Not just a pretty picture: Effects of colored drawings and photographs on living and non-living things naming

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Received August 25, 2025; Revised October 1, 2025; Accepted October 18, 2025

Abstract. Picture naming is the most commonly used task to assess different cognitive processes. Nowadays, the influence of stimulus format is a topic of discussion. According to some studies, the use of different visual formats affects concept recognition. Moreover, previous research has found that the use of either drawings or photos differentially influences the recognition of living things (LTs) and non-living things (NLTs). However, other studies did not identify differences across formats. This study aimed to assess whether the visual format of pictorial stimuli affects performance in an oral naming task, particularly across semantic domains: LTs and NLTs. Fifty-six Spanish-speaking adults were randomly assigned to name the same set of concepts, in colored drawings or in photograph format. Accuracy and reaction times were analyzed using generalized and linear mixed-effects models, respectively, with random intercepts for participants and items. No significant differences in accuracy were found between formats or semantic domains. However, participants named photographs significantly faster than drawings. Although NLTs were named faster than LTs, the difference did not reach statistical significance. While both formats yielded comparable accuracy, photographs facilitated faster lexical access, likely due to their higher visual iconicity. These findings support the use of photographs in clinical, educational and experimental research. The study also highlights the value of using mixed-effects models and the need to develop culturally adapted pictorial sets for Latin American populations.

Keywords: visual format, naming task, colored drawings, photographs, semantic domains, living things, non-living things.

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East European Journal of Psycholinguistics, 12(2), 278–293, https://doi.org/10.29038/mar

Мартінез-Квітіньо Макарена, Замора Долорес, Черутті Жозефіна Кастольо, Ромеро Нахуель Ніколас, Хуан Пабло Барейро. Не просто гарна картинка: Вплив формату кольорових рисунків та фотографій на називання живих та неживих об'єктів.

Анотація. Називання зображень є найпоширенішим завданням для оцінки різних когнітивних процесів. Сьогодні вплив формату стимулу є предметом дискусій. Згідно з деякими дослідженнями, використання різних візуальних форматів впливає на розпізнавання понять. Крім того, попередні дослідження виявили, що використання рисунків чи фотографій по-різному впливає на розпізнавання живих об'єктів та неживих об'єктів. Однак інші дослідження не виявили відмінностей між форматами. Це дослідження мало за мету оцінити, чи впливає візуальний формат зображувальних стимулів на продуктивність у завданні усного називання, зокрема в семантичних доменах живих і неживих об'єктів. П'ятдесят шість іспаномовних дорослих були випадковим чином відібрано для називання одного й того ж набору понять у форматі кольорових рисунків або фотографій. Точність та час реакції було проаналізовано з використанням узагальнених та лінійних моделей зі змішаними ефектами відповідно, з випадковим перетином для учасників та елементів. Не було виявлено значущих відмінностей у точності між форматами чи семантичними доменами. Проте учасники називали об'єкти на фотографіях значно швидше, ніж на рисунках. Хоча неживі об'єкти називалися швидше, ніж живі, різниця не досягла статистичної значущості. У той час як обидва формати забезпечили порівняну точність, фотографії сприяли швидшому лексичному доступу, ймовірно, через їхній вищий ступінь візуальної іконічності. Одержані висновки свідчать на користь використання фотографій у клінічних, освітніх та експериментальних дослідженнях. Дослідження також підкреслює цінність використання моделей зі змішаними ефектами та необхідність розробки культурно адаптованих наборів зображень для латиноамериканських популяцій вибіро).

Ключові слова: візуальний формат, завдання назвати, кольорові рисунки, фотографії, семантичні домени, живі об'єкти, неживі об'єкти.

Introduction

Visual stimuli are widely used in clinical, educational, and experimental research to assess cognitive functions such as memory, attention, and language (Souza *et al.*, 2020). In recent years, growing attention has been paid to the influence of pictorial materials, particularly drawings and photographs, in cognitive tasks.

Picture naming is one of the most frequently used tasks to assess lexical access and semantic processing. A schematic, simple and prototypical representation of a concept is presented in a pictorial format (such as a black-and-white or colored drawing, a gray or colored photograph), and the subject should retrieve the lexical item associated with the conceptual representation. The information recovered in a picture naming task allows conclusions about how conceptual information is processed and represented in semantic memory. Despite its apparent simplicity, picture naming involves complex

processes that depend on the nature of the visual stimulus format, which can facilitate or hinder access to semantic representations (Krautz & Keuleers, 2022).

Traditionally, black-and-white line drawings have been widely used to assess visual and lexical processing. Snodgrass and Vanderwart (1980) designed the seminal set of 260 black and white simple line drawings from different semantic categories. They obtained information about the main psycholinguistic variables that impact on visual recognition (image agreement, visual complexity, age of acquisition, among others). Since then, numerous sets have been developed and standardized for different languages and also for distinct cultures (Bartos & Diondet, 2024; Bonin et al., 2020; Duñabeitia et al., 2018; Gisbert-Muñoz et al., 2021; Moreno-Martinez et al., 2011; Nishimoto et al., 2005; Paplikar et al., 2022), expanding the pictorial tools available for research, educational and clinical contexts.

However, the use of black-and-white drawings has certain limitations. Rossion and Pourtois (2001, 2004) identified that black-and-white drawings were not easily recognized because the color attribute, omitted in this material, is part of the conceptual representation (i.e., lemon). Moreover, it has been found that the color of pictures and other perceptual properties have a differential impact on specific semantic categories. The absence of color in vegetables and fruits makes their recognition more difficult. For this reason, the Snodgrass and Vanderwart pictorial set incorporated the color (Snodgrass & Yuditsky, 1996). They found that color improves naming performance in terms of accuracy and also considering reaction times.

Based on the advantages identified using color, other corpora of colored drawings were created (Bakhtiar *et al.*, 2013; Dimitropoulou *et al.*, 2009; Raman *et al.*, 2014; Tsaparina *et al.*, 2011; Vivas *et al.*, 2022). However, another recent research identified that, while the amount of correct answers increased with the color format, longer reaction times were observed (Martínez-Cuitiño *et al.*, 2019). This increase in reaction times is related to the cognitive processes required to perceive the differences between the exemplars of a semantic category that share surface attributes of shape and color (i.e., lemon and lime).

In parallel, technological advances have enabled the development and standardization of photographic stimulus sets for adult (Adlington *et al.*, 2009; Krautz & Keuleers, 2021; Martínez *et al.*, 2020; Moreno-Martínez & Montoro, 2012; Ni *et al.*, 2019; Saryazdi *et al.*, 2018) and child populations (Martínez *et al.*, 2020; Martínez & Matute, 2019; Krautz & Keuleers, 2022). Photographs are considered more ecological stimuli because, unlike drawings, they offer a realistic representation of the concept, including surface details such as color, brightness, and shade (Martínez & Matute, 2019). These features may enhance perceptual processing and influence recognition speed.

Considering that pictorial characteristics of both formats (drawings and photographs) would affect object recognition processes and reaction times, new research has focused on elucidating which format facilitates recognition. Some compared the recognition of both materials taken from different corpora of stimuli (Biederman & Ju, 1988; O'Sullivan *et al.*, 2012; Shao & Stiegert, 2016), while others used black-and-white drawing and photograph stimuli from the same set (Salmon *et al.*, 2014). The evidence suggests that photographs prompt shorter reaction times and more correct answers, even compared to black-and-white drawings (Salmon *et al.*, 2014). Results are still controversial. O´Sullivan *et al.* (2012) found that, when naming photos, the use of specific names increases as the material allows identifying the subordinate concept. That is, when subjects look at a dog's photograph, they attempt to determine the animal's breed (i.e., a Dalmatian). By contrast, when a drawing is presented, participants keep the modal name (i.e., dog) and do not seek to access the breed. This suggests that visual stimulus format not only affects speed and accuracy but may also influence the level of semantic detail accessed. However, other studies did not identify differences between the two formats (Biederman & Ju, 1988). Moreover, a recent study (Adams *et al*., 2024) contrasted the same concept presented in grey vs. colored photographs and no differences in accuracy or reaction times between the two formats were identified

Although some studies have contrasted the influence of pictorial format on naming performance between the two formats (drawing vs. photograph), fewer studies have examined how this interaction affects semantic domains: living things (LTs) and non-living things (NLTs). Several studies suggest that the lack of visual detail, particularly color, can impair recognition of LTs, which often rely more heavily on surface features. For example, fruits and vegetables may be harder to identify without color cues (Chainay & Rosenthal, 1996; Rossion & Pourtois, 2001). However, findings are inconsistent, and further research is needed to clarify how visual formats interact with semantic domains.

This study aimed to examine the impact of visual format (drawings vs. photographs) on the oral naming of LTs and NLTs. We compared the recognition of the same set of concepts presented in both formats to healthy adult participants. According to the literature reviewed, we hypothesize that photographs will improve accuracy and reaction times for concepts, particularly for NLTs, which tend to elicit basic-level labels and are less visually confusable (e.g., a hammer). In contrast, LTs, which are more likely to be named at the subordinate level (e.g., specific dog breeds), may exhibit longer reaction times and lower accuracy due to increased visual and lexical competition.

Methods

Participants

In this study, 56 volunteers were divided into two material groups: (i) colored drawings and (ii) photos. The first group consisted of 28 subjects (70 % women), with a mean age of 27.57 years (*SD* = 5.71) and a mean of 16.82 years of education (*SD* = 2.52). The other group included 28 subjects (70 % women) with a mean age of 26.94 years (*SD* = 4.33) and a mean of 16.71 years of education (*SD* = 2.95).

The two groups were matched in gender, age ($t_{(27)}$= .447; p = .658) and years of education ($t_{(27)}$= .167; p = .869). All the subjects were native Spanish speakers from Argentina, with no history of psychiatric, neurological, or language acquisition problems. None of them presented any visual impairment at the time of the assessment. All participants provided written informed consent before the task.

This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethics Committee of the Faculty of Psychology, University of Buenos Aires (Approval No. CEI25026). All data were collected considering the Argentine Act No. 25525, which regulates the protection of personal data. All participants were assessed individually at the Institute of Cognitive Neurology, Favaloro University, or University of Buenos Aires. None of the participants received financial compensation for participating.

Materials

Stimuli consisted of 140 colored drawings taken from Cycowicz *et al*. (1997) and 140 photos taken from Brodeur *et al*. (2014). The same 140 concepts were shown using colored drawings and photographs. Half the stimuli depicted LTs and the other half represented NLTs. Each domain consisted of five categories with 14 exemplars per category. The categories included in the LTs domain were domestic animals, wild animals, insects, vegetables, and body parts. Those in the NLTs domain were utensils, transport, house objects, clothes, and musical instruments. Based on normative data for the Argentine adult population (Manoiloff *et al.*, 2010; Martínez-Cuitiño *et al.*, 2015), the lexical labels included in the lists were matched in the principal psycholinguistic variables: name agreement, subjective lexical frequency, conceptual familiarity, age of acquisition, number of syllables, and number of phonemes.

Procedure

Both tasks were designed and administered using the DMDX program (Foster & Forster, 2003). Subjects sat facing a microphone adjusted to an optimal distance from the participant's mouth to guarantee high-quality recordings. They had to name each stimulus using a single word, as accurately and quickly as possible. The design was based on the one reported by Laws (2000). Stimuli were individually presented against a white background in the center of the screen.

Before each picture, a fixation point (*) was presented for 400 ms, followed by a 200 ms blank screen. Next, the picture appeared for 800 ms, followed by another blank screen, which could last up to 4000 ms. Subjects could use this extra time to give their responses. If the subject uttered the answer before the first 800 ms had finished, the stimulus would remain visible for the duration of that period. Before starting with the task, participants performed a trial with 10 stimuli. The number of correct answers per subject and the response times (RTs) were recorded. The latter variable was indexed by voice-onset time, as measured with the Check Vocal program (Protopapas, 2007).

Analysis

The analyses were performed using Jamovi (The Jamovi Project, 2024), an open-source statistical software. Data were analyzed using mixed-effects models. First, a generalized linear mixed-effects model (GLMM) was used to analyze naming accuracy, a binary outcome (correct vs. incorrect answer). The model included accuracy as the dependent variable, and the fixed factors were the format (photos vs. colored drawings) and the semantic domain (LTs vs. NLTs), as well as their interaction. Random intercepts were items and participants to account for between-item and between-subject variability.

Second, to examine RTs, we employed a linear mixed-effects model (LMM). RTs were analyzed in their original millisecond scale. Extreme RTs (values exceeding ±2 standard deviations from the mean RT for each stimulus across participants) were excluded following the methodology proposed in psycholinguistic research (Gale *et al*., 2006; Snodgrass & Yuditsky, 1996). This represents less than 2 % of the data. As in the accuracy model, fixed effects included format, semantic domain, and their interaction, while random intercepts were specified for items and participants.

Results

Descriptive results for accuracy are presented in Table 1. This table shows the estimated marginal means for correct answers across visual formats (colored drawings and photographs) and semantic domains (NLTs and LTs).

Table 1
Estimated Marginal Means for Naming Accuracy (Proportion of Correct Answers)

Format	Domain	Mean	SE	95 % CI
Photograph	NLTs	.961	.0088	[.939, .975]
	LTs	.950	.0109	[.924, .968]
Colored drawing	NLTs	.954	.0105	[.928, .970]
	LTs	.944	.0124	[.915, .964]

Note. Accuracy values represent estimated marginal means derived from the GLMM. SE = standard error; CI = confidence interval. Accuracy is expressed as probability (range: 0–1). NLTs = Non-living things; LTs = Living things.

Detailed fixed-effects estimates from the generalized linear mixed-effects model (GLMM) for accuracy are presented in Table 2. Results indicated no significant main effect of format ($\chi^2_{(1)} = 3.07$, $p = .080$), semantic domain ($\chi^2_{(1)} = .55$, $p = .458$) or interaction between format and domain ($\chi^2_{(1)} = .16$, $p = .694$). Fixed-effect estimates confirmed these nonsignificant effects, with a trend toward higher accuracy in photographs (OR = .87, 95 % CI [.74, 1.02]).

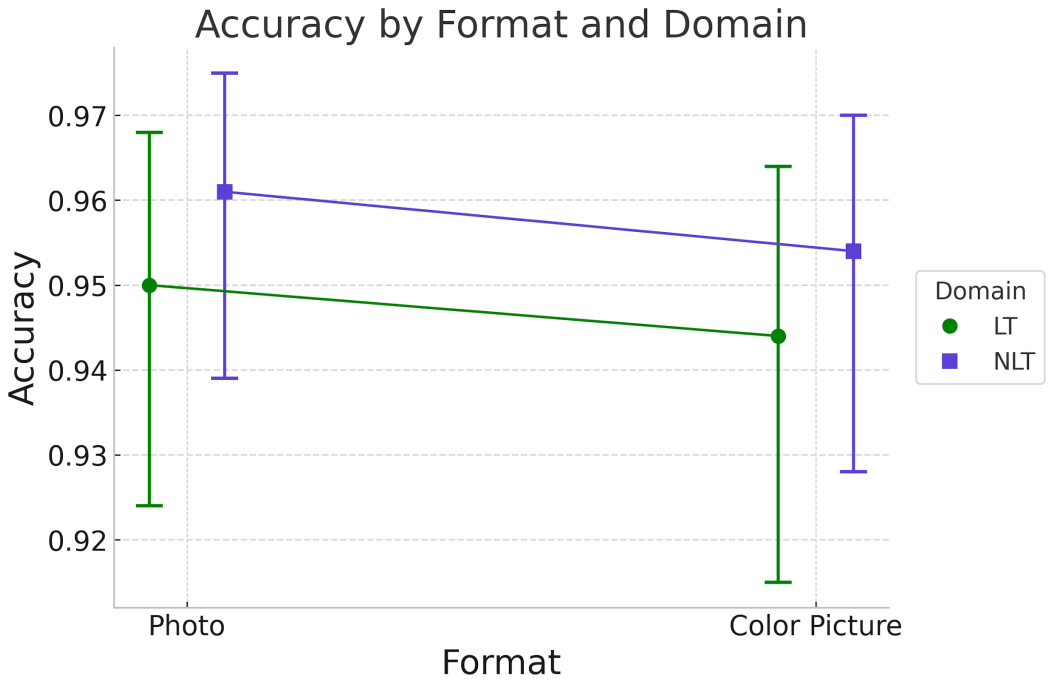
Table 2
Fixed Effects from the GLMM for Accuracy

Fixed Effect	Estimate	SE	OR	95 % CI	*z*	*p*
(Intercept)	3.0005	.1724	20.095	[14.33, 28.17]	17.39	<.001
Format						
Color vs. Photo	-.1433	.0818	.866	[.738, 1.020]	-1.15	.080
Domain						
LTs vs. NLTs	-.2205	.2973	.802	[0.448, 1.440]	-.74	.458
Interaction						
Color×Domain	.0576	.1464	1.059	[0.795, 1.410]	.39	.694

Note**.** SE = standard error; CI = confidence interval; OR = odds ratio; LTs = Living things; NLTs = Non-living things. Marginal $R^2 = .057$, Conditional $R^2 = .502$, $n = 5759$.

Accuracy was slightly higher for photographs, and across both formats, NLTs were named more accurately than LTs. The largest difference was observed in the photograph format, although none of these effects reached statistical significance. These differences between performances by formats and domains are illustrated in Figure 1.

Figure 1
Mean Accuracy Scores for LTs and NLTs Domains in Both Bormats



Post hoc analyses with Bonferroni correction revealed a significant advantage for NLTs over LTs across formats. This effect was consistent in both the photograph and colored drawing conditions, with no significant differences between formats or evidence of interaction.

For accuracy, the model revealed substantial variability across participants and items. The standard deviation of the random intercept for subjects was .515 (variance = .265; ICC = .074; 95 % CI [0.360, .736]), and for items, it was 1.623 (variance = 2.634; ICC = .446; 95 % CI [1.307, 2.016]).

Descriptive results for RTs are presented in Table 3. This table shows the estimated marginal means for reaction times across visual formats (colored drawings and photos) and semantic domains (NLTs and LTs).

Detailed fixed-effect estimates from the linear mixed-effects model (LMM) for RTs are presented in Table 4.

Table 3
Estimated Marginal Means for Reaction Times

Format	Domain	Mean	SE	95 % CI
Photograph	NLTs	1031	34.6	[963, 1100]
	LTs	1112.5	34.6	[1043, 1180]
Colored drawing	NLTs	1162	34.9	[1093, 1231]
	LTs	1169	34.9	[1169, 1307]

Note. Reaction time (RTs) values represent estimated marginal means (EMMs) derived from the LMM. SE = standard error; CI = confidence interval. RTs are expressed in milliseconds (ms). NLTs = Non-living things; LTs = Living things.

Table 4
Fixed Effects from the GLMM for Reaction Times

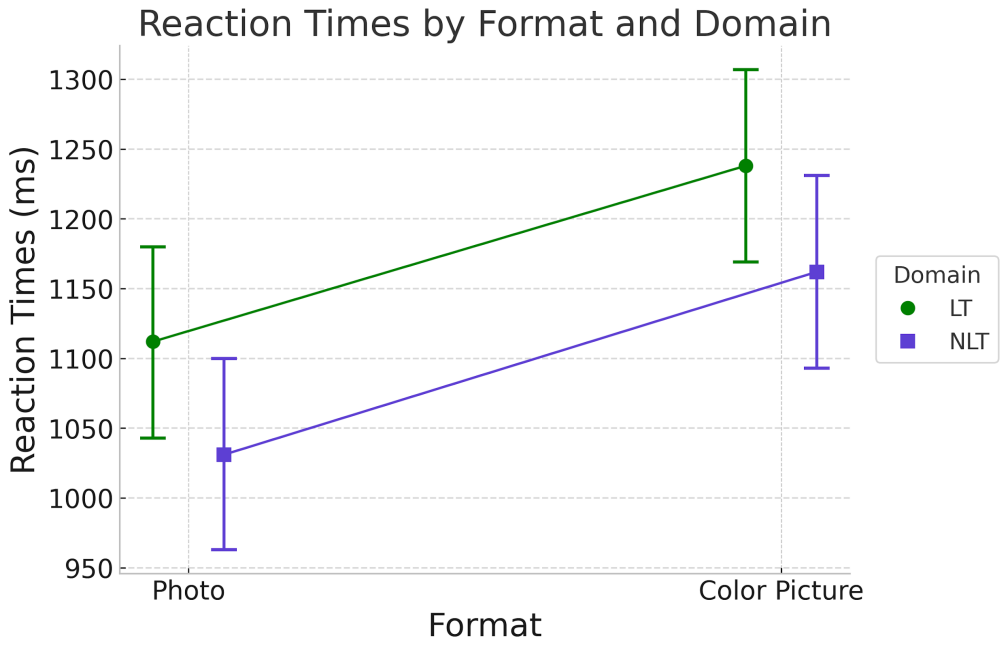
Fixed Effect	Estimate	SE	95 % CI	*t*	*p*
(Intercept)	1135.73	27.14	[1082.54, 1188.9]	41.845	<.001
Format					
Color vs. Photo	128.55	8.12	[112.53, 144.5]	15.829	<.001
Domain					
LTs vs. NLTs	77.95	42.03	[-4.42, 160.3]	1.855	.066
Interaction					
Color×Domain	-4.27	14.6	[-32.89, 24.4]	-.292	.0770

Note. SE = standard error; CI = confidence interval. LTs = Living things; NLTs = Non-living things. Marginal R^2 = .079, Conditional R^2 = .460, n = 4946.

For RTs, a significant main effect of format emerged ($F_{(1, 7328)}$ = 15.829, p < .001), indicating that photographs were named faster (M = 1071 ms) than colored drawings (M = 1200 ms). The analysis identifies a marginal effect of semantic domain ($F_{(1, 137)}$ = 1.855, p = .066). Additionally, the interaction between format

and domain was not statistically significant ($F_{(1,\ 7328)}$ = .292, p = .770). The estimated difference between formats was 129 ms (95 % CI [113, 145]), whereas the effect of domain was smaller and nonsignificant (78 ms, 95 % CI [−4, 160]). The RTs for both semantic domains across visual formats are illustrated in Figure 2.

Figure 2
Mean Reaction Times for LTs and NLTs Domains in Both Formats



The model also revealed substantial variability across participants and items. The standard deviation of the random intercept for subjects was 107 ms (variance = 11,432; ICC = .103; 95 % CI [87.4, 130.5]), and for items it was 244.7 ms (variance = 59,877; ICC = .377; 95 % CI [208.2, 279.9]). The residual standard deviation was 315 ms (variance = 99,198).

Discussion and Conclusions

The present study aimed to compare the performance of Spanish-speaking adults in a picture naming task using two visual formats: colored drawings and photographs. In previous studies using black-and-white line drawings, the impact of visual format has often been observed when comparing performance across semantic domains (LTs vs. NLTs). Therefore, we tried to determine whether LTs and NLTs are equally recognized when presented as colored drawings or photographs.

Nowadays, a different set of 2D-images (i.e., black-and-white drawings, colored drawings and color photographs) is available, and they differ in the degree to which pictorial materials resemble objects. Although drawings have been widely used in research and clinics with adults and children, their format may generate differences in perceptual processing and influence access to concepts. While drawings are prototypes and simple representations of concepts, photographs are considered a more ecological format because they are a realistic representation with more surface attributes. Moreover, the format material (drawings vs. photos) differs in visual iconicity, with drawings being less iconic material (Saryazdi et al., 2018).

The potential advantage of one material over the other (drawings vs. photographs) in adult processing is still controversial (Saryazdi *et al.*, 2018). Some studies have identified an advantage in recognizing drawings or photos (Brodeur et al., 2017; Salmon et al., 2014), while others have not found any differences (Biederman & Ju, 1988; Snow et al., 2014).

Another important aspect is that the format will be influenced differently depending on the cognitive processes required by the task. In a naming task, the aim is to recover a specific word associated with a picture. In this sense, a photograph of an object is a realistic representation of a category exemplar in a particular moment, whereas a drawing is a generalization of a concept. A previous study found that photograph naming generates more subordinate names (e.g., dog breeds) than more general names (e.g., dogs) in drawing naming (O'Sullivan et al., 2012). In addition, subordinate names occur more frequently in the LTs domain than in the NLTs domain.

In this study, no significant differences in performance (accuracy) were identified between the two formats (drawings vs. photographs). This means that participants correctly retrieve the same number of words regardless of the format used. However, a significant advantage for NLTs over LTs was observed, as we hypothesized. Thus, the hypotheses were only partially confirmed: photographs facilitated faster naming, but they did not significantly improve accuracy compared to colored drawings. These results align with previous studies in which the NLTs domain is better named than LTs using black-and-white drawings (Gaffan & Heywood, 1993; Martínez Cuitiño & Jaichenco, 2015). In this study, the greater number of surface attributes presented in photographs does not modify the number of correct answers. However, photographs were named faster than drawings, and this pattern suggests that photos, likely due to their higher visual iconicity and greater ecological validity, facilitate faster lexical access. Finally, although there was a trend toward faster naming of NLTs compared to LTs, this effect did not reach significance, even if the direction was consistent with previous studies

(Humphreys et al., 1988; Lloyd-Jones & Humphreys, 1997; Martínez-Cuitiño et al., 2019; Moreno-Martínez & Moratilla-Pérez, 2016)

Our results show that photographs facilitate perceptual processing in adult subjects. This advantage is observed in the RTs, but not so in the number of correct responses in the naming task. Although our findings are largely consistent with previous studies regarding the influence of visual format in naming tasks, the present research offers a methodological contribution that strengthens the robustness of these results: the use of mixed-effects models to examine both accuracy and reaction times. These models enable a more precise estimation of the influence of format and semantic domain, while accounting for item and participant variability. This approach enhances the reliability of our findings and underscores the importance of incorporating such models in psycholinguistic and cognitive research.

These findings have some practical implications. In educational and clinical practices, pictorial stimuli are frequently used to assess lexical access or semantic processing, so the visual format can affect recognition and processing speed. Therefore, photographs may produce advantages when efficiency is essential, such as in reaction time assessments or interventions that target processing speed.

A limitation of this study is that the photographic set used in the naming task was developed for another cultural population, not for Spanish-speaking adults from Latin America. Nowadays, other sets of photographs have been standardized for different languages and cultures (Decuyper et al., 2021; Brodeur et al., 2014), but none of those sets have been normed on Latin American populations. Consequently, an important aspect to consider in future research is to create a photographic set for these cultures, along with the assessment of the potential impact of Spanish language variants on the naming of LT and NLT.

Another limitation is that, although the same concepts were presented across both visual formats, the images were not strictly identical in their visual representations, unlike in Adams et al. (2024). Variations in visual attributes such as contour, perspective, and detail may have impacted accuracy or reaction times. In future studies, this limitation can be overcome using artificial intelligence tools, which enable the generation of photographs based on drawings while replicating key visual characteristics (i.e., shape, orientation, proportions). This new method offers a promising approach to achieving greater consistency across various formats.

Future studies could explore the effects of visual format in other tasks, such as semantic categorization or association tasks. Additionally, it would be valuable to examine whether the facilitation observed with photographs extends to clinical populations or individuals with varying educational

backgrounds, given that visual iconicity may differentially influence processing across these variables.

Funding

The study is carried out within the research project *Access to Conceptual Representations from Different Visual Formats: Vector Drawings, Photographs, and Emoji* supported by the National Scientific and Technical Research Council (CONICET), Argentina.

Disclosure Statement

The authors reported no potential conflicts of interest.

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