Psicothema

Psicothema 2021, Vol. 33, No. 4, 610-616
doi: 10.7334/psicothema2020.180

ISSN 0214 - 9915 CODEN PSOTEG

www.psicothema.com

Article

Linguistic Competence in Early Childhood Education as a Predictor of Verbal Naming Speed

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Abstract

Background: This study determined the predictive value of linguistic competence in children in Early Childhood Education for verbal naming speed. **Method:** The participants were 86 pupils in the second Early Childhood Education cycle. They were evaluated with WPPSI-IV Wechsler Preschool & Primary Scale of Intelligence (Verbal Comprehension, VC) and Vocabulary Acquisition, VA; Childish Vocabulary Test (Vavel) and the Rapid and Automatic Naming Test. **Results:** Children who had high scores in the Verbal Comprehension Index and Vocabulary Acquisition spent less time doing the verbal naming task. Linguistic competence predicted verbal naming speed, with Vavel having the strongest correlation. **Conclusions:** Linguistic competence of children in Early Childhood Education allows us to predict their aptitude for verbal naming. Lexical-semantic knowledge was linguistic competence dimension with the highest predictive value for the Verbal Naming Task. Automatic Naming and Verbal Comprehension depend on the same cerebral area, Wernicke's area.

Keywords: Children's language competence; naming speed; early detection; learning disabilities.

Resumen

La Competencia Lingüística en Educación Infantil Como Predictor de la Velocidad de Denominación Verbal. **Antecedentes**: el presente estudio determinó el valor predictivo de la competencia lingüística de niños/as de Educación Infantil en la velocidad de denominación verbal. **Método:** participaron 86 alumnos de segundo ciclo de Educación Infantil, quienes fueron evaluados con los Índices de Comprensión Verbal (ICV) y Adquisición de Vocabulario (AV) de WPPSI-IV; Vavel Infantil y el Test de Denominación Verbal (TDV). **Resultados:** alumnos/as que obtuvieron una puntuación elevada en el ICV y en AV precisaron de menos tiempo en el TDV. La competencia lingüística predijo la velocidad de denominación, siendo Vavel Infantil la tarea que obtuvo una mayor correlación. **Conclusiones:** la competencia lingüística de niños/as de Educación Infantil permite predecir su aptitud para denominación verbal. El conocimiento léxico-semántico fue la dimensión de competencia lingüística con mayor valor predictivo para el TDV. Las tareas propuestas dependen de la misma base anatómica. Las tareas de denominación y comprensión léxica están ligadas al lóbulo temporal y, más concretamente, al área de Wernicke.

Palabras clave: competencia lingüística infantil; velocidad de denominación; detección precoz; dificultades de aprendizaje.

Learning difficulties are not generated at the moment when the teaching of reading, writing or arithmetic takes place, but can be traced back to early developmental stages. (Duff et al., 2018; Hart & Risley, 1995; Rescorla, 2011). The period of schooling in Early Childhood Education is a key moment in which a large amount of learning is acquired, which forms the basis for the formal teaching processes that take place in Primary Education, such as written language or mathematics (Dale et al., 2015; Silinskas et al., 2017). First years of schooling contribute to forging the pillars on which later learning will be based. Given the importance of this stage, proactive action is the key to improving academic performance and preventing learning difficulties. The endorsement of a vast scientific production banishes from our educational system the already reviled models based on the "waiting to fail" philosophy (Al Otaiba et al., 2014; Milburn et al., 2017; Reynolds & Shaywitz, 2009). Language is a means of communication, as well as a method for decoding and storing knowledge. Hence, the process of language acquisition leads the way to academic success in the first years of schooling, and is a determining factor in cognitive and social development (Claessens et al., 2009; Klein & Becker, 2017). Likewise, the different lexical level and oral language skills from kindergarten predict literacy skills and school success. (Dickinson et al., 2003; Fernández & Lamas, 2018; Warren, 2015). After the first years of schooling and immersed in learning to read, the vocabulary available to the child may help or hinder the comprehension of the text. The cognitive process involved in reading is easier for children with a large vocabulary, who do not have to simultaneously acquire the meaning of new words. In this sense, these children have an increasing cognitive advantage, thus widening the gap between children with small lexicons and those with large vocabularies (Dale et al., 2015; De la Calle et al., 2009; Ouellette, 2006). Hernández-Expósito (2017) identifies a set of endophenotypic functions crucial to language performance

Received: May 20, 2020 • Accepted: May 19, 2021
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known as executive functions and described as the mental abilities that make possible the establishment of goals and objectives, the planning and implementation of the precise steps to achieve them (Kapa & Plante, 2015; Morgan et al., 2018; Paul & Archibal, 2016). Furthermore, rapid and automatic naming, together with phonological awareness, constitutes one of the main predictors of reading (Fernández & Lamas, 2018; Fonseca et al., 2019). Results from the empirical literature have pointed to phonological awareness, naming speed and letter knowledge as early cognitive precursors of reading in the first years of schooling (Braze et al., 2019; De la Calle et al., 2019). The aim of the present study was to determine the predictive value of language proficiency of pre-school children in verbal naming speed.

Method

Participants

Participants in this study were 86 students (49 boys and 37 girls) enrolled in the second cycle of pre-school education. Of these, 40 were enrolled in the second level of preschool (four years) and 46 in the third level (five years). Children were students from 11 schools of the Region of Murcia (Spain).

Instruments

Wechsler Preschool and Primary Wechsler Scale of Intelligence (WPPSI-IV) (Weschler, 2012). WPPSI-IV scale is the current version of the most widely used international benchmark for screening the cognitive abilities of children aged 2 years 6 months to 7 years 7 months, providing a broad assessment of general intellectual aptitude and secondary indices. The Vocabulary Acquisition Index (VIA) provides information on the performance of children with expressive language problems. It is the sum of the Picture Concepts and Picture Naming scores and is characterized as an indicator of the child's receptive and expressive vocabulary acquisition. In the Picture Concepts test, the child must point to the correct answer, while in the Picture Naming test he/she must orally indicate his/her answer. A low score on the Vocabulary Acquisition Index may indicate the presence of expressive language problems related to a clinical condition (e.g., expressive language disorder). The Verbal Comprehension Index (VCI) is a measure of knowledge acquired from the child's environment, verbal concept formation and verbal reasoning. It is the result of the sum of the Information and Similarities scores. It assesses verbal reasoning and concept formation, as well as crystallized intelligence, lexical knowledge, auditory comprehension, memory, associative and categorical thinking, the ability to distinguish between essential and secondary characteristics, and verbal expression.

Spanish Vocabulary Assessment Test (Vavel Infantil) (Brancal, Ferrer, Carreres, Tomás, & Ávila, 2005). This test is the Spanish version of the Peabody test and is aimed at assessing the vocabulary level of Spanish-speaking children aged 2.6 to 6.6 years. It consists of 70 items (each of which is composed of four images). The task of the child is to indicate the correct answer to the demands of the examiner, who in each item of the test indicates a noun, an adjective or a verb to which the child has to respond, without requiring a verbal answer.

Naming Speed Test (NST) (Fernández & Lamas, 2018). This test, intended for children from kindergarten to third grade of primary education, consists of a stimulus sheet containing five objects (house, knife, table, horse, and rabbit), each repeated ten times. The child's task is to name all the items, row by row and from left to right, as quickly as possible.

Procedure

This research is part of a pilot study in which the implementation of a program for the improvement of psycholinguistic skills was carried out. Prior to the implementation of the program, an assessment was designed in order to know the initial linguistic competence of the participating children. The students were randomly selected (in alphabetical order of five by five, choosing four at each level -four and five years old- from each school). The evaluation was carried out individually for each of the students.

The data were processed and analyzed using SPSS Statistics 24.

Results

In order to assess whether the data obtained presented a normal distribution, the Kolmogorov-Smirnov test, a goodness-of-fit procedure that measures the degree of agreement between the distribution of the data set collected and a specific theoretical distribution, was calculated. A z score > .05 indicates a normal distribution of the data.

In order to explore the correlation between the scores obtained in VCI (Verbal Comprehension Index), VA (Vocabulary Acquisition) and Naming Speed (NS), Pearson correlation analyses were applied after verifying that the distribution of the data followed a normal distribution (CVI $z = .20$, $p > .05$; SS PV $z = .20$, $p > .05$; SS PN $z = .18$, $p > .05$; VA $z = .20$, $p > .05$). Since the NST and Vavel dimensions did not present a normal distribution ($z < .05$), we resorted to Spearman's *rs* statistic for the calculation of the correlation between linguistic competence and naming speed. We will consider a correlation r = .1 as small; medium for $r = .3$ and large for $r = .5$.

Table 2 shows the index that assesses the level of correlation between linguistic competence and naming speed. Assuming an error of 1%, ($p = .01$), we found a significant negative linear correlation between the level of linguistic competence and naming speed. The analysis of the degree of correlation shown in Table 2 revealed that students who scored high on the Verbal Comprehension Index and Vocabulary Acquisition required less time to perform the verbal naming task. Students who performed higher on the Verbal Comprehension Index (VCI) showed higher verbal naming efficiency (VND) (*rs* (n = 86) = -.43); (mean correlation strength). High ICV scores found a negative linear

Table 1
Kolmogorov-Smirnov WPPSI-IV, Vavel and Naming Speed Test

	SS I	SS S	VCI	SS PC	SS PN	AV	V	NST	Age
K-S	.13	.14	.08	.09	.10	.08	.19	.19	.36
z	.01	.00	.20	.20	.18	.20	.00	.00	.00

Note: SS = Scalar Score, I = Information, S = Similarities, VCI = Verbal Comprehesion Index, PC = Picture Concpets N = Picture Naming, VA = Vocabulary Acquisition, V = Vavel, NST = *Naming Speed Test*

relationship with NST. The longer the time spent by the student to name the images presented, the lower his/her linguistic competence: VA (r (n = 86) = -.35) and V (rs (n = 86) = -.50) (medium and high correlation intensity).

Table 2
Spearman's Correlation between WPPSI-IV, Vavel and TDV

	I	S	CVI	PN	PC	VA	V	NST
I		.68**	.91**	.64**	.72**	.74**	.71**	-.48**
S			.92**	.64**	.64**	.71**	.69**	-.30*
CVI				.70**	.74**	.80**	.76**	-.43**
PN					.69**	.90**	.60**	-.26*
PC						.92**	.69**	-.27*
VA							.69**	-.30*
V								-.50**

Note: We calculated Spearman's correlation (rs) for the dimensions that do not follow a normal distribution (z < .05)

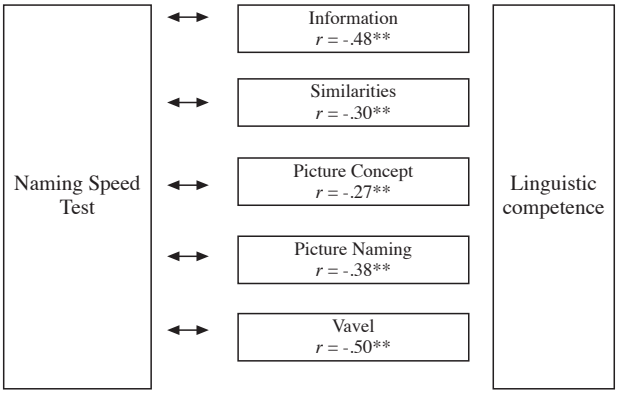

Figure 1. *Correlation between linguistic competence and naming speed*. *Note:* ** $p < .01$

Of the tasks that assessed the student's linguistic competence, the one that found the highest correlation was the one obtained when administering the Children's Vavel (verbal comprehension) (r (n = 86) = -.50) and Information (r (n = 86)= -.48) -subtask of the Verbal Comprehension Index- (Figure 1).

Linguistic competence predicted the naming speed ability (Table 3). Children with lower verbal comprehension spent more time on the verbal naming task. For each unit of verbal comprehension, time spent on the Verbal Naming Test decreased by 37% (CVI/NST β = -.37, SE = .00, p < .05). At a 95% significance level, 37% of the influence of verbal comprehension on naming speed could be predicted). Vocabulary Acquisition (AV) was able to predict verbal naming efficiency (AV/NST β = -.37, SE = .00, p < .05). At 95% significance level, 35% of the influence of verbal comprehension on naming speed could be predicted). Children's Vavel score was able to predict naming speed. For each vocabulary unit, time required to complete the verbal naming task decreased by 44%.

Table 4 shows the results of the comparison of the means of the 4 and 5 year-old children in the tasks that assessed their linguistic competence (CVI and VA) and naming speed. The non-normal distribution of the data for the variable age and Naming Speed Test did not allow us to assume the criteria for analysis by means of the parametric test. Since the data did not present a normal distribution, we resorted to the nonparametric Mann-Whitney U test.

Scores obtained by the four- and five-year-olds showed significant differences in LCI (p = .01), VA (p = .05) and NST (p = .00), with moderate (CVI and AV) and large (*NST*) effect sizes (d). Assuming an error of 5% (95% CI) we reject the null hypothesis (H_0) that assumes equality of means, regardless of child age.

Fifty percent of 4-year-olds spend around 115 seconds on the verbal naming task. This score coincides with 25% of 5-year-olds. (Q3 = 114.50). 25% (Q3 PC 75) of the four-year-olds obtain a score considered risky in the Naming Speed Test (the time used to solve the task exceeds the estimated time for the normotypical population and constitutes a risk factor for learning). The score obtained by 25% of the five-year-old students is also above the score that would be obtained by the normative sample (PC < 99).

The analysis of the degree of correlation shown in Table 6 revealed that five-year-old students required less time to perform the verbal naming task (NST rs (n = 86) = -.44); (mean correlation intensity). In addition, a positive linear correlation was found between age and the Verbal Comprehension Index (VCI rs (n = 86) = .34). However, the Vocabulary Acquisition (VA) dimension did not correlate with the age of the participating children.

Age's participant allowed us to predict their naming speed (Table 7). Younger children spent more time on the verbal naming task. For each "age" unit, the time spent on the Verbal Naming

Table 3
Influence of linguistic competence on naming speed

	Predictor variables								
	CVI		VA		Vavel		R^2	F	p
Dependent Variable	β	SE	β	SE	B	SE			
NST	-.37	.03	-.35	.01	-.44	.00	.18	.62	.00

Note: NST = Naming Speed Test

Table 4
Comparison of linguistic competence and naming speed in 4 and 5 years old students

	4 years old	5 years old	F	p	d
CVI	11.22(6.47)	15.47(6.37)	-2.66	**.01**	-0.66
VA	12.56(6.71)	15.97(6.22)	-1.92	**.05**	-0.53
NST	134(67.77)	91.73(26.35)	-3.90	**.00**	0.82

Note: CVI = Comprehension Verbal Index, VA = Vocabulary Acquisition, NST = Naming Speed Test

Test decreased by 40% (ICV/TVD β = -.40, *SE* = .00, p < .00). At a significance level of 95%, 40% of the influence of age on naming speed could be predicted).

Table 8 shows results of the comparison of means of 4- and 5-year-old children in the tasks that assessed their linguistic competence (CVI and VA) and naming speed as a function of gender. The non-normal distribution of the data did not allow us to assume the criteria for analysis by means of the parametric test.

Table 5
Linguistic competence and naming speed in 4 and 5 year old students

	4 years old	5 years old	F	p	d
NST t	134(67.77)	91.73(26.35)	-3.90	**.00**	0.82
Q_1	96.50	70			
Q_2	115.50	84			
Q_3	158.75	114.50			

Note: NST t = Naming Speed Test (time)

Table 6
Spearman's correlation between age, linguistic competence and naming speed

	CVI	VA	NST
Age	**.34****	.42	**-.44****

Note: We calculate Spearman's correlation (rs) for dimensions that do not follow a normal distribution (z < .05)

Table 7
Influence of linguistic competence on naming speed

	Predictor Variable				
	Age		R^2	F	p
Dependent Variable	**β**	**SE**			
Naming Speed Test	-.40	.00	.15	14.76	.00

Table 8
Language proficiency and naming speed in students according to gender

	Girls	Boys	F	p	d
CVI	12.97(5.73)	13.68(7.56)	-.19	.85	
VA	15.10(6.46)	13.53(6.82)	-.89	.37	
NST t	130.68(71.17)	95.94(26.35)	-2.85	**.00**	.65

Note: CVI = Comprehension Verbal Index, VA = Vocabulary Acquisition, NST t = Naming Speed Test time

Table 9
Linguistic competence and naming speed as a funtion of gender

	NST t	Q_1	Q_2	Q_3
Boys	95.94(26.35)	74	94	117
Girls	130.68(71.17)	85	116	150

Note: Q = Quartile

Since the data did not present a normal distribution, the Mann-Whitney U non-parametric test was used.

Scores obtained by boys and girls did not show significant differences in CVI (p = .85) and AV (p = .37) (Table 9). Assuming an error of 5% (95% CI) we accept the null hypothesis (H_0) that accepts equality of means, regardless of the gender of the student. However, boys were more efficient in solving the verbal naming task (M = 95.94 SD = 26.35) versus girls (M = 130.68 SD = 71.17).

Fifty percent of the boys spend 94 seconds to perform the task. While only 25% of the boys take 117 seconds for verbal naming, this is the time required by 50% of the girls tested (Q2). In addition to requiring more time, girls are more inaccurate. Fifty percent of the boys get 48 hits and make one error and 25% of the boys (PC 75) make two errors. In Q3 (PC 75) girls make more than three errors.

Discussion

The aim of this study was to determine the predictive value of the linguistic competence of pre-school children in verbal naming speed.

The linguistic competence of students in early childhood education is a predictor of literacy in later years (González-Valenzuela et al., 2016), with naming speed being one of the predictors of reading (Fonseca et al., 2019; González et al., 2015; Rabazo et al., 2016). Likewise, the lexical richness that children have in the first years of schooling determines their academic success (De la Calle et al., 2019; Dickinson et al., 2003). Early detection of children at risk of experiencing learning difficulties conditions their later school performance (Conti-Ramsden & Durkin, 2015).

The linguistic competence of the participating students was predictive of their naming speed. Children with lower verbal comprehension spent more time on the verbal naming task. Verbal Comprehension Index (VCI) and Vocabulary Acquisition (VA) were predictive of verbal naming efficiency. However, of the tasks that assessed the student's linguistic competence, the one that found the highest correlation was the one obtained when administering the Children's Vavel test, being a task that assesses verbal comprehension as opposed to those used for verbal expression (Information and Similarities, fundamentally). The correlation found between the dimensions finds its justification in the neuroanatomical bases dependent on each of the tasks requested. There is consensus among the scientific community around the relationship of language with the perisylvian region of the left hemisphere (Horowitz-Kraus et al., 2018; Krishman, Watkins, & Bishop, 2016; Landi & Perdue, 2019). However, different linguistic elements are associated with specific activity in certain brain regions. Verbs and nouns have been found to depend on the activity of different brain areas, and the naming of objects and actions can be compromised in the face of different types of pathology. Thus, when we produce nouns, the temporal lobe is mainly activated, while when we say verbs, Broca's frontal area is activated. Difficulties in finding nouns are associated with temporal lobe dysfunctions.

Likewise, the existence of different memory systems for lexical and grammatical memory has been evidenced. Declarative memory (of which we are aware) divided into semantic and episodic or experiential and procedural memory (procedures, actions, of which we are little aware) (Lee et al., 2020; Lum, Conti-Ramsden, Page

& Ullman, 2012). The lexical-semantic and grammatical aspects of language are associated with distinct neuroanatomical systems and are related to these two types of memory. The lexical-semantic aspects depend on a semantic declarative memory (knowledge about word meanings) and grammar is linked to a procedural memory (Arslan et al., 2020; Bermeosolo, 2012; Lee et al., 2020; Quintero et al., 2013).

The lexical-semantic knowledge assessed through the Children's Vavel was the dimension of linguistic competence that achieved the highest predictive value for the Verbal Naming Test. The proposed tasks depend on the same anatomical basis. The naming and lexical comprehension tasks are linked to the temporal lobe and, more specifically, to Wernicke's area (Krishman et al., 2016; Landi & Perdue, 2019).

The Verbal Comprehension Index (VCI) obtained a higher predictive value for verbal naming ability than the one assessing Vocabulary Acquisition (VA). The involvement of Wernicke's area (temporal lobe) affects the lexical repertoire as well as language comprehension. In addition, an explicit difficulty in recalling words (verbal memory) and associating words with specific meanings may be found. A disturbance in Wernicke's area may lead to difficulties in recalling words and associating words with their specific meanings (lexicosemantic associations). When performing a verbal naming task of visual stimuli, the child has to recognize the stimulus (posterior brain region, visual areas), and then activate the tempo-parietal area (selection of the lexical referent). The activity continues to the frontal motor area for phonemic selection and verbal production.

Results obtained are in line with recent studies that associate different brain areas to language learning (Arslan et al., 2020; Bishop et al., 2017; Landi & Perdue, 2019; Krishman et al., 2016) and their influence on reading acquisition and automatization. According to the Procedural Deficit Hypothesis, specific language difficulties could find their etiology in the deficient development of brain structures that constitute the procedural memory system (Lum et al., 2012; Ullman & Pierpont, 2005). This Hypothesis is based on the idea that language difficulties would encounter not only linguistic but also cognitive deficits (Conti-Ramsden & Durkin, 2015). Limitations in linguistic tasks such as those involving working memory, phonological processing or perception and rapid naming of stimuli support this theory. Thus, children with language development disorders manifest limitations in both verbal processing and processing of nonverbal stimuli presented quickly or over a short period of time.

Regarding gender differences, in this study boys were more efficient in solving the verbal naming task than girls. While there is scientific evidence that finds a higher prevalence of language delay in earlier children for language development (1girl/ 4-5 boys) (Adani & Cepanec, 2019), although the difference tends to equalize with age (Wallentin, 2009), the verbal naming task requires recognition of the initial visual stimulus. This visuospatial processing seems to be what generated the advantage to male children (Barel & Tzischinsky, 2018; Petersen, 2018).

In recent years, a model of categorization of learning difficulties with an eminently preventive character has been advocated. As a consequence, a proactive approach to learning difficulties has emerged. The conceptual advance is reflected in the way in which students who present difficulties in successfully achieving school learning are identified. The ability versus achievement discrepancy criterion gives way to new ways of detecting individual differences in students (Luque et al., 2016). The paradigm shift implies an early intervention with children at risk or future candidates of presenting learning problems (struggling students). Early action exponentially reduces later educational needs. Thus, the Response to Early Intervention (RTI) Model emerges, catalogued as a system for decision making and conveyed through a process of multiple supports (Multi-Tier System of Supports, MTSS) that guarantees early detection and attention to students with learning difficulties (Cortiella & Horowitz, 2014; Fuchs & Vaughn, 2012; Milburn et al., 2017; Silinskas et al., 2017; VanDerHeyden et al., 2007). Knowing the early indicators that correlate with the skills necessary for academic success, such as those assessed in this study: language proficiency and naming speed, allows the design of universal screening in the early years of schooling. Universal screening is the first step to mobilize, from the educational system, the necessary resources to promote individualized attention adapted to the diverse needs of students (Glover & Albers, 2007; Jenkins, et al., 2007; Petscher et al., 2011). It allows valuable information to be gathered about how children access learning and what the pitfalls may be that condition their academic outcomes (Jenkins et al., 2007; Grinblat & Rosenblum, 2016). This alternative contemporary mode of assessment takes into account the entire student body, thereby exponentially increasing the opportunity to identify early on those students who could benefit from preventive action in favor of their learning.

Acknowledgements

Funding: Project funded as part of the Strategy for the improvement of educational success OBJECTIVE 2020 (Ministry of Education). Coordinated by the General Directorate of Attention to Diversity and Educational Quality (Region of Murcia, Spain).

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