Behav Res
DOI 10.3758/s13428-013-0319-0

Objective age of acquisition norms for a set of 286 words in Russian: Relationships with other psycholinguistic variables

Andrei Grigoriev · Ivan Oshhepkov

Abstract Normative data on the objective age of acquisition (AoA) for 286 Russian words are presented in this article. In addition, correlations between the objective AoA and subjective ratings, name agreement, picture name agreement, imageability, familiarity, word frequency, and word length are provided, as are correlations between the objective AoA and two measures of exemplar dominance (exemplar generation frequency and the number of times an exemplar was named first). The correlations between the aforementioned variables are generally consistent with the correlations reported in other normative studies. The objective AoA data are highly correlated with the subjective AoA ratings, whereas the correlations between the objective AoA and other psycholinguistic variables are moderate. The correlations between the objective AoA of Russian words and similar data for other languages are moderately high. The complete word norms may be downloaded from supplementary material.

Keywords Objective age of acquisition · Picture norms · Imageability · Familiarity · Name agreement · Picture name agreement · Dominance · Russian

Objective age of acquisition norms for a set of 286 words in Russian

Age of acquisition (AoA) of a word is an important factor that affects processing speed in a number of cognitive tasks. Several studies have found correlations between AoA and picture-naming latencies (e.g., Barry, Morrison & Ellis, 1997; Catling, Dent & Williamson, 2008; Dent, Johnston & Humphreys, 2008; Holmes & Ellis, 2006; Lotto, Surian & Job, 2010). In addition, the effect of AoA on performance on a word-naming task was reported by Morrison and Ellis (1995), Brysbaert, Lange and Van Wijnendaele (2000), and others. AoA was shown to have important influences on lexical decision making (e.g., Brysbaert et al., 2000; Gerhand & Barry, 1999; Morrison & Ellis, 1995), object decision making, and category verification (e.g., Holmes & Ellis, 2006), and its role in sequential picture identification tasks (e.g., Catling & Johnston, 2009) and word fragment completion tasks (Spataro, Mulligan, Longobardi & Rossi-Arnaud, 2012), among others, has also been demonstrated.

There are two types of normative AoA data: subjective AoA ratings and objective AoA values. The first type of data is obtained by asking participants to report the age(s) at which they think they acquired different words. Data of the second type are usually gathered using a picture-naming task, in which children are shown pictures and asked to name the images. A brief survey of both of these types of studies is included in the following sections.

Ratings of word AoA

Carroll and White (1973b) were the first to collect AoA ratings from adults. In their study, adult participants were asked to report the approximate age at which they believed they had acquired each word. An 8-point scale was used; a rating of 1 indicated that *the word was acquired between 2 and 3 years of age*, and a rating of 8 corresponded to *word acquisition that occurred at 14 years of age or older*. Data for 94 "picturable nouns" (e.g., airplane, anchor, anvil, etc.) were presented. The primary goal of the aforementioned study was to elucidate the relationship between word frequency and response time for the picture-naming task.

Electronic supplementary material The online version of this article (doi:10.3758/s13428-013-0319-0) contains supplementary material, which is available to authorized users.

A. Grigoriev (✉)
Institute of Linguistics, Russian Academy of Sciences, Moscow
City University of Psychology and Education, Moscow, Russia
e-mail: grigoriev.ran@gmail.com

I. Oshhepkov
Department of Philosophy, Moscow State University,
Moscow, Russia
e-mail: oshhepkov@gmail.com

Published online: 23 February 2013

However, the study found that naming latencies were a function not only of word frequency, but also of the age at which a word had been learned. Hence, AoA was shown to be an important psycholinguistic variable. In their next study, the initial sample of 94 words was enlarged to 220 words (Carroll & White, 1973a). A 9-point scale was used (1 = *1 to 2 years of age*, 9 = *age 13 and older*).

In 1977, Gilhooly and Hay gathered AoA data for both picturable nouns and abstract words, such as *black* and *logic*. The stimulus set contained 205 words, and a 7-point scale was used (1 = *0 to 2 years of age*, 7 = *age 13 and older*).

AoA ratings for 1,944 words selected from the Thorndike and Lorge (1944) word count were presented by Gilhooly and Logie (1980), as were data about the imageability, concreteness, familiarity, and ambiguity of the words. Morrison, Chappell and Ellis (1997) collected both AoA ratings and "objective" AoA data for 297 picturable nouns. AoA ratings for 1,526 English words were gathered by Stadthagen-Gonzalez and Davis (2006). Similarly, Cortese and Khanna (2008) presented data for 3,000 monosyllabic words. The 7-point scale proposed by Gilhooly and Hay (1977) was used in all of these studies.

Typed words are usually used as stimuli in these types of experiments. However, pictorial stimuli are presented to participants in some cases; in these cases, the participants are asked to report the age at which they might have learned the name of the object in the picture (see Johnston, Dent, Humphreys & Barry, 2010).

Subjective AoA scores have also been obtained for languages other than English. AoA norms based on subjective ratings are available for French, Spanish, Italian, and other languages (Alario & Ferrand, 1999; Barca, Burani & Arduino, 2002; Bonin, Peereman, Malardier, Méot & Chalard, 2003; Cameirão & Vicente, 2010; Cuetos, Ellis & Alvarez, 1999; Dell'acqua, Lotto & Job, 2000; Dimitropoulou, Duñabeitia, Blitsas & Carreiras, 2009; Ghyselinck, De Moor & Brysbaert, 2000; Hirsh, Morrison, Gaset & Carnicer, 2003; Manoiloff, Artstein, Canavoso, Fernandez & Segui, 2010; Marques, Fonseca, Morais & Pinto, 2007; Moreno-Martínez, Montoro & Laws, 2011; Nishimoto, Miyawaki, Ueda, Une & Takahashi, 2005; Nisi, Longoni & Snodgrass, 2000; Pind, Jónsdóttir, Gossurardóttir & Jónsson, 2000; Ruts, De Deyne, Ameel, VanPaemel, Verbeemen & Storms, 2004; Schroder, Gemballa, Ruppin & Wartenburger, 2012; Sirois, Kremin & Cohen, 2006; Weekes, Shu, Hao, Liu & Tan, 2007). Ratings for a set of Russian words were presented by Tsaparina, Bonin and Méot (2011). Their procedure was the same as that in the Bonin et al. (2003) study.

The subjective AoA scores described above appear to be very reliable (a reliability of 0.968 was reported in Carroll and White (1973b); comparable values of 0.988 and 0.991 for two subgroups of the stimulus set used in the study by Carroll and White (1973a) were reported; a value of 0.95 was reported in the study by Tsaparina et al. (2011), etc.). The validity was shown to be remarkably high. For example, a study by Lyons, Teer and Rubenstein (1978) attempted to assess the validity of the collected AoA ratings. They asked first graders to define 60 words that had previously been rated by adults. Of these, 30 words were considered early-acquired words on the basis of the ratings of the adults, and the other 30 were considered late-acquired words. Although the words that were considered late-acquired words were not known by the first-grade children, 74 % of the children knew the meanings of the early-acquired words. Nevertheless, some researchers believed a more reliable measure, which they termed an "objective" measure, would have been preferable (e.g., Morrison et al., 1997, p. 549).

Objective AoA measures

Beginning with the study by Carroll and White (1973b), some attempts were made to establish an objective measure of the word AoA. A survey of these attempts can be found in Morrison et al. (1997); the article notes some shortcomings in all of them. Seeking to develop a more valid method of measuring word AoA, they proposed the use of a picture-naming task for this purpose.

In the Morrison et al. (1997) study, black-and-white line drawings of objects were shown to children, and the children were asked to name the object in each drawing. If a child's reply was not the target response, the experimenter asked him/her to try again and cued him/her with the initial phoneme of the target response. The stimulus set contained a total of 297 pictures, 232 of which were taken from the set developed by Snodgrass and Vanderwart (1980).

In all, 280 children between the ages of 2 years, 6 months, and 10 years, 11 months were involved in the study. The data were divided into 14 groups (age bands), with 20 participants in each group. The first 11 groups covered 6-month age bands; the last 3 covered spans of 1 year each. Their procedure was then reproduced by other researchers in a number of different countries. Table 1 shows some key characteristics of these normative studies.

Although all of the researchers attempted to follow the same procedure to collect comparable data, there were differences between the various studies, some of which were unavoidable. Thus, age ranges and numbers of 6- and 12-month age bands used in these studies differed from one study to another. The stimulus sets used in these studies mostly consisted of pictures from the Snodgrass and Vanderwart (1980) collection. However, some of the pictures may have been modified or even replaced altogether, and most of the researchers added some of their own stimuli. It is also worth noting that the stimulus names used by different authors do not necessarily correspond to each other.

Table 1 Key characteristics of objective AoA studies in different countries

Year	Language	Source	Participants			Material		Procedure	Results	
			Number of participants	Ages	Age ranges	Number of stimuli	Number of stimuli from the Snodgrass & Vanderwart set	Cueing	Assignment procedure	Data extrapolation to earlier ages (75 % rule)
1997	English	Morrison et al. (1997)	280	2:6–10:11[a]	14 total: 11; 6-month; 2:6–7:11[b] 3; 12-month; 8:00–10:11	297	232	First phoneme	75 %; LR[c]	Yes
2000	Icelandic	Pind et al. (2000)	279	2:6–10:11	14 total: 11; 6-month; 2:6–7:11 3; 12-month; 8:00–10:11	238	238	First phoneme	75 %	Yes (used their own method)
2003	French	Bonin et al. (2003)	280	2:6–10:11	14 total: 11; 6-month; 2:6–7:11 3; 12-month; 8:00–10:11	230	230	First phoneme	75 %; LR	No
2005	Spanish	Pérez and Navalón (2005)	397	2:6–9:00	10 total: 5; 6-month; 2:6–4:12 5; 12-month; 5:1–9:12	175	111	Semantic category; first syllable	75 % LR	No
2007	Spanish	Álvarez and Cuetos (2007)	380	2:4–15:00	19 total: 12; 6-month; 2:4–8:00 7; 12-month; 8:01–15:00	328	246	No cuing (Not named pictures were presented at the end of the task)	75 %	No
2005	Italian	Barbarotto, Laiacona and Capitani (2005)	202	2:10–5:9	6 total: 6; 6-months; 2:10–5:9	80		"Only generic encouragements" and no time limits	75 % LR	No
2010	Italian	Lotto et al. (2010)	300	2:00–10:11	14 total: 10; 6-month; 2:00–6:11 4; 12-month; 7–10:11	223	Not reported	No cuing	75 % LR	No
2012	Russian	This study	293	2:6–10:11	14 total: 11; 6-month; 2:6–7:11 3; 12-month; 8:00–10:11	286	188	First phoneme	75 %	No

[a] 10:11 = 10 years, 11 months

[b] 11; 6-month; 2:6–7:11 = 11 age bands corresponding to 6 months in the range of 2:6–7:11

[c] 75% = 75 % rule; LR = logistic regression

There were also some procedural discrepancies. Although the children in most of the studies were cued with the first phoneme of a word when they could not name a picture, Pérez and Navalón (2005) used the first syllable and the semantic category of an item instead of the first phoneme, and both Álvarez and Cuetos (2007) and Lotto et al. (2010) avoided cuing altogether.

Some deviations from the initial procedure for assigning AoA values also occurred. Morrison et al. (1997) used two procedures—namely, the so called 75 % rule (see details below) and logistic regression (LR). When using the former procedure (the 75 % rule), they extrapolated their data for ages of less than 30 months or greater than 131 months. However, some of the researchers who performed subsequent studies did not do extrapolations to earlier ages when using the 75 % rule, because they lacked additional data that could be used to verify the extrapolation method (see the two last columns of Table 1); in addition, some of the subsequent studies did not use LR. Also, there were some differences in scoring procedures (see the Scoring section below). These discrepancies should not be neglected when comparing results from the studies mentioned here.

With the emergence of these objective AoA norms, some attempts were made to reassess the validity of subjective AoA ratings by correlating the subjective and objective AoA for various words. The first report of this type of analysis was made by Morrison et al. (1997). The correlations between the subjective and objective values were reported to be 0.759 (LR) and 0.747 (75 % rule). In addition, the researchers noted that the adults tended to underestimate the AoA of late-acquired words (Morrison et al., 1997, p. 545). Other studies reported similar correlations for other languages: 0.728 for Icelandic (Pind et al., 2000); a range of values from 0.557 to 0.852 for Spanish (Pérez and Navalón (2005), using three objective and two subjective measures); 0.752 (LR) and 0.698 (75 % rule) for Italian (Lotto et al., 2010); and 0.687 (LR) and 0.650 (75 % rule) for French (Chalard, Bonin, Meot, Boyer & Fayol, 2003). Although these correlations are relatively strong, they do suggest that there might be a regular discrepancy between the two measures. Some researchers, including Morrison et al. (1997), attempted to explain this discrepancy on the basis of the observed correlations between AoA (both subjective and objective) and other psycholinguistic variables.

Relationships between AoA and other psycholinguistic variables

Studies of AoA usually include some analysis of correlations between AoA and other covariates, such as imageability, familiarity, frequency, and so on. In the studies of objective AoA, additional image-related variables were also included (e.g., name agreement [NA], picture name agreement [PNA], etc.). The correlations between these variables and the AoA values reported in these studies were usually moderate (rarely in excess of 0.5).

An analysis of the aforementioned results led some researchers to believe that subjective AoA might have been a composite variable; it may have depended on other variables, such as word frequency, familiarity, and imageability, among others (Morrison et al., 1997). Álvarez and Cuetos (2007) argued that because "it is very difficult to remember at what age we learned words, our answers can be influenced by other variables, such as word frequency or familiarity" (p. 378). This view is supported by the fact that these variables are usually more strongly correlated with subjective AoA estimates than with objective AoA values (Álvarez & Cuetos, 2007; Pérez & Navalón, 2005).

Thus, after the study by Morrison et al. (1997) was published, a tendency to consider the objective AoA to be a "clearly preferable" measure appears to have arisen, even though the subjective AoA is still considered an "adequate substitute" (Morrison et al., 1997, p. 549; Pind et al., 2000, p. 47). However, some authors went further, maintaining that the latter measure cannot even be relied upon as an "adequate substitute" (Barbarotto et al., 2005, p. 648).

The present study

The main purpose of the present study was to provide objective AoA norms for the Russian language. These data would be a valuable complement to the subjective ratings that have previously been reported (Tsaparina et al., 2011), because objective AoA values are believed to be both preferable and more valid than subjective AoA ratings (Barbarotto et al., 2005; Morrison et al., 1997; Pind et al., 2000). The present study also sought to analyze the relationships between the objective AoA values and other psycholinguistic variables, including subjective AoA ratings, and to compare these normative data with the normative data that have been reported for other languages.

Method

Participants

A total of 293 children attending nursery and primary schools were enrolled in the present study. The children were from two Russian cities, Moscow and Kaluga. Their ages ranged from 2 years, 6 months to 10 years, 11 months. All of the children were native Russian speakers. Summary information on the participants in each age band and on the number of stimuli used is provided in Table 2. Appropriate informed consent was obtained from the parents of all children.

Table 2 Summary data for children tested to obtain objective age of acquisition norms

Group	Age range in years	Age range in months	Mean age (months)	Boys	Girls	Total	Number of items
1	2.5–2.9	30–35	32.5	11	9	20	286
2	3–3.4	36–41	38.5	10	10	20	286
3	3.5–3.9	42–47	44.5	10	10	20	286
4	4–4.4	48–53	50.5	11	12	23	286
5	4.5–4.9	54–59	56.5	10	10	20	286
6	5–5.4	60–65	62.5	12	11	23	286
7	5.5–5.9	66–71	68.5	7	13	20	286
8	6–6.4	72–77	74.5	12	12	24	286
9	6.5–6.9	78–83	80.5	9	11	20	286
10	7–7.4	84–89	86.5	9	12	21	286
11	7.5–7.9	90–95	92.5	10	10	20	286
12	8–8.9	96–107	101.5	11	9	20	170
13	9–9.9	108–119	113.5	9	11	20	170
14	10–10.9	120–131	125.5	11	11	22	170
Total				142	151	293	

The numbers in the last column reflect the numbers of items presented to the children in each age range

Stimuli

The stimulus set used in the present AoA study comprised 286 black-and-white line drawings.

Most of the pictures (188) were taken from the Snodgrass and Vanderwart (1980) stimuli database. In addition, 8 pictures were selected from those added by Morrison et al. (1997). Finally, we considered it necessary to modify some of the pictures from the Snodgrass and Vanderwart set and also to create our own pictorial stimuli for certain words (a total of 90 items). For example, the picture of a goat from the Snodgrass and Vanderwart (1980) set was modified by adding an udder, because the Russian target word *koza* denotes a she-goat. The picture of a church from the same set was substituted by a picture of a more typical church for Russia.

The 231 children who were included in the 6-month age bands (and who were under the age of 7:11) were tested using all 286 pictures. The remaining 62 children in the 12-month age bands were tested using a subset of 170 pictures. This subset was generated by removing the pictures that had been named correctly by more than 85 % of children in each of the last five 6-month age bands (age 5:6 to age 7:11).

The target name for each picture was the word that had occurred most often in the adults' reactions during the NA task (Grigoriev, Oshhepkov, Baljasnikova & Orlova, 2010), although there were some exceptions to this rule. For example, because many of the adult participants were medical students, they often gave the more specific name *phonendoscope* when shown a picture of a *stethoscope*. However, the latter word is obviously much more common and is, therefore, more familiar to anyone without a medical background. Therefore, *stethoscope* was chosen as a target name. Each picture was printed on a single A4 page (210×297 mm) and was approximately 100 mm square.

Procedure

The procedure used in the present study was very similar to that used by Morrison et al. (1997). For children between the ages of 2:6 and 7:11, all 286 items were split into four groups of equal size. These images were randomly ordered into folders of different colors. At each testing session, the children were asked to choose whichever folder they liked. The subset of 170 items used with the older children was not split into groups.

The experimenter asked each child to name each picture ("What is that a drawing of?"). If the child did not answer within the first 5 s of being asked about the drawing, or if a child did not give the target name, he/she was cued with the initial phoneme of the word: "It begins with a(n) . . ." If he/she still did not respond within the next 5 s, the experimenter proceeded to the next picture. All answers were recorded in writing.

The experimenters were licensed psychologists who were working in schools. Each experimenter was given comprehensive instructions.

Scoring

In any study dedicated to measuring objective AoA, researchers must differentiate between significant and insignificant deviations from the target words in the children's answers. To do so, they usually establish some criteria regarding which kinds of answers should be considered correct. These criteria are usually based on various peculiarities both of the language being studied and of language acquisition.

Thus, minor childish mispronunciations were marked as correct in the study by Morrison et al. (1997). Pind et al. (2000) used a somewhat broader criterion: They discounted any deviations in pronunciation "if the word uttered by the child was clearly the intended word." Thus, the pronunciation *gjabaka* was considered correct for the target word *skjaldbaka* (*turtle*). Similarly, some childish variants of words were counted as correct (e.g., *kisa* for *köttur* [*cat*]). These researchers also considered both the dominant name that arose during the NA task and "those non-dominant responses which had at least received four nominations" to be valid responses (Pind et al., 2000, p. 46).

We generally followed the rule proposed by Morrison et al. (1997); namely, in the case of one-, two-, and three-phoneme words, the responses were scored as correct if not more than one phoneme was omitted or mispronounced; and in the case of words of four or more phonemes, two omissions or mispronunciations were regarded as admissible. In addition, we marked as correct diminutive forms of target words.

The Russian language is characterized by a rich morphology that includes a highly developed system of diminutives, which are productively formed from nouns by adding suffixes and combinations of suffixes to a stem—for example, *syn-ok*, *syn-oček*, *syn-ulj-a*. Because these rules are quite simple, they are acquired at a very early stage of development (2–2.5 years), and Russian children use them frequently (Gvozdev, 1961; Lepskaja, 1997; Olmsted, 1994; Protassova & Voeikova, 2007). Therefore, a child may know several diminutive forms of a word and may use them interchangeably. We therefore regarded diminutives as morphological forms of a target word (and not as other words) and counted them as correct responses.

Results

Morrison et al. (1997) used two procedures to assign objective AoA values, as did some other researchers. One of the procedures was the so-called 75 % rule. According to this rule, a word was considered acquired at a certain age if at least 75 % of children named it correctly at that age. The other procedure was based on LR.

In the present study, it was considered reasonable to use only the 75 % rule. There were two reasons for doing this. (1) The correlations between the scores calculated using both of these methods were very high in all of the relevant studies. Morrison et al. (1997) reported a correlation of 0.970; Lotto et al. (2010) reported a value of 0.958; and Chalard et al. (2003) reported a correlation of 0.937. (2) Using the method of LR resulted in the loss of some data. For example, LR values were not assigned to 44 of 297 words in the study by Morrison et al. (1997), whereas only three such omissions occurred when using the 75 % rule.

According to the 75 % rule, the item was "considered to have reached criterion if at least 75 % of the children at the relevant age band named it correctly and an average of at least 75 % of children over the next two age bands also named it correctly" (Morrison et al., 1997, p. 537). The mean age of the relevant age band was then assigned to the item. If an item did not meet the criterion even in the case of the oldest age band *and* its NA was at least 75 %, it was assigned an AoA value of 140 months. In addition, when the item did not meet the criterion for the oldest age band *and* its NA was lower than 75 %, it was not assigned an AoA value. In the present study, 11 words were not assigned AoA values on the basis of this criterion (diamond, flute, cymbals, chisel, accordion, pond, stethoscope, nun, pliers, tsar, and scarecrow).

The *reliability* of Russian objective AoA norms was estimated using the following procedure. The complete data set was split into two subsamples of roughly equal sizes by randomly dividing each age band. The relevant AoAs were then calculated for each subsample using the procedure described above. The correlation between the AoA of the two samples was very strong (0.926), which indicated high reliability of the data collected.

The correlation between the objective AoA values presented here and the rated AoA ratings collected by Tsaparina et al. (2011) is rather high (0.673). This finding is consistent with the data reported by other researchers (0.747 for English [Morrison et al., 1997]; 0.728 for Icelandic [Pind et al., 2000]; 0.650 for French [Chalard et al., 2003]; 0.558 for Spanish [Álvarez & Cuetos, 2007]; 0.698 for Italian [Lotto et al., 2010]) and shows the *validity* both of our data and of the data presented by Tsaparina et al. (2011).

One of the goals of this study was to present the correlations between the objective AoA and other psycholinguistic variables. These included NA, PNA, imageability, familiarity, word frequency, word length, and two measures of exemplar dominance (exemplar generation frequency [EGF], number of times an exemplar was named first).

The data on exemplar dominance were taken from Grigoriev and Oshhepkov (2005). The data on imageability were taken from Grigoriev, Baljasnikova and Oshhepkov (2009).[1]

The data on NA, PNA, and familiarity were taken from the study of Grigoriev et al. (2010). In the latter study, only one measure of NA was used—namely, the percentage of participants who gave the most common name for a word. For the sake of comparability with the normative data presented by other researchers, H values were computed for the present study by the formula

$$H = \sum_{i=1}^{k} p_i \log_2\left(\frac{1}{p_i}\right)$$

[1] Some errors were corrected when the data were prepared for this article.

where k is the number of different names given to an image and p_i is the value for each name as a proportion of participants giving each name (Snodgrass & Vanderwart, 1980).

Word frequency measures were taken from two sources: the frequency dictionary by Zasorina (1977) and the new frequency count by Ljashevskaja and Sharov (2009). In both sources, a lemma is used as a basic unit, but they have some significant differences. The dictionary by Zasorina is based on a 1-million-word corpus including journalistic, scientific, and literary texts. In contrast, the dictionary presented by Ljashevskaja and Sharov is based on a 150-million-word corpus, but the sources used are not always representative of the Russian language (e.g., Internet forums). We chose to use both of these dictionaries. The word length was defined as the number of letters.

The data on objective AoA, along with the other psycholinguistic variables and frequency measures, are provided in the supplementary materials. Table 3 shows the intercorrelations for objective AoA and other variables, including the subjective AoA ratings collected by Tsaparina et al. (2011).

There is a similarity between these correlations and those reported for other languages. The correlation between the objective AoA and imageability (−0.430) in our study is higher than the same correlation for Spanish (−0.287; Álvarez & Cuetos, 2007) and less than that found for the English language (−0.549; Morrison et al., 1997). The correlation between the Russian objective AoA and familiarity (−0.278) is quite close to those for Icelandic (−0.367) and Spanish (−0.205, reported by Pérez & Navalón, 2005; −0.368, given by Álvarez & Cuetos, 2007). However, this value is again higher in the case of the English data. The correlations of the objective AoA values with NA (NA [%], −0.163; NA [*H*], 0.244) and PNA (−0.256) in our study are generally similar to those obtained by other researchers. Thus, in Morrison et al. (1997), these correlations were −0.232 for NA (%) and −0.268 for PNA; in Pérez and Navalón (2005), these were −0.127 for NA (%), 0.229 for NA (*H*), and −0.060 for PNA.

Additionally, two measures of exemplar dominance were included in the analysis. These were EGF and the number of times an exemplar was named first (see Table 3). The effects of dominance and typicality might be comparable because these have been reported to be closely related (Chumbley, 1986). The correlations of the objective AoA values with the two measures of dominance in the present study (−0.286 and −0.264, respectively) and the ones with typicality reported for Spanish (Álvarez & Cuetos, 2007) and Italian (Lotto et al., 2010) (−0.232 and −0.247, respectively) are all significant and not high, although they are rather similar.

There might be concern with regard to these correlations because they are computed separately for each category. The most dominant category members from different categories might tend to obtain similar values. However, the mean AoA differs across categories.

We used a standardization procedure to control the influence of variation of the AoA values across different semantic categories. The standard scores for objective AoA were based on the means and standard deviations of the categories. There was some increase in the correlations after doing this procedure. Thus, the correlation with EGF changed from −0.286 to −0.344, and the correlation with number of times an exemplar was named first changed from −0.264 to −0.309.

Finally, the correlations between the objective AoA for Russian words and objective AoA for similar words in other

Table 3 Correlations between all of the psycholinguistic variables

Variable	1	2	3	4	5	6	7	8	9	10	11	12
1. Obj. AoA	1.000	0.673***	−0.163**	0.244***	−0.430***	−0.256***	−0.278***	−0.266***	−0.272***	−0.286**	−0.264**	0.230***
2. Rated AoA		1.000	−0.145*	0.179**	−0.572***	−0.082	−0.381***	−0.307***	−0.308***	−0.316***	−0.291**	0.332***
3. NA (%)			1.000	−0.826***	0.288***	0.270***	0.007	0.069	0.075	0.132	0.120	−0.213***
4. NA (*H*)				1.000	−0.282***	−0.343***	−0.020	−0.060	−0.064	−0.128	−0.106	0.222***
5. Imageability					1.000	0.151*	0.439***	0.140*	0.157*	0.304***	0.224*	−0.135*
6. PNA						1.000	−0.050	0.056	0.064	0.023	−0.001	0.013
7. Familiarity							1.000	0.293***	0.313***	0.513***	0.398***	−0.013
8. Freq. (1977)								1.000	0.969***	0.159	0.137	−0.220***
9. Freq. (2009)									1.000	0.219*	0.216*	−0.216***
10 EGF										1.000	0.775***	−0.058
11. First											1.000	−0.032
12. Length												1.000

Obj. AoA, objective age of acquisition; NA, name agreement; *H*, *H*-value; PNA, picture name agreement; Freq., word frequency; EGF, exemplar-generation frequency; First, number of times an exemplar was named first; Length, word length

* $p < 0.05$

** $p < 0.01$

*** $p < 0.001$

languages were calculated (using the 75 % rule only). The extrapolated data from the English and Icelandic studies were converted back to the initial values for the purpose of making an accurate comparison. The resulting correlations are shown in Table 4.

In general, the correlations between the objective AoA values and the values of other variables presented here correspond to similar correlations for other languages. The correlation between the objective AoA values for Russian words and those for words in other languages is similar to other interlanguage correlations that have been reported in the literature (see Álvarez & Cuetos, 2007; Lotto et al., 2010).

Discussion

The main goal of the present study was to provide objective AoA norms for a set of Russian words. In addition, the analysis of relationships between these data and other psycholinguistic variables and also comparison of these norms with word acquisition norms for other languages are presented here as well.

As in other studies, the objective AoA values we obtained are highly correlated with the subjective AoA ratings, which confirms the validity of our data. In addition, the correlations between the objective AoA collected in the present study and other psycholinguistic variables are generally consistent with similar correlations reported by other researchers (Álvarez & Cuetos, 2007; Chalard et al., 2003; Lotto et al., 2010; Morrison et al., 1997; Pérez & Navalón, 2005; Pind et al., 2000). Words that are acquired relatively early in life are usually characterized by having higher frequencies of occurrence. These words also tend to be rated as being both more imageable and more familiar than words acquired later in life, and there is more agreement about the names of the objects denoted by early-acquired words (NA). Moreover, the degree of correspondence between an early-acquired word and an appropriate image is generally rated higher (PNA).

Table 4 Correlations between the objective AoA data for the Russian language and the objective AoA reported in other studies

Language	Source	*r*	No. of cases
English	Morrison et al. (1997)	0.592*	253
Icelandic	Pind et al. (2000)	0.600*	207
French	Chalard et al. (2003)	0.511*	185
Spanish	Pérez and Navalón (2005)	0.657*	99
Spanish	Álvarez and Cuetos (2007)	0.470*	225
Italian	Lotto et al. (2010)	0.514*	104

* $p < 0.05$

Our data support the view that AoA ratings are confounded with other psycholinguistic variables, such as familiarity and imageability (Álvarez & Cuetos, 2007). This supposition is confirmed by the fact that the correlations between the objective AoA values obtained in the present study and both the familiarity and imageability values of the same words (−0.278 and −0.430, respectively) are weaker than the correlations between these two variables and the subjective AoA ratings (Tsaparina et al., 2011) (−0.58 and −0.60). Similar differences have been found for a number of other languages (Álvarez & Cuetos, 2007; Chalard et al., 2003; Lotto et al., 2010; Pérez & Navalón, 2005), so it is conceivable that the subjective AoA measures depend to some extent on the participants' opinions about variables such as familiarity and imageability.

We also present data on the correlations between objective AoA values and the dominance ratings of the words used. As far as we know, these relationships have not been discussed previously. According to our data, the earlier words are acquired, the more often they tend to be named as category members, and the more often they are named first.

Finally, we computed the correlations between the objective AoA values that we have reported and the objective AoA values reported by other researchers (see Table 4). The strengths of all of these correlations are moderately high, which implies that there exist both similarities and differences in the word acquisition dynamics associated with different languages.

There has been some criticism concerning objective AoA as a factor affecting word processing. Some authors argue that objective AoA is actually a "performance variable," which strongly depends on some other variables, such as the frequency with which a child encounters a word (Bonin, Barry, Méot & Chalard, 2004; Zevin & Seidenberg, 2002). Currently, the hypotheses within this framework have been tested mainly by means of computational (connectivist) modeling, with some effects demonstrated experimentally on adult participants (e.g., Bonin et al., 2004). However, with respect to the objective AoA theory, studies involving child participants would be more relevant.

In sum, normative data regarding the AoA of 286 Russian words were generated, with the full set of norms being available as supplementary material. We also provide information about the correlations between these AoA values and other variables, including subjective AoA ratings, NA, PNA, imageability, familiarity, word frequency, and word length, along with two measures of exemplar dominance (EGF and the number of times an exemplar was named first). The correlations we identified generally correspond with the correlations between similar pairings reported in other normative studies. The objective AoA data are highly correlated with subjective AoA ratings, while the correlations between the objective AoA and the values of other psycholinguistic variables are moderate. We also found moderately high

correlations between the objective AoA values we obtained for Russian words and similar data for other languages.

Author Note This research was supported by a grant from the Russian Foundation for Humanities (08-06-00311a). We would like to express our gratitude to Dr. C. Morrison (at the University of Leeds) for her helpful remarks and for the additional stimulus set she kindly shared with us. We are very grateful to all those who helped us during the data collection phase of this study, especially Svetlana Stepanova, Marina Tikhonova, and Maria Kazakova. Correspondence should be addressed to Moskva 125009, B. Kislovskijj per. d.1 str. 1, Institut jazykoznanija Rossijjskojj akademii nauk, Laboratorija psikholingvistiki, Grigoriev, A. Email: grigoriev.ran@gmail.com

References

Alario, F. X., & Ferrand, L. (1999). A set of 400 pictures standardized for French: Norms for name agreement, image agreement, familiarity, visual complexity, image variability, and age of acquisition. *Behavior Research Methods, 31*(3), 531–552. doi:10.3758/bf03200732

Álvarez, B., & Cuetos, F. (2007). Objective age of acquisition norms for a set of 328 words in Spanish. *Behavior Research Methods, 39*(3), 377–383. doi:10.3758/bf03193006

Barbarotto, R., Laiacona, M., & Capitani, E. (2005). Objective versus estimated age of word acquisition: A study of 202 Italian children. *Behavior Research Methods, 37*(4), 644–650. doi:10.3758/bf03192735

Barca, L., Burani, C., & Arduino, L. S. (2002). Word naming times and psycholinguistic norms for Italian nouns. *Behavior Research Methods Instruments & Computers, 34*(3), 424–434. doi:10.3758/bf03195471

Barry, C., Morrison, C. M., & Ellis, A. W. (1997). Naming the Snodgrass and Vanderwart Pictures: Effects of Age of Acquisition, Frequency, and Name Agreement. *The Quarterly Journal of Experimental Psychology Section A, 50*(3), 560–585. doi:10.1080/783663595

Bonin, P., Barry, C., Méot, A., & Chalard, M. (2004). The influence of age of acquisition in word reading and other tasks: A never ending story? *Journal of Memory and Language, 50*(4), 456–476. doi:10.1016/j.jml.2004.02.001

Bonin, P., Peereman, R., Malardier, N., Méot, A., & Chalard, M. (2003). A new set of 299 pictures for psycholinguistic studies: French norms for name agreement, image agreement, conceptual familiarity, visual complexity, image variability, age of acquisition, and naming latencies. *Behavior Research Methods, 35*(1), 158–167. doi:10.3758/bf03195507

Brysbaert, M., Lange, M., & Van Wijnendaele, I. (2000). The effects of age-of-acquisition and frequency-of-occurrence in visual word recognition: Further evidence from the Dutch language. *European Journal of Cognitive Psychology, 12*(1), 65–85. doi:10.1080/095414400382208

Cameirão, M. L., & Vicente, S. G. (2010). Age-of-acquisition norms for a set of 1,749 Portuguese words. *Behavior Research Methods, 42*(2), 474–480. doi:10.3758/brm.42.2.474

Carroll, J. B., & White, M. N. (1973a). Age-of-acquisition norms for 220 picturable nouns. *Journal of Verbal Learning and Verbal Behavior, 12*(5), 563–576. doi:10.1016/s0022-5371(73)80036-2

Carroll, J. B., & White, M. N. (1973b). Word frequency and age of acquisition as determiners of picture-naming latency. *Quarterly Journal of Experimental Psychology, 25*(1), 85–95. doi:10.1080/14640747308400325

Catling, J. C., Dent, K., & Williamson, S. (2008). Age of acquisition, not word frequency affects object recognition: Evidence from the effects of visual degradation. *Acta Psychologica, 129*(1), 130–137. doi:10.1016/j.actpsy.2008.05.005

Catling, J. C., & Johnston, R. A. (2009). The varying effects of age of acquisition. *The Quarterly Journal of Experimental Psychology, 62*(1), 50–62. doi:10.1080/17470210701814352

Chalard, M., Bonin, P., Meot, A., Boyer, B., & Fayol, M. (2003). Objective age-of-acquisition (AoA) norms for a set of 230 object names in French: Relationships with psycholinguistic variables, the English data from Morrison et al. (1997), and naming latencies. *European Journal of Cognitive Psychology, 15*(2), 209–245. doi:10.1080/09541440244000076

Chumbley, J. I. (1986). The roles of typicality, instance dominance, and category dominance in verifying category membership. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 12*(2), 257–267. doi:10.1037/0278-7393.12.2.257

Cortese, M. J., & Khanna, M. M. (2008). Age of acquisition ratings for 3,000 monosyllabic words. *Behavior Research Methods, 40*(3), 791–794. doi:10.3758/brm.40.3.791

Cuetos, F., Ellis, A., & Alvarez, B. (1999). Naming times for the Snodgrass and Vanderwart pictures in Spanish. *Behavior Research Methods, 31*(4), 650–658. doi:10.3758/bf03200741

Dell'acqua, R., Lotto, L., & Job, R. (2000). Naming times and standardized norms for the Italian PD/DPSS set of 266 pictures: Direct comparisons with American, English, French, and Spanish published databases. *Behavior Research Methods Instruments & Computers, 32*(4), 588–615. doi:10.3758/bf03200832

Dent, K., Johnston, R. A., & Humphreys, G. W. (2008). Age of acquisition and word frequency effects in picture naming: A dual-task investigation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*(2), 282–301. doi:10.1037/0033-295x.89.1.1

Dimitropoulou, M., Duñabeitia, J., Blitsas, P., & Carreiras, M. (2009). A standardized set of 260 pictures for Modern Greek: Norms for name agreement, age of acquisition, and visual complexity. *Behavior Research Methods, 41*(2), 584–589. doi:10.3758/brm.41.2.584

Gerhand, S., & Barry, C. (1999). Age of acquisition, word frequency, and the role of phonology in the lexical decision task. *Memory & Cognition, 27*(4), 592–602. doi:10.3758/bf03211553

Ghyselinck, M., De Moor, W., & Brysbaert, M. (2000). Age-of-acquisition ratings for 2816 Dutch four- and five-letter nouns. *Psychologica Belgica, 40*(2), 77–98.

Gilhooly, K., & Hay, D. (1977). Imagery, concreteness, age-of-acquisition, familiarity, and meaningfulness values for 205 five-letter words having single-solution anagrams. *Behavior Research Methods, 9*(1), 12–17. doi:10.3758/bf03202210

Gilhooly, K., & Logie, R. (1980). Age-of-acquisition, imagery, concreteness, familiarity, and ambiguity measures for 1,944 words. *Behavior Research Methods, 12*(4), 395–427. doi:10.3758/bf03201693

Grigoriev, A.A., Baljasnikova, O.V., & Oshhepkov, I.V. (2009). Ocenki obraznosti nazvanijj risunkov iz standartnogo nabora izobrazhenijj i rjada drugikh slov. *Voprosy psikholingvistiki*, *9*. http://iling-ran.ru/library/voprosy/10.pdf

Grigoriev, A.A., & Oshhepkov, I.V. (2005). Sopostavlenie kategorial'nykh norm dlja 21 kategorii russkogo i anglijjskogo jazykov. [Comparison of Russian and English category norms for 21 categories]. 92 p.

Grigoriev, A.A., Oshhepkov, I.V., Baljasnikova, O.V., & Orlova, E.A. (2010). Normativnye dannye po obraznosti, soglasovannosti naimenovanijj, znakomosti i sootvetstviju naimenovanija izobrazheniju dlja nabora iz 286 stimulov. *Vestnik Moskovskogo gosudarstvennogo oblastnogo universiteta*. *Psikhologicheskie nauki*, (1), 42–51. http://www.vestnik-mgou.ru/mag/2010/psy/1/st7.pdf

Gvozdev, A. N. (1961). *Voprosy izučenija detskoj reči*. Moscow: APN RSFSR.

Hirsh, K. W., Morrison, C. M., Gaset, S., & Carnicer, E. (2003). Age of acquisition and speech production in L2. *Bilingualism: Language and Cognition, 6*(2), 117–128. doi:10.1017/s136672890300107x

Holmes, S. J., & Ellis, A. W. (2006). Age of acquisition and typicality effects in three object processing tasks. *Visual Cognition, 13*(7–8), 884–910. doi:10.1080/13506280544000093

Johnston, R. A., Dent, K., Humphreys, G. W., & Barry, C. (2010). British-English norms and naming times for a set of 539 pictures: The role of age of acquisition. *Behavior Research Methods, 42*(2), 461–469. doi:10.3758/brm.42.2.461

Lepskaja, N. I. (1997). *Jazyk rebjonka (ontogenez rečevoj kommunikacii)*. Moscow: Lomonosov University.

Ljashevskaja, O.'g. N., & Sharov, S. A. (Eds.). (2009). *Chastotnyjj slovar' sovremennogo russkogo jazyka na materialakh Nacional'nogo korpusa russkogo jazyka [Frequency dictionary of Russian language based on Russian National Corpus]*. Moskva: Azbukovnik.

Lotto, L., Surian, L., & Job, R. (2010). Objective age of acquisition for 223 Italian words: Norms and effects on picture naming speed. *Behavior Research Methods, 42*(1), 126–133. doi:10.3758/brm.42.1.126

Lyons, A. W., Teer, P., & Rubenstein, H. (1978). Age-at-acquisition and word recognition. *Journal of Psycholinguistic Research, 7*(3), 179–187. doi:10.1007/bf01067041

Manoiloff, L., Artstein, M., Canavoso, M. B., Fernandez, L., & Segui, J. (2010). Expanded norms for 400 experimental pictures in an Argentinean Spanish-speaking population. *Behavior Research Methods, 42*(2), 452–460. doi:10.3758/brm.42.2.452

Marques, J. F., Fonseca, F. L., Morais, A. S., & Pinto, I. A. (2007). Estimated age of acquisition norms for 834 Portuguese nouns and their relation with other psycholinguistic variables. *Behavior Research Methods, 39*(3), 439–444. doi:10.3758/bf03193013

Moreno-Martínez, F. J., Montoro, P. R., & Laws, K. R. (2011). A set of high quality colour images with Spanish norms for seven relevant psycholinguistic variables: The Nombela naming test. *Aging, Neuropsychology, and Cognition, 18*(3), 293–327. doi:10.1080/13825585.2010.540849

Morrison, C. M., Chappell, T. D., & Ellis, A. W. (1997). Age of Acquisition Norms for a Large Set of Object Names and Their Relation to Adult Estimates and Other Variables. *The Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology, 50*(3), 528–559.

Morrison, C. M., & Ellis, A. W. (1995). Roles of Word Frequency and Age of Acquisition in Word Naming and Lexical Decision. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*(1), 116–133.

Nishimoto, T., Miyawaki, K., Ueda, T., Une, Y., & Takahashi, M. (2005). Japanese normative set of 359 pictures. *Behavior Research Methods, 37*(3), 398–416. doi:10.3758/bf03192709

Nisi, M., Longoni, A., & Snodgrass, J. G. (2000). Misure italiane per l'accordo sul nome, familiarità ed età di acquisizione per le 260 figure di Snodgrass e Vanderwart (1980) [Italian measurement on the relation of name, familiarity, and acquisition age for the 260 figures of Snodgrass and Vanderwart (1980)]. *Giornale Italiano di Psicologia, 27,* 205–218.

Olmsted, H. M. (1994). Diminutive morphology of Russian children: A simplified subset of nominal declension in language acquisition. In A. Lipson & C. E. Gribble (Eds.), *Alexander Lipson: In memoriam* (p. 313). Columbus, Ohio: Slavica Publishers.

Pérez, M. A., & Navalón, C. (2005). Objective-AoA norms for 175 names in Spanish: Relationships with other psycholinguistic variables, estimated AoA, and data from other languages. *European Journal of Cognitive Psychology, 17*(2), 179–206.

Pind, J., Jónsdóttir, H., Gossurardóttir, H., & Jónsson, F. (2000). Icelandic norms for the Snodgrass and Vanderwart (1980) pictures: Name and image agreement, familiarity, and age of acquistion. *Scandinavian Journal of Psychology, 41*(1), 41–48. doi:10.1111/1467-9450.00169

Protassova, E., & Voeikova, M. D. (2007). Diminutives in Russian at the early stages of acquisition. In I. Savickienė & W. U. Dressler (Eds.), *The acquisition of diminutives: a cross-linguistic perspective (pp. 43–72)*. Amsterdam: John Benjamins Pub. Co.

Ruts, W., De Deyne, S., Ameel, E., VanPaemel, W., Verbeemen, T., & Storms, G. (2004). Dutch norm data for 13 semantic categories and 338 exemplars. *Behavior Research Methods Instruments & Computers, 36*(3), 506–515. doi:10.3758/bf03195597

Schroder, A., Gemballa, T., Ruppin, S., & Wartenburger, I. (2012). German norms for semantic typicality, age of acquisition, and concept familiarity. *Behavior Research Methods, 44*(2), 380–394. doi:10.3758/s13428-011-0164-y

Sirois, M., Kremin, H., & Cohen, H. (2006). Picture-naming norms for Canadian French: Name agreement, familiarity, visual complexity, and age of acquisition. *Behavior Research Methods, 38*(2), 300–306. doi:10.3758/bf03192781

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory, 6*(2), 174–215.

Spataro, P., Mulligan, N. W., Longobardi, E., & Rossi-Arnaud, C. (2012). Effects of age-of-acquisition in the word-fragment completion task: Evidence for an orthographic locus in implicit memory. *Experimental Psychology, 59*(1), 22–29. doi:10.1037/0096-1523.32.1.104

Stadthagen-Gonzalez, H., & Davis, C. J. (2006). The Bristol norms for age of acquisition, imageability, and familiarity. *Behavior Research Methods, 38*(4), 598–605. doi:10.3758/bf03193891

Thorndike, E. L., & Lorge, I. (1944). *The teacher's word book of 30,000 words*. New York: Teachers College, Columbia University.

Tsaparina, D., Bonin, P., & Méot, A. (2011). Russian norms for name agreement, image agreement for the colorized version of the Snodgrass and Vanderwart pictures and age of acquisition, conceptual familiarity, and imageability scores for modal object names. *Behavior Research Methods, 43*(4), 1085–1099. doi:10.3758/s13428-011-0121-9

Weekes, B., Shu, H., Hao, M., Liu, Y., & Tan, L. (2007). Predictors of timed picture naming in Chinese. *Behavior Research Methods, 39*(2), 335–342. doi:10.3758/bf03193165

Zasorina, L.N. (Ed.) (1977) Chastotnyjj slovar' russkogo jazyka [Frequency dictionary of Russian language]. M.: Russkijj jazyk.

Zevin, J. D., & Seidenberg, M. S. (2002). Age of acquisition effects in word reading and other tasks. *Journal of Memory and Language, 47*(1), 1–29. doi:10.1006/jmla.2001.2834