010	.015	-.040	-.019	-.055	.228*	-.039	.175	.341**	.037	-.069	.377**	.359**	.059	1

** p < 0.01
* p < 0.05

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Table 4

Unrotated factor matrix

	Factors		
	1	2	3
Item 2	.710	.042	-.023
Item 8	.686	-.262	.006
Item 15	.645	-.011	-.052
Item 10	.582	-.195	.210
Item 19	.558	-.176	-.491
Item 16	.551	-.413	.119
Item 9	.521	-.314	.363
Item 11	.512	.124	.278
Item 7	.512	.134	.020
Item 1	.505	-.232	-.027
Item 12	.468	-.350	.228
Item 6	.182	-.177	-.025
Item 20	.190	.683	-.045
Item 14	.269	.594	.491
Item 17	.451	.554	.235
Item 18	.487	.505	.303
Item 13	.428	.043	-.627
Item 4	.385	.086	-.564
Item 5	.344	.290	-.533
Item 3	-.016	-.355	.460

Extraction model, factorization of main axes.

Table 5.

PSI Inventory Factor Loads

	Factors		
	1	2	3
Item 16	.817	.180	.323
Item 8	.721	.031	.125
Item 9	.662	.177	-.066
Item 10	.636	.246	.116
Item 12	.606	.073	.005
Item 2	.606	.413	.425
Item 15	.566	.327	.401
Item 1	.542	.092	.255
Item 11	.505	.274	.091
Item 7	.329	.308	.300
Item 6	.232	-.043	.084
Item 14	.071	.887	-.114
Item 18	.269	.757	.139
Item 17	.204	.750	.184
Item 20	-.134	.605	.289
Item 13	.246	.045	.798
Item 4	.202	.076	.685
Item 5	.083	.219	.681
Item 19	.480	-.002	.668
Item 3	.222	-.115	-.253

Rotation method: Promax with Kaiser normalization.

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Table 6.

Definitive PSI inventory after completing the factor analysis

	Nunca o casi nunca	**Pocas veces**	**A veces si o a veces no**	**Muchas veces**	**Siempre o casi siempre**
1. Tengo problemas para empezar una actividad. Me falta iniciativa					
2. Me resulta difícil concentrarme en algo					
3. Río o lloro con demasiada facilidad					
4. Me enfado mucho por cosas insignificantes. Me irrito con facilidad					
5. Tengo dificultades para tomar decisiones					
6. Me olvido de que tengo que hacer cosas, pero me acuerdo cuando me lo recuerdan					
7. No hago las cosas sin que alguien me diga que las tengo que hacer					
8. Tengo dificultades para seguir el argumento de una película o un libro					
9. Tengo dificultad para pensar cosas con antelación o para planificar el futuro					
10. Puedo pasar de la risa al llanto con facilidad					
11. Hago chistes/ bromas inapropiadas en situaciones inapropiadas					
12. Me cuesta ponerme en marcha. Me falta energía					
13. Me cuesta planificar las cosas con antelación					
14. Hago comentarios sobre temas muy personales delante de los demás					
15. Hago o digo cosas embarazosas					
16. Tengo explosiones emocionales sin una razón importante					
17. Hago comentarios sexuales inapropiados					

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Discussion and Conclusions

In this study, the objective was to establish the main psychometric properties of an inventory that allows the EF to be measured reliably and validly in a general population. No previous study had reported its application in a specific population of healthy individuals in Chile.

The results indicate that the PSI-20 is an instrument that shows the ability to preserve its properties in the general non-clinical population (Mendoza, Cuello & Lopez, 2016). It also constitutes a consistent test both as a whole and in each of the derived subscales. This coincides with the results previously obtained in different types of populations, when presenting very satisfactory consistency values (Rojo, et al., 2016).

In relation to the validity evaluated through the exploratory factor analysis (EFA), resulting in a structure of three factors: Executive problems, Social problems, and Emotional problems. This factorial solution is congruent with the theoretical formulation of the scale, with which the items were written and with the joint functioning of the explored subsystems, under natural conditions (Ruiz et al., 2012).

These data are linked to the theoretical formulations existing on prefrontal symptoms, which propose three syndromes: dorsolateral syndrome, ventromedial syndrome, and orbital syndrome in which the EF of a higher order are affected, such as: planning, attention, working memory, problem solving and cognitive flexibility (Mendoza et al., 2016).

In conclusion, this study constituted a first approach in a general non-clinical sample, and the data obtained indicate that PSI is a very useful instrument for the evaluation of prefrontal indicators. In addition, its efficiency stands out as it is a short and easy-to-apply inventory to provide a value related to executive disturbance and emotional and behavioral problems. However, it is suggested to carry out a confirmatory factor analysis (CFA), which is an extremely useful strategy in the field of hypothesis testing and theory confirmation. Likewise, it is necessary a convergent and discriminant validity analyzes with other neuropsychological tests to reinforce that it is a questionnaire that can be used to detect cognitive and emotional deficits, which are caused by complex psychopathological problems. All these analyzes should be done with a larger sample size since the sample used in this research made more robust statistical analyzes unfeasible.

Therefore, it is convenient to continue investigating in Chile the PSI-20, in broader samples with different characteristics, to establish the strength of the psychometric characteristics of the inventory.

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Conflicts of interest

The author declares she has no conflicts of interest.

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