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A standardized set of 260 pictures for Modern Greek: Norms for name agreement, age of acquisition and visual complexity.

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Abstract

The appropriate selection of both pictorial and linguistic experimental stimuli requires a previous language-specific standardization process of the materials across different variables. Considering that such normative data have not yet been collected for Modern Greek, in this study normative data for the color version of the Snodgrass and Vanderwart picture set (Rossion & Pourtois, 2004) were collected from 330 native Greek adults. Participants named the pictures (providing name agreement ratings) and rated them for visual complexity and age of acquisition. The obtained measures represent a useful tool for further research on Greek language processing and constitute the first picture normative study for this language.

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A thorough standardization process is fundamental to ensure the quality of the experimental materials used in cognitive psychological research. To guarantee that empirical findings are valid and generalizable, the pictorial and linguistic materials used have to be previously standardized in a language-specific manner (see Sanfeliu & Fernández, 1996; Yoon et al., 2000). That is, in order to effectively control for differences across materials, a large pool of native speakers has to provide normative data for them first. In spite of the importance of language-specific norms for pictures that are commonly used in psychological research, there are no such norms available for Modern Greek. In the present study, the colorized version of the Snodgrass and Vanderwart picture databank (S&V, hereafter) created by Rossion and Pourtois (2004) was viewed by Greek-speaking young adults that provided norms concerning name agreement, age of acquisition (AoA) and visual complexity. The following sections include a brief overview of the relevant literature as well as a description of the variables measured in the present study.

Cross-cultural standardization of a set of materials that is widely used in psycholinguistic research has its exponent in the S&V set of pictures. Snodgrass and Vanderwart (1980) created a set of 260 black-and-white line drawings that were initially standardized by English-American participants. By now, this same set of pictures has been normalized across different languages (e.g., British-English: Barry, Morrison, & Ellis, 1997; Spanish: Cuetos, Ellis & Alvarez, 1999; Sanfeliu & Fernandez, 1996; French: Alario & Ferrand, 1999; Japanese: Nishimoto, Miyawaki, Ueda, Une, & Takahashi, 2005; Icelandic: Pind, Jónsdóttir, Tryggvadóttir, & Jónsson, 2000; Italian: Nisi, Longoni, &

Snodgrass, 2000; Dutch: Martein, 1995) and across different populations (e.g., children of different age groups; Berman, Friedman, Hamberger & Snodgrass, 1989; Cycowicz, Friedman, Rothstein & Snodgrass, 1997) . Pictures from the S&V set have been widely used in different areas of cognitive psychological research like object perception (e.g., Dell' Acqua, Job & Grainger, 2001), attention (e.g., Pashler & Harris, 2001) or memory (e.g., Suzuki et al., 2002) and have become a recurrent tool especially in psycholinguistic research. Psycholinguists have used these pictures to study phonological, lexical and semantic processes in language perception and production (e.g., Belke, Brysbaert, Meyer & Ghyselinck, 2005; Damian & Martin 1998; Schriefers, Meyer & Levelt, 1990) in both monolinguals and bilinguals (see Hoshino & Kroll, 2008; Knupsky & Amrhein, 2007). Furthermore, the S&V picture databank has been extensively used in a variety of experimental paradigms, such as picture naming, picture-word interference tasks (e.g., Damian & Martin, 1998; Schriefers, Jescheniak & Hantsch, 2002) or the visual-world paradigm (e.g., Duñabeitia, Avilés, Afonso, Scheepers & Carreiras, in press; Huettig & Altmann, 2005).

Despite their extended use, the black-and-white line-drawings of the S&V database provide a limited amount of visual information as compared to objects in real life, and do not offer information about essential visual characteristics of the objects like color or texture[1] (see Price & Humphreys, 1989). Rossion and Pourtois (2004) compared name agreement values and naming latencies across groups of French adults who viewed either the line drawings of the S&V picture set or the same pictures graphically manipulated to include detailed texture and color information. These authors found that the addition of color and texture information provided a clear advantage for both the name agreement rates (i.e., more homogeneous responses) and the picture naming latencies (i.e., faster recognition and naming latencies) as compared to the original line drawings (see also Weekes et al., 2007). For this reason, in the present study the colorized and texturized version of the S&V set provided by Rossion and Pourtois (2004) were used for standardization purposes.

The variables measured in the present study were name agreement, visual complexity and AoA. These variables (among others) represent a constant in studies providing norms for the S&V database (see Alario et al., 2004, for a review). In fact, as shown by Alario and colleagues, these three variables, together with image agreement and word frequency, were found to be the most effective predictors of picture naming latencies[2]. Next, a short description of the measured variables is provided.

Name agreement refers to the degree to which participants agree on the name of a picture. The most commonly used name agreement measures are the percentage of participants giving a name for a particular picture, on the one hand, and the information statistic *H* (Shannon, 1949), which reflects the level of agreement or discrepancy across participants for the given answers, on the other hand. As previously mentioned, name agreement has been found to be one of the strongest predictors of picture naming latencies by Alario et al. (2004; see also Barry et al., 1997; Bonin, Chalard, Méot, & Fayol, 2002; Ellis & Morrison, 1998; Nishimoto et al., 2005; Snodgrass & Yuditsky, 1996; Vitkovitch & Tyrrell, 1995).

Visual complexity corresponds to the subjective evaluation of the number of lines and details in a drawing. A number of studies have reported longer naming latencies for pictures with higher visual complexity values (e.g., Alario et al., 2004; Ellis & Morrison, 1998; Lloyd-Jones & Nettlemill, 2007), highlighting the impact of this variable on picture naming. Visual complexity is proposed to affect naming latencies especially when the pictorial material is colored, as is the case in the present study (see Biederman, 1987; Paivio, Clark, Digdon & Bons, 1989). Thus, this variable should be controlled for in tasks involving picture presentation and especially when more than one picture is simultaneously displayed. For instance, in the visual world paradigm (see Altmann & Kamide, 2007, for review), participants are presented with several pictures on a screen, while their eye movements towards these images are being recorded. Considering that visual attention is highly driven by the saliency of the displayed pictures, visual complexity is a factor that has to be unavoidably controlled for in this paradigm (e.g., Huettig & Altmann, 2005).

A*ge of acquisition* (AoA) of a given item has been also proved to influence performance in word production and visual word recognition tasks (e.g., Barry et al., 1997; Dent, Johnston & Humphreys, 2008; Lachman, 1973; Lachman et al., 1974; Morrison & Ellis, 2000; Snodgrass & Yuditsky, 1996; for similar evidence on Greek see Bogka, Masterson, Druks, 2003). AoA is positively correlated with reaction times in picture naming, reading aloud and lexical decision tasks, suggesting that concepts that have been earlier acquired (namely concepts with low-AoA values) are processed faster than those acquired later in life (concepts with high-AoA values). In that sense, a recent study by Cortese and Khanna (2007) has shown that AoA is the most important predictor for word naming and lexical decision performance, over and above twenty-two other factors.

The present normative study

The present study aimed at providing researchers with full picture naming norms for Modern Greek. Greek is the official language in Greece and Cyprus, and is fluently spoken by more than 15 million individuals around the world. The specific orthographic and phonological properties of Greek make it especially relevant for psycholinguistic research (e.g., transparent orthography, unique script). In spite of this, Greek is one of the most understudied European languages. Efforts to provide empirical data on Greek language processing have been recently initiated (e.g., Ktori & Pitchford, 2008; Orfanidou & Sumner, 2005; Protopapas, Archonti, & Skaloumbakas, 2007). However, in order to efficiently control for the materials, normative databases on Modern Greek are required, both for printed words and for pictures. GreekLex (Ktori, Pitchford & Van Heuven, 2008), a recently created lexical database providing a series of lexical indexes on Greek (e.g., word frequency, length, number of orthographic neighbors), represents a step forward for the standardization of useful psycholinguistic statistics for Greek. The present study aims at providing Greek norms regarding name agreement, age of acquisition and visual complexity for the 260 pictures of the colorized and texturized Rossion and Pourtois (2004) picture set.

Method

Participants. Three hundred and thirty undergraduates from the Informatics Department of the National and Kapodistrian University of Athens participated in the study. They were all native speakers of Greek and participated in the study in exchange for course credit.

Materials. The Rossion and Pourtois (2004) colorized version of the 260 Snodgrass and Vanderwart (1980) object dataset was used for the collection of both the picture naming and the free-association norms. This set of pictures was created by Rossion and Pourtois by scanning and “cleaning” the original S&V black-and-white line drawings, and then adding surface and color information using Adobe Photoshop 5.0. The whole set of pictures was acquired from the authors' website (http://www.cog.brown.edu/_tarr/stimuli.html).

Procedure. Instructions were given to the whole group of participants both orally and by a written form along with the answer sheet. The instructions closely followed those adopted by Alario and Ferrand (1999) and Bonin, Peereman, Malardier, Méot and Chalard (2003) in parallel studies. In the *name agreement* task, participants were instructed to identify each picture and to write down its name as it first came to their mind. In case they did not know the object or its name, participants were asked to give *DK* (corresponding to *don't know*) as a response. In the *AoA* rating task, participants had to give an estimate of the age at which they thought they had learned each of the names in its written or oral form. They were provided with a scale with values from 1 to 5 corresponding to 3-year age bands. 1 corresponded to a word "learned between 0 and 3 years" and 5 to one "learned at 12 years or later". In the *visual complexity* rating task, participants were instructed to evaluate the visual complexity of each drawing on a scale from 1 (very simple) to 5 (very complex). They were explicitly told not to rate the visual complexity of the object in real life, but of the drawing. All the participants completed the study at their own pace during non-teaching hours, by filling a Microsoft Excel document accessible to them via the virtual e-class (electronic classroom) platform. Along with this file, an attached document containing the full set of instructions was always provided. The Microsoft Excel file contained the whole set of pictures, together with empty slots for collecting the written responses. The entire Microsoft Excel file containing the pictures was protected against modification, except for the empty response boxes which had to be filled by the participants. An "OK" sign appeared after participants provided each response, so that they knew that they could move to the subsequent response box. Upon completion of the questionnaire, the Microsoft Excel documents stayed saved at the virtual e-class platform, and accessible only to the researchers. Participants were instructed to work as fast as possible, responding to the stimulus series in order of appearance. It was made explicit that there were no correct or incorrect answers. Two examples, in which filler stimuli and responses were used, were presented to further clarify the tasks. The order of appearance of the 260 pictures in the study was randomized to avoid semantic category sequence effects (to this end, four different lists were created).

Results and Discussion

Each participant was asked to give 780 responses (260 pictures x 3 questions: name of the depicted entity, visual complexity and AoA) which led to a total of 156.620 responses across participants. Data from one participant were discarded from the analysis because he/she did not provide any answer. Therefore, data from a total of 329 participants were analyzed. For the name agreement measures, *DK* (*Don't Know*) responses represented only a 0.76% of the data). Words with unambiguous spelling errors were recoded in their orthographically correct form. Alternative spellings were only considered as valid when accepted by an online Greek dictionary. Considering that linguistic stimuli in experiments are usually used in their singular forms, picture names provided in plural were grouped with their singular form with the exception of cases in which only the plural form was found across participants' answers (e.g., *μαλλιά* meaning "hair").

The preferred answers and mean ratings corresponding to each picture are presented in Appendix A (see Archived Materials section). Starting from the left-most column the information provided for each item is: (1) the item number with the most frequent Greek name and the most frequent English name as reported in the Snodgrass and Vanderwart (1980) study; (2) the semantic category corresponding to each picture according to the category subdivisions reported by Rossion and Pourtois (2004) and by Snodgrass and Vanderwart (1980)[3]; (3) the *word length* (measured as number of letters) and (4) the *word frequency* (measured as the number of occurrences per million words) of the dominant picture name taken from the GreekLex database (Ktori et al., 2008). In the cases that the preferred picture name corresponded to a plural word form, the frequency values were those corresponding to the singular word form (e.g., for the name *χείλη* meaning "lips", the frequency of *χείλος* [lip] is given), since the database does not include plurals. It should be noted that word frequencies were not available in the database for 4 picture names, and also that word frequency for the picture of a rocking chair (*καρέκλα κουνιστή*) could not be obtained since the picture name was composed by two words. For the *name agreement* ratings (5) the information provided for each item is the total number of valid responses, the percentage of participants giving the most common name (%) and the *H* statistic reflecting the percentage agreement score taking into account the number of different names provided for a picture. For the *visual complexity* ratings (6), and for the *age of acquisition* ratings (7) the information presented for each picture refers to the mean scores (M) as provided according to the 1-to-5 Likert scales, along with their corresponding standard deviations (SD) (see also Table 1 for summary statistics of the measured variables).

Table 1

Summary statistics for name agreement (percentage of participants providing the most frequent name (%) and *H* values), visual complexity and age of acquisition ratings.

	Name Agreement			
	%	*H*	Visual Complexity	Age of Acquisition
Mean	87.45	0.55	2.48	0.80
Standard Deviation	17.71	0.68	0.46	0.14
Median	96.78	0.24	2.00	2.00

Note: Visual complexity and age of acquisition were rated on a 5-point Likert scale.

The mean percentage of name agreement for the whole set of pictures was 87.45% across participants, showing that the majority of items were named with the same word by the vast majority of participants. In further detail, results regarding name agreement showed that 54 out of 260 pictures were univocally named by all participants with the same word (H=0, 100% agreement). Furthermore, 148 out of the 260 pictures yielded name agreement percentages ranging from 80% to 99%, 29 had percentages from 60% to 79%, 15 from 50% to 59% and only 14 pictures had name agreement rating scores below 50%. Even though percentages provide a straightforward measure of name agreement, the most informative and widely used measure of this variable is the H statistic (e.g., Rossion & Pourtois, 2004; Bonin et al., 2003; Alario & Ferrand, 1999; Snodgrass & Vanderwart, 1980). The mathematical formula used to calculate the H statistic was the same as in the original Snodgrass and Vanderwart (1980) study, where k refers to the number of different names given to each picture and pi is the proportion of subjects giving each name (see Figure 1). Increasing H values indicate decreasing levels of name agreement. When the same name for an item is given by all the participants, the obtained H value is 0, while, when two names are given with the exact same frequency the item's H value is 1. The H statistic is more informative regarding distribution as compared to the percentage agreement measure; for example, for two concepts with the same agreement percentage on the most frequent name the *H* values will differ depending on the amount of alternative names given for each one of them.

Figure 1

Mathematical formula used to calculate the *H* statistic.

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

A first set of correlation analyses was performed among the measured variables (see Table 2). In these analyses we also included word frequency and word length as taken from the GreekLex database. Results showed that the earlier a word is acquired (i.e., pictures eliciting lower AoA scores), the more participants agreed on its name (i.e., lower *H* values), as shown by the significant correlation between these two variables, r=.42, p<.001. Contrarily, name agreement did not correlate significantly with word frequency (r=-.07, p<.29). The correlation among AoA and word frequency however, was significant (r=-.30, p<.001), showing that higher frequency words are acquired earlier in life (see also Alario & Ferrand, 1999, for a similar pattern of results with a French-speaking sample). The strong correlation between AoA and word frequency has been typically observed in preceding picture naming research (e.g., Barry et al., 1997; Ellis & Morrison, 1998), leading some authors to propose that both frequency and AoA effects arise at the same stage of processing (e.g., Barry et al., 1997). However, the idea that AoA and frequency, although closely related, affect different processing stages has been recently put forward (e.g., Dent et al., 2008). Dent and colleagues have proposed that AoA is more closely related to object recognition and semantic processing stages while word frequency is more closely linked to lexical-phonological retrieval stages. Consequently, it is feasible to assume that in the process of providing a name for a given depicted object and without having to pronounce it (as in the case of the present study), the influence of AoA should be more noticeable than the influence of word frequency, coinciding with the pattern of correlations we obtained.

With regard to visual complexity, simpler drawings (i.e., pictures with lower visual complexity scores) corresponded to shorter names, as shown by the positive correlation between visual complexity and word length (r=.22, p<.001). Also, participants rated as visually simpler pictures with higher frequency names, as indicated by the significant negative correlation between these two variables (r=.-12, p<.05). In this line and not surprising, the correlation between visual complexity and AoA was also significant (r=.53, p<.001), with pictures depicting earlier acquired concepts (i.e., pictures with lower AoA values) being rated as less complex. Finally, the correlation between visual complexity and name agreement was also significant (r=.30, p<.001), showing that simpler pictures produced higher name agreement scores (i.e., lower *H* values).

Table 2

Matrix of correlations among the reported measures.

	NA (*H*)	VC	AoA	Len.
Visual Complexity	.30**			

Age of Acquisition	.42**	.53**		
Length	.03	.22**	.23**	
Frequency	-.07	-.12*	-.30**	-.17*

Note: NA (*H*), name agreement; VC, visual complexity; AoA, age of acquisition; Len., length.

**significant at the $p<.001$ level, *significant at the $p<.05$ level

A second set of correlation analyses was also performed in order to contrast specific values obtained in this normative study with those obtained in similar studies in other languages (for a similar procedure, see Alario & Ferrand, 1999; Bonin et al., 2003; Dell'Acqua, Lotto & Job, 2000). We compared the present data with (1) the data reported in the Rossion and Pourtois (2004) study for both the colorized and non-colorized version of the S&V picture set as rated by a group of French adults, (2) the data reported in the original Snodgrass and Vanderwart (1980) study with an American-English sample, (3) the data reported for the same line drawings by Alario and Ferrand (1999) with another French sample, and (4) the data reported by Sanfeliú and Fernández (1996) with a Spanish sample (see Table 3). Appendix B contains name agreement [NA (*H*)], visual complexity (VC) and age of acquisition (AoA) values obtained for each item in the present study and in the parallel studies. These analyses showed that the name agreement (*H*) values obtained in this study were highly correlated with the *H* values reported in all the studies (Snodgrass & Vanderwart: $r=.45$, $p<.001$; Alario & Ferrand: $r=.38$, $p<.001$; Sanfeliú & Fernández: $r=.53$, $p<.001$), with the exception of the Rossion and Pourtois study. Considering that Rossion and Pourtois also used the colorized version of the S&V pictures, one could have also expected a positive correlation between the present and their *H* values. However, it should be noted that with regard to name agreement consistency there are not *a priori* reasons to expect significant cross-cultural correlations, given that the distribution of the alternative names for a given depicted object is not constant across languages (see Yoon et al., 2004). Thus, lower *H* values for a specific picture in one language not necessarily correspond to lower *H* values for the same picture in a different language. As a paradigmatic example, consider the drawing of a lamp which in the Rossion and Pourtois study was uniquely named as *lampe* by all participants (*H*=0), while in the present study it yielded a more heterogeneous set of responses (*H*=1.90; *πορτατίφ*, *φωτιστικό*, *λαμπατέρ*, *λάμπα*, among others). Yet, it remains to be examined why the correlation of the name agreement values for the original black and white S&V pictures obtained with the two French samples (Alario & Ferrand, 1999, and Rossion & Pourtois, 2004) was not significant (r=-.49, p>.42).

One of the picture naming variables for which consistent values could be expected across languages is visual complexity, given that it is a purely perceptive measure. The results of the correlation analysis performed further confirmed this idea, since the visual complexity values obtained in the present study were highly correlated to those reported across all the parallel studies (Snodgrass & Vanderwart: r=.82, p<.001; Rossion & Pourtois colorized: r=.84, p<.001, Rossion & Pourtois non-colorized: r=.86, p<.001, Alario & Ferrand; r=.84, p<.001; Sanfeliú & Fernández: r=.68, p<.001).

Another variable that could be expected to show cross-language significant positive correlations is AoA. However, from the above mentioned studies only a single one (Alario & Ferrand, 1999) provided AoA scores for the black and white S&V drawings. The correlation analysis between our study and the Alario and Ferrand study for the AoA showed a significant positive correlation (r=.78, p<.001).

Table 3

Matrix of correlations between the reported measures for the Greek sample and the American, French and Spanish samples for the same colorized and non-colorized picture set.

	NA (*H*)	VC	AoA
American (Snodgrass & Vanderwart, 1980)	.45**	.82**	-
French Color (Rossion & Pourtois, 2004)	-.19	.84**	-
French (Rossion & Pourtois, 2004)	-.09	.86**	-
French (Alario & Ferrand, 1999)	.38**	.80**	.78**
Spanish (Sanfeliú & Fernández, 1996)	.53**	.68**	-

Note: NA (*H*), name agreement; VC, visual complexity; AoA, age of acquisition.
**significant at the $p<.001$ level

In conclusion, the present study presents Greek normative data for the set of 260 color pictures from Rossion and Pourtois (2004). A large group of native Greek speakers (330 university students) provided name agreement responses for these pictures, as well as ratings corresponding to their visual complexity and age of acquisition. To our knowledge, the set of norms provided here constitute the first normative study for a set of pictures in Modern Greek. We believe that these norms are a valuable tool for researchers throughout the different areas of cognitive psychology. Furthermore, we consider that these norms largely contribute to the recently initiated effort of standardizing the Greek language as well as at enhancing the limited research on Greek.

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Archived Materials

The following materials and links may be accessed through the Psychonomic Society's Norms, Stimuli and Data Archive, www.psychonomic.org/archive. To access these files or links search the archive for this article using the journal (*Behavior Research Methods, Instruments, & Computers*), the first author's name (Dimitropoulou) and the publication year (2009).

DESCRIPTION: The compressed archive file contains two files:

Appendix_A.pdf, containing the name agreement, visual complexity and age of acquisition norms for the 260 Rossion and Pourtois (2004) pictures.

Appendix_B.pdf, containing the above norms along with those reported by Snodgrass and Vanderwart (1980), Rossion and Pourtois (2004), Alario and Ferrand (1999) and Sanfeliú & Fernández (1996) for the colorized and non-colorized versions of the S&V picture set.

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Footnotes

Footnote 1: During object recognition texture and color information are considered to be of great relevance, especially for structurally similar objects and objects with a diagnostic color (e.g., fruits and vegetables). For instance, in the S&V picture databank, the image corresponding to "snow" could be very easily mistaken as a cloud. By including texture information this confusion is resolved. Similarly, the addition of color is fundamental in some cases, for example in discriminating between the images of an orange and a peach.

Footnote 2: In the present study participants did not rate the pictures for image agreement (the degree to which images generated by participants to a picture's name agree with the picture's appearance). The omission of this variable was based on previous evidence suggesting that image agreement does not predict naming latencies when the drawings presented include color information (Rossion & Pourtois, 2004; Weekes et al., 2007).

Footnote 3: Note that the pictures were divided into five subsets according to Rossion and Pourtois' (2004) subdivision (animals, fruits/vegetables, body parts, man-made objects, and unclassified) and into sixteen subsets based on Snodgrass and Vanderwart's (1980) subdivision (insects, musical instruments, vegetables, birds, carpenter's tools, clothing, fruits, animals, kitchen utensils, basic level, vehicles, human body parts, furniture, weapons, building parts, and toys).

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