Abstract

This paper presents the results of a picture-naming and picture-categorization task incorporating high-quality color images and low-quality black and white images. Research participants—all adults recruited from a beginning-level, community-based English as a Second Language (ESL) class—were asked to perform two tasks: 1) naming *all* the pictures they saw appear on a computer screen one-by-one, and 2) naming *only* the pictures which appeared on the screen and belonged to a certain semantic category, such as fruits. In conditions involving high-quality pictures, research participants performed similarly on both the naming and categorization tasks, suggesting that the two tasks require equal access to the semantic processing systems. However, in conditions involving low-quality images, participants performed significantly more slowly on the picture-naming task than they did on the picture-categorization task, suggesting that picture-naming may require fuller access to the semantic system in the case of low-quality images. The results of the higher processing cost for picture naming, as well as implications for language teaching, will be discussed in the paper.

Asymmetries in Naming and Categorizing Low-Quality Pictures: A Pilot Study of Learners in a Community-Based Adult ESL Class

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Introduction and Theoretical Underpinnings

Naming and Categorization Tasks

The speed at which adults name and categorize pictures and words reveals the psycholinguistic processes involved in these different tasks. Previous research has shown that research participants perform faster on word-naming tasks, such as saying every item on a given word list, compared to when they are asked to perform a word-categorization tasks, such as saying *only* the words on a list which belong to a specific semantic category, such as fruits (Lotto, 1996; Job & Tenconi, 2002). However, unlike words, *picture* naming has been found to be slower than picture categorization (Lloyd-Jones & Humphreys, 1997). In addition, pictures are named more slowly, but categorized more quickly, than words (Job, Rumiati, & Lotto, 1992). These distinctions suggest that different psycholinguistic processes are involved in the two modalities.

One of the main explanations for participants' asymmetric performance on picture and word naming and categorization tasks considers the system (lexical or semantic) through which words are retrieved. Dual-route models maintain that access to the semantic system is required for picture naming and categorization, whereas *word* naming can be accomplished through a variety of routes: a nonlexical route, a lexical nonsemantic route, or a semantic route (Job & Tenconi, 2002, p. 793). In other words, word naming does not require access to the semantic system, but word categorization does. In addition, according to this model, pictures may be *categorized* more quickly than they are *named* because picture categorization may require partial access to the semantic system, whereas picture naming could be expected to require fuller access (p. 790).

Job and Tenconi (2002) found that word classification is indeed slower than word naming, but shockingly, they found no significant difference between naming and classifying pictures. In their study, university students were randomly assigned to one of two conditions. In the conditional-naming conditions, they were presented with an entire list of stimuli but only instructed to name the words or pictures in a prespecified category (biological elements or artifacts). In the free-naming conditions, participants named *all* words or pictures. In other words, in the free-naming conditions, they read each word that appeared on their screen, whereas in the conditional naming task, participants only read the word on the screen if it belonged to the specified category. If the category was biological elements, and a train appeared on the screen, they remained silent. In experiment one, i.e., word naming and categorization, participants' reaction times were significantly longer when they had to classify words as opposed to just name them. However, in experiment two, which involved pictures instead of words, conditional naming tasks did not result in longer response times as compared with the free-naming task. The authors also found that participants' reaction times to words were significantly faster than their reaction times to pictures, with their conditional naming of words approximately 100 ms faster, on average, than their conditional naming of pictures. Job and Tenconi (2002) conclude that categorizing pictures before naming them actually does not require an extra processing step, unlike categorizing words, and they suggest that both free and conditional naming of pictures

require the same levels of activation in the structural description system, the semantic system, and the name-production system. However, more research is needed to fully explore the implications of Job and Tenconi's (2002) findings. First, their experiment tested participants in their L1, so it is unclear whether the same results would hold if they tested bilingual participants in their L2. In addition, they only tested highly literate participants (university students), which may not be representative of other populations, such as learners with less formal education.

Another factor that Job and Tenconi (2002) did not explore is picture quality, which could impact participants' performance on picture naming and categorization tasks. Several other studies have examined how picture quality influences performance on a variety of picture naming and categorization tasks for monolingual and bilingual participants. Laws and Hunter (2006) examined how variations in viewing conditions (i.e., presentation speed, image blurring, and color, for example) varied by category (e.g., natural vs. man-made objects). They found that color provides an advantage for natural, but not man-made, items. Similarly, Zannino et al. (2010) found that color helps semantic processing of stimuli and impacts the visual (image agreement) part of the recognition process. Considering both characteristics of the participants and of the pictures, Severens, Lommel, Van, Ratinckz and Hartsuiker (2005) found that age-of-acquisition of a language as well as number of syllables influenced naming latencies in picture naming tasks in Dutch.

The language in which participants are tested also impacts their performance on picture naming and categorization tasks. Previous research has found that bilingual participants perform differently in their L2 than in their L1 on picture naming and categorization tasks (Gollan, Montoya, Fennema-Notestine & Morris, 2005; Hernandez & Meschyan, 2006). Bilinguals name pictures more slowly than monolinguals (Gollan et al., 2005), and picture naming in a less proficient L2 requires increased executive function (Hernandez & Meschyan, 2006), In fact, Gollan et al. (2005) concluded that "bilinguals differ from monolinguals at a postconceptual processing level, that implicit activation of lexical representations in the non-target language can facilitate retrieval in the target language and that being bilingual is analogous to having a lexicon full of lower frequency words, relative to monolinguals" (p. 1220). These findings suggest the need to further explore the differences between naming and categorizing tasks in an L1 and L2.

The impact of high- and low- quality images may also depend on participants' level of literacy and formal education. Research participants with limited or no print literacy, for example, perform much differently on tasks than typical subject pools of university students (Olivers, Huettig, Singh, & Mishra, 2014; Reis & Castro-Caldas, 1997; Smith, Monaghan, & Huettig, 2014). Huettig and Mishra (2014) explain that literacy impacts cognitive processing "in non-trivial ways" (p. 401). Literacy impacts not only auditory and visual perception, and phonological processing (including phonological awareness, pseudoword repetition, phonological fluency, and phonological word-object mapping), but also memory, abstract categorization, inference, and semantic processing, with individuals with no print literacy performing much better at memorizing pairs of semantically related words compared to pairs of phonologically related words (Huettig and Mishra, 2014, p. 410). Huettig, Singh and Mishra (2011) found that low literates (i.e., individuals with very limited literacy and/or limited to no formal schooling) achieve word-object mapping largely at the semantic level, relying when necessary on phonological information but much less proficiently than individuals with high levels of print literacy. Reis and Castro-Caldas (1997) also noted that semantics is a major reference system for language processing for illiterate adults, suggesting that secondary systems are developed through formal learning. In other words, adults with limited print literacy rely on

their semantic system—rather than the phonological or other systems—in word-recognition and repetition tasks.

The present experiment attempts to address some of the gaps in the current literature, such as how bilinguals perform on conditional and free picture naming tasks in their L2, whether quality of an image impacts their performance, and how adult English L2 learners at the community level perform in conditional and free naming tasks involving pictures. The study examines conditional and free naming of high- and low-quality visual images for bilingual, Spanish (L1) beginning-level English (L2) speakers and attempts to answer the following questions:

1. What are the relative *processing costs* (as indicated by participant response times in these tasks) of naming and classifying high resolution color photographs as compared to lower quality black and white images?
2. Do beginning-level L2 learners name and categorize pictures at the same rate?
3. When varying the *quality* of images in a naming task, do beginning-level L2 learners name and categorize pictures at the same rate?

Methods

Seven participants took part in the study. Participants were female L1 Spanish speakers who began learning English as adults. Six of the seven were currently enrolled in the same beginning-level, community-based English as a Second Language course offered for free in a metropolitan area in the American Southwest. Six participants were from Mexico and one was from Honduras. All of them had immigrated to the United States as adults and were between 21 and 50 years old. They had varying degrees of formal education, ranging from three years of elementary school to vocational degrees in their home countries.

Participants consented to participate in the IRB-approved project, and were familiar with all items on the list before the experiment began. A bilingual Spanish L1 speaker went through the experiment before it was given to participants to make sure it ran smoothly. All items were high-frequency basic nouns that they would encounter in a beginning-level English as a Second Language class. They were tested in a quiet computer lab at a public library, where they attended ESL classes. The researcher sat with participants individually as they performed the experiment to answer any technological questions that arose and verbally explain the instructions before each part of the experiment. After 10-15 practice items in which they were asked to free name or conditionally name pictures that appeared on the screen, participants began the tasks. In each of the four conditions in the experiment, participants were presented with a free naming task followed by a conditional naming task using high- or low-quality images. Then they repeated the task with the second "quality" condition. Quality and order of items were counterbalanced.

Materials and Design

The experiment was programmed using DMDX (Forster & Forster, 2003). Each subject was tested on twenty free-naming items and twenty conditional-naming items (paired with twenty total nonexemplars). The participants performed the task using both high- and low-quality images. There were four conditions:

Condition A: Free and conditional naming of high-quality images followed by low-quality images

Condition B: Free and conditional naming tasks counter-balanced with condition A

Condition C: Free and conditional naming of low-quality images followed by high-quality images

Condition D: Free and conditional naming tasks counter-balanced with condition C

In conditions A and B, the free and conditional item sets were counter balanced. Participants began with the free and conditional naming task using high-quality images and then repeated the same task (using the same images, which were scrambled differently) using low-quality images. In conditions C and D, the item set was the same as in conditions A and B, respectively, but the quality was counterbalanced so that participants began with low-quality images before moving on to high-quality images. The practice items allowed participants to become familiar with the format of the experiment. The item set is listed below:

Practice items (10-15):

Articles of clothing (shirt, pants, coat, socks, underwear, dress, shoes, shorts, belt)
Food (bread, chicken, beef, pork, fish, rice, beans, eggs, butter)

Experimental item set 1 (20):

Fruits (apple, strawberry, orange, banana, grapes)
Body parts (hand, foot, nose, eye, ear)
School items (pencil, book, pen, scissors, backpack)
Furniture (table, chair, desk, bed, couch)

Experimental item set 2 (20):

Vegetables (potato, onion, carrot, corn, pepper)
Animals (cat, dog, horse, cow, pig)
Kitchen items (fork, spoon, knife, cup, plate)
Transportation (bike, car, bus, plane, boat)

Nonexamplars (20):

clock, key, glasses, toothbrush, tree, cactus, house, purse, flower, ball, computer, pillow, blanket, phone, camera, police officer, sandals, umbrella, necklace, ring

Overall, the experiment included 80 items (40 high-quality and 40 low-quality similar images), 40 nonexemplars (20 high-quality items and 20 low-quality items), and 15 practice items. Participants in conditions A and B were given high-quality practice items while participants in conditions C and D were given low-quality practice items. Images appeared on the screen one at a time. Items appeared on the screen for 4000 ms, and nonexemplars appeared on the screen for 2000 ms. Participants were instructed to respond vocally as quickly as possible, and the voice key in DMDX recorded their response time in milliseconds. They were asked not to respond to nonexamplars, which disappeared from the screen after 2000 ms. After participants responded vocally, the next item appeared. Below are examples of high- and low-quality items that appeared in the experiment.

Figure 1. High-Quality Banana

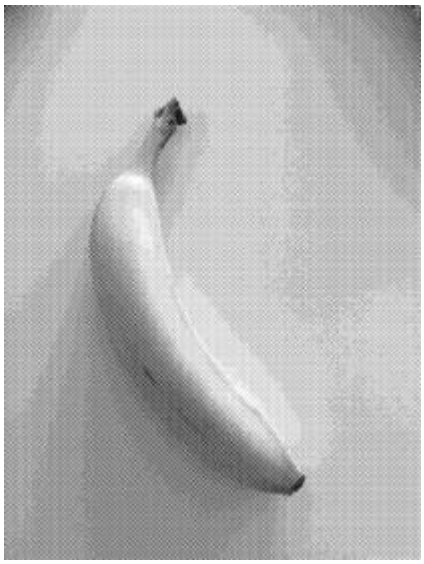

Figure 2. Low-Quality Banana

Figure 3. High-Quality Dog

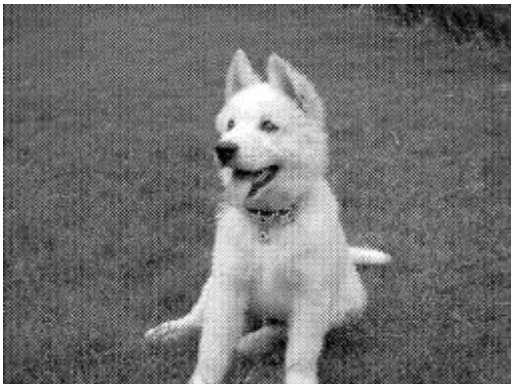

Figure 4. Low-Quality Dog

Mean reaction times for each condition were calculated. Data more than two standard deviations from the mean were trimmed (a total of 51 items, bringing the total data from 560 to 509 items). Mixed effects modeling was used to determine which variables (task, quality, and order) were correlated with reaction times.

Results

Table 1: Mean Reaction Times, Conditions A-D

	High-Quality Images	**Low-Quality Images**
Free Naming	1369.108	1314.713
Conditional Naming	1354.439	1261.714
Task Effect	14.669	52.999

After calculating the mean reaction times for all the trials, mean reaction times for each task in conditions A and B (which began with high-quality items) and conditions C and D (which

began with low-quality items) were calculated. In all cases, the task effect was calculated for the high- and low-quality conditions.

Table 2: Mean Reaction Times, Conditions A & B

	High-Quality Images	Low-Quality Images
Free Naming	1454.100	1265.145
Conditional Naming	1460.273	1190.819
Task Effect	6.173	74.326

Table 3: Mean Reaction Times, Conditions C & D

	High-Quality Images	Low-Quality Images
Free Naming	1185.621	1519.211
Conditional Naming	1262.569	1290.804
Task Effect	76.948	228.407

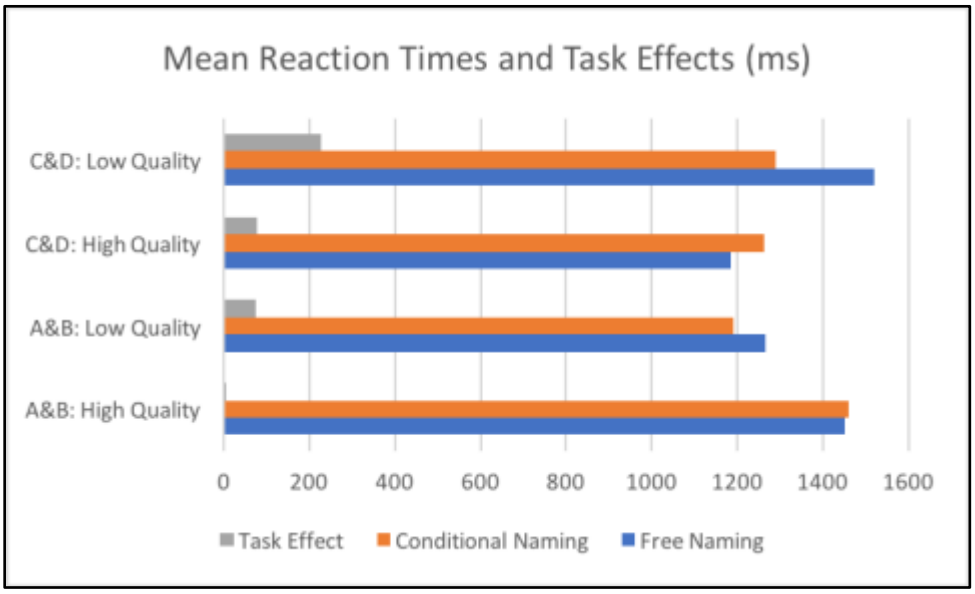

Figure 5. Mean Reaction Times (ms) for High- and Low-Quality Items

Figure 5 shows the average reaction times for each task. Conditions A and B are grouped because participants in these conditions were presented with high-quality images followed by low-quality images. In conditions C and D, participants were presented with the lower quality images followed by the higher quality images.

The data were analyzed using linear mixed effects modeling, and statistics were calculated using the *lmer4* package in R (R core team, 2013). There was a significant effect of quality, both for conditions A and B, in which high-quality images were presented first ($F = 40.69$, $p < .001$) as well as in conditions C and D, in which low-quality images were presented to participants first ($F = 68.49$, $p < .003$).

Task type and quality were fixed factors, while subjects and items were random factors. The experiment was by-subject, with all subjects and all items participating in each condition (quality, i.e., high or low, and task type, i.e., naming or categorizing). Only the order in which items appeared varied. Therefore, the factors of quality and task type had random slopes by both subject and by item in LME. Both subjects and items have random intercepts. Since the design is counterbalanced, the statistics by subjects will be reported.

In all of these cases, there was no significant main effect for tasks involving high-quality images, but the task effect in trials involving low-quality images was significant. In other words, for tasks involving high-quality images, participants' performance was not significantly different in the free naming task and the conditional naming task. However, in all conditions, there was a significant difference in how participants performed in each task, with free naming taking longer than conditional naming. Order interacted with the task—that is, participants performed more quickly on the second task they were given—but order was not significant and was not a main effect.

Table 4: Summary of statistics (LME analysis) for reaction times to low quality images

Low-Quality Images	
Mean	1266.23
T-value	2.388
Effects	132.15
P-value	0.0177

Table 5: Summary of statistics (LME analysis) for reaction times to high quality images

High-Quality Images	
Mean	1375.448
T-value	-0.188
Effects	-9.172
P-value	.851

Discussion and Conclusions

In the current study, the results were expected to provide information about the semantic processes participants used to name or categorize items. If the processing cost is much greater for low-quality pictures than for rich, well-represented images, one may conclude that semantic representation of the lower quality object does not include information about its category. For example, a difference due to quality of pictures could have indicated that when research participants see a poor picture, then the semantic properties of that object aren't as readily available. Similarly, if there had been no cost for conditional naming even though the pictures were low quality, one could conclude that the relevant semantic properties were still present and as readily accessible as the high-quality images.

The results of the current experiment concur with Job and Tenconi's (2002) results, which suggest that there is no difference between free naming and categorical naming of pictures, but only for high-quality images. Job and Tenconi argue that there is no difference for picture naming and categorization because when we see a picture the semantics are directly available from the physical signal, unlike when we name and categorize words. For the high-quality items in the current experiment, there is relatively little difference between the free naming and categorical naming conditions. In other words, there is no main effect for high-quality items, which is consistent with Job and Tenconi's (2002) findings.

However, for low-quality items, conditional naming is significantly faster than free naming. In fact, quality has a highly significant effect on naming, even with a subject pool of seven, a sample which is not expected to yield high statistical power. This is a surprising finding given the processing costs of categorization before naming. However, the results suggest that conditional naming doesn't have to take longer than free naming and may depend on the quality of an image.

The results, which indicate that the effect is significantly greater for low-quality images, are surprising but could be explained in a number of ways. One explanation could be that the presence of a category guides the interpretation of a picture. For example, if participants are asked to name fruits, they will be anticipating items which belong to this semantic category. In cases where the image is ambiguous, having a category could provide a helpful clue, and research participants can infer that 50% of images that appear on the screen in a conditional task will belong to the given category. However, the images in the experiment were recognizable and unambiguous. Another explanation could be that there are different processing costs for free and conditional naming tasks which cancel each other out. Conditional naming offers the subject an advantage (i.e., a category), as well as providing a processing cost (i.e., deciding whether to respond). It could be the case that the effect of visual quality is greater than the effect of conditional naming, leading the conditional naming results to be faster than free naming in the case of lower quality images.

These findings could have implications for L2 teachers, especially those working with beginning-level language learners in community-based settings (like the participants in this study). Teachers in community-based contexts must often create or compile their own materials, and due to the cost of color printing, they might find lower quality black-and-white images more accessible. However, teachers should keep in mind that the quality of images directly influences how adults process them; this is especially true for low-quality items. Participants in this study performed more slowly in both tasks involving low-quality images, but their performance on the free-naming tasking involving low-quality pictures was significantly slower. These findings suggest that while using high-quality images is ideal, teachers using low-quality images should present these images in a highly contextualized way, such as a categorization task, to ensure they are as clear to learners as possible. Asking learners to free-name low-quality pictures will result in a high processing cost, and teachers should especially avoid presenting low-quality images without a category or context. This may be especially important for teachers working with learners who are acquiring print-literacy for the first time, since these learners may rely more heavily on the semantic system than their highly literate counterparts.

This study is also important because it recruited participants from the population of learners the research aimed to benefit. Studies in psycholinguistics research most often recruit highly educated participants, such as university students, because these participants are easy to access. However, it is not clear whether the results of these studies generalize to other populations, such as adult L2 learners with limited formal education or print literacy. This lack of generalizability is significant for language teachers, since psycholinguistics research typically informs pedagogical approaches.

This project examined how adult L2 learners in a beginning-level English as a Second Language (ESL) class performed on picture naming and categorization tasks. It aimed to 1) understand the psycholinguistic processes these learners use to name words and 2) identify pedagogical implications for community-based language learning contexts.

The results of this experiment indicate that the difference between free and conditional naming holds only for low-quality images. In order to understand how these results compare with Job and Tenconi's (2002) experiments, a word-naming task would be necessary. Specifically, degradation of words would be required. In addition, more research is needed on how the subject pool impacts these results. Future research should group participants according to the number of years of formal education they have received. This would allow researchers to better understand how cognitive processes involved in picture naming and categorization vary with formal education. In addition, the study included a small number of participants. The pilot study was helpful, because adult learners' time is valuable. Unlike university students, they do not receive extra credit or other incentives for participating in the research, and it was important for me, the researcher, to only ask them to participate in research tasks which were expected to have significant implications and would benefit them pedagogically. In the future, the research should be expanded to include a larger pool of participants, which would lead to greater statistical power, or the likelihood of finding a significant effect if it does exist.

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