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Usefulness of the Bayley scales of infant and toddler development, third edition, in the early diagnosis of language disorder

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Abstract

Background: Language disorder (LD) is a neurodevelopmental disorder, and early diagnosis has an impact on speech therapy practice. The aim of this work is to test the usefulness of the Cognitive and Language scales of the Bayley-III in the early diagnosis of LD. **Method:** In a longitudinal study, a clinical sample of 187 children with diagnostic hypothesis of communication disorders at 4.5 years was assessed with the Bayley-III before age 3.5 years and subsequently with other scales of different psychological and psycholinguistic functions. **Results:** The results indicate that children with LD scored significantly lower than their control groups in all subtests and compounds of the Bayley-III. Additionally, low scores on the Language composite in the Bayley-III predicted lower scores in the Auditory-vocal Channel of the ITPA. A significant correlation was obtained between the Cognitive Scale of the Bayley-III and the General Cognitive Scale of the MSCA and the Mental Processing Composite of the K-ABC. **Conclusions:** We can draw the conclusion that the Cognitive and Language scales of the Bayley-III are a useful instrument for early diagnosis of LD, and can also discriminate more severe forms of LD.

Keywords: Communication disorder, language disorder, receptive communication, expressive communication, speech sound disorder, Bayley-III.

Resumen

Utilidad de las escalas de desarrollo para niños y bebés de Bayley, tercera edición, en el diagnóstico precoz de los trastornos del lenguaje.

Antecedentes: el trastorno del lenguaje (TL) es un trastorno del desarrollo neurológico. El objetivo de este trabajo es comprobar la utilidad de las escalas Cognitiva y de Lenguaje de Bayley-III en el diagnóstico precoz de los TL. **Método:** una muestra clínica de 187 niños con hipótesis diagnóstica de trastorno de la comunicación a los 4,5 años fue evaluada con Bayley-III antes de los 3,5 años y posteriormente con otras escalas de evaluación de diferentes funciones psicológicas y psicolingüísticas en un estudio longitudinal. **Resultados:** los resultados indican que los niños con TL obtuvieron puntuaciones significativamente inferiores a sus grupos control en todos los subtests y compuestos de Bayley-III. Además, puntuaciones bajas en el compuesto de Lenguaje de Bayley-III predecían puntuaciones inferiores en el Canal Auditivo-vocal del ITPA. Se halló una correlación significativa entre la Escala Cognitiva del Bayley-III y la Escala General Cognitiva de MSCA y con la de Procesamiento Mental Compuesto del K.ABC. **Conclusiones:** concluimos que las escalas Cognitiva y de Lenguaje de Bayley-III son un instrumento útil en el diagnóstico precoz de los TL, capaces además de discriminar sus formas más graves.

Palabras clave: trastorno de la comunicación, trastorno del lenguaje, comunicación receptiva, comunicación expresiva, trastorno fonológico, Bayley-III.

Language disorder (LD) is a neurodevelopmental disorder (*Diagnostic and Statistical Manual of Mental Disorders* [DSM]-5th edition, American Psychiatric Association [APA], 2013) and the conceptualization, classification and criteria for identifying it have been evolving through clinical practice and scientific literature. The American Speech-Language Hearing Association (ASHA, 1980), defined language disorder as "the abnormal acquisition, comprehension or expression of spoken or written language". The ASHA specified, moreover, that the problem "may involve all, one, or some of the phonological and morphological, semantic, syntactic, or pragmatic components of the linguistic system". Currently there is a consensus in the consideration of LD as a highly heterogeneous diagnostic entity, and there are several classification proposals depending on whether a clinical or empirical approach is used. The most frequently reported clinical approaches are those of Rapin and Allen (1989) and those of the *DSM-III* (APA, 1980) and its later editions. The *DSM-5* (APA, 2013) includes LDs in the diagnostic category of communication disorders, along with speech sound disorder, childhood-onset fluency disorder, social communication disorder, and other specified communication disorders.

Currently the identification of LD is based on the following criteria: (a) inclusion/exclusion, differentiating it from other developmental disorders; (b) specificity: the disorder especially affects linguistic capabilities; (c) discrepancy, demonstrating that linguistic capabilities

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are significantly worse than other cognitive capabilities; and (d) evolution, assessing durability and resistance to treatment, according to the revision by Fresneda and Mendoza (2005). To this diagnostic complexity must be added, as suggested by Bishop (1992), Hill (2001), Leonard (2002) and the APA (2013) that the majority of individuals with LD also present non-linguistic difficulties.

In the clinical context of early intervention, delayed language acquisition entails the most common reason for consultation related to developmental disorders between 2- and 4-year-olds. The differential diagnosis of LD below 4-years of age is particularly complex because of the close relationship between language development and other cross-sectional skills related to cognition and communication, and also, individual differences, as single indicators, are not highly predictive of later outcomes (*DSM-5*; APA, 2013). Furthermore, in the neuropsychological development process, other diagnostic entities such as intellectual disability (Puyuelo, Lorente, & Brun, 2001), autism spectrum disorder (Levy et al., 2010; Bishop, 2010; Carlsson, Norrelgen, Kjellmer, Westerlund, & Fernell Gillberg, 2013), attention deficit disorder / hyperactivity disorder (Hagberg, Miniscalco, & Gillberg, 2010), etc., will also share symptoms related to the communication and language functions and, in some cases, can coexist with LD.

The importance of the detection and early diagnosis of LD is justified by the importance of initiating specific therapeutic intervention given the advantage of greater brain plasticity in children at early ages (Van den Bergh, 2011). A diagnosis of LD is made based on the synthesis of the individual's history, direct clinical observation in different contexts, and scores from standardized tests of language ability that can be used to guide estimates of severity (*DSM-5*; APA, 2013). Clinical practice requires a rigorous diagnostic process at a functional, differential and etiologic level by an interdisciplinary team expert in neurodevelopment, and needs validated assessment instruments that allow the greatest accuracy in the diagnostic criteria.

The *Bayley Scales of Infant and Toddler Development, Third Edition* (Bayley-III) were created by Nancy Bayley (2006) and assess the development of infants and toddlers between 1 and 42 months of age. The Bayley-III provides a clear advantage in the differential diagnosis of the initial suspicions of developmental disorders by allowing obtaining independent standard scores in the different scales and subtests (Cognitive, Language, Receptive Communication, Expressive Communication, Fine Motor, Gross Motor, Social-Emotional and Adaptive Behavior). Predecessors Bayley-II (BSID-II; Bayley, 1993) only allowed obtaining a Mental Development Index as a result of the set of scores of the Cognitive and Language scales, which underestimated the cognitive ability of children with different specific developmental disorders, as described in the study by Hack et al. (2005).

The purpose of this study is to assess the validity, reliability, and usefulness of the Cognitive and Language scales of the Bayley-III in the early diagnosis of communication disorders detected before 3.5 years of age, through a longitudinal study using the diagnostic criteria of the *DSM-5* (APA, 2013) in the classification of symptoms, as they affect processes of expressive, receptive language or speech sound.

In the context of the above, the following objectives were proposed:

1. To confirm whether, in children with a clinical diagnosis of LD at 4.5 years, the Bayley-III had already detected discrepancies between cognitive and language level before the age of 3.5 years.
2. To determine whether, in children with receptive-expressive language disorder at 4.5 years, the Bayley-III had already detected verbal comprehension deficits before the age of 3.5 years.
3. To study the cognitive profile of children with a suggestive communication disorder (LD and speech sound disorder) at the age of 4.5years.
4. To assess the possible discrepancies between the sequential processing level (based on the seriation or temporal order of presentation of stimuli in problem solving) and simultaneous processing (which requires a graphic representation, frequently spatial, as well as the effective integration of stimuli in the solution to the problem) in children with a suggestive communication disorder (LD and speech sound disorder) at age 4.5 years.

Method

Participants

The clinical sample consisted of a total of 187 children (126 boys, 61 girls) with communication disorder diagnostic hypothesis as the primary diagnosis at 4.5 years (children diagnosed with intellectual disability, autism spectrum disorder, motor impairment, childhood-onset fluency disorder, social [pragmatic] communication disorder and sensory disorder were excluded). A classification in three subtypes of communication disorder as the diagnostic criteria of *DSM-5* (APA, 2013) was established: The subtype 1: speech sound component (n = 35, 54% males), the subtype 2: expressive language component (n = 85, 62% males) and the subtype 3: receptive and expressive language component (n = 67, 80% males). All participants were born between August 2005 and December 2008 and had received attention at the Centre for Child Development and Early Intervention (CDIAP) Parc Taulí Sabadell-Hospital Universitari before 3.5 years for consultation reasons related to their development. Established as inclusion criteria were: a minimum of 12 month of follow-up, and accordance in the clinical LD or speech sound disorder impression between the neurologist and the clinical psychologist.

The control group sample consisted of 66 children (33 boys, 33 girls) between 3 and 3.5 years born between May 2009 and April 2010. The sample was obtained from different public and private schools in the area of Vallès Occidental (Barcelona). Parents interested in participating in the study answered a questionnaire about their educational level and their children's personal medical history. The sample was selected so that the level of education of the parents represents the level of the population in the Catalan environment, according to the Institut d'Estadística de Catalunya (2012). Children diagnosed with a relevant clinical condition and/or children who are at risk for developmental delay (premature birth, small for gestational age, severe attachment disorders) were excluded from the sample.

The clinical sample and the control group sample for this study are part of a larger study to validate the Spanish adaptation of Bayley-III Scales that "Pearson Education, SA" has leased to the "Fundació Parc Taulí", and that will be published in 2014.

The study was approved by the Ethics Committee for Scientific Research from the Fundació Parc Taulí.

Instruments

Bayley Scales of Infant and Toddler Development (Bayley-III; Bayley, 2006) are intended to assess the developmental functioning of infants and children between 1 and 42 months. They consist of five scales: Cognitive, Language (including the Receptive and Expressive communication subtests), Motor (including the Fine and Gross Motor subtests), Socio-Emotional, and Adaptive Behavior.

McCarthy Scales of Children´s Abilities (MSCA; McCarthy, 2006) are a battery of tasks organized into 6 scales: Verbal (VS), Perceptual-Performance (P-PS), Quantitative (QS), General Cognitive (GCS), Memory (MS), and Motor (MS). They evaluate the skills profile of children between 2.5 and 8.5 years of age.

Kaufman Assessment Battery for Children (K-ABC; Kaufman, 2005) provides a measurement of intelligence and knowledge. It considers the degree of skill of each style of information processing (sequential-simultaneous) Sequential Processing Scale and a Simultaneous Processing Scale. Both comprise the Mental Processing Scale Composite (MPC). It also has an Achievement Scale (ACH) and Nonverbal Scale (NV). Application ages: from 2.5 to 12.5-year-olds.

Illinois Test of Psycholinguistic Abilities (ITPA; Kirk, 2004) evaluates the psycholinguistic functions involved in the communication process. It distinguishes between psycholinguistic skills when the information flows through the auditory-vocal channel or through the visual-motor channel. It also distinguishes between the representational level and the automatic level of the psycholinguistic functions. Ages of application: from 3 to 10-year-olds.

Procedure

All children evaluated had received LD or speech sound disorder diagnostic hypothesis, based on the diagnostic criteria of *DSM-5* (APA, 2013). The process of diagnosis and therapeutic monitoring in our service for children with communication disorder diagnostic hypothesis consisted of a periodic evaluation (every six months) by a paediatric neurologist and a clinical psychologist specialized in neurodevelopment, and weekly speech therapy sessions. The psychological evaluation procedure included a psychometric assessment consisting of the application Cognitive and Language Scales of Bayley-III before the age 3.5 years and a subsequent measurement with other scales of different psychological functions (MSCA and /or K-ABC) from 4 - 4.5 years, and of psycholinguistic functions (ITPA) after 4.5 years. All tests were administered by a team of 6 psychologists specialized in psychodiagnosis in early childhood who share clinical and technical criteria. Each test was administered in two sessions and the choice of MSCA or K-ABC in the follow-up obeys the clinical judgment and the overall interest of the research team to check whether the MSCA underestimate children with LD in relation to the K-ABC.

The control group sample was evaluated with Bayley-III from 3 - 3.5 years.

Data analysis

SPSS.20 was used to: (a) obtain general descriptive statistics; (b) compare means between different groups of communication disorder and the control group by mean of the analysis of variance (ANOVA) with post hoc Bonferroni; and (c) obtain Pearson's correlations and simple linear regressions between the results obtained through Bayley-III with those obtained through MSCA, K-ABC and ITPA.

Results

In relation to the first objective, in the data analysis of the comparison of means between the different communication disorder subgroups and the control group, significant differences were found between the means of the scores obtained for all subtests and all studied compounds of Bayley-III. It also shows that the discrepancy between the means of the Cognitive Scale and Language Composite is higher the more severe the communication disorder is: (a) speech sound disorder = 2.86-point scale ($t_{(31)} = 2.41$; r = .022, 95% CI [0.45, 5.42]); (b) expressive language disorder = 5.81-point scale ($t_{(76)} = 7.74$; r = <.001, 95% CI [4.08, 6.90]); and (c) receptive-expressive language disorder = 8.46-point scale ($t_{(58)} = 11.14$; r = <.001, 95% CI [6.98, 10.04]) while, at the same time, the cognitive level is lower the more severe the communication disorder is, but remains within the normal range in all groups. This data suggests that Bayley-III is capable of detecting discrepancies between cognitive and linguistic level.

The analysis of Language Composite subtests of Bayley-III (see Table 1) indicates that the receptive-expressive language disorder group obtained the lowest scores on the Receptive Communication subtest (m = 7.60, s = 1.43), almost a standard deviation below the average. A positive correlation was found between the Receptive Communication subtest of the Bayley-III and the Auditory Reception subtest of ITPA ($R^2_a = .354$). This data supports the validity of Bayley-III for detecting verbal comprehension deficits. Tables 2 and 5 show the correlations and regressions between the scores of the subtests and the compound scores of Bayley-III obtained before 3.5 years and the scores of the auditory-vocal channel tests from ITPA obtained from 4.5 years onwards. The comparative analysis between these two evolutionary stages indicates that the receptive-expressive language disorder group obtained the lower yields in all tests of auditory-vocal channel ITPA (representational level and automatic level) and shows that from 4.5 years difficulties with verbal comprehension scores persist with scores significantly below the average in the Auditory Reception subtest of ITPA (m = 28.22, s = 3.82) and in the Grammatical Closure (m = 28.17, s = 3.07). Speech sound disorder and expressive language disorder groups evolve maintaining verbal comprehension levels within normal and difficulties persist in Grammatical Closure and Auditory Sequential Memory, suggesting that their difficulties are found more often in the automatic level of the psycholinguistic functions and not so much in the representational level (ITPA).

The analysis of the development of cognitive and linguistic profiles of communication disorders, between two evolutionary stages, assessed with Bayley-III and MSCA supports our third objective. A cognitive and linguistic suggestive profile of communication disorder at 4.5 years will tend to keep within normal range the perceptual-performance organizational capabilities (P-PS = 50.24, s = 6.38), while difficulties will persist in verbal areas (VS = 42.97, s = 7.47), quantitative areas (QS = 44.84, s = 7.29), and of memory (MS = 43.28, s = 6.92) more

Table 1
Mean performance of communication disorder and control group

	Composite (μ = 100, σ = 15) Subtests (μ = 10, σ = 3)	Communication disorder		Control group[a]		Difference of means			
		Mean	SD	Mean	SD	DIF	LL	UL	Sig
Speech sound disorder (n = 35)	Cog	100.29	8.18	104.63	10.60	4.32	0.10	8.56	.042
	Lang	97.43	5.51	108.98	10.28	11.55	7.13	15.99	<.001
	RC	10.40	1.28	11.48	1.61	1.08	0.28	1.89	<.005
	EC	8.69	0.96	11.47	2.14	2.78	1.84	3.72	<.001
Expressive language disorder (n = 85)	Cog	96.29	6.08	104.63	10.60	8.32	5.04	11.61	<.001
	Lang	90.48	7.19	108.98	10.28	18.50	15.00	22.01	<.001
	RC	9.48	1.36	11.48	1.61	2.00	1.36	2.64	<.001
	EC	7.17	1.63	11.47	2.14	4.30	3.56	5.04	<.001
Receptive Expressive language disorder (n = 67)	Cog	91.19	4.69	104.63	10.60	13.42	9.95	16.90	<.001
	Lang	82.73	7.14	108.98	10.28	26.25	22.50	30.01	<.001
	RC	7.60	1.43	11.48	1.61	3.88	3.20	4.57	<.001
	EC	6.40	1.49	11.47	2.14	5.06	4.27	5.86	<.001
Total communication disorder (n = 186)	Cog	95.19	6.90	104.63	10.60	9.44	7.16	11.70	<.001
	Lang	89.98	8.68	108.98	10.28	19.00	17.20	22.44	<.001
	RC	9.01	1.74	11.48	1.61	2.47	1.98	2.96	<.001
	EC	7.20	1.67	11.47	2.14	4.27	3.74	4.78	<.001

Note: Cog = Cognitive, Lang = Language Composite, RC = Receptive Communication, EC = Expressive Communication, SD = Standard Deviation, LL = Lower Limit, UL = Upper Limit, n[a] = 66

Table 2
Scores' correlations between the Bayley-III before the age 3.5 years and auditory-vocal channel ITPA at 4.5 years

	Composite/ Subtest	Correlation Bayley-III / ITPA and mean scores ITPA (μ = 36, σ = 6)					Bayley-III (μ = 10, σ = 3) (μ = 100, σ = 15)	
		Representational level			Automatic level		Mean	SD
		AR	AA	VE	GC	ASM		
Speech sound disorder (n = 10)	Cog	.184	.185	-.096	-.059	.409	99.29	4.49
	Lang	.262	.381	.146	-.049	.533	96.57	5.02
	RC	.013	.427	.411	-.012	.340	10.14	0.90
	EC	.456	.256	-.132	-.076	.611	8.71	0.95
	Mean ITPA	38.86	35.86	35.29	33.57	31.14		
	SD	6.91	2.85	1.38	5.31	5.04		
Expressive language disorder (n = 32)	Cog	.106	.294	.106	.045	.236	97.12	5.13
	Lang	.196	.356*	.257	.436*	.092	90.85	5.84
	RC	.357*	.306	.121	.480**	.144	9.54	1.24
	EC	-.013	.270	.279	.229	.045	7.27	1.31
	Mean ITPA	35.88	35.77	35.19	32.73	33.65		
	SD	5.23	3.69	6.37	3.99	4.25		
Receptive-Expressive language disorder (n = 27)	Cog	.382*	.326	.189	.004	.151	93.26	4.15
	Lang	.422*	.624**	.375	.511**	-.032	84.70	5.80
	RC	.411*	.531**	.422*	.355	-.018	7.91	1.24
	EC	.268	.473*	.199	.432*	-.013	6.74	1.32
	Mean ITPA	28.22	30.43	32.52	28.17	30.04		
	SD	3.82	4.69	6.22	3.07	4.35		
Total communication disorder (n = 69)	Cog	.449**	.458**	.214	.229	.302*	95.56	5.61
	Lang	.531**	.591**	.323**	.537**	.169	89.06	7.18
	RC	.598**	.582**	.303*	.556**	.211	9.00	1.49
	EC	.295*	.415**	.248*	.348**	.090	7.18	1.49
	Mean ITPA	33.11	33.59	34.11	30.96	31.86		
	SD	6.44	4.79	5.99	4.43	4.64		

Note: Cog = Cognitive, Lang = Language Composite, RC = Receptive Communication, EC = Expressive Communication, AR =Auditory Reception, AA = Auditory Association, VE = Verbal Expression, GC = Grammatical Closure, ASM = Auditory Sequential Memory, SD = Standard Deviation. * = signification <0.05, ** = signification <0.01

related to language, except from the speech sound disorder group, which evolves with good yields in all areas, as detailed in Table 3. The data shows a significant correlation between Bayley-III Cognitive Scale and MSCA's General Cognitive Scale (R^2_a = .344) and between the Bayley-III Language Scale and MSCA's Verbal Scale (r = .536) for the total of subjects with communication disorder.

Regarding our fourth objective, we see in Table 4 that the analysis of the two evolutionary stages assessed with Bayley-III and K-ABC, suggests that a cognitive and linguistic suggestive profile of communication disorder at 4.5 years to evolve towards disharmonious cognitive profiles with higher sequential processing difficulties than of simultaneous processing of information processing. The differences in scores between the two types of processing are of 10.43-point scale ($t_{(19)}$ = -4.15; r = .001, 95% CI [-19.48, -6.42]), 16.85-point scale ($t_{(41)}$ = -9.06; r = <.001, 95% CI [-22.95, -14.58]), 17.82-point scale ($t_{(33)}$ = -6.79; r = <.001, 95% CI [-19.34, -10.43]) for the speech sound disorder, the expressive language disorder and the receptive-expressive language disorder (σ = 15). The results show a significant correlation between the Bayley-III Cognitive Scale and the K-ABC's MPC Scale (R^2_a = .529) for all subjects with communication disorder.

Discussion and conclusions

The neuropsychological diagnosis in toddlerhood is often a process over time in which the initial diagnostic hypotheses are modulating and completing as neuropsychological functions are maturing and symptomatology becomes more specific. There is evidence suggesting that early language delays indicate later difficulties, however, this finding does not easily translate to identification at an individual level (Law, Rush, Anandan, Cox, & Wood, 2012).

The results obtained from this longitudinal study show the Bayley-III is a useful instrument in the early detection and early diagnosis of children with known or suspected LD providing quantitative and qualitative information in relation to the criteria of exclusion, specificity, evolution and discrepancy. We believe that, despite the difficulties in establishing criteria which preclude different types of likely communication disorder at an early age, Bayley-III allows a functional assessment of communication skills and difficulties presented by children before 3.5 years in a continuum level of proficiency that facilitates evolutionary studies beyond the diagnostic boundaries and enables the establishment of therapeutic programs tailored to the real needs, while changing, for each of the children with communication disorder diagnostic hypothesis.

Table 3
Scores' correlations between the Bayley-III before the age 3.5 years and MSCA at 4 - 4.5 years

		Correlation Bayley-III / MSCA and mean scores MSCA (μ = 50, σ = 10) EGC (μ = 100, σ = 15)					**Bayley-III (μ = 10, σ = 3) (μ = 100, σ = 15)**	
	Composite/ Subtest	**VS**	**P-PS**	**QS**	**GCS**	**MS**	**Mean**	**SD**
Speech sound disorder (n = 22)	Cog	.380	.427	.496*	.538*	.293	100	6.88
	Lang	.370	.246	.495*	.461*	.456*	96.70	5.52
	RC	.341	.244	.462*	.416	.426	10.25	1.29
	EC	.249	.117	.328	.307	.296	8.60	1.04
	Mean MSCA	48.50	51.80	48.65	101.10	48.40		
	SD	6.40	5.72	6.34	9.74	5.92		
Expressive language disorder (n = 53)	Cog	.497**	.576**	.324*	.616**	.421**	96.76	4.98
	Lang	.390**	.174	.092	.369**	.356**	91.27	6.87
	RC	.409**	.246	.179	.424**	.287*	9.53	1.28
	EC	.277*	.052	-.019	.217	.338*	7.39	1.56
	Mean MSCA	44.41	51.00	47.31	95.43	44.08		
	SD	6,07	5.83	6.56	10.20	6.23		
Receptive-Expressive language disorder (n = 46)	Cog	.265	.123	.257	.265	.246	92.14	4.29
	Lang	.280	-.190	.178	.139	.132	83.76	6.72
	RC	.244	-.165	.299	.157	.083	7.79	1.27
	EC	.255	-.169	.096	.91	.167	6.57	1.45
	Mean MSCA	38.38	49.95	41.14	87.38	40.12		
	SD	6.49	6.64	7.21	9.80	6.20		
Total communication disorder (n = 121)	Cog	.524**	.381**	.451**	.581**	.431**	95.33	6.07
	Lang	.536**	.089	.366**	.477**	.435**	89.50	8.11
	RC	.536**	.127	.425**	.504**	.404**	9.00	1.60
	EC	.419	.020	.216*	.337**	.379**	7.33	1.59
	Mean MSCA	42.97	50.24	44.84	93.25	43.28		
	SD	7.47	6.38	7.29	11.0	6.92		

Note: Cog = Cognitive, Lang = Language Composite, RC = Receptive Communication, EC = Expressive Communication, VS = Verbal Scale, P-PS = Perceptual-Performance Scale, QS = Quantitative Scale, MS = Memory Scale, GCS = General Cognitive Scale (VS+P-PS+QS), SD = Standard Deviation
* = signification <0.05, ** = signification <0.01

Table 4
Scores' correlations between the Bayley-III before the age 3.5 years and K-ABC at 4 - 4.5 years

		Correlation Bayley-III / K-ABC and mean scores K-ABC (μ = 100, σ = 15)					Bayley-III (μ = 10, σ = 3) (μ = 100, σ = 15)	
	Composite/ Subtest	**Sequ. Pr**	**Simul. Pr**	**MPC**	**ACH**	**NV**	**Mean**	**SD**
Speech sound disorder (n = 14)	Cog	.682**	.694**	.823**	.662*	.888**	105.00	12.91
	Lang	.517	.467	.586*	.319	.733**	98.00	6.33
	RC	.502	.437	.561*	.346	.784*	10.71	1.38
	EC	.435	.397	.491	.192	.453	8.57	1.13
	Mean K-ABC	98.14	108.57	104.71	100.71	107.71		
	SD	18.80	13.26	17.83	10.88	16.52		
Expressive language disorder (n = 28)	Cog	.667**	.700**	.790**	.510*	.616**	95.77	6.07
	Lang	.499*	.670**	.718**	.418	.558*	91.08	4.53
	RC	.260	.458*	.445*	.146	.399	9.69	1.03
	EC	.615**	.702**	.801**	.515*	.532*	7.15	1.40
	Mean K-ABC	87.92	104.77	96.08	92.69	102.08		
	SD	10.81	11.54	10.95	11.40	14.68		
Receptive-Expressive language disorder (n = 26)	Cog	-.152	.246	.098	.457*	-.162	88.64	5.04
	Lang	-.139	.077	.012	.407	-.308	79.45	9.24
	RC	.192	.090	-.016	.470	-.184	7.45	2.25
	EC	.005	.068	.116	.194	-.328	5.45	1.63
	Mean K-ABC	79.18	97.00	85.64	77.91	91.55		
	SD	10.34	9.16	7.72	13.68	11.54		
Total communication disorder (n = 68)	Cog	.580**	.646**	.732**	.603**	.616**	94.41	8.26
	Lang	.453**	.533**	.594**	.616**	.457**	89.05	9.87
	RC	.353**	.454**	.488**	.571**	.405*	9.16	2.00
	EC	.496**	.523**	.612**	.538**	.420*	7.04	1.74
	Mean K-ABC	86.50	104.18	94.78	89.15	98.54		
	SD	11.66	12.21	12.88	13.22	15.22		

Note: Cog = Cognitive, Lang = Language Composite, RC = Receptive Communication, EC = Expressive Communication, Sequ., Pr = Sequential Processing, Simul., Pr = Simultaneous Processing, MPC = Mental Processing Composite, ACH = Achievement, NV = NonVerbal, SD = Standard Deviation
* = signification <0.05, ** = signification <0.01

Table 5
Scores' regressions between the Bayley-III before the age 3.5 years and MSCA, K-ABC, ITPA at 4 - 4.5 years

Criterion (adjusted R^2)	**Predictors**	**B (IC95%)**	**β**	**P**	**F (p)**
GCS MSCA (.344)	Cog Bayley-III	1.132 (.85; 1.42)	.592	<.001	62.440 (<.001)
MPC K-ABC (.529)	Cog Bayley-III	1.141 (.88; 1.40)	.732	<.001	76.146 (<.001)
AR ITPA (.354)	RC Bayley-III	2.546 (1.71; 3.39)	.603	<.001	36.575 (<.001)
AR ITPA (.275)	Lang Bayley-III	.467 (.28; .65)	.535	<.001	25.656 (<.001)
AA ITPA (.343)	Lang Bayley-III	.398 (.26; .53)	.594	<.001	34.983 (<.001)
VE ITPA (.090)	Lang Bayley-III	.265 (.07; .46)	.324	.010	7.148 (.010)
GC ITPA (.280)	Lang Bayley-III	.327 (.20; .46)	.540	<.001	25.549 (<.001)
ASM ITPA (.014)	Lang Bayley-III	.108 (-.50; .27)	.171	.176	1.872 (.176)

Note: Cog = Cognitive, Lang = Language Composite, RC = Receptive Communication, GCS = General Cognitive Scale, PMC = Mental Processing Composite, AR =Auditory Reception, AA = Auditory Association, VE = Verbal Expression, GC = Grammatical Closure, ASM = Auditory Sequential Memory

The evolutionary analysis of the various cognitive and linguistic profiles of this study supports the hypothesis that Cognitive and Language scales of the Bayley-III are able to discriminate the most serious forms of communication disorder. The psycholinguistic profiles obtained with ITPA from 4.5 years onwards indicate that the greatest difficulties in verbal comprehension and mastery of the grammar presented by the group with clinical and psychometric receptive-expressive language disorder could already be detected and treated before 3.5 years. In this sense, results suggest that deficits in receptive

language components before 3.5 years are a clear indicator of more severe language disorders.

The correlation between the scores of the Bayley-III Cognitive Scale and the K-ABC Mental Processing Composite Scale (R^2_a = .529) is higher than the relationship between the Bayley-III Cognitive Scale and the MSCA General Cognitive Scale (R^2_a = .344). This data suggests that K-ABC is a more appropriate instrument in the cognitive assessment of children with communication disorder as they were designed in order to use oral language as little as possible.

Despite the discrepancies between the scores of the Cognitive and Language scales in all the studied communication disorder groups suggesting specific language problems, we must also assess the role of the cognitive component of language when verbal comprehension is affected because the receptive-expressive language disorder group obtains the lowest cognitive performance in all tests (Bayley-III, MSCA and K-ABC) (see Tables 1, 3 and 4). Still, one must be cautious in the differential diagnosis because their cognitive profile differs from a lower normal cognitive capacity profile in which some areas remain more independent from language within the normal, such as: the Bayley-III Cognitive Scale, the MSCA Perceptual-performance Scale, the Simultaneous Processing Scale, and the Non-Verbal K-ABC Scale. The cognitive profile obtained from K-ABC shows an underperformance in sequential processing relative to the simultaneous processing in all groups of communication disorder. Although these discrepancies cannot be interpreted as significant in children under 5 years (Kaufman & Kaufman, 2005), they reflect the tendency to be more pronounced the more severe the communication disorder is.

These results add to the controversy between positions defending the specificity of communication disorder (Chomsky, 1986; Pinker, 1995) and those considering it a heterogeneous disorder and that the linguistic differences presented by different subgroups may have origins in the different underlying causes (Goorhuis-Brouwer & Wijnberg-Williams, 1996; Leonard, 2002; van der Lely, 2005). In addition, this study has shown that the prevalence in boys over girls is greater the more severe the communication disorder is (54%, 62%, 80%) suggesting that different phenotypes of communication disorder may have different genetic correlations, as current communication disorder research suggests (Bishop, 2009).

More research is needed to identify key indicators that can predict which children may be at higher or lower risk of evolving into more serious forms of communication disorder, so that affected children can receive early attention to improve their prognosis. Also, it would be needed to improve the definition of criteria and levels of evidence regarding the effectiveness of treatment programs.

It should be noted that although the communication disorder sample size is sufficiently large, it has been opted for the assessment of potential differences between different types of communication disorder and this has meant that, especially in the speech sound disorder group, the sample remained smaller. Another limitation is related to the fact that the study analyzes in a retrospective way the different cases according to communication disorder diagnostic criteria between 4 and 5 years of age. It has not been taken into account the evolution of the false positives, that sharing communication disorder profile in the initial diagnostic hypothesis, have evolved into other forms of developmental disorder. Finally, it should be noted that although the clinical sample is large enough, the same ratio boys/girls has not been respected in the control group. The higher proportion of girls in the control group could bias the results.

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