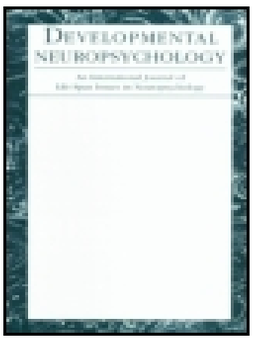

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The Childhood Executive Functioning Inventory (CHEXI) Parent and Teacher Form: Factor Structure and Cognitive Correlates in Spanish-speaking Children from Argentina

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ABSTRACT

The aims of the present study were: (1) to explore the CHEXI factor structure parent (n = 183) and teacher (n = 206) forms in Spanish-speaking children aged 6 to 11 years, (2) to analyze the relationship between parent- and teacher-rated data and performance-based measures of EF (including working memory, inhibition, and cognitive flexibility tasks) and academic achievement and (3) to examine the association between parents and teachers reports. Confirmatory Factor analysis (CFA) showed that the two-factor model including (1) Working memory and (2) Inhibition best fit the data. McDonald's Omega coefficient was adequate for both the total parents (ω = .98). and teachers' (ω = .98) scales. In addition, low and selective associations were found between performance and rater-based assessments. However, stronger associations were observed between CHEXI and academic performance with differences according to the informant (parents vs. teachers). Finally, low correlations were found between parents and teachers reports. Taken together, our results suggest that the CHEXI is a reliable measure to assess EF in Argentinean Spanish-speaking children, supporting existing evidence that proposes that ratings and performance-based measures would assess different underlying mental constructs. Clinical and educational implications for considering both perspectives during neuropsychological assessment, further including parent- and teacher-rated reports are discussed.

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Introduction

Executive Functions (EF) are defined as a set of cognitive processes necessary for goal-directed behavior (Luria, 1966; Stuss & Benson, 1986). These higher-order cognitive processes are considered a diverse-but-unitary construct composed of three separate but related main components, namely, (1) working memory, (2) inhibition and (3) shifting (Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000). EF in school-aged populations has recently received increased attention, as these skills enable thinking and behavior self-regulation (Miyake & Friedman, 2012) and constitute good predictors of academic performance (Arán Filippetti & Krumm, 2020; Arán Filippetti & Richaud, 2017; Jacobson, Williford, & Pianta, 2011; St Clair-Thompson & Gathercole, 2006) and socio-emotional skills (Riggs, Jahromi, Razza, Dillworth-Bart, & Mueller, 2006) during school age.

In the clinical neuropsychology field, executive dysfunction has been associated with attention-deficit/hyperactivity disorder (ADHD) (Arán Filippetti, Krumm, & Raimondi, 2019; Arán Filippetti &

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Mías, 2009; Barkley, 1997), Autism (Ozonoff, Pennington, & Rogers, 1991; Pennington et al., 1997), Gilles de la Tourette Syndrome (Channon, Pratt, & Robertson, 2003; Rasmussen, Soleimani, Carroll, & Hodlevskyy, 2009), Phenylketonuria (Anderson, Anderson, Northam, Jacobs, & Mikiewicz, 2002; Diamond, Prevor, Callender, & Druin, 1997; Welsh, Pennington, Ozonoff, Rouse, & McCabe, 1990), Fetal Alcohol Syndrome (Green et al ., 2009; Kodituwakku, Kalberg, & May, 2001) and hydrocephalus (Anderson et al., 2002), among others. In addition, in children diagnosed with cancer (Anderson, Godber, Smibert, & Ekert, 1997; Spiegler, Bouffet, Greenberg, Rutka, & Mabbott, 2004; Walsh et al., 2015) or brain trauma, executive deficits have been observed when assessed through performance-based measures or rating scales (Levin, Song, Ewing-Cobbs, & Roberson, 2001; Mangeot, Armstrong, Colvin, Yeates, & Taylor, 2002). Thus, it is essential to have valid and reliable instruments to assess EF both in clinically referred and typically developing children.

Ratings scales vs performance-based measures of executive functions

Although executive functioning has been mainly assessed through performance-based measures, such as the Trail Making tests (Reitan & Wolfson, 1992) or the Stroop Color and Word Test (Golden, 1978), recently, there has been an increasing interest in its evaluation through ratings scales such as the Behavior Rating Inventory of Executive Function (BRIEF) (Gioia, Isquith, Guy, & Kenworthy, 2000; Gioia, Isquith, Guy, & Kenworthy, 2017a, 2017b) or the Childhood Executive Functioning Inventory (CHEXI) (Thorell & Nyberg, 2008). The relevance of considering both domains relies in the fact that existing evidence has suggested that rantings and EF performance-based measures would evaluate distinct underlying mental constructs (see e.g., Toplak, West, & Stanovich, 2013). Indeed, discrepancies between the results obtained by both methods have arisen when working with clinical samples (Anderson et al., 2002; Conklin, Salorio, & Slomine, 2008; Davidson, Cherry, & Corkum, 2016; McAuley, Chen, Goos, Schachar, & Crosbie, 2010; Vriezen & Pigott, 2002) and typically developing children (Camerota, Willoughby, Kuhn, & Blair, 2018; Pino-Muñoz & Arán Filippetti, 2019; Thorell & Nyberg, 2008). This dissonance could be explained by the fact that performance-based measures are assumed to tap cognitive abilities (i.e., cool EFs) manifested in more analytical, non-emotional situations and under standardized conditions (Toplak et al., 2013), while rating measures emphasize the assessment of EFs in more real-life situations (Anderson et al., 2002; McAuley et al., 2010). Thus, while performance-based measures would assess underlying cognitive abilities, rating scales would evaluate the proper use of those skills in diverse sceneries (i.e., school and home) (McAuley et al., 2010; Toplak et al., 2013). This emphasizes the importance of considering both assessment approaches when examining EF in TD children and clinic-referred samples.

The Childhood Executive Functioning Inventory (CHEXI)

The CHEXI is an EF 24-item rating scale for parents and teachers, which has been translated into different languages including English, Spanish, Chinese, French and Swedish, being available for free download (see www.chexi.se). The relevance of the inventory for the clinical and educational neuropsychology field has been reflected in several studies, actually addressing its validity as a screening measure for the detection of poor school performance and early learning difficulties in children from different countries (Thorell, Veleiro, Siu, & Mohammadi, 2013), as well as the identification of children with ADHD (Catale, Meulemans, & Thorell, 2015; Thorell, Eninger, Brocki, & Bohlin, 2010). Though the instrument originally included four subscales (i.e., Working Memory, Planning, Inhibition, and Regulation), Thorell and Nyberg (2008) found two factors in Swedish children when using Exploratory Factor analyses techniques, i.e., working memory and inhibition. Both factors demonstrated acceptable levels of internal consistency (Cronbach's $\alpha > .85$ for inhibition and >.89 for WM) and adequate reliability ($r > .77$) in different countries (Thorell et al., 2013) and were highly correlated both for the parent ($r = .65$) and teacher ($r = .69$) forms (Thorell & Nyberg, 2008). To date, this two-factor structure has been replicated in French (Catale, Lejeune, Merbah, & Meulemans, 2013;

Catale et al., 2015) and English (Camerota et al., 2018)-speaking children. Precisely, in French-speaking children, this two-factor structure showed an adequate fit for data, good psychometric properties, and high sensitivity and specificity in discriminating between children with ADHD and healthy controls from different countries (i.e., Belgian and Swedish) (Catale et al., 2015). In English-speaking preschoolers, a two-factor solution has also provided the best fit for data when being compared to alternative models (Camerota et al., 2018).

The Present Study

Ratings scales such as the CHEXI significantly contribute to EF assessment in applied research, given that performance-based measures and ratings would explore different aspects of EF. Although previous studies have examined its dimensionality in English (Camerota et al., 2018) and Swedish-speaking preschoolers (Thorell & Nyberg, 2008) and in French-speaking school-aged children (Catale et al., 2015), to our knowledge, no studies have neither analyzed its factor structure in Spanish-speaking children, nor considered the relationship between parents and teachers reports and their association with performance-based EF measures in Spanish-speaking children. This analysis is of great relevance, considering that as ratings and performance-based measures would assess different aspects of the EF construct (Anderson et al., 2002; McAuley et al., 2010), they should not be granted as equivalent or interchangeable (Toplak et al., 2013).

Based on the expressed, this study aimed to examine the construct validity of the CHEXI parent and teacher forms in Spanish-speaking children. In addition, it implied an attempt to analyze the relationship between both CHEXI forms and performance-based measures of EF (i.e., working memory, cognitive flexibility and inhibition) and academic performance. Finally, we aimed to analyze the relationship between CHEXI parents and CHEXI teachers reports. Considering previous theoretical and empirical evidence, we first hypothesized that the CHEXI reflects different but related dimensions. However, since earlier studies have found that WM and inhibition factors are highly correlated (Thorell & Nyberg, 2008), two theoretical models will be tested to analyze whether the structure is diverse (i.e., two-factor model) or unitary (i.e., one-factor model). Second, considering the results yielded by earlier studies from different countries (see, e.g., Camerota et al. 2018; Thorell & Nyberg, 2008), it is assumed that there are low -to -moderate correlations between the CHEXI indicators and EF performance-based measures. In addition, we expected to find differences according to the informant (parent vs teacher) regarding the association between CHEXI and academic performance in different domains (i.e., language and mathematics). Finally, we hypothesized that there were exist low to-moderate correlations between parents and teachers reports.

Method

Participants

The sample consisted of 133 middle-class Spanish-speaking children of both sexes (61 women, 72 men), aged between 6 to 11 years ($M = 8.25$; $SD = 1.53$). Inclusion criteria included: (1) no neurological or psychiatric history, (2) regular school attendance, and (3) no school repetition. Prior to assessment, we certified with the school department of psychopedagogy that children authorized to participate in the study met the inclusion criteria. Besides, before any statistical analyzes, the sample intellectual capacity was examined through Raven Progressive Matrices test (Raven, Court & Raven, 2008), showing an expected performance according to age ($M = 26.88$; $SD = 5.60$). Parents' educational level was categorized by means of a 5-point scale as follows: 1. Primary level, 2. Secondary level, 3. More education than secondary school but less than a university degree, 4. University degree, 5. Master's degree or higher education. The average of fathers' educational level was 3.42 (0.93) while the average of mothers' educational level was 3.55 (0.86). Data for the CHEXI parent form were obtained

from 183 subjects. Data for the CHEXI teacher form were obtained from 206 teachers. All participants lived in, Entre Ríos, Argentina.

Instruments

Childhood Executive Functioning Inventory (CHEXI) (*Thorell & Nyberg, 2008*)

This scale consists of 24 items with five response options ranging from 1 (definitely not true) to 5 (definitely true). Highest scores reflect higher EF deficits. It includes four subscales: working memory (9 items), planning (4 items), inhibition (6 items) and regulation (5 items) that are grouped into two factors, namely WM and inhibition (Thorell & Nyberg, 2008). Cross-cultural studies (Catale, Lejeune, Merbah, & Meulemans, 2011; Catale et al., 2015) have consistently identified two broad factors named working memory (working memory and planning subscales) and inhibition (inhibition and regulation subscales).

Digit Span and Letter–Number Sequencing subtests of the WISC-IV (Wechsler, 2003). It consists of two main subtests: digits (D) that provides a measure of immediate oral retention when assessed with digit forward (DF), and maintenance and manipulation of information when using digit backwards (DB). Letters and numbers (LN) subtest includes a series of numbers and disorganized letters for participants to recall, order the numbers from lowest to highest and arrange the letters alphabetically. The WISC IV has been standardized in Argentina. The average internal consistency using the two-half method is .85 for LN, .82 for DF and .74 for DB. The test-retest reliability coefficient is .77 for LN, and .76 and .68 for DF and DB respectively (Wechsler, 2010).

Knock and Tap, NEPSY (Korkman, Kirk, & Kemp, 1998). It assesses self-regulation and inhibition. Subjects must suppress a motor action to produce a conflicting motor response. NEPSY battery has been study in Spanish-speaking children (Aguilar-Alonso, Torres-Viñals, & Aguilar-Mediavilla, 2014). Several recent studies have used this task to assess inhibition in English (Pratt, Leonard, Adeyinka, & Hill, 2014), French (Mainville, Brisson, Nougarou, Stipanicic, & Sirois, 2015) and Spanish (Arán Filippetti & Richaud, 2017) -speaking children.

Trail Making Test (TMT; Reitan & Wolfson, 1992). It includes two subtests, A and B. It enables to get a measure of attention and cognitive flexibility (Spreen & Strauss, 1998). In each subtask, the time and number of errors are recorded. The test-retest reliability coefficient ranges from .60 to .90 (Spreen & Strauss, 1998). Exploratory and Confirmatory Factor Analytic studies have showed that the task taps shifting ability (Arán Filippetti & Krumm, 2020; Lehto et al., 2003).

Semantic Verbal Fluency (SVF) and Phonologic Verbal Fluency (PVF) (FAS fluency test; Benton & Hamsher, 1989). Subjects are instructed to retrieve and utter all possible words belonging to a certain category (i.e., fruits and animals) or beginning with a specific letter (i.e., F, A and S) within 60 seconds. These VF tasks have norms for Spanish-speaking children (Arán Filippetti & Allegri, 2011; Ardila & Rosselli, 1994). The score is the total number of correct words given for each subtask (i.e., SVF: total animals + total fruits and PVF: total letter F + total letter A + total letter S), excluding proper names, alternate endings of the same word, intrusions and repetitions.

Raven's Colored Progressive Matrixes (RPM) (Raven, Court, & Raven, 2008) It measures abstract reasoning ability, valuing a common component to all operations (factor g). It is a 36-item test, organized in 3 series (A, Ab, B) of 12 items each, progressively increasing in difficulty. Each correct answer is given a point, eventually obtaining a partial (for each series) and a total score. Series A consists of simple, perceptual problems, which assess the ability to complete a continuous pattern. Ab series assesses the ability to apprehend discrete figures as a related whole. Series B evaluates the ability to think by analogies. Items show relationships between discrete or discontinuous elements (Raven et al., 2008).

Academic Performance. It was assessed considering the school grades attained in Language and Mathematics during the first trimester using a numerical scale from 1 to 10, with a passing grade of 6.

Similar numerical scales have been used in previous studies analyzing the relationship between executive functioning ratings and academic performance in different countries (Thorell et al., 2013).

Ethics procedures

School principals were interviewed in order to receive information on the research characteristics. Likewise, teachers got acquainted of the objectives of the study and particularities of data collection. Parental or legal representatives written consent and children's verbal assent were obtained before beginning the assessment. It was explicitly clarified that collaboration was voluntary and confidential. The CHEXI parent form was attached to the informed consent in order to assess parental perception of their children's executive functioning. This study was part of a larger research project approved through Resolution 1/9.2018 by the Research Ethics Committee of the Faculty of Health Sciences (FHS) of the Universidad Adventista del Plata, with number CE000237 of the National Health Research Registry (NHRR).

Statistical Procedures

Descriptive statistics was used: means and standard deviations were calculated for each of the cognitive tasks used. Confirmatory Factor Analysis (CFA) by means of the LISREL was conducted, based on polychrome matrices and meeting the polytomic nature of the items. Factors were extracted with the Maximum Likelihood method with robust estimation. The goodness-of-fit of the models was evaluated using the $\chi 2$ statistic, the Comparative Fit Index (CFI), the Normed Fit Index (NFI), the Incremental Fit Index (IFI) and Akaike's Information Criterion (AIC), Besides, the Root Mean Square Error of Approximation (RMSEA) was calculated for each model to test the degree of error. CFI values can range between 0 and 1, being values greater than .90 indicators of an acceptable fit (Hu & Bentler, 1995, 1999). IFI values can be higher than 1.0. The root mean square error of approximation (RMSEA) is considered acceptable when values are below .08 (Hu & Bentler, 1999). Coefficient omega (ω McDonald's) was used for estimating reliability. Likewise, the composite reliability (CR) and the average variance extracted (AVE) were calculated. Pearson's r correlations were used to analyze the relationship between the CHEXI and performance-based measure of EF and academic achievement, as well as to explore the relationship between parents and teachers reports. Analyses were performed with the Statistical Package for the Social Sciences (SPSS) 22.0 for Windows.

Results

Descriptive Statistics

Table 1 shows descriptive statistics for EF cognitive and behavioral measures of the total sample of children.

Confirmatory Factor Analysis of the CHEXI parent form

A one- and two- factor models were compared. The two-factor model revealed an excellent fit as the ratio χ^2/df was 1.70, the fit indices CFI = .97; NFI = .93; IFI = .97 were higher than .90 and the RMSEA was equal to .062. In turn, the one-factor model was tested considering the high and significant correlation between the two factors (.73). Results indicated that the two-factor model better explained the data than the one-factor model (see Table 2). Reliability measured through ω McDonald was adequate for both the extracted factors (WM ω = .86; IN ω = .84) and the total scale (ω = .92). In addition, CR value was similar for the two factors (WM = .92; IN = .84) and the total scale (FC = .94). Finally, the AVE for WM, IN and total scale was .46, .33 and .40, respectively (see Figure 1 for the model).

Table 1. Descriptive statistics for cognitive and behavioral measures.

		M	SD
Performance-based measures	WM-WISC IV	26.69	5.41
	PVF	13.91	6.68
	SVF	20.26	5.51
	TMT-A	38.20	18.90
	TMT-B	84.44	44.59
	Knock and Tap	27.90	2.03
Rating scale	CHEXI-WM Parents	29.88	8.38
	CHEXI-IN Parents	31.16	6.95
	CHEXI-WM Teacher	29.23	12.50
	CHEXI-IN Teacher	26.27	11.26
	TOTAL CHEXI Parents	61.04	13.53
	TOTAL CHEXI Teachers	55.40	22.86

Note: WM = Working Memory; PVF = Phonological Verbal Fluency; SVF = Semantic Verbal Fluency; TMT-A = Trail Making Test-A; TMT-B = Trail Making Test-B; K-T = Knock and Tap.

Table 2. Fit indices for the two-factor model and reduced model for the parent form.

Models	χ^2	*df*	*p*	$\chi^2_{/df}$	CFI	NFI	IFI	AIC	RMSEA
1. Two-factor model	**428.18**	**251**	**<.001**	**1.70**	**.97**	**.93**	**.97**	**526.18**	**.062**
2. One-factor model	567.65	252	<.001	2.25	.95	.91	.95	663.65	.083

Note. CFI, NFI and IFI values greater than .95, AIC low values and RMSEA values below .08 are indicators of good adjustment. The best-fit model values are presented in bold type.

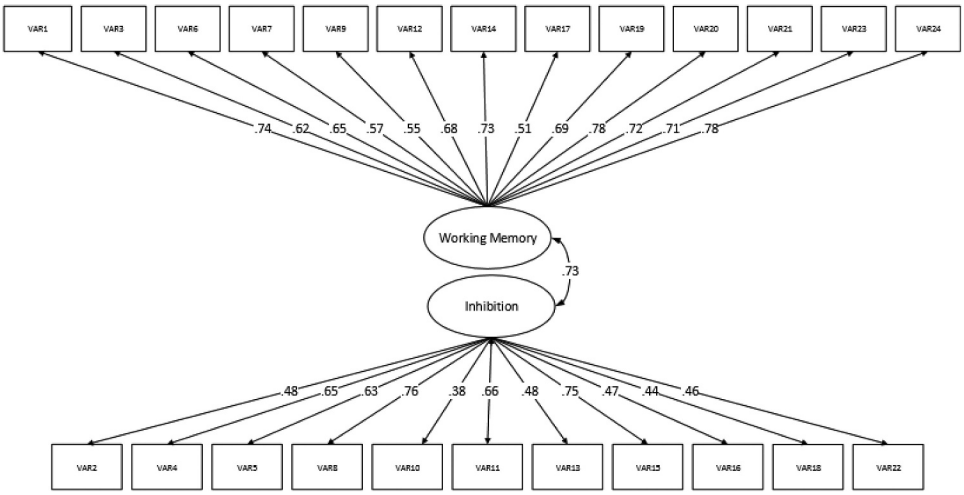

Figure 1. Bifactorial model of the CHEXI parent form.

Confirmatory Factor analysis (CFA) of the CHEXI teacher form

A one- and two- factor models were compared. The two-factor model revealed an acceptable fit as the ratio χ2/df was 2.36, the fit indices were greater than .95 (CFI = .99; NFI = .98; IFI = .99), and the RMSEA remained equal to .08. As the correlation between the two factors was also high and significant (.92), a one-factor model was tested. The two-factor model better fit for the data than the one-factor model (see Table 3). Reliability measured through ω McDonald was adequate both for the two factors extracted (ω = .97) and the total scale (ω = .98). In addition, the CR value was similar for both factors (WM = .98 and IN = .97) and for the total scale (CR = .99). Finally, the AVE for WT, IN and total scale was .41, .64 and .73, respectively (see Figure 2 for the model).

Table 3. Fit indices for the two-factor model and reduced model for the teacher form.

Models	χ^2	*df*	*p*	$\chi^2_{/df}$	CFI	NFI	IFI	AIC	RMSEA
1. Two-factor model	**591.13**	**251**	**<.001**	**2.36**	**.99**	**.98**	**.99**	**689.13**	**.081**
2. One-factor model	922.07	252	<.001	3.66	.98	.97	.98	1018.07	.011

Note. CFI, NFI and IFI values greater than .95, AIC low values and RMSEA values below .08 are indicators of good adjustment. The best-fit model values are presented in bold type.

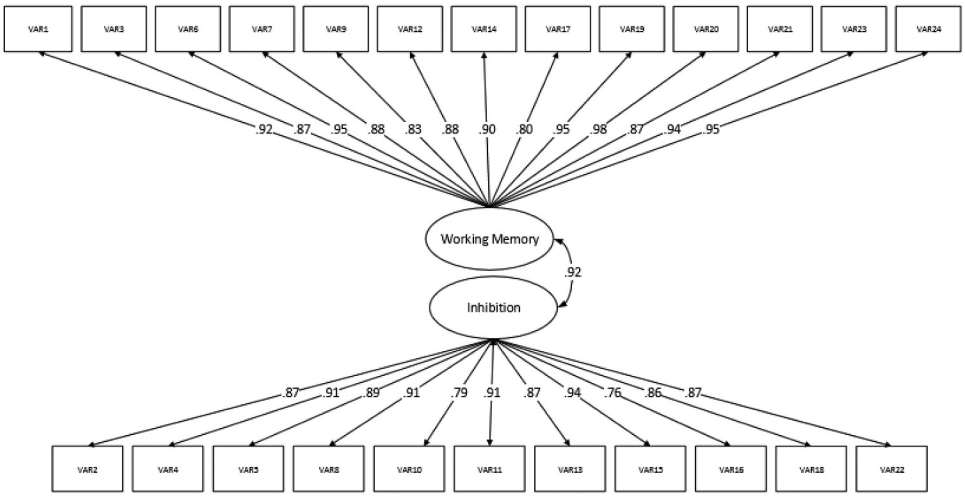

Figure 2. Bifactorial model of the CHEXI teacher form.

Relationship between CHEXI and performance-based EF measures

Significant correlations were found between the WM subscale of the CHEXI and the performance in WM and cognitive flexibility tasks and between the IN subscale and the performance in cognitive flexibility tasks. The greater the difficulty on EF as reported by parents and teachers, the worse the children's performance on WM and cognitive flexibility (spontaneous and reactive) tasks. However, we did not find an association between the CHEXI and inhibition as measure by the paper-and-pencil task. Interestingly, we observed a greater association between the teachers' perception and children's neuropsychological test performance in comparison to parents' assessment. However, although being significant, the magnitude of these relationship was in general low (See Table 4).

Relationship between CHEXI scale and academic achievement

Significant correlations were found between the CHEXI WM and IN subscales and children's school performance. Specifically, the greater the difficulties reported in the CHEXI domains by parents or teachers, the worse the children's academic performance in the area of language and mathematics. It is worth noting that a greater association was also observed between teachers' reports and children's school performance when compared to parents' assessment and their children's academic performance (See Table 5).

Relationship between the CHEXI parent and teacher forms

Significant correlations were found between parents and teachers' reports both for WM and the inhibition factors. However, the associations between parents and teachers' reports were low in magnitude (range from $r = .26$ to $r = .40$) (See Table 6).

Table 4. Correlations between CHEXI and performance-based EF measures.

	CHEXI – WM		CHEXI – Inhibition	
	Teachers	Parents	Teachers	Parents
r	r	r	r	
WM WISC IV	−.49***	−.28**	−.014	−.00
PVF	−.34***	−.17*	−.28**	−.17*
SVF	−.33***	−.19*	−.21*	−.19*
TMT-A	.30***	.37***	.22*	.22**
TMT-B	.45***	.20*	.36***	.17*
K-T	−.16	.00	−.14	−.00

*p < .05. ** p < .01. *** p < .001.
Note: WM = Working Memory; PVF = Phonological Verbal Fluency; SVF = Semantic Verbal Fluency; TMT-A = Trail Making Test-Part A; TMT-B = Trail Making Test-Part B; K-T = Knock and Tap.

Table 5. Correlations between the CHEXI forms and children's school achievement.

	School performance	
	Language	Mathematics
	r	*r*
CHEXI-WM – Teacher	−.63***	−.61***
CHEXI-IN – Teacher	−.46***	−.44***
CHEXI-WM – Parents	−.38***	−.34***
CHEXI-IN – Parents	−.29**	−.22**

**p < .01. *** p < .001.

Table 6. Relationship between the CHEXI parents and the CHEXI teachers reports.

		CHEXI-WM	CHEXI-IN
		Teachers	Teachers
		r	*r*
CHEXI-WM	Parents	.40**	.26**
CHEXI-IN	Parents	.37**	.39**

**$p < .01$.

Discussion

The aims of the present study were to examine the dimensionality of the CHEXI parent and teacher forms in Spanish-speaking children and to analyze the association between the CHEXI and performance-based measures of EFs and academic achievement, considering both parents and teachers' reports.

First, CFA offered support for a two-factor solution including behaviors related to (1) WM and (2) inhibition. This two-factor structure is consistent with the model proposed by authors working with Swedish-speaking children (Thorell & Nyberg, 2008) and further replicated with French-speaking children (Catale et al., 2013, 2015) and English-speaking preschoolers (Camerota et al., 2018). Besides, the fit indices are similar to those reported for the French and English versions with CFI values greater than .90 and RMSEA values below .08. Therefore our findings offers additional support for the CHEXI construct validity, and they are in line with the multidimensional view of children's EF as assessed both through paper-and-pencil tasks (Arán Filippetti, 2013; Arán Filippetti & Richaud, 2017; Lehto et al., 2003) and ratings (Catale et al., 2013, 2015; Gioia, Isquith, Retzlaff, & Espy, 2002; Pino Muñoz & Arán Filippetti, 2019).

Second, aligned with data reported by previous studies using both the CHEXI (Camerota et al., 2018; Thorell & Nyberg, 2008) and the BRIEF (Davidson et al., 2016; Garon, Piccinin, & Smith, 2016;

Pino Muñoz & Arán Filippetti, 2019), we found significant but low correlations between executive functioning as measure by ratings scales and children's executive performance as valued by means of WM and cognitive flexibility paper-and-pencil tasks. Interestingly, the magnitude of the correlations between the CHEXI and performance-based EF measures was higher (mainly for the WM dimension) than that observed when using other questionnaires such as the BRIEF in Spanish-speaking children (range to r = .12 to r = .32; see e.g., Pino Muñoz & Arán Filippetti, 2019). This would suggest the existence of at least some differences between ratings, which would be consistent with the purpose of the CHEXI authors regarding the development of a questionnaire (different to BRIEF), including items that are attempted to capture executive functioning more specifically (Thorell & Nyberg, 2008). However, and consistent with Bodnar, Pralune, Cutting, Denckla, and Mahone (2007) findings, we did not find an association between the behavioral scale and inhibition as measure by performance-based measures. As inhibition is a multidimensional construct (Nigg, 2000), it could be hypothesized that paper-and-pencil tasks and ratings scales assess different subtypes of inhibition. Thus, while ratings generally refer to behaviors related to different inhibition subtypes (i.e., cognitive and behavioral), the paper-and-pencil test used in the present study assesses the inhibition of motor responses. Besides, a potential weakness in the performance-based measure of inhibition should also be considered. Together, our results support the existing evidence suggesting that different EF measures – ratings and performance-based measures – would assess different underlying mental constructs (see Toplak et al., 2013 for review). That is, cognitive tasks and behavioral (ratings) measures would evaluate different aspects of the EF construct (Toplak et al., 2013). While ratings would capture and reflects a more global behavior in diverse natural contexts (e.g., home and school) and over prolonged periods of time, performance-based measures would assess underlying cognitive skills (Toplak et al., 2013) in a much more predictable and structured environment (Anderson et al., 2002; McAuley et al., 2010).

When examining the relationship between the CHEXI and academic achievement in language and mathematics, stronger correlations were found than those observed between the inventory and performance-based EF measures. These data are in line with previous works that found that CHEXI was significantly related to language and math skills (Thorell & Catale, 2014; Thorell & Nyberg, 2008; Veleiro & Thorell, 2012) and academic achievement (Thorell et al., 2013), suggesting that this inventory could be used as a measure of detection of early learning difficulties (Catale et al., 2015). However, although a significant relationship was found between the CHEXI parents and teachers' reports and academic performance, the association was stronger when executive functioning was valued by teachers (range r = −.44 to r = −.63). Previous studies have also reported a greater association between teachers' reports and academic performance in children from different cultures (Pino Muñoz & Arán Filippetti, 2019; Thorell et al., 2013). As regards the relationship between parents and teachers' reports, we found significant correlations for both the WM and Inhibition factors. However, it is important to note that the magnitude of these relationships was low. Previous studies that have examined the nature of this relationship in Swedish-speaking children have also reported low correlations between factors (i.e., range from r = .32 to r = .38) (Thorell & Nyberg, 2008). Disagreements between informants could be explained by several reasons. First, it has been suggested that teachers would be more sensitive than parents to the development of EF (Bausela-Herreras, 2018), as they would observe more frequently children under situations that demand high executive control (Thorell & Nyberg, 2008). Second, it has been argued that teachers and parents may perceive the probable causes of children's behavior differently (Duku & Vaillancourt, 2014) as EFs are being assessed in dissimilar environmental sceneries. An alternative explanation may be that parents would have more difficulties than teachers in distinguishing between the diverse EF problem domains since teachers do have wide experience working with children and therefore would count with an implicit normative database against which the different kinds of problem behaviors can be judged (Thorell & Nyberg, 2008). Taken together, our results also emphasize the importance of considering both parents and teachers reports when assessing EFs in Spanish-speaking children.

The present study has some limitations that need to be addressed. First, although different tasks were used to assess working memory and cognitive flexibility, only one non-verbal task was used to assess inhibition. However, through the use of different EF paper-and-pencil tasks and ratings scales

(i.e., CHEXI and BRIEF) it has been consistently demonstrated the existence of low correlations between performance- and rater-based EF measures (see e.g., Camerota et al., 2018; Catale et al., 2013; Conklin et al., 2008; Davidson et al., 2016; Garon et al., 2016; McAuley et al., 2010; Pino Muñoz & Arán Filippetti, 2019; Thorell & Nyberg, 2008). Second, no standardized measures of academic outcomes were used. However, previous research has also incorporated ratings of academic performance (including mathematics and language skills) across four different countries to explore the relationship between the CHEXI subscales and academic achievement (Thorell et al., 2013). Finally, our study included only typically developing children and a small sample of parents and teachers from Argentina, which limits the generalizability of the results to children with atypical development or to other Spanish speaking countries. However, our results regarding the CHEXI construct validity and reliability are similar to those reported in earlier studies with children from different countries.

This study has important clinical and educational implications for the assessment of EF in children. The CHEXI has the advantage of being available for its downloading, being shorter than other existing questionnaires and becoming an attractive tool for managing low-resource settings (Camerota et al., 2018). Thus, the analysis of its factor structure in Spanish-speaking children, and considering different informants (i.e., teachers vs parents) indeed provides support for the construct validity of the questionnaire in distinct populations and diverse settings (i.e., school and home). Furthermore, our findings regarding the relationship between CHEXI and academic performance suggest that the former scale could be considered as a valuable screening measure to predict early academic difficulties in Spanish-speaking children. Our results also emphasize the importance of considering both parents and teachers' perspectives when analyzing its relationship with children's cognitive and academic performance. Finally, considering that ratings and paper-and-pencil tasks would capture different aspects of the EF construct, it should be stressed the need to use a multiple assessment strategy when examining children's EFs (Anderson et al., 2002; Thorell & Nyberg, 2008; Toplak et al., 2013) both in clinically referred and typically developing samples.

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