

Subjective age-of-acquisition norms for 7,039 Spanish words

María Angeles Alonso · Angel Fernandez · Emiliano Díez

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Abstract Subjective estimations of age of acquisition (AoA) for a large pool of Spanish words were collected from college students in Spain. The average score for each word (based on 50 individual responses, on a scale from 1 to 11) was taken as an AoA indicator, and normative values for a total of 7,039 single words are provided as [supplemental materials](#). Beyond its intrinsic value as a standalone corpus, the largest of its kind for Spanish, the value of the database is enhanced by the fact that it contains most of the words that are currently included in other normative studies, allowing for a more complete characterization of the lexical stimuli that are usually employed in studies with Spanish-speaking participants. The norms are available for downloading as [supplemental materials](#) with this article.

Keywords Age of acquisition · Spanish norms · Word attributes · Word norms

Age of acquisition (AoA) refers to the average chronological age at which a particular word is first learned, thus reflecting the word's time of entrance into the lexical repertoire of an individual. A large body of empirical results, extensively reviewed by Juhasz (2005) and by Johnston and Barry (2006), has shown effects of AoA in classic language tasks such as word and picture naming (Barry, Morrison, & Ellis, 1997; Carroll & White, 1973b) or lexical decision (Morrison & Ellis, 2000; Turner, Valentine, & Ellis, 1998), with a majority of the results showing faster and more accurate

recognition times for earlier words. Because these effects are strongly associated with lexical accessibility, AoA has been presented by some researchers (e.g., Morrison & Ellis, 1995) as a determining factor in explaining reading processes, independent of other important influences such as frequency. However, the extent to which AoA is a relevant independent contributor to word processing has been the subject of a long debate in the field that goes beyond frequency issues. Of particular relevance is the discussion of whether the initial conceptualization of AoA as an explanatory variable should be revised to consider AoA as a variable that needs to be explained further in terms of simpler independent variables, such as frequency trajectory (Zevin & Seidenberg, 2002, 2004) or the order in which words are encountered by the language user (Mohaghan & Ellis, 2010). Recent efforts at collecting data in more varied tasks, the use of larger lexical sets, and the development of simulation-based theorization are facilitating analyses aimed at determining the net contributions of specific factors and the ways in which interactions among them may modulate AoA effects (e.g., Mermillod, Bonin, Méot, Ferrand, & Paindavoine, 2012).

AoA effects can be observed in the performance of language-impaired participants, such as in the case of anomic demented patients (Woollams, Cooper-Pye, Hodges, & Patterson, 2008), aphasic patients (Cuetos, Aguado, Izura, & Ellis, 2002), and other conditions resulting from brain damage (Ellis, 2011). In an educational context, second-language acquisition has been shown to be affected by AoA (Silverberg & Samuel, 2004), and recent experimental work by Izura, Pérez, Agallou, Wright, Marín, Stadthagen-González, and Ellis (2011), who manipulated the order of word acquisition in a controlled laboratory setting, has identified learning patterns that are of relevance for the design and implementation of foreign-language teaching in classroom settings. There is also evidence that the neural representations of early and late words could be related to separate brain areas (Fiebach, Friederici, Müller, von Cramon, & Hernandez, 2003). Finally,

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M. A. Alonso (✉)
Facultad de Psicología, Universidad de La Laguna, Campus de
Guajara, 38205 La Laguna, Spain
e-mail: maalonso@ull.es

A. Fernandez · E. Díez
INICO, Universidad de Salamanca, Salamanca, Spain

manipulations of AoA have evidenced effects in nonlinguistic tasks, such as face recognition (Moore & Valentine, 1998), object recognition (Moore, Smith-Spark, & Valentine, 2004), or semantic processing (Brysbaert, Lange, & Van Wijnendaele, 2000). All of these indications of relevance, although from diverse angles, point to the implication that priority in acquisition is an important characteristic of cognitive representations.

In the lexical realm, AoA scores have been obtained using objective procedures, such as picture-naming tasks with children of different ages (Morrison, Chappell, & Ellis, 1997) or naturalistic recording of children's verbal productions in everyday settings (Jorm, 1991), and using subjective procedures that rely on estimations from adults (e.g., Cortese & Khanna, 2008). Some researchers have compared objective and subjective norms, with the aim of finding which ones provide better predictors of word-processing performance, and they have concluded that objective norms are preferable, due to their lesser contamination by other related variables. The discussion is far from settled, though, because it involves issues related to the ongoing controversy, mentioned above, about the nature of the mechanisms underlying AoA effects (Bonin, Barry, Méot, & Chalard, 2004, present a detailed analysis of this point). Because of the difficulties in gathering objective AoA data, and because of the fortunate finding that correlations between indicators obtained with the two types of strategies tend to be high (Morrison et al., 1997), researchers have more often opted for the collection of subjective norms. Obtaining objective ratings is not only a laborious task, but it often results in the collection of data for a limited set of stimuli; nonetheless, normative data of this kind exist for English (Morrison et al., 1997) and other languages such as French (Chalard, Bonin, Méot, Boyer, & Fayol, 2003), Italian (Barbarotto, Laiacona, & Capitani, 2005; Lotto, Surian, & Job, 2010), and Spanish (Álvarez & Cuetos, 2007). Subjective indicators of AoA are typically obtained by asking adults to estimate the age at which they learned various words. Participants in this type of normative study are usually given a response scale that may vary in the range of values to be used, with studies using broadly defined scales of 5 points (e.g., Dimitropoulou, Duñabeitia, Blitsas, & Carreiras, 2009), or other scales incorporating more specific instructions to place specific age ranges within scales of 7 points (e.g., Cortese & Khanna, 2008), 9 points (e.g., Carroll & White, 1973a), or 11 points (e.g., Cuetos, Ellis, & Alvarez, 1999). A recent trend, adopted to facilitate responses by participants, is to directly ask for the number corresponding to the age at which they think they learned each word, without further conversion or referral to a predetermined scale (Stadthagen-Gonzalez & Davis, 2006).

Most of the available data are for words in the English language, with a recent study (Kuperman, Stadthagen-

Gonzalez, & Brysbaert, 2012) providing ratings for over 30,000 words. But recent times have seen the elaboration of AoA norms in a number of other languages, including Chinese (Liu, Shu, & Li, 2007), Dutch (Moors et al., 2013), French (Ferrand et al., 2008), German (Schröder, Gemballa, Ruppín, & Wartenburger, 2012), Italian (Barca, Burani, & Arduino, 2002), and Portuguese (Cameirão & Vicente, 2010).

With regard to the Spanish language, a few normative studies have been published over the last 15 years (all based on data from speakers in Spain, except where noted). The first reported study was conducted in Cuba by Manzano, Piñeiro, and Pereira (1997; Piñeiro & Manzano, 2000), who derived AoA estimates for 1,259 Spanish words using a corpus of 15,428 words uttered by 1- to 4-year-olds ($N = 200$) in a play situation involving one other child and two adults. Another set of objective ratings was obtained by Pérez and Navalón (2005) by requesting the naming of common objects depicted in a set of 178 line drawings presented to children from 2.5 to 9 years of age ($N = 397$). And a third set of objective norms was collected by Álvarez and Cuetos (2007), by registering name responses given by children (2;4 [i.e., 2 years 4 months] to 15 years of age, $N = 380$) to 328 line drawings that included most of the standardized stimuli from the Snodgrass and Vanderwart (1980) database. In the case of norms based on subjective ratings given by adult participants, a first study was conducted by Cuetos et al. (1999) with a sample of university students ($N = 50$), and it provided norms for 140 Spanish words corresponding to a subset of the names for the Snodgrass and Vanderwart drawings. Subsequent subjective studies have been conducted by several researchers: Hirsh, Morrison, Gaset, and Carnicer (2003) reported estimations of AoA for 83 Spanish words obtained from a sample of university students ($N = 14$); Izura, Hernández-Muñoz, and Ellis (2005) obtained norms for 500 words belonging to the semantic categories of animals, body parts, furniture, clothing, and intelligence, requesting direct word-learning-age estimations from adults ($N = 25$); Barbón and Cuetos (2006) gathered norms from university students ($N = 27$) for 159 words corresponding to natural categories; Manoiloff, Artstein, Canavoso, Fernández, and Seguí (2010) compiled norms corresponding to the names of 400 pictures, drawn from university students ($N = 35$) in Argentina; Cuetos, Samartino, and Ellis (2012) reported norms for 500 words obtained with a sample of people over 60 years of age ($N = 30$); and finally, Wilson, Cuetos, Davies, and Burani (2013) obtained norms for 120 low- and high-frequency words with a sample of university students (N unreported). What this listing shows is the result of several unrelated attempts to gather AoA data, in studies with quite different purposes, different stimuli (although at times overlapping to different degrees), different types of rating scales, varied and small sample sizes, and not always with the same type of native speakers.

The AoA data obtained in these studies have been instrumental in conducting studies with Spanish verbal materials, but the field would greatly benefit from a larger-scale attempt at collecting a large, homogeneous, and reliable database. As this report was being written, Davies, Barbón, and Cuetos (2013) published a study on the lexical and semantic factors affecting the reading of a set of 2,764 Spanish words, for which a sample of undergraduate university students ($N = 25$) provided AoA ratings using a 7-point scale. These ratings are included in the electronic [supplementary materials](#) accompanying this article, and their availability is a notable improvement over the prior situation. However, the normative study reported here, with a new associated database, is a worthy contribution to the repertoire of quantitative descriptors of the linguistic units of Spanish. First, the set of words for which AoA ratings are provided is 2.5 times larger than the largest of the previously existing sets. Second, larger ranges of length and frequency are covered by the selected words. Third, the number of participants providing valid scores for each word ($N = 50$) is higher than in all but one of the comparable subjective-method studies. Fourth, the database includes not only the mean AoA, but also the standard deviation, minimum and maximum values, and mean z score for each word. And fifth, a few other potentially useful lexical descriptors recently provided by other studies are also included for each item.

Method

Participants

A total of 2,150 university students at the University of La Laguna were involved in the age estimation task. All participants were undergraduate students at this university, with a mean age of 20.7 years. Women constituted 83 % of the sample, and Spanish was the native language of all of them, with 3 % declaring themselves to be bilingual.

Materials

The words used as stimuli were selected with the aim of assembling a database that was large, representative of the language, and potentially integrable with other lexical databases already existing in Spanish. The result was a pool of 7,039 single words, present in one or more of a number of Spanish lexical compendia, such as written- and oral-frequency dictionaries (Alameda & Cuetos, 1995; Alonso, Fernandez, & Díez, 2011; Sebastián, Martí, Carreiras, & Cuetos, 2000), free-association norms (Fernandez, Díez, Alonso, & Beato, 2004; Fernandez, Díez & Alonso, 2013), subjective indicators (Algarabel, 1996), and so forth. In terms of length, the words ranged from one letter (as in the proposition *a*) to 22 letters (as in the anatomical name

esternocleidomastoideo), and their written frequencies ranged from 1 to 58,240 per million, with a median value of 16. With regard to grammatical categories, 66 % were nouns, 16 % were adjectives, 14 % verbal forms, and the remaining 4 % were of an assorted nature (e.g., adverbs, pronouns). For data collection purposes, the words were distributed into 37 booklets, each containing between 190 and 200 unrelated words, that were printed in five different random orders to control for order-of-presentation effects. Each booklet had a first page with task instructions, advising participants that their task was to make an estimation of the age at which they had first learned each of the words in the following pages. The rest of the booklet consisted of the pages containing the stimuli. The words, in uppercase letters, were placed in two columns per page, each word followed by a space in which the numerical AoA estimator could be written.

Procedure

Data were collected in sessions lasting approximately 30 min, with groups of 20 to 30 participants at a time. Booklets were randomly distributed among the participants, who were told to carefully read the instructions, ask any questions they might have, and wait for the administrator's instruction to turn the page and proceed with the age-estimation task. The instructions asked them to make age estimations using an 11-point lineal scale, choosing a value of 1 to indicate an age *less than 2 years old*, a number from 2 to 10 to indicate learning ages of *2 to 10 years*, and the number 11 to indicate that the learning age for the word was *11 years or older* (this is the same procedure used by Cuetos et al., 1999). The 1-to-11 scale was printed at the top of each page, as a key to remind participants of the appropriate range of responses. They were required to start with the words in the left column in each page, completing all responses, in order and without blanks, before proceeding to the words in the second column.

Results

Booklets were processed so as to extract the individually provided values for each word, entering the handwritten numbers into a computerized spreadsheet. Means, standard deviations, range values, and average z scores were computed for each stimulus on the basis of the responses of 50 participants to each word. To assess interrater reliability, intraclass correlation (ICC) indexes were calculated for all booklets (two-way random consistency model). The mean ICC of .6 (range = .42 to .71) indicated good interrater reliability (Cicchetti, 1994; Hallgren, 2012).

The resulting normative database is available for downloading from the journal website in two different file formats—tab-delimited text (SpanishAoA.txt) and

spreadsheet (SpanishAoA.xls)—both with identical contents and general structure. In both files, all of the words are listed in alphabetical order, and each of them is followed by quantitative indexes and descriptors. The first six columns include the 7,039 words, in alphabetical order, and the indexes computed for them: average AoA of the word, the associated standard deviation, the minimum value assigned to the word in the 1–11 scale, the maximum value assigned to it, and the item's *z* score (the average of the participants' *z* scores for that item). For completeness, a few additional lexical properties that are of common use by researchers are also included for most words in the database. Listed in order, columns 7 to 13 present values for oral frequency (from Alonso et al., 2011); three different written-frequency values (from Cuetos, González-Nosti, Barbón, & Brysbaert, 2011; from Sebastián et al., 2000; and from Duchon, Perea, Sebastián-Gallés, Martí, & Carreiras, 2013); and descriptors of the predominant part of speech, morphosyntactic properties, and number of syllables (from Duchon et al., 2013).

A Kolmogorov–Smirnov test indicated that the AoA distribution deviated significantly from a normal distribution ($D = .054$, $p < .05$), with a skewness of $-.09$ ($SE = .03$) and a kurtosis value of $-.97$ ($SE = .06$). The mean AoA rating was 6.9 ($SE = 0.025$), with a minimum of 1.12 and a maximum of 10.96.

The reliability of the mean scores as indicators of AoA was assessed through a planned consistency check on the provided subjective estimations, with a split-half correlational analysis showing a high rate of internal consistency ($r = .95$, $p < .001$). An additional, unplanned reliability assessment was performed on a small portion of the data, due to the fact that a set of 135 words was inadvertently included twice in the booklets, and this was administered to two different samples of participants separated by a 30-month interval. The average difference between the estimators in the two sets was .43, and the correlation across words was almost perfect ($r = .994$, $p < .001$).

The validity of the AoA indexes can be assessed by examining the correlations between the values obtained in the present study and other subjective and objective AoA indexes

available in Spanish. As is shown in Table 1, in all cases the correlations were positive, significant, and high (between .61 and .92), evidencing adequate validity in the norms provided here. Additionally, for a subset of 1,872 shared words, analyses were performed to examine the correlations between the AoA indexes presented here and reaction times recently reported for word naming (Davies et al., 2013) and lexical decision (González-Nosti, Barbón, Rodríguez-Ferreiro, & Cuetos, 2013). For naming latencies the correlation was $r = .03$, and for lexical decision times the correlation was $r = .56$. These correlation values are very similar to those obtained in the studies by Davis and collaborators and by González-Nosti and collaborators with their own set of AoA values ($r = -.03$ for naming and $r = .58$ for lexical decision). Finally, the usual negative correlations with word frequency estimations were also found in the present study, $r = -.24$, in the case of written frequency (from Duchon et al., 2013), and $r = -.38$ in the case of oral frequency (from Alonso et al., 2011).

Discussion

Using an empirical method widely employed in the field, AoA ratings were collected for a large set of words in Spanish. The ratings provided by individual participants were averaged in order to compute mean acquisition values for the sampled words, and this allowed for the elaboration of the set of norms reported here, which to date is the largest of its kind for Spanish words. Statistical analyses focusing on reliability and validity demonstrated that the norms provide adequate estimators of AoA for this set of verbal stimuli.

As is the case with most normative materials of this type, attention should be paid to dialectal variations within a language. AoA values for the set of words ($n = 269$) that are common to the present norms and the ones recently published for Argentinian adult speakers of Spanish (Manoiloff et al., 2010) show a sizable correlation ($r = .82$), but none the less, caution should be used when stimuli are selected for use with Spanish-speaking participants in regions other than Spain. In

Table 1 Correlations between the present age-of-acquisition (AoA) indexes and those reported for shared words in seven databases for Spanish spoken in Spain

AoA Estimation Method	Study	Common Words	<i>r</i>
Objective	Pérez & Navalón (2005)	175	.80**
	Álvarez & Cuetos (2007)	312	.61**
Subjective	Cuetos, Ellis, & Alvarez (1999)	137	.80**
	Izura, Hernández-Muñoz, & Ellis (2005)	465	.79**
	Cuetos, Samartino, & Ellis (2012)	444	.74**
	Davies, Barbón, & Cuetos (2013)	1,872	.92**
	Wilson, Cuetos, Davies, & Burani (2013)	96	.89**

** $p < .01$.

the same vein, the fact that judgments were provided by a rather uniform sample of participants, all of them young adults pursuing a university degree, might restrict the generalizability of the indexes to other segments of the general population. However, the relatively high correlation [$r(400) = .74$] of the scores reported here with the scores obtained by Cuetos et al. (2012) with a sample of elderly participants from a variety of professional backgrounds, and the fact that Kuperman et al. (2012) did not find effects of educational level on their AoA ratings suggest that this is an unimportant concern.

A limitation of the present norms refers to the contents of the word sample, which are mostly nouns and with a limited set of verb forms. Because verbs are an important part of everyday language, in terms of both frequency of usage and meaning transmission, AoA norms for a sizable set of verbs should be a goal for future work. Still, the norms provided here are of immediate use, and their value can be supplemented by combining the use of these AoA ratings with other important lexical indexes already available for Spanish words. With the exception of 12 entries (corresponding to a few acronyms and anglicisms), all of the words in the presently described pool of words have additional lexical information in EsPal (Duchon et al., 2013), a recently created, Web-accessible repository offering subtitle-derived word frequencies, lemma information, orthographic and phonological characteristics, and subjective ratings. Additionally, written-frequency estimations for 6,630 of the words can be found in the norms of Alameda and Cuetos (1995), and oral-frequency estimations for 6,669 words are in the norms of Alonso et al. (2011). Free associates for 5,629 words are available in the norms of Fernandez et al. (2013), and the combined norms in the Valencia word pool (Algarabel, 1996) and LEXESP (Sebastián et al., 2000) provide imageability ratings for 3,674 words, plus familiarity ratings for 3,717 words. Finally, 1,029 of the words have values for valence, arousal, and dominance in the affective norms of Redondo, Fraga, Padrón, and Comesaña (2007), an overlap that results in all but five of the affectively normed words having AoA values in the norms presented here. Because there has recently been a surge of interest in the gathering and distribution of normative lexical data (e.g., Duchon et al., 2013; Guasch, Boada, Ferré, & Sánchez-Casas, 2013), the possibility of characterizing a large set of Spanish verbal stimuli in most, if not all, of the relevant dimensions seems a reachable goal in the near future. The value of large and well-characterized data sets can be seen in the recent contribution of Davies et al. (2013), who observed that AoA significantly affected word-naming performance in Spanish independently from frequency using a sample of over 2,700 words, an effect reflecting semantic influences that had failed to appear in earlier studies using smaller word samples (see González-Nosti et al., 2013, for another example of findings revealed by the use of larger word data sets).

With regard to further advances, it is worth noting that technological developments allowing for massive storage, virtually universal access to the Internet, and the availability of vast repositories of textual material are making possible the construction of a new type of normative lexical database. These new databases are characterized by both an increment in the number of stimuli (types) that are normed and an increment in the sample from which the indexes are estimated (tokens). For example, Brysbaert and New (2009) obtained frequency estimations for over 60,000 English words from a pool of 51 million words serving as subtitles of conversational exchanges in films and television series. More relevant to the present discussion, Kuperman et al. (2012) assembled subjective AoA ratings for a total of 30,121 English words, 5 times the size of the combined data sets that had previously been available. They were able to gather data for such a sizable word sample by paying a small quantity of money to 1,960 participants who submitted their estimates via the Internet. Because the AoA ratings collected in this way correlated almost perfectly with ratings obtained under traditional conditions in the laboratory, and because the overall cost was relatively low, the approach could be of interest when considering future extensions of the work described here.

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