

## The effect of psycholinguistic factor on picture naming in Persian speaking children

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Received: 12 June 2017

Accepted: 10 Sep 2017

### Abstract

**Background:** Cross-linguistic studies on picture naming tasks have shown that several psycholinguistic variables predict naming accuracy and latency. However, differing effects of these variables across languages and age groups are unclear. The aim of this study was first to examine the normative data for a set of picture stimuli using psycholinguistic features of name agreement, familiarity, visual complexity, and age of acquisition. The second aim was to report on the effects of the psycholinguistic variables on timed picture naming in children.

**Methods:** At first, 128 pictures from Cycowicz et al's study (1997) were selected and collect normative data for each item. Then 128 black and white pictures were presented to 120 healthy Persian speaking children aged 7-9-year-old to measure the reaction time as it relates to psycholinguistic variables.

**Results:** The regression analysis revealed that only name agreement and age of acquisition could be considered as significant predictors of naming latency for the Persian speaking children.

**Conclusion:** We concluded that psycholinguistic features such as name agreement and age of acquisition might have effect on the naming skills in children like in adults.

**Keywords:** Age of Acquisition, Children, Familiarity, Name agreement, Naming latency, Visual complexity

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**Cite this article as:** Hassanati F, Nilipour R, Ghoreishi Z, Pourshahbaz A, Momenian M. The effect of psycholinguistic factor on picture naming in Persian speaking children. *Int J Child Adolescent.* 2017(30 Nov);3:4.

### Background

Lexical access and retrieval are the basic information processing steps while performing a naming task [1]. Lexical retrieval difficulties can be considered as the predictors of reading problems and poor educational performance in school age children, particularly in children with dyslexia [2]. Picture naming task is a common method for the investigation of lexical access and retrieval [3, 4]. Based on the current models of picture naming, the underlying cognitive processes of timed picture naming consist of the following stages: 1) identification of the object, 2) activation of the semantic information in mental lexicon and selection from among the competing words, and 3) phonological encoding [5-

7].

It is reported that psycholinguistic variables may have some effects on different stages of picture naming [8-11]. For instance, name agreement - the degree to which participants agree on the name of the picture- is shown to have some effects on lemma selection. At this level of picture naming, each active lexical concept spreads activation to the corresponding lexical items (lemma) in the speaker's mental lexicon [9]. When the number of alternative concepts increases, co-activation of the lemma increases resulting in higher naming latencies for some concepts [9, 11].

Table 1. Summary table of the effects of psycholinguistic variables on picture naming in adults

	Language	Num. of pic.	NA (%) / H	AoA	VC	F
Snodgrass & Yuditsky (1996)	English	250	+	+	-	+
Cuetos et al. (1999)	Spanish	140	+	+	-	+
Dell' Acqua, Lotto, & Job (2000)	Italian	266	+	+	N/A	N/A
Pind & Tryggvadóttir (2002)	Icelandic	175	+	+	-	+
Bonin et al. (2003)	French	299	+	+	-	+
Alario et al. (2004)	French	388	+	+	+	N/A
Severens et al. (2005)	Dutch	590	+	+	-	-
Liu et al. (2011) [12][13]	Chinese	435	+	+	-	+
Bakhtiyar et al. (2013)	Persian	200	+	+	-	-

Num. of pic= number of pictures; NA = percentage of name agreement; H = H value; AoA = age of acquisition; VC = visual complexity; F = familiarity; +, significant effect; -, not significant effect; N/A, not applicable.

Table 2. Summary table of the effects of psycholinguistic variables on picture naming in children

	Language	Age	Num. of pic.	NA (%) / H	AoA	VC	F
Cycowicz et al. (1997)	English	5 to 6	260 (set 1)	+	+	+	+
			61 (set 2)	+	-	-	-
			79 (set 3)	+	-	+	-
D'Amico et al. (2001)	Italian	5 to 6	250	N/A	+	N/A	N/A
Newman & German (2002)	English	7 to 12	255	N/A	+	N/A	N/A
Masterson et al. [14] (2008)	English	3 & 5	100	N/A	+	+	N/A

Based on the studies conducted on adults, the age of acquisition (AoA) is reported as an effective factor on semantic system or lemma selection stage of name retrieval [4, 8-10, 15-23]. Lexical items with an early AoA are reported to have a stronger lemma representation [9, 24] and more neural connections in the mental lexicon [16]. Therefore, early acquired words are selected faster in the competition process [9, 25].

Visual complexity and familiarity are also shown to have effects on picture recognition [9]. When the picture is more complex, it is more difficult to recognize it leading to a longer time for the retrieval of the relevant concept [26]. However, familiarity has the opposite effect. When the picture is more familiar, its recognition and, therefore, retrieval from the mental lexicon is done more rapidly [27].

Although picture naming in children and adults involves the same stages, there are several minor differences regarding the role of psycholinguistic variables and accuracy and speed of lexical retrieval [11] (see Tables 1 & 2 for comparison between studies on adults and children in this regard). Name agreement and AoA have consistently been shown to have robust effects across both age groups and languages, while the results of other variables such as visual complexity and familiarity are controversial [8, 11].

The effects of psycholinguistic variables on picture naming in children and adults can be explained in terms of several variables such as automaticity of the language processing [28], size of processing capacity and speed [29], general fragility of words in

the child's lexicon, richness of semantic representations [5, 7, 30], and increasing experience in reading over time [31].

In addition, a number of studies have focused on cross-cultural differences [32-35], and found that object familiarity varies across cultures. For example, some common objects in the U.S., such as animals and vegetables, seem to be unknown in East Asia [33]. Moreover, there are objects for which naming responses may vary for different age groups within a culture. Therefore, due to structural and cultural characteristics of different languages in this study, normative data were collected for the Persian speaking children.

Persian, as an Indo-European language spoken in Iran and some regions of other countries such as Afghanistan, Tajikistan and Pakistan, is a fairly rich inflected language. Morphologically, Persian is richer than other languages such as Chinese and English, including many suffixes and smaller prefixes [36]. Unlike English, the word order for the canonical sentences is SOV [37]. Phonologically, the Persian language consists of 29 segmental phonemes, including six vowels and 23 consonants: four pairs of fricatives, four pairs of stops, three glides, two nasals, one liquid and one trill. In Persian, all three syllable structures (i.e., CV-CVC-CVCC) begin with a consonant. There is no initial cluster in Persian [38].

Several studies were conducted on picture naming on Persian adults [10, 21, 39-41]. The results of these studies showed that the percentage of name agreement and familiarity were higher in younger adults. However, mean scores of image agreement

and visual complexity for other groups were higher as compared with younger subjects (see Ghasisin et al., 2015; Bakhtiar et al., 2013 for more details).

Except for a single study about object and action naming accuracy and latency on 3-6 year-old Persian-speaking children [41], there is no published study on the development of a standardized picture stimuli set for Persian school-aged children using psycholinguistic variables as predictors of timed picture naming. We focused on 7-9 year-old children because it is believed that the development of basic components of language and vocabulary (particularly knowledge of objects) at this stage has almost reached relative stability [42]. In Iran, the age of admission to school is 7.

Given the lack of research on picture naming in school-aged Persian speaking children and the role of naming performance as a predictor of literacy skills in children [43], the first aim of this study was to collect normative data for a set of picture stimuli for Persian speaking children aged 7 to 9 years old, and the second aim was to report on the effects of name agreement, AoA, familiarity and visual complexity as psycholinguistic variables on timed picture naming in children.

## Experiment I

In experiment I, we described how stimuli were chosen and reported on standardizing psycholinguistic features of a set of picture naming stimuli for 7-9 year-old Persian speaking children.

## Methods

### Participants

One hundred children participated in the name agreement phase (F= 50, M=50; mean age= 7.9, SD= 0.69). In addition, 30 new children, aged 7-9-year-old (F=17, M=13; mean age= 8.1, SD= 0.53) were randomly selected for familiarity and visual complexity rating of the normative data purposes. The children were native Persian speakers from the middle sociocultural class and educational level with normal cognitive, visual and auditory status from elementary schools in Tehran. The exclusion criteria were bilingualism of children, and presence of communicative, phonological, neurological and emotional/behavioral disorders.

Finally, 30 parents with children of normal development whose children did not participate in this study were asked to rate the AoA checklist of the normative data.

### Materials

Four hundred pictures from Cycowicz et al. (1997) were selected to collect the norms. As a

screening procedure, each picture was presented to two speech and language pathologists and one linguist to remove the linguistically and culturally inappropriate items from the list (e.g., cigar). Also, pictures with compound name (e.g., spinning wheel) were deleted from the list. Some studies have reported the significant effect of the word length on picture naming latency in other languages [4, 44], but since the word length in picture naming latency and accuracy was not reported as predictive variables in Persian [10, 40], our picture stimuli were selected from the one- or two-syllable words.

Three hundred fifty-three pictures remained after the first screening stage. Due to the risk of fatigue or loss of attention and interest in children during the test, we decided to exclude more items. Fifteen children aged 7-9 years old were asked to name each item only using the first name that came to their mind. Each picture was presented on a laptop screen without time pressure. The answers were recorded by an examiner. We consulted some experts in the field and removed those items which were not described fully by 75% of children. Also, when two stimuli had the same name in Persian (for example, /saæt/ for clock and watch), the picture with a higher naming accuracy was selected. As a result of this screening stage, 111 pictures remained as our normative data. Seventeen more items were selected from a database core elementary school vocabulary of Persian children [42]. A suitable black and white picture was selected for each new item from various sources to suit the main picture set. The final set consists of 128 culturally and linguistically appropriate items as our normative stimuli. The final stimuli can be divided into eight semantic categories: foods (10 items), four-foot animals (17 items), insects (five items), birds (nine items), body parts (11 items), clothing (12 items), artifacts (55 items), and nature (eight items). "Fish" did not belong to any of our semantic categories.

### Procedure

The participants were asked to make decision about name agreement, visual complexity, and familiarity of each item. Each participant was seated in front of the monitor to follow the instructions. Initially, three trial pictures were presented to each participant.

To measure the name agreement, pictures were presented to the children without time limitation. The participants were instructed to name each item based on their first response. For scoring the name agreement we considered the following points: 1) the expected name refers to the most common name for a picture in the Persian language, 2) the modal

Table 3. Summary statistics of the psycholinguistic factors for 7-9 year-old children for 128 -picture set

	Name agreement (%)	Name agreement (H)	Familiarity	Visual complexity	AoA (in months)
Mean	86.09	0.33	3.67	2.32	27.22
Std.D	17.10	0.45	1.23	0.91	5.85
Max	100	2.20	5	4.60	42
Min	31	0.00	1.20	1.00	11.60
Skewness	-1.25	1.74	-0.62	0.68	-.11

name refers to the name that most of the children use to name a concept, 3) the alternative answers, which were determined by counting the number of different names given by participants for each picture including the target name. Name agreement was evaluated by calculating the percentage of participants who used the target name and the H statistic:  $k$  is the different names that children used for each concept and  $p$  is the percentage of the children who used the target name [25].

$$H = \sum_{i=1}^k P_i \text{Log} \text{Log}_2 \left( \frac{1}{P_i} \right)$$

If there is one name for an object, H will be zero. In contrast, when there are several alternative names, H will be high. Naming failures (description instead of naming, visual similarity, phonological substitution, or no semantic relationship between the target and the alternative names) were not considered in estimating the H static, and mispronunciations (e.g., substitution of /l/ instead of /r/ in words) were considered as a correct target word. The whole procedure was performed in one session with a mean length of 42 minutes.

Based on Berman et al. (1989) and Cycowicz et al. (1997), for visual complexity rating, the subjects were asked "how difficult is it to draw or trace this picture?" The answer to this question was used as a rating of the visual complexity of the picture. For scoring, 1 corresponded to a simple drawing (the response: "easy"), 3 corresponded to a less simple drawing (the response: "medium") and 5 corresponded to the most complex drawing (the response: "hard").

To measure the familiarity rating, the children were asked "how often do you think about this object or use it in your daily life?" The answer to this question was used as a rating of the familiarity of the pictures. Score 1 was allocated to "a little" familiar items, score 3 to responses: "sometimes", and score 5 to responses: "a lot".

Each participant was tested individually in one session with a possible short interval rest. The whole procedure lasted 50 to 60 minutes. The order of rating the familiarity and visual complexity done randomly by each participant.

To measure the AoA rating, a list of the pictures

was presented to the parents. They were asked about the age acquisition of their children for each item. Their answers were to be based on a 9-point scale: "1= below 1 year, 2=1-2 years old, 3=2-3 years old and so on, up to 9 = 8 years old or older.

### Results

Detailed data of the results of Experiment I are available in an Excel file in the supplemental material, which includes the modal names, the expected names (Persian and English), name agreement (percentage of name agreement and H value), visual complexity, familiarity, AoA, and the semantic categories. Psycholinguistic features of picture naming set are presented in Table 3.

As noted earlier, two measures of name agreement were calculated. The first measure was the percentage of participants who used the dominant name. The minimum and maximum name agreement measures were 31 and 100%, respectively. The name agreement of 29 pictures was 100%. The second measure was H value which ranged from 0 to 1.81 ( $m = 0.33$ ).

The five items with different modal names included three superordinates and two coordinates. Results showed that out of the 128 pictures, 47 yielded a single name, 29 were given two names, 12 were given three names, 15 were given four names, nine were given five names, nine were given six names, one was given seven names, four were given eight names, one was given nine names, and finally one was given ten names by the children.

### Discussion

The aim of this experiment was to provide the normative data on 128 pictures for Persian speaking children. In the following section, we discuss the results of psycholinguistic features of visual complexity, familiarity, name agreement, and AoA.

The measure of name agreement via H value for children ( $m = 0.33$ ) was higher than Persian adults ( $m = 0.25$ ) [10], demonstrating that children produced more alternative names than adults. If a picture had more alternative names, the H value was higher than a picture with no or less alternative names. Also, H value in the present study was lower

Table 4. Correlation matrix for predictor variables and naming latency in 7-9 year-old Persian speaking children

	1	2	3	4	5	6
1. Naming RT						
2. Name agreement (H)	0.68**					
3. Name agreement (%)	-0.75**	-0.77**				
4. Familiarity	-0.32**	-0.24**	0.23**			
5. Visual complexity	0.36**	0.35**	-0.32**	-0.32**		
6. AoA	0.52**	0.42**	-0.45**	-0.47**	0.16	

\*\* Correlation is significant at the 0.01 level. (2-tailed)

than other studies on children [11, 45, 46]. Previous studies indicated that name agreement was affected by culture, the difficulty of object, as well as the age of children [11, 46, 47]. In the present study, culturally inappropriate and cognitively difficult concepts were deleted; therefore, the lower H value in our study compared with other studies [14, 46] was due to higher age of the subjects.

Compared with adults, five items (shirt, jacket, boot, kettle, and chicken) achieved different modal names: three superordinates (clothing, clothing, shoes) and two coordinates (teapot, rooster). Moreover, sometimes children choose the synonyms of target names with simpler structures and lower AoA. Some studies revealed that modal names in children differed from adults for some pictures. These authors indicated that the majority of non-modal name belonged to the same category of the target name [11, 46]. In the present study, the majority of alternative names belonged to the same category of the target name.

In the present study, the subjective AoA was collected from the parents of the children. Some authors have used both objective (from early lexical development norms) and subjective AoA (based on adult rating) [14, 8], but others have used only adult rating of AoA [11, 48]. Generally, there was a high correlation between the two measurements [14, 8, 17].

## Experiment II

In the Experiment II, the effect of psycholinguistic variables on picture naming latency in 7-9 year-old Persian children was examined.

## Methods

### Participants

In this experiment, 120 children (F = 30, M = 30; age = 7-8 years old;  $m = 7.6$ ,  $SD = 0.44$ ; F = 30, M = 30; age = 8-9 years old;  $m = 8.4$ ,  $SD = 0.65$ ) were randomly selected from primary schools (first and second grades) in Tehran. Due to the repetition effects and exhaustion, these children were different from children in the previous experiment. The inclusion and exclusion criteria were the same as the previous experiment.

## Materials

The picture naming set in Experiment I was used for the Experiment II.

## Procedure

The participants were asked to name each picture presented by DMDX software [49]. They wore a headphone connected to a microphone. The participants were instructed to name the pictures as quickly and accurately as possible using one word, without coughs, hesitations, preparatory interjection sounds like "uhmmm". Three experimental pictures selected from Cycowicz et al.'s (1997) study were shown to the participants as a trial preparation. The responses were recorded by DMDX and voice recorder. Each picture was presented for 5000ms with a 1000ms inter-stimulus interval. If the participant could not respond in 5000ms, an error was recorded by DMDX. The examiner provided no feedback on the child's responses. The stimuli were presented in 4 blocks randomly and DMDX scrambled the items of four blocks for each participant. Each participant was tested in one session with a possible short interval rest, usually lasting 25 to 30 minutes.

## Results

In the reaction time analysis, invalid responses were defined as those with invalid reaction time (RT) (e.g., coughs, hesitations, etc.) or missing RT (responses that were not recorded by DMDX) and any item that participants did not name correctly. Also, we controlled the outliers in naming latency by SPSS software. The error responses by the children were 12.24%, and DMDX errors were 8.02%. Overall mean for naming latency in 7-8 year-old children was 1438.3ms ( $SD = 141.29$ ) and for 8-9 year-old children it was 1361.3ms ( $SD = 123.2$ ). The mean latencies for the items are reported in the supplemental material.

The relationship between the dependent and independent variables was examined. The Pearson product-moment correlation coefficients between all variables are shown in Table 4.

The correlations between the percentage of name

agreement as well as familiarity and naming latency were negative and those between AoA as well as visual complexity and naming latency were positive, as expected. Moreover, all the correlations were statistically significant ( $p \leq .01$ ).

A multiple regression analysis (inter method) was calculated to evaluate how well the psycholinguistic variables (name agreement, AoA, familiarity, and visual complexity) predicted the naming latency. The assumptions of linear regression, such as normal distribution of data, the assumption of collinearity, and independent errors (Durbin-Watson value = 1.91) were considered.

In the first step, the effect of initial phonemes on naming latencies was examined. There are

eight places of articulation (bilabial, labio-dental, dental, alveolar, alveo-palatal, palatal, uvular and glottal) in the Persian language [50]. These eight variables as well as the independent variables were entered into the regression equation. Results showed that the change in R square with these variables was 0.5% which was not statistically significant,  $F$  change = 0.75,  $p = 0.38$ . In the second step, all the independent variables mentioned above were entered into the regression equation. These variables accounted for 61% of the variance,  $F(4, 121) = 6.47$ ,  $p < 0.000$ . Results showed that the percentage of name agreement ( $B = -8.31$ ,  $SE = 0.86$ ,  $t = -9.66$ ,  $p < 0.000$ ) and AoA ( $B = 6.48$ ,  $SE = 2.74$ ,  $t = -2.36$ ,  $p < 0.01$ ) were two significant predictors of naming latency (Table 5).

### Discussion

The results of this study revealed that name agreement and AoA were significant predictors of naming latency. In the present study, AoA was a significant predictor of naming latency and had a high correlation with name agreement consistent with previous studies in Persian and other languages [8-11, 20, 22, 51-53]. For instance, Snodgrass and Yuditsky (1996) believed that AoA is the best predictor of naming latency compared to frequency and rated familiarity [54].

The results of AoA effect on naming latency were similar to those of previous studies on children [8, 11, 48, 55]. Newman and German (2002) examined the effect of AoA on lexical access.

These authors observed this effect in children with typical language development and children with word finding difficulties [48]. When the individual gets older, the pathway of word access becomes stronger and lexical retrieval becomes more automatic. With age, the effect of AoA on naming continues to decrease but does not disappear completely overtime [8, 10, 19-23, 52, 56, 57]. Moreover, based on the growing network model, early acquired words have a lot of connections and their nodes have a central role in the semantic network [16]. Also, the words with early AoA are retrieved more accurately, because there are more connections between the semantic and phonological components of these words compared with recently-learned words [5, 58].

In the present study, name agreement was a strong predictor of picture naming latency. A high degree of name agreement caused the lower naming latency in line with several previous studies [3, 10, 11, 59]. This result may be due to the existence of more alternative names. When a target name has a variety of alternatives, the selection of the target name among the alternatives in the mental lexicon requires longer time [9, 11].

In the present study, familiarity did not predict latency in naming. Some picture naming studies obtained similar results for familiarity effect [4, 10], while other studies did not [44, 54, 60]. Also, in our study, visual complexity was not a significant predictor of naming latency, which is consistent with some previous studies [5, 8, 44, 60-62]. One explanation might be the use of simple black and white pictures used in this study as well as some other studies [63, 64]. Snodgrass and Vanderwart (1980) argued that the style of artist and similarity between the picture and real-life situation can influence the results [25]. The similarity between picture and the real object is important for children with less exposure to objects. In contrast, D'Amico et al. (2001) and Cycowicz et al. (1997) found that visual complexity had a significant effect on naming latency in children. Variety of results in the literature may be the consequence of the quality of pictures being applied in some studies or the measure of complexity rating (e.g see D'Amico et al., 2001).

Table 5. Regression analyses for reaction times in 7-9 year-old Persian children

	Variables	B	Std.Error	Beta	t value	P	Adjusted R <sup>2</sup>
Step 1	Initial Phonemes	-7.08	8.15	-.07	-.86	0.38	0.005
Step 2	Name agreement (%)	-8.31	0.86	-.64	-9.66*	0.00	0.61
	Familiarity	-6.36	12.18	-.06	-1.34	0.47	
	Visual complexity	6.17	14.84	.03	0.41	0.69	
	AoA	6.48	2.74	.17	2.36*	0.01	

$p^* < 0.05$

The present study aimed to provide normative data on Persian picture naming set in 7-9-year-old children. This set contained 128 pictures along with their psycholinguistic features. This normative data, to the best of our knowledge, is the first report on Persian speaking children. It could be useful for future research on children with typical language development and children with language disorders.

The effect of several psycholinguistic factors on picture naming task was further investigated in this study. Similar to all previous studies on children and adults [14, 8-11, 65], the results of this study indicated that AoA, compared to familiarity and word frequency, had a significant effect on lexical retrieval system [24].

The results of this study along with the findings of other studies in the Persian language in adults indicated that the name agreement and AoA have effects on picture naming in both populations. However, the naming latency means were not same. The naming latency mean in our study (1399.8ms) was higher than that in adult Persian speakers (916ms) [10].

### Conclusion

Timed picture naming is a valuable method to investigate the process of lexical access across different age groups. Psycholinguistic variables could affect picture naming in each stage of lexical access depending on the age and language. We hope that this study as the first Persian normative data for young children will be practically useful for future researches and clinical applications in children with and without language impairments.

Also, future studies may focus on the effect of semantic category and other psycholinguistic factors such as word frequency in naming processing in children. Moreover, colored images could be used to find the effect of picture quality variable on visual complexity as well as naming latency in the future studies.

### Acknowledgements

This research was supported by Cognitive Sciences and Technological Council (2340).

*Conflicts of interest:* None declared.

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