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ORIGINAL ARTICLE

Communicative development of Portuguese infants aged between 8 and 15 months



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Abstract The main aim of this study was to investigate the development of gesture and language acquisition in European Portuguese infants. These were assessed using the European Portuguese MacArthur-Bates Communicative Development Inventory: words and gestures. The parents' reports of gestures and lexical competence of 1314 children, aged between 8 and 15 months, were collected. As expected, the results indicated that word comprehension, word production, and the use of gestures increased with age. A main gender effect was found for total gestures, with girls obtaining higher scores than boys, but the effect size was small. No differences were found between girls and boys for word comprehension, word production, and phrases understood. All lexical and gesture measurements were positively correlated, even after controlling for age and gender effects. These findings are discussed in terms of their consistency with those obtained for other languages.

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PALABRAS CLAVE

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Desarrollo comunicativo de los niños portugueses con edades comprendidas entre los 8 y los 15 meses

Resumen El objetivo principal de este estudio fue investigar el desarrollo de gestos y la adquisición del lenguaje en niños hablantes de portugués europeo. Los gestos y los conocimientos lingüísticos de los niños se evaluaron utilizando la versión en Portugués Europeo del Inventario de Desarrollo Comunicativo MacArthur-Bates: palabras y gestos. Se recogieron los informes paternos de los gestos y competencia léxica de 1,314 niños, con edades comprendidas entre los 8 y los 15 meses. Como era esperable, los resultados indican que la comprensión de palabras, la producción de palabras y el uso de gestos aumentan con la edad. Se encontró también un efecto principal del género para el total de gestos, obteniendo las niñas puntuaciones más altas que los niños, pero el tamaño del efecto es pequeño. No se encontraron diferencias entre niños y niñas para la comprensión y producción de palabras y para frases entendidas. Todas las medidas de léxico y gestos están correlacionadas positivamente, incluso después de controlar los efectos de la edad y del género. Estos resultados se discuten en términos de su consistencia con los obtenidos para otros idiomas.

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In the last decades, research has shown the importance of oral language development, not only as a facilitator of learning, but also as fundamental to social integration (Locke, Ginsborg, & Peers, 2002; Neaum, 2012). Moreover, a developmental relationship between gestures and oral language exists: the production of first words is preceded by the use of gestures, especially deictic ones, and gestures and words coexist in children's early communicative repertoires, forming an integrated system (Bavin et al., 2008; Capirci, Montanari, & Volterra, 1998; Caselli, Rinaldi, Stefanini, & Volterra, 2012; Hall, Rumney, Holler, & Kidd, 2013; Olson & Masur, 2015; Sansavini et al., 2010; Kraljević, Cepanec, & Šimleša, 2014).

Early assessment of the communicative development allows the detection of difficulties or problems that children present in this area, leading to an effective intervention and to better clinical and educational practices (Andrade, 2008; Mariscal et al., 2007; Puyuelo, 2003; Westerlund, Berglund, & Eriksson, 2006). Three main approaches are used in the assessment of communicative development: standardized tests, analysis of language samples and parental reports (Law & Roy, 2008). The use of standardized tests is a formal method that provides information that allows to compare children with their peers (Paul, 2007), but requires trained professionals and the children's collaboration (Fenson et al., 2007), as the testing situation is always artificial. The use of this method is difficult with children under 3 years old, because of the emotional lability and the high sensibility and reactivity they present in formal contexts of assessment (Fenson et al., 2007; Mariscal et al., 2007).

Language samples' analysis is often used in research, allowing a precise description of children's language and a detailed analysis of the different dimensions and processes of language (Acosta, Moreno, Ramos, Quintana, & Espino, 2006; Condouris, Tager-Flusberg, & Meyer, 2003). Is a methodology that allows to know in detail the linguistic characteristics of children in its various components,

especially at morphosyntactic level, highlighting the richness of information obtained and the capability of analysis of different aspects of language (Acosta et al., 2006; Triadó & Forns, 1989; Vázquez & Alonso, 2007). Nonetheless, the language samples need to be large enough to be representative of the children's skills, and in order to pick up different contexts, and this aspect is more critical with young children and with children with delays. For this reason, this is a very laborious and expensive method (Acosta et al., 2006; Fenson et al., 2007; Triadó & Forns, 1989).

Parental reports are an alternative to the previous procedures. Several studies have shown that the use of parental reports is a valid method for collecting information about linguistic development (Feldman et al., 2000; Fenson et al., 2007; Jackson-Maldonado, Thal, Marchman, Bates, & Gutiérrez-Clellen, 1993; Thal, Jackson-Maldonado, & Acosta, 2000). Many instruments employed in clinical practice use questions addressed to parents, or other relatives, about the child development because it is assumed that parents can observe and have access to a wide range of daily situations where children use their communicative skills, whereas the possibilities of observation of these skills by the professionals are much more limited. This method provides more representative data than the previous ones, namely if this measures has well defined psychometric properties (Paul, 2007). Especially in early stages of development, parental reports are a cost-efficient procedure that allows collecting the necessary data for establishing population-based norms (Fenson et al., 2007; Mariscal et al., 2007; Simonsen, Kristoffersen, Bleses, Wehberg, & Jorgensen, 2014). The main concern with this method is the risk that parents might over or under report their children's communicative skills. Although, if the recognition format is used and only current and emergent behaviors are assessed, parental reports seem to be a reliable indicator (Fenson et al., 2007).

One of the most used parent report instrument is the MacArthur-Bates Communicative Development Inventories (CDI). These inventories are an assessment tool of communication and language development for children from ages 8 through 30 months based on information given by parents, and can be used both as a research tool and as a clinical measure (Fenson et al., 2007; Law & Roy, 2008; Simonsen et al., 2014). Translated and adapted for more than 50 different languages (Dale & Penfold, 2011), CDI has been used in multiple studies about communicative development, such as studies focusing language skills in children with developmental disabilities and other syndromes (Caselli, Casadio, & Bates, 1999; Charman, Drew, Baird, & Baird, 2003; Luyster, Lopez, & Lord, 2007; Thal, Bates, Goodman, & Jahn-Samilo, 2009; Westerlund, Berglund, & Eriksson, 2006), studies investigating the existence of gender differences (Bauer, Goldfield, & Reznick, 2002; Reese & Read, 2000; Stennes, Burch, Sen, & Bauer, 2005) or the effects of socio-economic status and education (Arriaga, Fenson, Cronan, & Pethick, 1998; Hamilton, Plunkett, & Schafer, 2000; Hart & Risley, 1995; Locke et al., 2002).

Based on the Communicative Development Questionnaire and on the Language and Gesture Inventory, the original CDI: words and gestures (CDI-WG) (Fenson et al., 1994, 2007) was developed to assess American English speaking children between 8 and 15 months, and provides information about word and sentences comprehension, word production, and the use of communicative and symbolic gestures. CDI-WG is divided into two parts. In the first part, information about early comprehension of familiar words and phrases, comprehension of everyday phrases and routines, imitation and labeling, and comprehensive and productive vocabulary, is collected. The second part is composed of items that assess the production of communicative and symbolic gestures (Fenson et al., 2007).

The CDI reliability has been studied using internal consistency statistics and the test-retest method. In the American version of CDI, Cronbach's alpha was computed for three sub-scales – word comprehension, word production and total gestures. Very high internal consistency was found on vocabulary comprehension (.95), vocabulary production (.96) and total gestures (.88). Similar results were found for other languages. Cronbach's alpha of .99 and of .98 for word comprehension and word production were found in the Spanish (López-Ornat et al., 2005) and in the Norwegian (Simonsen et al., 2014) versions respectively. In Danish version Cronbach's alpha of .98 and .97 were found for the same two sub-scales (Bleses et al., 2008). Higher Cronbach's alpha (.99) for total gestures were found in the Norwegian version and in the Spanish and Danish versions (.91) (Bleses et al., 2008; López-Ornat et al., 2005; Simonsen et al., 2014). The Galician CDI version presents Cronbach's alphas of .92 for phrases understood, of .99 for the vocabulary checklist, of .88 for first communicative gestures, actions with objects, and pretending to be a parent, of .79 for games and routines and of .87 for imitating other adult actions (Pereira & Soto, 2003).

In the American version, test-retest correlations were .87, .95 and .86 for word comprehension, word production and gestures, respectively (Fenson et al., 1994, 2007). Higher test-retest correlations were found in the Spanish adaptation: .98, .99 and .94, for word comprehension, word

production and gestures, respectively (López-Ornat et al., 2005).

Research on CDI-WG has also focused on developmental trends and on the relationship between receptive and productive vocabulary. Results have shown that vocabulary comprehension precedes vocabulary production, and that the use of gestures, comprehension and production of vocabulary increases with age (Bleses et al., 2008; Caselli, Rinaldi, Stefanini, & Volterra, 2012; Feldman et al., 2000; Fenson et al., 1994, 2007; López-Ornat et al., 2005; Pereira & Soto, 2003; Sansavini et al., 2010; Simonsen et al., 2014). Other studies have focused on the relationship between gestures and lexical skills. A study using the Italian version of CDI-WG (Caselli et al., 2012) has shown that the transition from gestures to word production is mediated by word comprehension. The use of gestures allows the assignment of meanings and concepts and this understanding is needed to enable the word production. Some studies with different measures showed that the use of gesture precedes and predicts the onset of spoken language (Hall et al., 2013) and that gestural development could be looked upon as an early marker of language trajectory (Olson & Masur, 2015). A study using an Australian version of CDI showed that CDI gestures measures were found to be good predictors of vocabulary development, being better predictors of vocabulary comprehension than of vocabulary production (Bavin et al., 2008).

The gender differences in emerging language skills have also been studied, and the results have been mixed. Eriksson and colleagues (2011) studied these differences in 10 non-English language communities and found that girls had better results than boys in gestures and productive vocabulary. Studies with the American CDI-WG (Fenson et al., 1994, 2007) and the Norwegian CDI-WG (Simonsen et al., 2014) found similar results, with girls having better results in gestures and word production but also in word comprehension. In the Norwegian version boys only outperformed girls in the gestures subscale "Imitation of other adult activities". In the Italian (Sansavini et al., 2010) and the Danish (Bleses et al., 2008) versions of the CDI, girls have better results than boys in word comprehension (in the Danish CDI only after 14 months) and in gestures, but not in word production. Different results were obtained with the Galician version (Pereira & Soto, 2003), with boys having better results in phrases understood, and with the Spanish version (López-Ornat et al., 2005) that found no differences between boys and girls in all sub-scales of CDI-WG.

The relationship between the CDI-WG subscales has also been studied. In the American version of the CDI-WG, the intercorrelations among the subscales were medium-to-high (ranging between .50 and .80) and the highest correlations were between the subscales phrases understood and words understood (.80) and between words understood and total gestures (.79). The correlation between the subscales phrases understood and words produced was the lowest (.50) (Fenson et al., 1994, 2007; López-Ornat et al., 2005). Similar results were found in studies using the Spanish version of the CDI-WG: correlations ranging between .50 and .84, where correlations between phrases understood and words understood (.84) and between words understood and total gestures (.79) were the strongest, and the correlations

Table 1 Comparison between the sections and number of items of the American, Spanish and Portuguese versions of the CDI.

Sections	American CDI	Spanish CDI	Portuguese CDI
1. Vocalizations	-	12	-
2. Early words			
First signs of understanding	3	3	3
Phrases	28	32	32
Starting to talk	2	3	3
Vocabulary checklist	396	303	317
Interjections, animal and object sounds	12	14	22
Animals	36	23	21
Vehicles	9	9	9
Toys	8	17	7
Food and drink	30	16	23
Clothing	19	17	16
Body parts	20	18	24
Small household items	36	-	24
Furniture and rooms	24	41	17
Outdoor elements	27	12	15
Places to go	-	-	9
People	20	16	21
Words for games, routines and greetings	19	24	24
Verbs	55	41	34
Descriptive words	37	22	15
Words about time	8	7	9
Possessive, demonstrative and personal pronouns, and contraction of prepositions and pronouns	11	7	6
Question words	6	6	6
Adverbs	11	9	9
Quantifiers	8	4	6
3. Actions and gestures			
First communicative gestures	12	13	13
Games and routines	6	1	1
Actions with objects	17	13	17
Pretending to be a parent	13	-	13
Imitating other adults actions	15	-	15
Actions with an object instead of other	-	1	1

between phrases understood and words produced were the weakest (.50) (López-Ornat et al., 2005).

The main goal of this study is to present the results of the validation process of the European Portuguese version of the MacArthur-Bates Communicative Development Inventory: words and gestures. Specific goals were: (a) to study the reliability of each subscale; (b) to test the existence of age and gender effects; (c) to study the intercorrelation between the subscales.

Method

Measures

The European Portuguese adaptation of the CDI-WG (PT CDI-WG) was used. Some aspects were taken into consideration in the construction of the PT CDI-WG: the second edition of the American version of CDI-WG (Fenson et al., 2007), the cultural and linguistic particularities of the European Portuguese, and the linguistic proximity between Portugal and Spain, which lead us to take into account also the

Spanish version (López-Ornat et al., 2005) of the instrument. An experts panel discussed the inclusion or substitution of items, considering the content of the American and Spanish versions of the instrument and taking into account some linguistic and cultural factors. The selection of words to be included in the vocabulary checklist also considered the data in one corpora of child speech in European Portuguese – CEPELEXicon (Santos, Freitas, & Cardoso, 2014).

After performing a pilot study, some adjustments were made in the vocabulary list, excluding the words selected for less than 10% of the children and adding the words suggested by parents in at least 11% of the filled inventories. Words such as names of TV programs, cartoons characters, brands and person first names were not added.

The PT CDI-WG has two main sections: (1) early words and (2) actions and gestures. The first section is divided into four parts: (a) First signs of understanding; (b) Phrases; (c) Starting to talk; and (d) Vocabulary checklist. The second section is divided into six parts: (a) First communicative gestures; (b) Games and routines; (c) Actions with objects; (d) Pretending to be a parent; (e) Imitating other adult actions; and (f) Actions with an object instead of other. Table 1

shows a comparison between the sections and the number of items between the three versions: American, Spanish and Portuguese.

Participants and procedure

A stratified sampling method was used and strata were defined according to the distribution of the population in the different geographic areas of Portugal, presented by the statistical data from the Census 2011, the largest national data source about population, family and housing. After gathering the authorization of the National Commission of Data Protection for data collection, an informed consent was signed by all parents who filled the PT CDI-WG, saying that they were informed about the purpose of the study and agreed to participate. Two types of supports were used in data collection: (a) online data collection; and (b) data collection using a paper version. A webpage was created for the online data collection and parents were recruited by social networks and by email lists to fill this version. Only around 2% of the data was collected online. In the case of the sample whose data were collected using the paper version, the procedure was as following: 250 institutions were contacted and asked to collaborate in the project, and about 200 institutions accepted to participate. In this case, two procedures were performed for data collection: (a) inventories were delivered, filled and collected in predetermined meetings with the parents; or (b) inventories were sent by mail to the institutions and were then distributed to the children's parents and later collected by teachers. The questionnaires which were incompletely filled were excluded from the study.

The final sample was composed of 1314 participants aged between 8 and 15 months old, whose parents accepted to fill the PT CDI-WG. Children born prematurely and with low weight (less than 32 weeks of pregnancy and 1500gr), those whose both parents did not speak European Portuguese and children with severe medical conditions that could impair language development (for example Down syndrome) were not included in the sample.

Table 2 presents the description of the sample by geographic area, gender, sibling status, daycare attendance and parents' education. The number of children per month of age ranges between 126 and 183, and the number of female and male participants is similar in all the ages analyzed, $\chi^2(7) = 7.33, p = .34$. The majority of the children attended day care contexts (94.5%). About one third of the parents completed high school (29.3% of the mothers and 30.6% of the fathers) and about other third has a college degree (42.7% of the mothers and 25.5% of the fathers).

Results

Reliability

The reliability of the PT CDI-WG was measured in terms of internal consistency, by computing the Cronbach's alpha. Internal consistency was high for the subscales of phrases understood (32 items, $\alpha = .94$), word comprehension (317 items, $\alpha = .99$), word production (317 items, $\alpha = .97$),

Table 2 Demographic characteristics of the sample ($N = 1314$).

Characteristics	N	%
<i>Residence area</i>		
North	468	35.6
Center	244	18.6
Lisbon	365	27.8
Alentejo	71	5.4
Algarve	65	4.9
Azores	39	3
Madeira	62	4.7
<i>Gender</i>		
Boy	687	52.3
Girl	623	47.4
No information	4	.3
<i>Siblings status</i>		
Only child	694	52.8
At least 1 sibling	613	46.7
No information	7	.5
<i>Daycare attendance</i>		
Yes	1242	94.5
No	69	5.3
No information	3	.2
<i>Mother education</i>		
Grades 1–4	28	2.1
Grades 5–6	80	6.1
Grades 7–9	242	18.4
Grades 10–12	385	29.3
Higher education	561	42.7
No information	18	1.4
<i>Father education</i>		
Grades 1–4	45	3.4
Grades 5–6	137	10.4
Grades 7–9	319	24.2
Grades 10–12	401	30.6
Higher education	335	25.5
No information	77	5.9

and total gestures (60 items, $\alpha = .95$), showing high internal consistency of the PT CDI-WG.

Age and gender effects

The age and gender effects on the number of phrases understood, number of words comprehended, number of words produced and number of gestures produced were analyzed using a 2-way ANOVA for each dependent variable. The interaction age \times gender was also tested.

Results showed a significant main effect of age in all four subscales (see Table 3).

No significant main effect of gender was found on phrases understood, on word comprehension and on word production (see Table 3), and only a very small main effect of gender was found on the number of gestures used by children with higher average scores for girls than for boys.

No significant age \times gender effects were found for any of the PT CDI-WG subscales.

Table 3 Effects of age, gender and their interaction in all PT CDI-WG subscales.

Subscale	Age				Gender				Age × Gender		
	8 mo. M (SD)	12 mo. M (SD)	15 mo. M (SD)	F (df)	Partial η^2	Boys M (SD)	Girls M (SD)	F (df)	Partial η^2	F (df)	Partial η^2
	Phrases under- stood	6.1 (5.7)	14.7 (7.5)	20.6 (7.7)	89.064*** (7, 1310)	.325	13.0 (8.5)	13.9 (8.3)	3.710 (1, 1310)	.003	1.136 (7, 1310)
Word compre- hension	25.3 (29.9)	78.9 (64.3)	126.5 (78.8)	57.830*** (7, 1310)	.238	70.3 (70.1)	74.0 (67.9)	.735 (1, 1310)	.001	.636 (7, 1310)	.003
Word pro- duction	.9 (5.5)	5.0 (8.2)	16.9 (22.2)	40.391*** (7, 1310)	.179	5.9 (11.8)	6.9 (13.8)	2.164 (1, 1310)	.002	1.000 (7, 1310)	.015
Total gestures	7.3 (5.1)	22.3 (9.1)	32.6 (9.6)	232.775*** (7, 1310)	.557	19.2 (11.7)	21.2 (12.2)	14.414*** (1, 1310)	.011	1.808 (7, 1310)	.010

Note: mo.-months old.
*** $p < .001$.

Intercorrelations between subscales

Table 4 shows the correlations among all subscales, separately for boys and girls. Significant and positive correlations were found, with the coefficients ranging between .418 and .738. In both genders, the correlations between word and phrases comprehension, and between phrases comprehension and total gestures were the strongest. The correlations between word production and phrases understood, and between word production and total gestures were the weakest.

The partial correlations among the total scores in each subscale, after controlling for gender and age, were significant with correlations coefficients ranging from .262 to .642 (see Table 5). The correlations between word and phrases comprehension, and between phrases comprehension and total gestures were the highest. The correlations between word production and phrases understood, and between word production and total gestures were the lowest.

Discussion

In this article, the results of the validation study of the PT CDI-WG, which used a representative sample of infants who were European Portuguese speakers, are presented.

The first specific goal was to study the reliability of the four subscales' scores. The results indicated high internal consistency of the PT CDI-WG. The Cronbach's alpha values obtained for the subscales are comparable to those obtained in other CDI versions (Bleses et al., 2008; Fenson et al., 1994, 2007; López-Ornat et al., 2005; Pereira & Soto, 2003; Simonsen et al., 2014).

The second specific goal was to investigate age and gender effects on the four PT CDI-WG scores. The results indicated the existence of a clear age effect in all four dimensions: the number of phrases understood, word comprehension, word production and total gestures increased with age. The results of Portuguese children are similar to those observed in many other languages, despite the mean number of phrases understood, word comprehension, word production and total gestures be slightly lower in relation to the results found in other studies (Bleses et al., 2008; Fenson et al., 1994, 2007; Mariscal et al., 2007; Pereira & Soto, 2003; Simonsen et al., 2014).

A very small gender effect was found in the gestures subscale, with girls having higher results than boys, but no gender effects were obtained for the other subscales. These findings are only partially consistent with the results obtained in the validation studies of the CDI in other languages (Bleses et al., 2008; Fenson et al., 1994, 2007; Sansavini et al., 2010; Simonsen et al., 2014), which found a gender effect not only on the gestures subscale, but also on other CDI-WG subscales.

The final goal was to investigate the relationship among the four CDI scores. The correlations between all subscales were moderate to high, with the highest correlations being between the two comprehension subscales (phrases and word comprehension) and between phrases comprehension and total gestures, whether for boys or girls. The lowest

Table 4 Correlations between all measures by gender.

Variables	Phrases understood	Word comprehension	Word production	Total gestures
Phrases understood	–	.738 ^{***}	.430 ^{***}	.700 ^{***}
Word comprehension	.734 ^{***}	–	.540 ^{***}	.687 ^{***}
Word production	.418 ^{***}	.546 ^{***}	–	.503 ^{***}
Total gestures	.694 ^{***}	.639 ^{***}	.481 ^{***}	–

Note: Coefficients below the diagonal are for girls and above de diagonal are for boys.

^{***} $p < .001$.

Table 5 Partial correlations between all measures after controlling gender and age.

Variables	Phrases understood	Word comprehension	Word production	Total gestures
Phrases understood	–	.642 ^{***}	.262 ^{***}	.500 ^{***}
Word comprehension		–	.435 ^{***}	.521 ^{***}
Word production			–	.320 ^{***}
Total gestures				–

^{***} $p < .001$.

correlations were found between phrases understood and word production, and between word production and total gestures and this was observed for both genders. These results are consistent with the results found for the American English (Fenson et al., 2007) and the Spanish (López-Ornat et al., 2005) CDI versions. Moreover, our results are consistent with the findings obtained in other studies (Bavin et al., 2008; Caselli et al., 2012; Fenson et al., 1994, 2007), showing that gestures are more closely associated with vocabulary comprehension than with vocabulary production, thus suggesting that CDI gestures score is a good predictor of vocabulary development, although it is a stronger predictor of vocabulary comprehension than vocabulary production.

According to Sansavini and colleagues (2010), gestures may be critical for the emergence of verbal abilities, because they contribute to the development of meanings and concepts that will allow the infant to understand words progressively and both of them are needed in order to word production begin. The meanings developed through the interactions of gestures and vocal abilities serve as a basis for words' production (Iverson & Goldin-Meadow, 2005). Future studies should investigate the possible mediation role of word comprehension in the transition of gesture production to word production.

The main limitation of this study was its cross-sectional design and the consideration of only two variables on the examination of the communicative development of children who are speakers of European Portuguese. In future studies, other demographic factors, such as maternal education should also be analyzed. Moreover, longitudinal studies should be developed in order to understand the developmental patterns in the linguistic and communicative areas in infants who are speakers of European Portuguese.

Conflict of interest

The authors declare no conflict of interest.

Ethical disclosure

Protection of human and animals subjects

The authors state that the procedures followed were in accordance with regulations established by the heads of the Commission for Clinical and Ethical Research and in accordance with those of the World Medical Association and the Helsinki Declaration.

Confidentiality of data. The authors state that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors declare that they have received written consent from the patients and/or subjects mentioned in the article. Corresponding author must be in possession of this document.

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