Behav Res (2013) 45:834–841
DOI 10.3758/s13428-012-0298-6

Predictors of timed picture naming in Persian

Mehdi Bakhtiar · Reza Nilipour · Brendan S. Weekes

Published online: 5 January 2013

Abstract In this study, we report normative data by native Persian speakers for concept familiarity, age of acquisition (AoA), imageability, image agreement, name agreement, and visual complexity, as well as values for word frequency, word length, and naming latency for 200 of the colored Snodgrass and Vanderwart (Journal of Experimental Psychology: Human Learning and Memory 6:174-215, 1980) pictures created by Rossion and Pourtois (Perception 33:217-236, 2004). Using multiple regression analysis, we found independent effects of name agreement, image agreement, word frequency, and AoA on picture naming by native Persian speakers from Iran. We concluded that the psycholinguistic properties identified in studies of picture naming in many other languages also predict timed picture naming in Persian. Normative data for the ratings and picture-naming latencies for the 200 Persian object nouns are provided as an Excel file in the Supplemental materials.

Keywords Age of acquisition · Aphasia · Cross-linguistic · Lexical processing · Object recognition · Persian

Timed picture naming is an established method for the real-time investigation of the underlying cognitive and linguistic processes involved in oral communication (Bates et al., 2003; Glaser, 1992; Székely et al., 2003). Studies of timed picture naming provide important constraints on theories of word production and serve to inform researchers about the basic processes used for speech production in people with normal and impaired language skills (Levelt, Roelofs, & Meyer, 1999). It has been theorized that timed picture naming is achieved through a hierarchical process starting from visual recognition of the object depicted in the picture, followed by activation of semantic knowledge, lexical retrieval (lemma selection), and finally word articulation (Alario et al., 2004). Studies reporting the effect of psycholinguistic variables on picture naming across languages converge on the view that these are the minimal stages of processing in spoken-word production. However, no study has reported the effect of psycholinguistic variables on picture naming in Persian despite a growing literature on spoken-word production in impaired and normal Persian speakers (Rezai, Nilipour, Azimian, & Rahgozar, 2011).

Snodgrass and Vanderwart (1980) developed a standardized set of 260 black-and-white line drawings for speakers of American English that has been widely used in studies of picture naming. Rossion and Pourtois (2004) subsequently developed a color version of the Snodgrass and Vanderwart object pictures. These stimuli provide a standard set of items for studies of timed picture naming across languages. Normative data for the black-and-white pictures have been reported for languages including British English (Barry, Morrison, & Ellis, 1997), Spanish (Sanfeliu & Fernandez, 1996), French (Alario & Ferrand, 1999), Icelandic (Pind, Jónsdóttir, Gissurardóttir, & Jónsson, 2000), Italian (Nisi & Longoni, 2000), and Japanese (Nishimoto, Miyawaki, Ueda, Une, & Takahashi, 2005), and for the color pictures in Chinese (Weekes, Shu, Hao, Liu, & Tan, 2007), Modern Greek (Dimitropoulou, Duñabeitia, Blitsas, & Carreiras, 2009), and Russian (Tsaparina, Bonin, & Méot, 2011).

The effects of psycholinguistic variables such as name agreement, rated image agreement, rated familiarity, rated age of acquisition (AoA), rated imageability, rated visual complexity, word frequency, and word length on picture-naming latencies are well documented in different languages (Alario et al., 2004; Cuetos, Ellis, & Alvarez, 1999; Severens, Van Lommel, Ratinckx, & Hartsuiker, 2005; Snodgrass & Yuditsky, 1996). Bates et al. (2003) compared

Electronic supplementary material The online version of this article (doi:10.3758/s13428-012-0298-6) contains supplementary material, which is available to authorized users.

M. Bakhtiar (✉) · B. S. Weekes
Laboratory for Communication Science, Division of Speech and Hearing Sciences, University of Hong Kong, 8/F Meng Wah Building,
Hong Kong, Hong Kong SAR, China
e-mail: bakhtiar@hku.hk

R. Nilipour
Speech Therapy Department, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran

picture-naming latency across seven languages and reported significant effects of name agreement, frequency, and goodness of object depiction on picture naming times in all of the languages. However variables related to word structure (e.g., word length or syllable structure) had different effects across languages. Subsequent studies have suggested that the most reliable predictors of picture naming across languages are the measures of name agreement and rated AoA (see Table 1). Therefore, it might be inferred that objects with common names that are learned earlier in life are retrieved more quickly in adulthood. However, this claim demands evidence from different languages before the theoretical relevance of name agreement and rated AoA can be established.

Indeed, there is some controversy regarding the claim that rated AoA has a unique effect on picture-naming latencies. Some authors believe that AoA is a proxy for name frequency (Balota, Cortese, Sergent-Marshall, Spieler, & Yap, 2004; Zevin & Seidenberg, 2002). The reason for this is that words learned earlier in life tend to be more frequent in the adult language than are late-acquired words. This claim is central to the *cumulative frequency hypothesis*, which assumes that exposure to a word over a lifespan rather than the age that a word is acquired is the key predictor in adult word-processing tasks (Lewis, 1999), including picture naming (Juhasz, 2005). Zevin and Seidenberg reported that when variables highly correlated with rated AoA are controlled, cumulative frequency (i.e., the sum frequency that a word is encountered in each grade of elementary school) showed a unique effect on lexical processing over and above the effect of AoA. AoA is correlated not only with word frequency, but also with other variables such as familiarity and imageability. Carroll and White (1973) were the first to investigate this issue, by examining the effects of correlated variables on naming latencies using multiple regression analysis. They reported that when the effects of other variables are first explained, AoA is the most significant predictor of picture naming. Subsequent studies have also reported that AoA is a reliable predictor of picture naming and is more robust than other correlated variables (Juhasz, 2005). However, although AoA has an effect on picture naming in all studies, it is necessary to clarify whether the effects of AoA on picture naming are independent of correlated variables such as word frequency in a language. This is also necessary to test the main assumption of the cumulative frequency hypothesis.

The present study has two parts. First, we report normative data from native Persian speakers for picture name agreement, rated familiarity, image agreement, AoA, imageability, and visual complexity, as well as values for word frequency and length of picture names for Rossion and Pourtois's (2004) colored version of the Snodgrass and Vanderwart (1980) pictures. Our aim was to determine the correlations between variables, given the potential for multicollinearity, particularly between word frequency and rated AoA. In the second part of the study, our aim was to determine which variables have independent effects on picture-naming latencies in native Persian speakers. Our main hypothesis was that AoA and name agreement would have independent effects on picture naming in Persian, despite the cultural and linguistic differences between Persian and other languages.

Persian is an Indo-European language predominately spoken in Iran, Afghanistan, and Tajikistan. Persian is a morphologically rich language (Megerdoomian, 2000) with great word order variations and no gender or case agreement (Nilipour & Raghibdoust, 2001). There are three types of syllabic structures in Persian, and all have initial consonants

Table 1 Summary table for significant predictor variables and their beta weight from more recent studies of timed picture naming in different languages

	Language	NA/*H*	IA	VC	IM	FAM	AoA	WF	WL
Snodgrass & Yuditsky (1996)	English	–.34**	n.s.	n.s.	n.s.	–.12**	.30**	–.11**	n.s.
Barry et al. (1997)	English	–.17**	–.11*	n.s.	n.s.	n.s.	.15*	–.31***	n.s.
Cuetos et al. (1999)	Spanish	–.16*	–.14*	n.s.	n.s.	–.20*	.52***	–.27***	.15*
Dell'Acqua, Lotto, & Job (2000)	Italian	.16*	n.s.	n.s.	n.s.	n.s.	.14*	n.s.	n.s.
Bonin, Chalard, Méot, & Fayol (2002)	French	–.17**	–.32**	n.s.	–.32**	n.s.	.33**	n.s.	n.s.
Pind & Tryggvadóttir (2002)	Icelandic	–.21*	n.s.	n.s.	n.s.	–.35**	.55***	n.s.	n.s.
Bonin et al. (2003)	French	.24**	.22**	n.s.	n.s.	n.s.	.19*	.23**	n.s.
Severens et al. (2005)	Dutch	.60***	n.s.	n.s.	n.s.	n.s.	.24***	n.s.	.11**
Nishimoto et al. (2005)	Japanese	.58**	n.s.	n.s.	n.s.	–.17**	.12*	n.s.	n.s.
Weekes et al. (2007)	Chinese	–.39**	n.s.	n.s.	n.s.	–.32**	.26**	n.s.	n.s.
Liu et al. (2011)	Chinese	–.08*	–.08*	n.s.	n.s.	–.46***	.14***	n.s.	n.s.

NA = percentage name agreement; *H* = *H* value; IA = image agreement; VC = visual complexity; IM = imageability; FAM = familiarity; AoA = age of acquisition; WF = word frequency; WL = word length. n.s. = not significant. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

(i.e., CV–CVC–CVCC). One characteristic of spoken Persian, as compared to most other languages studied (Bates et al., 2003), is an absence of word-level stress. Another unique feature is that Persian has six vowels and 23 consonants, normally written using a modified version of the Arabic alphabet. Vowel transcription has an essential role in determining the depth of transparency in printed Persian, because three vowels (i.e., long vowels) can be written in a letter format and become part of a word (transparent words), whereas the other three vowels (i.e., diacritics) are not written as part of a word (opaque word) following early reading instruction. The absence of diacritics makes reading challenging, even for proficient readers (Baluch, 2005; Rahbari & Senechal, 2009).

Given the unique properties of Persian script, we were curious whether word transparency would have an effect on picture naming in Persian. This is of interest because behavioral studies have reported that orthographic knowledge has an independent effect on spoken word production (Damian & Bowers, 2003; Zhang, Chen, Weekes, & Yang, 2009). Moreover, as Persian has no word stress (i.e., prosodic information in a syllable), we hypothesized that word length would have relatively little impact on picture naming for Persian speakers, in contrast to the significant effects observed in languages, such as Dutch and Spanish, that do use stress to distinguish between syllables.

Preparatory study

In this study, 200 of the 260 colored pictures from Snodgrass and Vanderwart (1980) were selected. In the first step, we excluded pictures that were not culturally familiar or were not popular objects in Persian (e.g., asparagus and artichoke). This was done by the first two authors—one of whom is a linguist—on the basis of criteria that the object should be used in the Iranian community and/or that a standard name for the object should be available in the Persian language context. In addition, if two objects had the same modal name in Persian (e.g., *Sa æt* for a clock and a watch), one object was excluded from the study. Subsequently, 100 native Persian-speaking undergraduates (68 females and 32 males, ranging in age from 18 to 29 years; mean = 20.9, *SD* = 1.75) from Tehran and Isfahan universities volunteered to produce ratings for these pictures. Measures of name agreement, rated concept familiarity, rated image agreement, rated AoA, rated visual complexity, rated imageability, word frequency, and number of phonemes (length) for each item are reported in the Supplemental materials linked to this article. Note that the Persian names assigned to items refer to the most common names produced by participants in the preparatory study (see the Supplemental materials). Therefore, some names are not literal translations of the corresponding English names for the Snodgrass and Vanderwart pictures.

We used the same methods applied in previous normalization studies (Snodgrass & Vanderwart, 1980; Weekes et al., 2007) to collect normative data for each item. Each picture was shown through a slide projector to participants who were asked to (1) write down the name of each picture or choose another response option, including *don*'t *know the object* or *don*'t *know the name of the object*; (2) rate the image agreement of each picture, defined as how much the picture resembled their own mental image of the object using a -point rating scale with 1 indicating a *very poor match* and 5 a *very good match*; (3) rate the concept familiarity of each picture, defined as how often they were in contact with or thought about the object, using a 5-point rating scale in which 1 was defined as *very unfamiliar* and 5 as *very familiar*; (4) rate the visual complexity of each picture using a 5-point scale in which 1 indicated *very simple* and 5 indicated *very complex*; and (5) rate the estimated age of acquisition (AoA) of the name of each object, using a scale with 1 = *under 2 years old*; 2 = *2 years old*; 3 = *3 years old*; and so on, up to 11 = *11 years old or older*. Two measures of name agreement were used. The first was the percentage of name agreement, which is equal to the number of participants who gave the most common name, and the second was an *H* value, which is a measure of name disagreement or uncertainty. *H* values, as reported by Snodgrass and Vanderwart, were calculated using the formula

$$H = \sum_{i=1}^{k} P_i \log_2 \left(1/P_i\right),$$

where k is the number of different correct names produced for a picture, and P_i is the proportion of participants producing *each name*. According to Shu, Cheng, and Zhang (1989) and Weekes et al. (2007), if all participants give the same name for a particular picture, a perfect score of $H=0$ is assigned to that picture.

The objective word frequencies for the most common names assigned to pictures in the sample were taken from a standardized Persian written corpus—namely, Peykare, which contains around 110 million words from both written and spoken texts from contemporary Persian (Bijankhan, Sheykhzadegan, Bahrani, & Ghayoomi, 2011). As reported by Bijankhan et al., around 10 million words in this resource were randomly selected and labeled based on the EAGLES guidelines. The word frequency values used here refer to the number of individual names of the objects without any bounded inflectional postposition (e.g., plurals or reflexive suffixes). Finally, the rated imageability values for the most common object names assigned to the pictures were collected through an online survey completed by 65 native Persian speakers who were not involved in the rating of the other variables.

The instructions given to each participant were as follows: "Different words have the potential to generate a mental image, which can appear as a visual and/or an auditory image. Meanwhile, some words can provoke a mental image more easily or quickly than others. Please determine the imageability of each object name using a 5-point scale in which 1 indicates *very difficult imageability* (or *low imageability*) and 5 indicates *very easy imageability* (or *high imageability*)." Summary statistics for all predictor variables are summarized in Table 2, and correlation coefficients (Pearson's *r*) are reported in Table 3. Most values correlated significantly. However, of most relevance, AoA was highly correlated with word frequency (i.e., names learned earlier in life are encountered more often), as well as with familiarity (i.e., names learned earlier in life are more familiar) and rated imageability (i.e., early-acquired words are normally concrete nouns with highly imageable concepts). The correlation between familiarity and imageability seems to show that perceived contact with an object has an effect on the ease of object mental imagery.

Experiment

Method

Participants and procedure A group of 95 undergraduate students (43 males and 52 females) from Tehran and Qazvin Universities in Iran. All were native Persian speakers ranging in age from 18 to 26 years (mean = 21.33, *SD* = 1.5), and none of them had been involved in the preparatory study. The DMDX software (Forster & Forster, 2003) was used to present pictures and record picture-naming latencies. Each participant was seated in front of monitor with a microphone connected to headphones located about 7 cm away from the mouth. After a response was received and recorded via DMDX, a cross or fixation point appeared for 500 ms in the center of the monitor. The naming latency was recorded from the presentation of the picture on the monitor up to the naming onset (the whole naming response was not considered), with a time out of 2,000 ms. If participants could not respond during this time period, an error was recorded by DMDX and the fixation point subsequently appeared on the monitor. Participants were instructed to name each picture as quickly and accurately as possible after it had appeared on the monitor. Moreover, they were asked to avoid deep breathing, coughing, head movements, and producing starters or fillers—for instance, "um"—during or before naming each picture. At the beginning of the experiment, 12 practice trials were presented to make the participants familiar with the task. Stimuli were then randomly presented for two experimental trials (110 pictures were presented as the first set of stimuli), including a short break between the sets. Participant errors, such as producing the wrong object name and nontarget sounds, were recorded by the examiner, checked for error classification, and then eliminated before the data analysis.

Table 2 Summary statistics for predictor variables

Variable	Mean	*SD*	Min.	Max.	Skew
Name agreement (*H*)	0.25	0.39	0.00	2.08	2.16
Percentage name agreement	0.90	0.15	0.29	1.00	−2.02
Image agreement	4.16	0.33	2.92	4.74	−1.17
Rated familiarity	4.07	0.54	2.66	4.88	−0.41
Visual complexity	2.21	0.41	1.35	3.58	0.20
Age of acquisition	4.85	1.26	2.33	8.54	0.40
Log (1 + frequency)	1.63	0.80	0.00	3.80	0.06
Phoneme number	5.71	2.00	2.00	12.00	0.74
Imageability	4.02	0.47	2.81	4.90	−0.37

This summary is based on the 200 items reported in the Supplemental material.

Results

In order to calculate the mean reaction time for each picture name, incorrect responses and voice key errors were first deleted, which accounted for 9.4 % of the responses. Also following the procedure of previous studies (Snodgrass & Yuditsky, 1996; Weekes et al., 2007), picture-naming latencies that were more than two standard deviations from the mean were eliminated to reduce the effect of outliers, which resulted in deletion of 4.1 % of the responses. Then, the mean naming time for each item was calculated. Naming latencies for all 200 items are reported in the Supplemental materials. The overall mean naming latency for the 200 colored pictures was 916 ms (*SD* = 146), which was faster than the Mandarin Chinese naming latencies reported by Weekes et al.—1,121 ms for the colored and 1,025 ms for black-and-white drawings—and slower than those in Spanish, reported by Cuetos et al. (1999, 829 ms), or in English, reported by Snodgrass and Yuditsky (1996, 791 ms), Ellis and Morrison (1998, 794 ms), and Barry et al. (1997, 748 ms). The correlations between all predictor variables and picture-naming latencies are reported in Table 3. All variables were significantly correlated with naming latencies, although name agreement, image agreement, word frequency, and AoA had relatively high coefficients.

Regression analysis Hierarchical multiple regression was used. The dependent variable was mean naming latency, and the independent variables were one measurement of name agreement (the percentage of name agreement); log word frequency; number of phonemes; and rated familiarity, visual complexity, imageability, image agreement, and

Table 3 Correlation matrix for predictor variables and naming latencies

	1	2	3	4	5	6	7	8
1. Naming RT								
2. Name agreement (*H*)	.55**							
3. Percentage name agreement	–.67**	–.88**						
4. Image agreement	–.56**	–.38**	.53**					
5. Rated familiarity	–.47**	–.16*	.29**	.25**				
6. Visual complexity	.40**	.13	–.25**	–.36**	–.60**			
7. Age of acquisition	.54**	.26**	–.34**	–.14*	–.73**	.40**		
8. Log (1 + frequency)	–.56**	–.35**	.41**	.21**	.40**	–.17*	–.56**	
9. Phoneme number	.33**	.28**	–.26**	–.13	–.06	.14	.27**	–.41**

* Correlation significant at .05 level. ** Correlation significant at .01 level. RT, reaction time.

AoA. We used the percentage of name agreement because it has a higher simple correlation with naming latencies than does the *H* value. However, note that regression analyses with *H* as a measurement of name agreement produced very similar results. The results for the regression analysis are outlined in Table 4.

At first, the initial phonemes were coded as eight nominal variables on the basis of their place of articulation in Persian (i.e., bilabial, labio-dental, dental, alveolar, alveo-palatal, palatal, uvular, and glottal) and entered in the regression equation. This was done to assess the effect of initial place of articulation on naming latencies. These variables together accounted for 3.5 % of the change in R^2, which was not statistically significant, *F* change = 0.993, $p = .44$. In the second step, all predictor variables were entered, which accounted for 66 % of the variance, $F(8, 184) = 46.4$, $p < .001$. The most robust predictors were percentage of name agreement ($b = -0.32$, $t = -5.98$, $SE = 0.51$, $p < .001$), image agreement ($b = -0.28$, $t = -5.25$, $SE = 22.3$, $p < .001$), word frequency ($b = -0.19$, $t = -3.35$, $SE = 10.3$, $p < .01$), and AoA ($b = 8.18$, $t = 2.29$, $SE = 8.9$, $p < .05$). None of the other variables added significant value to explaining the variance in naming latencies. In order to assess the unique effects of AoA and Frequency, these factors were entered in a stepwise multiple regression. When AoA was entered last in the equation, it accounted for an additional 1.4 % R^2 change, which is statistically significant ($p < .01$). When frequency was entered last, it explained a 2.5 % R^2 change, which is also statistically significant ($p < .001$). It was observed that when familiarity was entered subsequent to AoA and word frequency, it had no significant effect on variance change. Similarly, when rated imageability was entered after all of the other variables, it had no significant effect on variance change in naming latencies ($p > .05$). In order to test the hypothesized effect of word transparency on picture naming latency in Persian, the stimulus nouns were classified into two groups of opaque (155 items) and transparent (45 items) words. The results showed that naming latencies for pictures with orthographically transparent names (mean = 896.5, $SD = 124.1$, $SE = 18.5$) were slightly faster than those for opaque items (mean = 922.2, $SD = 152.1$, $SE = 12.2$). However, the difference was not statistically significant ($p = .12$). Furthermore, entering degree of word transparency (i.e., number of letters divided by the number of phonemes) as an independent variable in the regression equation did not add any significant variance in R^2 ($b = .002$, $t = 0.034$, $SE = 52.61$, $p = .97$).

Table 4 Standardized coefficients and R^2 changes in multiple regression analysis

	Variable(s)	Beta	*t*	R^2 change
Step 1	Initial Phonemes			.035
Step 2				.66
	Percentage name agreement	–.319	−5.981***	
	Image agreement	–.280	−5.498***	
	Log (1 + frequency)	–.188	−3.329**	
	Age of Acquisition	.167	2.228*	
	Imageability	–.141	−1.774	
	Word Length	.073	1.480	
	Visual complexity	.064	1.162	
	Familiarity	.044	0.529	

* $p < .05$, ** $p < .01$, *** $p < .001$.

Discussion

The results showed that name agreement, image agreement, word frequency, and rated AoA have significant effects on picture naming in Persian. These findings agree with studies in other languages, specifically by confirming the effects of name agreement on timed picture naming across languages. As was suggested by Alario et al. (2004), name agreement most likely influences lexical processing or lemma selection in picture naming. Objects with many alternative names (lower name agreement) need more time to be retrieved from the mental lexicon because there are competitive candidates for a particular concept in naming, thus requiring inhibition of alternative names before responding (Alario et al., 2004). Also similar to the findings of other studies, frequency had an effect on naming latencies. In models of spoken-word retrieval, word frequency effects reflect activation in the phonological output lexicon (see Alario et al., 2004, for a discussion).

Rated AoA also had a significant effect on picture naming, as in previous studies. AoA is highly correlated with frequency across languages (Alario et al., 2004), as we confirmed ($r = -.56$). Rated AoA was also correlated with rated familiarity ($r = -.73$) and rated imageability ($r = -.76$). However, using multiple regression analysis, we showed that AoA and frequency have similar effects on naming latencies, beyond those of other variables (Table 4). Entering AoA and frequency (but not familiarity and imageability) as the last variables in the regression explained a significant change in variance. The results show that these variables have significant independent effects when variance due to other variables is first explained.

The effects of AoA have been explained in terms of encoding differences between early- and late-acquired words learned through development (Ellis & Lambon Ralph, 2000) or by differences in retrieval from nodes in a semantic network (Juhasz, 2005; Steyvers & Tenenbaum, 2005). It has been argued that the effects of AoA on picture naming can be localized to the lexical level (lemma selection) of picture naming (Alario et al., 2004), with words learned earlier in life being retrieved faster from the lexicon. Other loci of frequency-independent AoA effects on lexical retrieval include accessing stored phonological representations due to lexical semantic competition for a naming response (Belke, Brysbaert, Meyer, & Ghyselinck, 2005) and due to semantic processing (Juhasz, 2005). We cannot isolate the locus of AoA effects during picture naming in Persian. However, it is clear that effects of AoA are independent of word frequency. These results provide further evidence that AoA has a real effect on picture naming that is at least as relevant to models of picture naming as the effect of word frequency. We did not measure cumulative frequency directly. However, it has been argued that rated familiarity is a proxy measure for cumulative frequency, as it reflects the amount of exposure to a lexical item over the lifespan (Juhasz, 2005). We found no effect of familiarity on picture-naming latencies (unlike studies of picture naming in other languages). Although we cannot exclude cumulative frequency as an account of AoA effects on naming in Persian, there are several reasons to doubt this hypothesis (see Juhasz, 2005, for a discussion). Together with evidence of a frequency-independent effect of AoA, we contend that cumulative frequency does not explain any of the variance in picture-naming latencies for native Persian speakers, at least for items in the colored version of the Snodgrass and Vanderwart (1980) set.

We found significant effects of image agreement on picture-naming latencies, and this is comparable to the results of studies in French (Bonin, Peereman, Malardier, Méot, & Chalard, 2003), American English (Snodgrass & Yuditsky, 1996), British English (Ellis & Morrison, 1998), Spanish (Cuetos et al., 1999), Welsh (Barry et al., 1997), and Putonghua Chinese (Liu, Hao, Li, & Shu, 2011). All of those studies used the black-and-white pictures from Snodgrass and Vanderwart (1980). Weekes et al. (2007) used colorized pictures of the Snodgrass and Vanderwart items for picture naming with Putonghua speakers and did not find any significant effect of image agreement. They suggested that previous effects of rated image agreement resulted from the use of lower-quality images, such as black-and-white line drawings. However, the present results cast doubt on their interpretation, since we found an effect of rated image agreement on picture naming with color pictures. One way to explain the effect in the present study is that, although image agreement is a variable that is influenced by image quality (e.g., color), cultural experience plays a role. Cross-linguistic studies have tested individuals from a wide variety of cultural backgrounds, and each culture makes different judgments about the representation of an object in a picture stimulus. The present results, taken together with those of studies in other languages (see Table 1) showing a mixed pattern of rated image agreement effects on picture naming, highlight the need to develop culturally appropriate standardized pictures. Without preselection of such pictures, it will be difficult to interpret the impact of psycholinguistic variables on picture naming across languages that are not simply the result of sociocultural differences.

We found no evidence to suggest that orthography (i.e., transparent and opaque words) had an effect on picture-naming latencies in Persian. The present results point to independent systems for picture naming and oral reading. However, studies using alphabetic and nonalphabetic scripts do show an effect when a picture-word paradigm is used (Damian & Bowers, 2003; Zhang et al., 2009). This effect is more obvious for opaque nonalphabetic languages like Chinese, for which the connection between the orthographic representation and semantic information plays an essential role in oral word reading (Zhang et al., 2009; Zhang & Weekes, 2009). Future research could use this paradigm to examine the effects of orthography on spoken-word production in Persian, a script in the midrange of the opacity continuum.

As expected, word length in Persian (i.e., number of phonemes, mean = 5.71) made no significant contribution to picture-naming latencies, despite a relatively high number of phonemes—as in Spanish (mean = 5.56; Cuetos et al., 1999) and Dutch (mean = 5.31; Severens et al., 2005), which both showed significant effects of word length on picture-naming latencies. This discrepancy may reflect differences across languages, such as a less demanding word structure (consonant cluster and/or word stress) for picture naming in Persian when compared to other languages.

The normative data in this study can be applied to investigations of language processing in normal Persian speakers and patients with acquired or developmental language disorders (aphasia, dyslexia, or developmental language disorders). The normalized object pictures can also be used for clinical practice in speech and language pathology to improve the naming abilities of children and adults with language disorders in Iran and other Persian-speaking communities around the world.

To sum up, studies of timed picture naming in different languages with the same set of objects continue to show that name agreement and AoA are common factors that predict naming latencies across languages, including various Indo-European languages, Chinese, and Japanese. Our results confirm this consensus. The finding that both word frequency and AoA are significant and important predictors of picture-naming latencies suggests that these two variables have independent effects, contrary to the cumulative-frequency hypothesis. Further research will be needed to determine the precise locus of AoA effects on picture naming, although it is likely that there will be multiple loci.

Author note The authors report no conflict of interest. They thank Mostafa Daemi, Daryush Nikbakht, and Sudabe Abbasi for their kind collaboration during data collection in Iran.

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, Instruments, & Computers, 31,* 531–552. doi:10.3758/BF03200732

Alario, F.-X., Ferrand, L., Laganaro, M., New, B., Frauenfelder, U. H., & Segui, J. (2004). Predictors of picture naming speed. *Behavior Research Methods, Instruments, & Computers, 36,* 140–155. doi:10.3758/BF03195559

Balota, D. A., Cortese, M. J., Sergent-Marshall, S. D., Spieler, D. H., & Yap, M. J. (2004). Visual word recognition of single-syllable words. *Journal of Experimental Psychology: General, 133,* 283–316. doi:10.1037/0096-3445.133.2.283

Baluch, B. (2005). Persian orthography and literacy. In R. M. Joshi & P. G. Aaron (Eds.), *Handbook of orthographies and literacy* (pp. 365–376). Mahwah, NJ: Erlbaum.

Barry, C., Morrison, C. M., & Ellis, A. W. (1997). Naming the Snodgrass and Vanderwart pictures: Effects of age of acquisition, frequency, and name agreement. *Quarterly Journal of Experimental Psychology, 50A,* 560–585. doi:10.1080/783663595

Bates, E., D'Amico, S., Jacobsen, T., Székely, A., Andonova, E., Devescovi, A., & Tzeng, O. (2003). Timed picture naming in seven languages. *Psychonomic Bulletin & Review, 10,* 344–380. doi:10.3758/BF03196494

Belke, E., Brysbaert, M., Meyer, A. S., & Ghyselinck, M. (2005). Age of acquisition effects in picture naming: Evidence for a lexical–semantic competition hypothesis. *Cognition, 96,* B45–B54.

Bijankhan, M., Sheykhzadegan, J., Bahrani, M., & Ghayoomi, M. (2011). Lessons from building a Persian written corpus: Peykare. *Language Resources and Evaluation, 45,* 143–164.

Bonin, P., Chalard, M., Méot, A., & Fayol, M. (2002). The determinants of spoken and written picture naming latencies. *British Journal of Psychology, 93,* 89–114. doi:10.1348/000712602162463

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, Instruments, & Computers, 35,* 158–167. doi:10.3758/BF03195507

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

Cuetos, F., Ellis, A. W., & Alvarez, B. (1999). Naming times for the Snodgrass and Vanderwart pictures in Spanish. *Behavior Research Methods, Instruments, & Computers, 31,* 650–658. doi:10.3758/BF03200741

Damian, M. F., & Bowers, J. S. (2003). Effects of orthography on speech production in a form-preparation paradigm. *Journal of Memory and Language, 49,* 119–132.

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,* 588–615. doi:10.3758/BF03200832

Dimitropoulou, M., Duñabeitia, J. A., 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,* 584–589. doi:10.3758/BRM.41.2.584

Ellis, A. W., & Lambon Ralph, M. A. (2000). Age of acquisition effects in adult lexical processing reflect loss of plasticity in maturing systems: Insights from connectionist networks. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26,* 1103–1123. doi:10.1037/0278-7393.26.5.1103

Ellis, A. W., & Morrison, C. M. (1998). Real age-of-acquisition effects in lexical retrieval. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 24,* 515–523. doi:10.1037/0278-7393.24.2.515

Forster, K. I., & Forster, J. C. (2003). DMDX: A Windows display program with millisecond accuracy. *Behavior Research Methods, Instruments, & Computers, 35,* 116–124. doi:10.3758/BF03195503

Glaser, W. R. (1992). Picture naming. *Cognition, 42,* 61–105.

Juhasz, B. J. (2005). Age-of-acquisition effects in word and picture identification. *Psychological Bulletin, 131,* 684–712. doi:10.1037/0033-2909.131.5.684

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22,* 1–38. disc. 38–75.

Lewis, M. B. (1999). Age of acquisition in face categorisation: Is there an instance-based account. *Cognition, 71,* B23–B39.

Liu, Y. Y., Hao, M. L., Li, P., & Shu, H. (2011). Timed picture naming norms for Mandarin Chinese. *PLoS ONE, 6,* e16505.

Megerdoomian, K. (2000). *Persian computational morphology: A unification-based approach (Memoranda in Computer and Cognitive Science, Report No. MCCS-00-320).* Las Cruces,

NM: New Mexico State University, Computing Research Laboratory.
Nilipour, R., & Raghibdoust, S. (2001). Manifestations of aphasia in Persian. *Journal of Neurolinguistics, 14,* 209–230.
Nishimoto, T., Miyawaki, K., Ueda, T., Une, Y., & Takahashi, M. (2005). Japanese normative set of 359 pictures. *Behavior Research Methods, 37,* 398–416. doi:10.3758/BF03192709
Nisi, M., & Longoni, A. (2000). Italian measurement on the relation of name, familiarity, and acquisition age for the 260 figures of Snodgrass and Vanderwart. *Giornale Italiano di Psicologia, 27,* 205–218.
Pind, J., Jónsdóttir, H., Gissurardóttir, H., & Jónsson, F. (2000). Icelandic norms for the Snodgrass and Vanderwart (1980) pictures: Name and image agreement, familiarity, and age of acquisition. *Scandinavian Journal of Psychology, 41,* 41–48. doi:10.1111/1467-9450.00169
Pind, J., & Tryggvadóttir, H. B. (2002). Determinants of picture naming times in Icelandic. *Scandinavian Journal of Psychology, 43,* 221–226. doi:10.1111/1467-9450.00290
Rahbari, N., & Senechal, M. (2009). Lexical and nonlexical processes in the skilled reading and spelling of Persian. *Reading and Writing, 22,* 511–530.
Rezai, H., Nilipour, R., Azimian, M., & Rahgozar, M. (2011). Relationship between brain lesion location and aphasia type in Persian speaking patients with stroke. *Journal of Rehabilitaion, 11,* 60–66.
Rossion, B., & Pourtois, G. (2004). Revisiting Snodgrass and Vanderwart's object pictorial set: The role of surface detail in basic-level object recognition. *Perception, 33,* 217–236. doi:10.1068/p5117
Sanfeliu, M. C., & Fernandez, A. (1996). A set of 254 Snodgrass–Vanderwart pictures standardized for Spanish: Norms for name agreement, image agreement, familiarity, and visual complexity. *Behavior Research Methods, Instruments, & Computers, 28,* 537–555. doi:10.3758/BF03200541
Severens, E., Van Lommel, S., Ratinckx, E., & Hartsuiker, R. J. (2005). Timed picture naming norms for 590 pictures in Dutch. *Acta Psychologica, 119,* 159–187. doi:10.1016/j.actpsy.2005.01.002
Shu, H., Cheng, Y., & Zhang, H. (1989). Name agreement, familiarity, image agreement, and visual complexity for 235 pictures. *Acta Psychologica Sinica, 21,* 389–396.
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,* 174–215. doi:10.1037/0278-7393.6.2.174
Snodgrass, J. G., & Yuditsky, T. (1996). Naming times for the Snodgrass and Vanderwart pictures. *Behavior Research Methods, Instruments, & Computers, 28,* 516–536. doi:10.3758/BF03200540
Steyvers, M., & Tenenbaum, J. B. (2005). The large-scale structure of semantic networks: Statistical analyses and a model of semantic growth. *Cognitive Science, 29,* 41–78. doi:10.1207/s15516709cog2901_3
Székely, A., D'Amico, S., Devescovi, A., Federmeier, K., Herron, D., Iyer, G., & Bates, E. (2003). Timed picture naming: Extended norms and validation against previous studies. *Behavior Research Methods, Instruments, & Computers, 35,* 621–633. doi:10.3758/BF03195542
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,* 1085–1099. doi:10.3758/s13428-011-0121-9
Weekes, B. S., Shu, H., Hao, M., Liu, Y., & Tan, L. H. (2007). Predictors of timed picture naming in Chinese. *Behavior Research Methods, 39,* 335–342. doi:10.3758/BF03193165
Zevin, J. D., & Seidenberg, M. S. (2002). Age of acquisition effects in word reading and other tasks. *Journal of Memory and Language, 47,* 1–29. doi:10.1006/jmla.2001.2834
Zhang, Q., Chen, H., Weekes, B. S., & Yang, Y. (2009). Independent effects of orthographic and phonological facilitation on spoken word production in Mandarin. *Language and Speech, 52,* 113–126.
Zhang, Q., & Weekes, B. S. (2009). Orthographic facilitation effects on spoken word production: Evidence from Chinese. *Language and Cognitive Processess, 24,* 1082–1096.