BEHAVIOR RESEARCH METHODS

Free associate norms for 139 European Portuguese words for children from different age groups

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Abstract

The present study presents normative ratings of free association for 139 European Portuguese (EP) words for 8-, 10- and 12-year-old children attending the 3rd, 5th and 7th grades of elementary and middle school in Portugal. For each word, five indices are presented: a) the percentage of associates, b) the strength of the first associate, c) the strength of the second associate, d) the distance between the first and the second associates and e) the percentage of idiosyncratic responses. Additionally, grade-level frequency values for each word from the ESCOLEX database (Soares et al., in press) are also provided. As expected, the results revealed developmental changes in the knowledge organization of children, ocurring at the age of 9-10 (5th grade) and remaining stable in 11-12 year-old children (7th grade). Specifically, we observed a decrease in the percentage of associates and idiosyncratic responses as well as an increase in the strength of the first and the second associate from the 3rd grade to the 5th grade. Moreover, the comparative analysis with the previous work of Carneiro, Albuquerque, Fernandes, & Esteves (2004) on EP and Macizo, Gómez-Ariza, & Bajo (2000) on Spanish for a subset of common words (16 and 58, respectively) shows that the present norms fit well with previous EP data but differ from Spanish data. The normative values can be downloaded at http://p-pal.di.uminho.pt/about/databases or at http://brm.psychonomic-journals.org/content/supplemental.

Keywords: free associate norms, European Portuguese, child development

Introduction

"We assume that a dynamic associative structure is created in memory that involves representations of the words themselves as well as connections to other words, and we have reasons to believe that this lexical structure plays a critical role in any task involving familiar words. The role is complex because it differs for different goals and for different tasks but we presume its omnipresence is essential whenever and wherever meaning is sought." (Nelson, McEvoy, & Schreiber, 1998).

The associative structure of memory incorporates the representations of words and their associates and arises from previous experience (Nelson, McEvoy, & Dennis, 2000; Nelson, McEvoy, & Schreiber, 1998). The association of words provides us with insights about speakers' knowledge and their lexical memory, showing how the mental lexicon is organized and how that organization influences performance in verbal and memory tasks. When speakers tend to frequently produce a word as the first that comes to their minds as they read/listen to another word, the memory representations of both words are considered to be strongly connected (Nelson et al., 2000). Importantly, it has been widely established that the strength of those connections influences the performance in numerous tasks such as priming (e.g., Meyer & Schvaneveldt, 1971; Thompson-Schill, Kurtz, & Gabrieli, 1998), translation-recognition (e.g., Comesaña, Perea, Fraga, & Piñeiro, 2009; Comesaña, Soares, Sánchez-Casas, & Lima, 2012; Moldovan, Sánchez-Casas, Demestre, & Ferré, 2012), and free (Bjorklund & Jacobs, 1985; Deese, 1959) or cued recall (e.g., Nelson, McKinney, Gee, & Janczura, 1998; Davis, Geller, Rizzuto, & Kahana, 2008). For instance, using a paired-associate recall test, Davis et al. (2008) observed a significant number of intrusion errors, i.e., recalled nontarget items, which tended to come from nearby target pairs. The results were interpreted as evidence for the existence of temporal associative processes (see Davis et

al., 2008, for more detail). Therefore, the availability of normative free association data which allow researchers to select materials for the careful design of experiments on language comprehension, production and memory is imperative for the scientific community.

Free association norms usually consist of a list of written words to which participants are asked to respond by giving the first word that comes to their minds as quickly as possible. This procedure, widely used to measure connection strengths, has a long history as a reliable technique (e.g., Cramer, 1968; Deese, 1965; Jenkins & Palermo, 1964). It is also usual to record three main indices: the number of associates, the associative strength, and the number of idiosyncratic responses (see for instance Callejas, Correa, Lupiáñez, & Tudela, 2003; Carneiro, Albuquerque, Fernandes, & Esteves, 2004; Fernández, Díez, Alonso, & Beato, 2004; Macizo, Gómez-Ariza, & Bajo, 2000; Nelson, McEvoy, & Schreiber, 1998, 2004; Palermo & Jenkins, 1964). The number of associates refers to the frequency of different associates produced for a given word. The associative strength comes from the percentage of participants that respond with the same associate for one target word. Finally, idiosyncratic responses are defined as those responses provided by a single participant. These indices seem to indicate how associative knowledge is organized and, consequently, they are very useful to explore the changes that occur through development (see Carneiro et al., 2004; Macizo et al., 2000; Sell, 1992).

Since the early twentieth century many word association techniques were used for multiple research interests, especially for psychodiagnosis (e.g., Jung, 1918), and even today they are considered as excellent tools to study different cognitive processes such as language and memory. Indeed, since 1950 a vast number of studies were undertaken to collect word association norms with adult and children populations (see

Cramer, 1968, for a detailed review; also Moss & Older, 1996; and Palermo & Jenkins, 1965), and they have been widely used in studies of network growth, lexical access and word recognition with healthy (e.g., Bueno & Frenck-Mestre, 2008; Comesaña et al., 2009; Hills, Maouene, Maouene, Sheya, & Smith, 2009; Perea, Duñabeitia, & Carreiras, 2008; Perea & Gotor, 1997; Sánchez-Casas, Ferré, Demestre, García-Chico, & García-Albea, 2012; Thompson-Schill, Kurtz, & Gabrieli, 1998) and clinical populations (e.g., Budson, Sitarski, Daffner, & Schacter, 2002, with Alzheimer´s patients; Brooks, Seiger-Gardner, & Sailor, 2012, with children with specific learning imparment; Pratter, Zurif, Love, & Brownell, 1997, with aphasic patients; Watkins, 2002, with depressive patients). However, as these dataset need to be time- and age-adjusted (Nelson et al., 1998; Palermo & Jenkins, 1964, 1965) and are determined by linguistic and cultural differences (Fernández, Díez, Alonso, & Beato, 2004; Nelson et al., 1998; Rosenzweig & Miller, 1966), researchers have been collecting normative data for word associations that allow them to develop reliable research in many areas of cognitive science such as psycholinguistics, developmental psychology, natural language processing and neurolinguistics. Particularly in the last decades, several free associative norms have been created in different languages for the adult population (e.g., Dutch – de Deyne & Storms, 2008; English – Nelson, McEvoy, & Schreiber, 2004; European Portuguese (EP) - Marques, 2002; French - Thérouanne & Denhière, 2004; Japanese – Joyce, 2005; Russian – Karaulov, Cherkasova, Ufimtseva, Sorokin, & Tarasov, 1994, 1996, 1998; and Spanish – Fernández et al., 2004) and to a lesser extent for children (e.g., EP – Carneiro, et al., 2004; Spanish – Macizo et al., 2000). This divergence between adult and children databases is remarkable even though the application of adult norms to children is not recommended (Carneiro et al., 2004; Casey, 1989; Palermo & Jenkins, 1964, 1965), especially because conceptual knowledge is reorganized throughout

development, and performance in memory tasks varies significantly as a function of age. Thus, there is abundant evidence showing differences between preschoolers and school children (see Blewit, 1994; Carneiro, 2007; Emerson & Gekoski, 1976; Schmithorst, Holland, & Plante, 2007), particularly at the ages of 8 and 14 (see Bjorklund, Coley, & Gaultney, 1992; Case, 1995; Cowan, 1995; Emerson & Gekoski, 1976; Sauzéon, Lestage, Raboutet, N´Kaoua, & Claverie, 2004), as well as between children and adults (e.g., Carneiro et al., 2004; Isacoff, 2011; Macizo et al., 2000; Woodrow & Lowell, 1916; Zortea & de Salles, 2012). Interestingly, in the age range from 8 to 14, students gradually increase the time they devote to reading and writing and, as a consequence, they improve their knowledge of words (Cronin, 2002). In fact, as vocabulary increases, not only the number of items and their connections in semantic networks change, but also the richness and accessibility of representations is improved (e.g., Bjorklund, 1987; Chi & Ceci, 1987; Gathercole, Willis, Emslie, & Baddeley, 1992; Markman & Dietrich, 2000; Munson, Swenson, & Manthei, 2005; Nelson, 1977; Pinheiro, Soares, Comesaña, Niznikiewicz, & Gonçalves, 2010; Schneider & Pressley, 1997; Storkel, 2002, 2009; Swingley, 2003; Vicente, Castro, & Walley, 2003).

From studies of free association there is evidence showing a differential performance among children and adults which is thought to reflect changes in their semantic-conceptual organization (e.g., Carneiro et al., 2004; Koff, 1965; Macizo et al., 2000; Zortea & de Salles, 2012). It is worth mentioning here the study developed by Carneiro et al. (2004) to obtain normative data for 16 words with a Portuguese population. This study includes the free association word norms for children of three age groups (preschool -3/4 years old-; 2nd and 3rd grades of primary school -7/8 years old; and 6th and 7th grades of middle school-11/12 years old) as well as for adults (M_{age}= 24; age range from 18 to 38). The authors found an increase in the number of associates

produced from preschoolers (3/4 years old) to school children (7/8 years old) as well as a decrease in the number of syntagmatic responses, i.e., responses based on syntactic or temporal/spatial contiguity (e.g., song-sing). These results are consistent with the idea that there is a transition from memory structures that rely on scripts, schemas, or events in early ages, towards an organization that encompasses not only associative relations, but also functional and categorical ones in older children and adults (Sell, 1992). Thus, from a developmental cognitive approach, as well as from a language acquisition perspective, the availability of children association norms is of special interest.

The above mentioned study developed by Carneiro et al. (2004) is the only dataset available for children in EP. Though useful, it contains a very small set of words (16 words) which is insufficient for research purposes. Of note, these 16 words were taken from the Macizo et al. (2000) Spanish associative norms. Macizo et al. collected data for 58 Spanish words for children of three school groups (from 3rd and 5th grades of primary school and from 1st grade of secondary school). Two of these groups (3rd and 1st grades) are equivalent in age to those considered in the Carneiro et al. work, which allowed the comparability of data between the two studies. However, it is worth noting that even though children ages in each school grade were equivalent, in Portugal primary school comprises the first four grades (1st to 4th grades), which is followed by the middle school (5th to 9th grades) before entering high school (which comprises grades 10th to 12th at age 14-15). So, from now on we will use 7th grade to refer both to the 7th grade in Portugal and to the 1st grade of secondary school in Spain.

The results from the Portuguese and the Spanish populations do not fit totally. Carneiro et al. (2004) showed that the number of associates and the percentage of idiosyncratic responses decreased from the 3rd grade (7/8 years old) to the 7th grade (11/12 years old), whereas in the Macizo et al. study this number increased. In addition,

the strength of the first associate increases with age in the Carneiro et al. study and diminishes in the Macizo et al. study. Carneiro et al. (2004) explained their results pointing to developmental differences in the nature of word associations, since the answers of younger children were mostly triggered by stimuli-induced contexts (syntagmatic responses- e.g., song-sing) and the answers of older children were triggered by the semantic and abstract content of the stimuli (paradigmatic responses- e.g., song-music). However, they failed to explain the reason for the discrepancies in the number of associates as well as in the strength of the first associate found between the two studies.

Given the scarce norms of free association words with EP children (only norms for 16 words in the Carneiro's study), the disparity of results between equivalent studies with linguistically diverse populations, as well as the growing interest to conduct studies with children populations, we decided to develop a larger normative base for 139 words (58 words out of 139 are common to the Macizo et al.'s database and 16 words are common to the Carneiro et al.'s study). For the 139 words the following indices were collected: The number of associates, the percentage of associates, the strength of the first and the second associate, the distance between the first and the second associate – note that this measure provides an index of the structure of the associative set (see Macizo et al., 2000; see also Nelson & Bajo, 1985), and the percentage of idiosyncratic responses. Additionally, we also provide grade-level frequency values for each word obtained from ESCOLEX (Soares et al., in press). The three age-groups of children considered in the Macizo et al.'s study were here preserved (3^{er}, 5^{th} and 7^{th} grades). This methodological option allowed us to compare the results obtained in the Macizo et al.'s study with the results of the present work for the common subset of words (58). The

comparison with the previous EP study developed by Carneiro et al. (2004) was also possible for 16 words in the 3rd and 7th grades groups.

Method

Participants

A total of 325 children from a public school in Portugal took part in the experiment. The children had normal or corrected-to-normal vision. They were native speakers of EP and none of them had any sensory, neurological, or learning disabilities. Of these 325 children, 101 attended the 3rd grade of primary school (7/8 years; M_{age} = 8.08; *SD* = 0.27; 58 females), 126 attended the 5th grade (9/10 years; M_{age} = 10.21; *SD* = 0.43; 65 females), and 98 attended the 7th grade (11/12 years; M_{age} = 12.01; *SD* = 0.10; 46 females).

Materials

A set of 139 EP words were selected for the purposes of this study: 36 words were taken from a second language acquisition study carried out by Comesaña et al. (2012) with children, 58 words were taken from the Macizo et al.'s study (2000), and the other 45 words were taken from the Elhuyar dictionary (http://www.euskara.euskadi.net/r59-15172x/eu/hizt_el/index.asp). From the 139 EP words, 91 words were common nouns, 29 were nouns + verbs, 13 were nouns + adjectives, 3 were nouns + adjectives + verbs, 1 was noun + adjective +adverb, 1 was noun + preposition, and 1 was noun + adverb + verb. The experimental words are presented in the Appendix followed by their English translations (in brackets).

Frequency word values for each grade were taken from the ESCOLEX dataset (Soares et al., in press). ESCOLEX is a database containing grade-level word frequency

statistics for children aged 6 to 11 (1st to 6th grade). It has 48,381 wordforms extracted from a 3.2 million word corpus taken from 171 elementary and middle school.

As ESCOLEX only contains frequency values for children from 1st to 6th grade, here we have considered the frequency values of children from the 6th grade as applicable to the 7th grade group. For the 3rd grade group the values of the estimated frequency per million words (U) were, M = 218.01, SD = 401.05; for the 5th group, M = 135.72, SD = 223.36; and for the 7th group, M = 90.86, SD = 91.99.

Procedure

Participants from 5th and 7th grades performed the task collectively in their corresponding classrooms. In order to avoid children´s fatigue two lists of random materials were created (list 1 contained 70 words and list 2 contained 69 words). Both lists were presented to all children in two different days, with a week interval. The order of word presentation in each list was randomized in a way that there were two different versions for each list (list 1a, 1b and list 2a, 2b). Half of the participants saw one order (list 1a and 2a) and the other half saw the other order (list 1b and 2b). The order of the list's presentation was also counterbalanced. In all the lists the words were presented on double column pages. Each word appeared on the left side of each column followed by a blank space in which participants had to write the first word that came to their minds. Next, there was a check box to tick in case they did not know the word. The instructions, presented at the beginning of the page and followed by three words which served as examples, were read aloud to the participants. The first two were followed by an associate word (e.g., MACIO-suave [soft-smooth] and CASTELO–princesa [castle-princess]) whereas the third one (a low-frequency word with a high probability that the

children did not know its meaning) was followed by a tick in the checkbox (e.g., ERUDITO [erudite]).

The instructions were similar to those used by Macizo et al. (2000). Children were asked to read words one by one and to write in the blank space the first word that came to their minds as fast as possible. If they did not know the word they should tick the checkbox placed at the right of the blank space. Additionally, if the word did not bring anything to their minds they were allowed to go back to that word once more before returning the questionnaire to the experimenter. They were encouraged not to look at the classmates´ responses, as all responses were equally valid. Besides, they were asked not to talk about their responses at the end of the first day. Each session lasted 45 minutes. At the end of the last day the experimenter gave a gift to each child. For younger children (3rd grade), and following the recommendations of Macizo et al. (2000) regarding the maximum number of words to be displayed to children from this age group, the two lists were subdivided into another two. Therefore, the procedure was the same as that used with the other age groups, yet younger children performed the task in four days (one list per day).

Results and Discussion

This section is organized as follows. Firstly, we present the statistical analysis performed on valid responses for each age group. The criteria for inclusion of valid responses within the same associate were the same as used in previous works (Carneiro et al., 2004; see also Marques, 2002). That is: a) spelling mistakes (they were corrected); b) gender differences (if the gender was marked by the last letter of the word: -o for male and -a for females; c) singular and plural words; and d) different verb conjugations and verb tenses whenever their meaning did not vary. In all these cases,

those forms with higher frequency were preserved. However, if different forms had the same frequency, we opted for the male form, the singular form and infinitives in the case of verbs. In addition, we also considered compound words like *ponta-do-dedo* (the EP word for fingertip). Responses such as: a) blank responses, b) illegible responses, c) the same word as the target word or its plural, and d) proper nouns like *Sara* were considered invalid. Illegible responses were assessed by two judges. In case of disagreement, a third judge assessed the participants' answer to reach consensus. The interjudge agreement was of 97%.

Secondly, we present and discuss the data analysis for blank responses and responses that children did not know. Third, we compare our results with those obtained by Carneiro et al. (2004) for the same subset of words (16 out of 139) in order to assess the stability of data for EP children. Finally, with the aim of exploring the existence of intercultural differences previously found by Carneiro et al., we present and discuss the results based on the comparison of the data obtained in the study of Macizo et al. (2000) with the data obtained in the present study for the same set of words (58 out of 139).

Association norms for 139 EP words

The statistical analyses were performed based on valid responses given by each participant to each word. The indices calculated from these data were the same as those calculated in the Macizo et al.´s study. Specifically for each word in each grade we presented: a) The number of associates (A), b) the percentage of associates (%A), that is, the proportion of associates for each word given by more than one participant (this was calculated by dividing the number of associates for each word by the number of participants from each age group that gave a response), c) the strength of the first (F1) and the second associate (F2), d) the distance between the first and the second associate

(F1-F2), and e) the percentage of idiosyncratic responses (%ID). Additionally we also provide grade-level frequency values for each word obtained from ESCOLEX (Soares et al., in press).

As instances, the normative values for the EP words *acidente* and *actor* [accident and actor] in the youngest age group are presented in Figure 1. The complete dataset from the three age groups can be downloaded as a pdf file at http://p-pal.di.uminho.pt/about/databases or at http://brm.psychonomic-journals.org/content/supplemental.

<INSERT FIGURE 1 ABOUT HERE>

To investigate age differences in the way children answered the 139 words, we conducted a multivariate analysis of variance (MANOVA) with age group (3^{rd}, 5^{th}, 7^{th}) as a between-subject factor and the %A, F1, F2, F1-F2, and the %ID as dependent variables. As in the Macizo et al. (2000) study, we decided to focus on the %A rather than the number of associates (A) because the size of the sample of children from 5^{th} grade (126 children) differed from the other two age groups (101 for 3^{th} grade and 98 for 7^{th} grade).

The MANOVA analysis revealed a main effect of age group in all of the dependent variables, with the exception of the F1-F2 index, $F(2, 414) = 1.31$, MSE = 382.98, $p = 0.27$; $\eta^2 = .006$. Thus, data showed a decrease in the %A ($F(1, 414) = 6.41$, MSE = 86.79, $p < .01$, $\eta^2 = .03$), as well as an increase in strength of F1($F(1, 414) = 3.54$, MSE = 920.42, $p < .05$, $\eta^2 = .02$) and F2 ($F(1, 414) = 5.28$, MSE = 121.67, $p < .01$, $\eta^2 = .03$) as a function of age. On the other hand, the %ID diminished significantly with age ($F(1, 414) = 11.67$, MSE = 873.42, $p < .01$, $\eta^2 = .05$). Mean values and standard

deviations (in brackets) for the F1, the F2 and the F1-F2 as well as the percentage of associates (%A) and idiosyncratic responses (%ID) obtained for each grade are presented in Table 1.

<INSERT TABLE 1 ABOUT HERE>

The %A for children from the 3rd grade differed statistically from the children of the other two groups ($p < .01$ for the 5th grade group and $p < .01$ for the 7th grade one). However, the difference in the %A for children from 5th and 7th grades did not approach significance, indicating that the observed shift seems to occur in the structure of the associative set around the age of 9-10, becoming stable from that point onwards. Consistent with this result are the data relative to the strength of F1 and F2 as well as to the %ID, where no differences were found between children of 5th and 7th grades. Not only did results reveal an increment in the strength from 3rd to 7th both for the F1 ($p< .05$) and the F2 ($p< .01$), but also a decrease in the %ID throughout age. The %ID for children from the 3rd grade differed from those observed in the 5th ($p< .001$) and the 7th ($p< .001$) grades. These results seem to indicate a consolidation of memory structure. Consistent with this idea were the results obtained from the analysis of the type of responses given by children. We analyzed the distribution of the first and second associates responses (1 = syntagmatic response [*fly* for the target PLANE] vs. 2 = paradigmatic response [*sun* for the target HEAT] vs. 3 = ambiguous, i.e., it can be classified simultaneously as a syntagmatic and a paradigmatic response [medal for the target BRONZE] given by children in each age group (3rd, 5th, and 7yh grades). It is worth noting that children responses were classified by two independent judges experts in Linguistics. The inter-judge agreement was of 85%. The cases of disagreement were

resolved by a third judge. Chi-square analysis failed to revealed significance for the first associate (X^2 (4) = 4.02, p= .404). However, the difference in the distribution of second associate responses among the three age groups reached significance (X^2 (4) = 14.98, p < .01). Children from the 3rd grade gave more syntagmatic responses (39.5%) than children from 5th (20.9%) and 7th grades (15.8%). Conversely, in the paradigmatic responses, children from the 3rd grade gave fewer responses (62.6%) than children from 5th (74.8%) and 7th grades (81.3%). Ambiguous responses were equally distributed among age groups (2.9%, 4.3%, 2.9% from 3rd, 5th, and 7th grades respectively). Interestingly, differences between children from 5th grade and 7th grade in the distribution of responses from the three types (syntagmatic, paradigmatic and ambiguous) did not reach significance. This is an important finding to take into account in future developmental studies or studies of association norms for children, since greater changes seem to occur at the age of 9-10, being stable from that point onwards (see Emerson & Gekoski, 1976, for another evidence of the syntagmatic-paradigmatic shift around this age). Indeed, previous developmental studies on lexical-semantic fluency showed that the age of 9-10 seems to be a crucial point for the development of conceptual knowledge (see Sauzéon et al., 2004; see also Blewitt, 1989, 1994). This has also been observed within the second language acquisition domain. For instance, Fraga, Comesaña, & Perea (2006) carried out a study to explore how lexical-semantic processing evolves along the first stages of second language acquisition. With this aim, they assessed the performance of a sample of native Spanish children from different school grades (4th, 5th, 6th grades of primary school and 1st grade of secondary school) by using a translation recognition task (English-Spanish). In this task participants are asked to identify if a second word is the correct translation of a first word or not. Semantic variables like concreteness (concrete vs. abstract words) or semantic

relatedness (associate vs. unrelated words) between first and second words were manipulated. They found that the pattern of data of children from the 5th grade differed statistically from the youngest group and, more importantly, that this pattern became consolidated with age. Specifically, the effect of semantic relatedness and its interaction with concreteness did not appear until the age of 9-10.

The results observed in the aforementioned studies on lexical-semantic processing and second language acquisition sustain the idea that around the age of 9 a change in the organization of knowledge representation occurs, probably through the effect of re-structuring mechanisms, as Rumelhart and Norman (1976, 1978) and Norman and Rumelhart (1981) proposed some decades ago. These authors considered three mechanisms to account for changes in conceptual structure, namely accretion, tuning and re-structuring. Accretion refers to the process of adding new information to previous knowledge structures. When the incoming information does not fit with the contents of memory, tuning comes into play to adjust the new information to our schema. The changes are minimal and the basic relational structure of the existing schema remains unchanged. However, if tuning fails to adjust the contents of memory to new information, then restructuring is needed and a new schema is created (see Ameel, Malt, & Storms, 2008, for recent evidence of gradual reorganizations in later lexical-semantic development).

The pattern of data obtained for blank responses and *did not know* responses is consistent with this view. As can be observed in Table 1, the percentage of *did not know* responses and blank responses decreases with age. This may be probably indicating an increase in the vocabulary size of children as age increases, which is consistent with the accretion mechanism proposed by Rumelhart and Norman (1976, 1978). It is important to note here that the decrease in the %A and the %ID and the increment of the F1 and

F2 was not linear as a function of age, since the comparison of the values for children from 5th and 7th grades was not statistically significant. This may be indicating that during early stages of development new information is added to existing associative networks, but later on those networks are modified or even changed by the conjunction of tuning and re-structuring processes (see Amee et al., 2008; Clark, 2009; Norman & Rumelhart, 1981).

Comparative analysis with previous normative free association databases

Comparative analyses of results obtained in the present study and in previous normative studies of free association words (Carneiro et al., 2004; Macizo et al., 2000) were conducted. Since in the Carneiro et al.'s study three indices of associates (number of associates -A, F1 and %ID) were only analyzed in two age groups equivalent to those considered here (3rd and 7th), we conducted a MANOVA on the responses of the 16 common words with study (Carneiro et al. study vs. present study) and age group (3rd vs. 7th) as between-subject factors and the number of associates, F1 and the %ID, as dependent variables. Note that in both studies the size of the samples was very similar (100 participants in each age group in the study of Carneiro et al. and 98 and 101 participants from 3rd and 7th grade respectively in the present study), which make it possible to use the A index for analysis. Figure 2 presents the pattern of data obtained for the three indices of association (A, F1, %ID) as a function of grade (3rd vs. 7th) in the Carneiro et al.'s study and in the present study.

<INSERT FIGURE 2 ABOUT HERE>

The results showed a significant main effect of study but only in the A index: $F(1, 60)= 7.31$, $MSE= 60.06$, $p < .01$; $\eta^2 = .10$, as the number of associates was higher in the study of Carneiro et al. than in the present study (14.85 vs. 12.91, respectively). In addition, the main effect of age group was also significant in A, $F(1,60) = 6.50$; $MSE = 100.00$, $p \leq .001$, $\eta^2 = .17$, and in F1, $F(1,60) = 6.00$, $MSE = 659.33$, $p < .05$, $\eta^2 = .10$. These data showed that in both studies A decreased with age, whereas F1 increased - similarly to what was observed with the total sample of words (139). The effect of age group in the %ID failed to reach significance ($p = .17$), as well as the interaction between age group and study type in any of the three indices (all $p > .79$). Therefore, the results were quite stable across the two studies.

In order to explore intercultural differences in the Spanish and in the present EP dataset, we conducted a similar MANOVA based on the responses of the 58 common words between our study and Macizo et al.'s study in the three age groups (3^{rd}, 5^{th} and 7^{th} school groups), for the %A, F1, F2, and %ID variables. Figure 3 presents the mean values obtained for these four indices of association as a function of age group (3^{rd}, 5^{th} and 7^{th}) in both studies.

<INSERT FIGURE 3 ABOUT HERE>

The MANOVA results revealed a main effect of study in the F1, $F(1, 342) = 6.41$, $MSE = 1104.69$, $p \leq .01$, $\eta^2 = .02$) and the %ID indices, $F(1, 342) = 63.06$, $MSE = 2587.05$, $p < .001$, $\eta^2 = .16$), as EP children showed a higher strength of F1 and a lower %ID relative to Spanish children (see Figure 3). The interaction between study and age group also reached significance in all the indices considered (A%: $F(2, 342) = 11.99$, $MSE = 137.02$, $p \leq .001$, $\eta^2 = .07$; F1: $F(2, 342) = 7.41$, $MSE = 1276.29$, $p \leq .001$, $\eta^2 =$

.04; F2: $F(2, 342) = 9.74$, $MSE = 244.87$, $p \leq .001$, $\eta^2 = .05$; and %ID: $F(2, 342) = 14.03$, $MSE = 572.62$, $p \leq .001$, $\eta^2 = .08$). Thus, for the %A, the interaction revealed significant differences in this index between the 3rd group and the other two groups in both studies (all $p < .05$). However, the pattern of results was the opposite as a function of the study. That is, for Spanish children the %A increases from 3rd to 7th groups, whereas for our EP children, and similarly to what was observed in the Carneiro et al. study (2004), the %A decreases with age (see Figure 3). Regarding the F1 and the F2 indices, a differential pattern among studies was also observed. The strength of these two indices decreases with age in the Spanish study but increases in the EP study. The interaction also revealed that the strength of F1 showed by children from the 3rd group differed from those of the 7th group in both studies (all $p_s < .05$). The same was true for the F2 index, although in the Spanish study the F2 values also differed from the children of the 5th group ($p < .01$) –note that in the EP dataset the differences between 5th and 7th grade did not reach significance in any of the indices considered. Finally, for the %ID, the interaction revealed that this index increases with age in the Spanish study whereas it decreases in the EP study. The differences in the %ID among children of the 3rd group and the other two groups reached significance in both studies (all $p < .01$). However, the differences between the 5th and 7th groups did not reach significance (as in the remaining indices).

Taken together, these results seem to indicate important differences between the normative free association data for Spanish and EP children that should be borne in mind, especially if researchers aim to develop cross-linguistic studies. Thus, whereas the %A and the %ID decrease with age in the two EP datasets, they increase in the Macizo et al. (2000) study. The opposite occurs when we consider the strength of F1 and F2, since their values decrease with age in the EP studies but increase in the

Spanish study. It is worth noting here that Carneiro et al. (2004) observed a similar pattern of results obtained with the Spanish sample when they compared the data from preschoolers (3/4 years of age) with the data from the oldest children (11/12 years of age), i.e., an increase of the %A and the %ID and a reduction of the strength of F1 and F2 as age increases. Thus, one possible explanation for the discrepancies on data would be the existence of some delay in the development of knowledge structure when we take the results from Spanish children into consideration. Indeed, some authors have posed that cultural context shapes the way children interiorize the associated concepts to some words. Thus, world experience, as for example that related to living in a rural versus an urban environment, or the way some notions are understood in a specific cultural context may influence the conceptual structure of children minds (Waxman, Medin, & Ross, 2007). Perhaps a more plausible explanation would lay on language differences. Indeed, despite the geographic and cultural proximity between Portugal and Spain, there are important vocabulary differences that stem from different factors (e.g., the influence of different languages in the two countries, the existence of words with a broader meaning in one language than in the other or words with two forms in one language but just one in the other, etc.) which might explain the differences in the way EP and Spanish children respond to words that are part of the present data set. Further research is needed in order to explore these issues in more detail. Anyway, the present results sustain the idea that the normative values of free word association seem to be determined by linguistic and cultural differences, as previous studies have pointed out (Fernández, Díez, Alonso, & Beato, 2004; Nelson et al., 1998).

Conclusion

The aim of the present study was to provide researchers with normative values of free association data for 139 EP words for 8-, 10- and 12-year-old children attending the 3rd, 5th and 7th grades of elementary and middle school in Portugal. Fifty-eight words out of 139 are common to the Macizo et al.'s dataset which will allow researchers to develop cross-linguistic studies.

The results obtained with children from primary and middle school revealed that the %A and the %ID decrease with age, whereas the strength of the F1 and the F2 increases. The really remarkable changes occur between the participants from the youngest age group (3rd grade) and the participants of the intermediate age group (5th grade), whereas no differences were observed between participants from the intermediate and the highest level age group (7th grade). Besides, children from 3rd grade gave more idiosyncratic responses and fewer paradigmatic responses than children from 5th and 7th grades). This may be indicating a reorganization of the mental lexicon between the ages of 7-8 and 9-10 that remains stable from that point onwards. This is consistent with what has been observed in developmental and second language acquisition research (Blewitt, 1989, 1994; Carey, 1985, cited by Rogers & McClelland, 2008; Emerson & Gekoski, 1976; Fraga et al., 2006; Pinker, 1989; Sauzéon et al., 2004).

In summary, given the scarcity of normative ratings of free association in EP for the children population, the database here presented constitutes a valid and useful tool for the careful selection of word stimuli in experiments on language comprehension, production and memory. Since 58 words out of 139 are common to the Spanish database developed by Macizo et al. (2000), this database is also suitable for researchers interested in the developing of cross-linguistic studies.

Appendix

Experimental stimuli

The items are presented in alphabetical order with their English translations in brackets.

Acidente [accident], actor [actor], aeroporto [airport], água [water], aldeia [village], amor [love], ar [air], arco [arc], armário [wardrobe], árvore [tree], automóvel [automobile], avião [airplane], baile [dance], banco [bank], banho [bathroom], barco [ship], beijo [kiss], bronze [bronze], cadeira [chair], café [coffe], caixa [box], calor [hit], cama [bed], campo [field], canção [song], cão [dog], cara [face], carne [meat], carro [car], carta [letter], cartão [card], casa [house], casamento [wedding], chave [key], chuva [rain], cinema [cinema], conto [tail], copo [glass], cor [colour], coração [heart], corrida [race], costas [back], cozinha [kitchen], cura [cure], dedo [finger], dente [tooth], doutor [doctor], edifício [building], escala [scale], escola [school], espaço [space], fábrica [factory], família [family], ferro [iron], festa [party], filho [son], fogo [fire], fonte [fountain], fumo [smoke], futebol [football], gota [drop], grupo [group], guerra [war], hora [hour], hospital [hospital], igreja [church], ilha [island], inverno [winter], janela [window], jardim [garden], jogador [player], jornal [newspaper], juiz [judge], lâmpada [lamp], lápis [pencil], leite [milk], língua [tongue], linha [line], lista [list], livro [book], mãe [mother], mão [hand], máquina [machine], massa [pasta], médico [physician], mesa [table], moeda [coin], motor [motor], mundo [world], museu [museum], música [music], neve [snow], noite [night], norte [north], nota [note], núcleo [core], objecto [object], oficial [official], ouro [gold], papel [paper], parede [wall], parque [park], pedra [stone], peixe [fish], pessoa [person], piso [floor], pobre [poor], político [politician], ponta [tip], porta [door], povo [people], prisão [prison], quadro [frame], rádio [radio], rapaz [boy], régua [ruler], relógio [watch], rosa [rose], roupa [clothes], rua [street], ruído [noise], sala [room], salão [salon], sangue [blood], símbolo [symbol], sinal [signal], sombra [shadow], sonho [dream], sopa [soup], tapete [rug], tarde [afternoon], táxi [taxi], terra [earth], texto [text], tribunal [court], velho [old], vento [wind], verde [green], vinho [wine].

Acknowledgements

The authors thank Pedro Macizo for allowing us to use their normative data for 58 Spanish words with the purpose of comparison with EP data. We also want to thank Isabel Padrón and Álvaro Iriarte for helping us with the classification of children responses as a function of sintagmatic/paradigmatic typology.

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Author Note:

This work is part of the research project “Bilingual semantic processing: a study with cognate words by using different learning methods” (PTDC/PSI-PCO/104671/2008) and “Procura-PALavras (P-PAL): A software program for deriving objective and subjective psycholinguistic indices for European Portuguese words” (PTDC/PSI-PCO/104679/2008), funded by FCT (Fundação para a Ciência e Tecnologia), and FEDER (Fundo Europeu de Desenvolvimento Regional) through the European programs QREN (Quadro de Referência Estratégico Nacional), and COMPETE (Programa Operacional Factores de Competitividade).

FREE ASSOCIATE NORMS FOR 139 EUROPEAN PORTUGUESE WORDS FOR CHILDREN FROM DIFFERENT AGE GROUPS

Note: A) number of associates; F1) strenght of the first associate; F1-F2) distance between the strenght of the first and the second associate; %ID) percentage of idiosyncratic responses; FREQ.)frequency of use

3rd grade (M_{age} = 8.08)

ACIDENTE

A: 17.00 F1: 25.53 F1-F2: 19.15 %ID: 23.40 FREQ: 14.37

A	F	A	F	A	F	A	F
Carros	25.53	Dente	2.13	Automóvel	1.06	Estragado	1.06
Hospital	6.38	Feridos	2.13	Avariar	1.06	Gigante	1.06
Morte	6.38	Fogo	2.13	Cair	1.06	INEM	1.06
Grave	5.32	Grande	2.13	Camiões	1.06	Ligaduras	1.06
Bater	4.26	Mau	2.13	Destruído	1.06	Magoar	1.06
Estrada	3.19	Mota	2.13	Direitos	1.06	Matar	1.06
Morrer	3.19	Pessoa	2.13	Doença	1.06	Mortal	1.06
Perigoso	3.19	Aleijada	1.06	Emergências	1.06	Morto	1.06
Camioneta	2.13	Ambulância	1.06	Esmagado	1.06	Simpático	1.06
Choque	2.13	Atropelamento	1.06	Esmurrar	1.06		

ACTOR

A: 15.00 F1: 9.78 F1-F2: 3.26 %ID: 38.04 FREQ: 6.73

A	F	A	F	A	F	A	F
Filmes	9.78	Fixe	2.17	Estrela	1.09	Microfone	1.09
Televisão	6.52	Palco	2.17	Famoso	1.09	Músico	1.09
Representar	5.43	Accionar	1.09	Feio	1.09	Papéis	1.09
Teatro	5.43	Apresentador	1.09	Gracioso	1.09	Peças	1.09
Actriz	4.35	Artista	1.09	Grande	1.09	Pessoa	1.09
Escrever	4.35	Autor	1.09	Homem	1.09	Pintor	1.09
Novela	4.35	Belo	1.09	Ilusionista	1.09	Poeta	1.09
Personagem	4.35	Bonito	1.09	Inteligente	1.09	Preferido	1.09
Escritor	3.26	Câmara	1.09	Jornalista	1.09	Programas	1.09
Música	3.26	Canção	1.09	Livro	1.09	Rico	1.09
Bom	2.17	Cenário	1.09	Marcador	1.09	Senhor	1.09
Cantor	2.17	Céu	1.09	Membro	1.09	Ver	1.09
Cinema	2.17	Espectáculo	1.09				

Figure 1. An example of the normative data collected for the 139 EP words in the 3rd grade. (A): number of associates, (F1): strength of the first associate, (F1-F2): distance between the strength of the first and the second associates, (%ID): percentage of idiosyncratic responses, and (FREQ): ESCOLEX grade-level frequency.

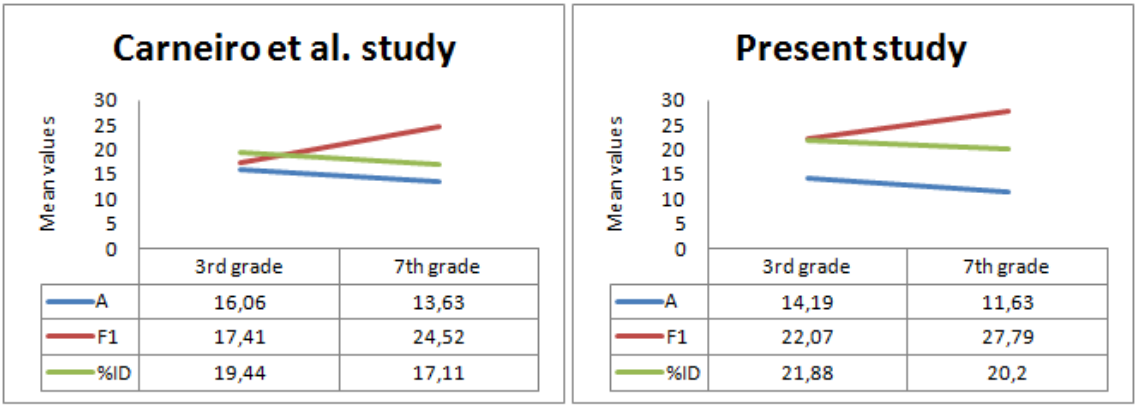

Figure 2. Mean values obtained for the three indices of association (A, F1, %ID) as a function of age group (3rd grade vs. 7th grade) in the study of Carneiro et al. (2004) and in the present study for the 16 common words.

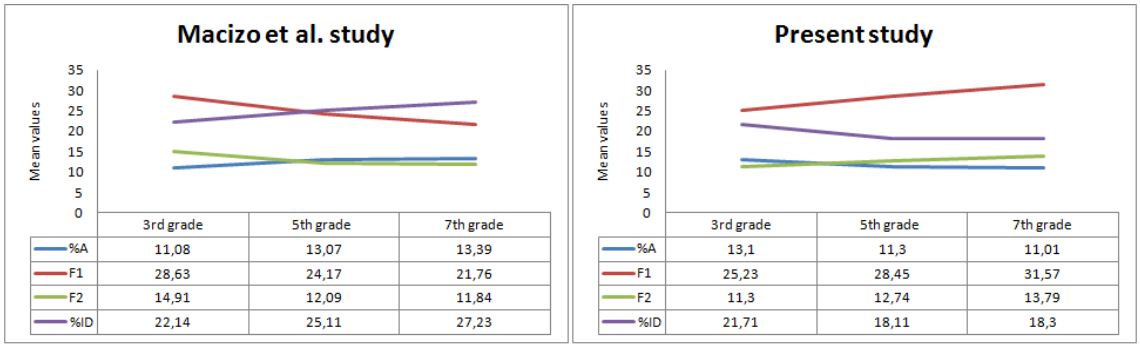

Figure 3. Mean values obtained for the three indices of association (A, F1, %ID) as a function of age group (3rd grade, 5th grade and 7th grade) in the study of Macizo et al. (2000) and in the present study for the 58 common words.

Table 1. Mean and standard deviations (in brackets) for the strength of the first (F1) and the second associate (F2), the distance between the F1 and the F2 (F1-F2), the percentage of associates (%A), the percentage of idiosyncratic responses (%ID), the percentage of words with less than 25% of *did not know* responses (% words < 25%), the percentage of words with more than 25% of *did not know* responses (% words > 25%), and the percentage of blank responses and illegible responses per grade school.

Indices	Age group		
	3rd group	5th group	7th group
F1	25.76 (14.50)	28.36 (16.33)	30.90 (17.39)
F2	11.05 (4.20)	11.71 (4.56)	12.90 (5.53)
F1-F2	14.70 (15.22)	16.66 (17.1)	18 (18.75)
%A	13.02	11.67	11.64
%ID	24.06	20.05	19.45
% words < 25%	34.53	17.27	2.88
% words > 25%	4.32	0.72	0.00
% of blank resp.	21.58	20.28	5.76
% of illegible resp.	0.01	0.14	0.01