Psicológica (2009), 30, 301-321.

The naming of gender-marked pronouns supports interactivity in models of lexical access

Eduardo Navarrete[*1] & Albert Costa[2]

[1]*Center for Brain/Mind Sciences (CIMeC), University of Trento, Italy*
[2]*ICREA, Universitat Pompeu Fabra, Barcelona, Spain*

When a speaker names an object using a gender-marked pronominal form, the referent word corresponding to the target object has to be selected in order to access the grammatical gender. By contrast, the phonological content of the referent word is not needed. In two picture-naming interference experiments we explored whether the lexical selection of a referent word is affected by its phonological properties. In Experiment 1, Spanish participants named pictures using a sentence with a noun or a pronoun while ignoring words semantically or phonologically related. The results showed a semantic interference effect and a Phonological Facilitation Effect (PFE) in both type of utterances. In Experiment 2 the PFE was replicated with Italian participants in a different pronominal utterance. The PFE suggests that the lexical selection of the referent word is facilitated by the presentation of a distractor word phonologically related. These findings are consistent with the predictions of interactive models of lexical access.

Current models of lexical access in speech production agree on the notion that semantic, lexical-syntactic and phonological information are stored at different levels of processing. However, models still disagree about the dynamics of the activation flow through these different levels of processing. The major disagreement regards to the extension with which models restrict the flow of the activation between the lexical-syntactic and the phonological levels of processing. For instance, the so-called discrete models of lexical access assume that only selected lexical representations are in disposition to activate phonological representations; while cascade models of lexical access assume that any activated lexical representation

* Eduardo Navarrete was supported by a postdoctoral grant of the Departament d'Universitats, Recerca i Societat de la Informació de la Generalitat de Catalunya. We are grateful to Mikel Santesteban for his comments on the manuscript and to Davide Pluda for his help running the Italian participants. Address for Correspondence: Eduardo Navarrete.Center for Mind/Brain Sciences. University of Trento. Corso Bettini, 31. I-38068-Rovereto, Italy. Email: eduardo.navarrete@unitn.it

propagates part of its activation to phonological representations independently of whether it is finally produced or not (for a revision of the discrete/cascade debate in spoken word production, see Navarrete and Costa, 2005)

Another topic of disagreement regarding the activation flow refers to whether or not models allow interactivity between lexical and phonological representations. Feed-forward proposals of lexical access assume that information flows in only one direction: from the lexical to the phonological level (e.g., Caramazza, 1997; Levelt, Roelofs & Meyer, 1999a; Jescheniak, Schriefers & Hantsch, 2001). According to these models, processes that occur at a certain level of processing would be unaffected by processes that take place at lower levels of the system. In this sense, the lexical selection of a word would be unaffected by its phonological properties. By contrast, interactive models assume both top-down (from lexical to phonological) and bottom-up (from phonological to lexical) direction of the activation (e.g. Dell, 1986; Harley, 1993; Rapp & Goldrick, 2000). According to the interactivity account, the activation that phonological representations send back to lexical representations could affect the lexicalization process over the target word. In this article we test the interactivity hypothesis in speech production by exploring whether processes that are localized at a phonological level of processing are also observable at a lexical level of processing.

One of the most reliable findings in the field of spoken word production is the observation that picture naming latencies decrease when the phonological content of the target word is primed by a phonologically related word (Schriefers, Meyer & Levelt, 1990; see below). Here we explore whether phonological priming effects are still reliable in naming tasks that do require the lexical selection of the target word but do not require its phonological encoding. We did that in two gender-marked pronominal production experiments. In the following paragraphs we describe how gender-marked pronominal production is achieved.

Gender-marked pronominal production

In languages like German or Spanish, the form of gender-marked pronouns depends on the grammatical gender of the referent noun. Thus, the Spanish pronominal form *esta* (this$_{fem}$ one) corresponds to feminine nouns while the form of masculine nouns is *este* (this$_{mas}$ one). It is generally assumed that grammatical gender is a syntactic feature of the nouns (Caramazza, 1997; Levelt et al. 1999; Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997; Vigliocco & Franck, 1999). Although in some cases

grammatical gender is contingent on conceptual properties as with natural gender, the grammatical gender of a lexical item generally cannot be predicted from conceptual properties and, therefore, speakers have to retrieve the lexical item in order to access it. Supporting this idea is the fact that some translation equivalent words have different grammatical genders in different languages. For instance, the words moon and death are masculine in German (*Moond*, *Todt*) but feminine in Italian (*luna*, *morte*). If grammatical gender is a conceptual property, we should expect the gender of a noun to be the same across languages.

In the same vein, it is also assumed that grammatical gender is independent of phonological properties. Despite the fact that in some languages there is a correlation between the phonological properties and the grammatical gender (e.g., Spanish words ending in *-o* are predominantly masculine), evidence from tip of the tongue studies (e.g., Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997) and from the performance of aphasic patients (Badecker, Miozzo, & Zanuttini, 1995; Leek, Tainturier, & Wyn, 2003; Tainturier, Leek, Schiemenz, Williams, Thomas, & Gathercole, 2005) shows that the retrieval of grammatical gender and the retrieval of phonological information are two dissociated phenomena. This evidence supports the assumption that grammatical gender forms part of lexical knowledge and is stored independently of the phonological properties.

In sum, the production of a gender-marked pronominal form entails the lexical selection of the referent noun but not the selection of its phonological content. In such a situation, we can explore whether the selection of the lexical representation corresponding to the referent noun is affected by priming its phonological properties. One paradigm that allows this experimental manipulation is the picture-word interference naming task. In this kind of task, participants name pictures while ignoring distractor words. One of the most stable effects in this paradigm is the Phonological Facilitation Effect (hence after, PFE): naming latencies are faster when the target picture (e.g., dog) and the distractor word (doll) share phonological segments than when they are phonologically unrelated (table). The usual explanation for the PFE is that the distractor word primes part of the target's phonological representation that is going to be uttered (e.g., Schriefers et al., 1990, Levelt, Roelofs and Meyer, 1999b).

In the two experiments reported here participants named target pictures through gender-marked pronominal utterances while ignoring the presentation of distractor words phonologically related or unrelated to the picture. Crucially, models of lexical access make different predictions. Interactive models predict that the priming of the phonological segments of the referent noun should led to faster naming latencies. This would be so

because the referent noun would receive more activation from the phonological representations in the phonologically related condition than in the unrelated one. By contrast, feed-forward models do not predict influence of phonologically related distractors during pronominal tasks. This is so because these models avoid feedback links from phonological to lexical representations. To our knowledge, three studies have addressed the influence of phonological distractor words during pronominal naming tasks. In the next section we describe these studies.

The Picture-word interference paradigm in pronominal production

The first study was conducted by Jescheniak et al. (2001). In the relevant condition here, German speakers were instructed to name pictures with pronominal forms while ignoring the presentation of auditory distractor words. Phonological and semantic conditions were explored. The results showed a semantic interference effect, that is, pronominal naming latencies were slower in the context of distractor words semantically related to the picture than in the context of semantically unrelated words. In the phonological condition no differences between phonologically related words and unrelated words were observed. While the semantic interference effect was taken as evidence that in pronominal utterances participants were selecting the referent noun; the lack of phonological effects was interpreted as evidence that the phonological content of the referent noun was not activated[1]. In line with this evidence, Finocchiaro and Caramazza (2006) observed a same pattern of effects: lack of phonological effects in the context of semantic interference effects in an Italian clitic naming task. Participants were instructed to name target pictures thorough construction as "*portalo*" (bring it mas). Crucially, Italian clitics are gender-marked, and thus, in order to perform the task, target pictures need to be lexically selected.

[1] The rationale of the argument is beyond our main aim here. According to the authors, if the referent noun activates its phonological form, interference should appear from a phonologically related distractor as compared to an unrelated distractor. This would be so because in the related condition the distractor would activate the already activated noun's phonological form, leading to highly activated non-target phonological segments. In this condition, the non-target phonological segments would interfere with the processing of the phonological encoding of the pronoun form more strongly than in the unrelated condition (see for other studies with the same argument Jescheniak & Schriefers, 1998; Oppermann, Jescheniak & Schriefers, 2008).

The null phonological effect on the previous two studies has to be taken cautiously because it contrasts with the data obtained by Starreveld and La Heij (2004) in Dutch. In the first experiment of this study, article naming latencies were faster when target pictures were presented with phonologically related distractor words than with phonologically unrelated distractor words. This effect was replicated in a second experiment with one-letter distractor stimuli. Finally, the PFE from initial-letter distractor was replicated in a manual-response gender decision task. Altogether, the results of Starreveld and La Heij indicate that phonological related distractors (completed words and initial letters) affect the lexical selection process of words that are not produced[2].

So far, the evidence reported in the above mentioned studies seems to be contradictory. While Jescheniak et al. (2001) and Finocchiaro and Caramazza (2006) did not reported phonological effects, Starreveld and La Heij (2004) get to phonological facilitation effects. What can account for this discrepancy? One difference between these studies that could account for the discrepancy is the response format. While in the first two studies participants provide their responses through sentence utterances; this is not the case in the last study, in which participants produced articles or make button-press responses. It is important to remark here that some studies have argued the existence of syntactic modulations in the propagation of the activation between lexical and phonological representations. For instance, Jescheniak et al. (2001) argued that in pronominal utterances the referent nouns do not activate its phonological content because the propagation of the activation is blocked by the syntactic frame. According to them, the syntactic frame involved in pronominal utterances "*consists of a slot that can be occupied by a pronoun only but not by a noun*", and this frame *"would allow the system to filter out the noun competitor*" (p.1074). In addition, Janssen, Alario and Caramazza (2008) have recently proposed the existence of word-order syntactic constraints in the phonological facilitation effect from distractor pictures observed in color naming tasks (Navarrete and Costa, 2005). Finally, the studies of Abrams and colleagues also suggest the relevance of syntactic influences on the activation of the phonological properties of words. Abrams and Rodriguez (2005) found that the probability to resolve a tip-of-the-tongue (TOT) state increases when a phonologically related prime word from a different grammatical class is

[2] As previous studies exploring the phonological influences during pronominal tasks, we assume here that the PFE arises at the level of phonological encoding (Jescheniak et al, 2001; Finocchiaro & Caramazza, 2006; see also for a different paradigm Schmitt, Meyer & Levelt, 1999).

presented. Importantly, when the prime is a phonologically related word from the same grammatical class, the probability of TOT resolution did not increase (see also Abrams, Trunk & Merril, 2007).

Although the existence of syntactic modulations on the spreading of the activation between lexical and phonological representations does not undermine the results reported by Starreveld and La Heij (2004), it is worth to explore whether it is reliable to obtain a PFE with pronominal sentence utterances. This was the aim of the Experiment 1. In this experiment Spanish participants were required to name pictures using a pronominal construction while ignoring distractor words that could be semantically or phonologically unrelated. In order to test the reliability of the results observed by Jescheniak et al. (2001), the same kind of paradigm was used in Experiment 1 (see below). Contrary to their results, we obtained a PFE in pronominal utterances. The aim of the Experiment 2 was to test the reliability of the PFE in pronominal utterances under different conditions. In Experiment 2 Italian participants named pictures with "determiner + adjective" structures.

EXPERIMENT 1

Spanish pronominal production

In this experiment Spanish participants were presented with pairs of displays shown on successive trials. In the first display two objects were positioned side by side and participants named them using constructions like "*La mesa y el casco*" (The fem table and the masc helmet). Then, the first display was replaced by the target display that contained one of the two objects colored in blue or green. One group of participants named the target using the construction "*Esta mesa es verde*" (This fem table is green, the Full Noun condition) and another group of participants named the target with sentences such as "*Esta es verde*" (This fem is green, the Pronoun condition). Concurrent to the appearance of the target, a distractor word was presented in the middle of the picture. For each picture there were four distractor words: one phonologically related, one semantically related and two unrelated.

METHOD

Participants. Sixty native speakers of Spanish students at the University of Barcelona took part in this experiment.

Materials. Thirty-two pictures of common objects (from Snodgrass and Vanderwart's set, 1980, or similar collections) were selected (16 with feminine grammatical gender names and 16 with masculine grammatical gender names). Each picture (e.g., *mesa*, table) was paired with a) phonologically related (*melon,* melon), b) phonologically unrelated (*pino,* pine), c) semantically related (*taburete*, stool) and d) semantically unrelated (*bolso*, bag) distractor words. The phonological distractors shared an average of 2.5 segments and always shared at least the first two segments with the picture names. Semantic distractors came from the same semantic category as the picture. Phonological and semantic unrelated conditions were created by reassigning the related distractor to the pictures. The four distractor words have a different gender than the one of the target picture (see Appendix A). With the set of 32 pictures 16 preamble scenes that contained two pictures side by side drawn in black lines were created. Both pictures of the preamble scene were of different gender and were neither phonologically nor semantically related. To create the target pictures, half of the masculine and feminine pictures were colored in green and the other half in blue.

Half of the participants were assigned to the Full Noun condition and the other half, to the Pronoun condition. The experiment contained four different blocks of 32 trials each. Each target picture appeared once per block. Each block contained 8 trials of each of the four experimental conditions. Trials inside each block were randomized with the restrictions that: a) the appearance of one picture in preamble scenes was separated by at least two trials, b) two distractors of one condition never appeared consecutively and c) no more than three consecutive trials with the same gender were allowed. Participants were randomly and equally assigned to six different block orders. In total, 128 experimental trials were administrated to each participant. Two pictures were selected and used as warm-up trials in the first two trials of each block.

Procedure. At the beginning of the experiment, participants were presented with the 32 target pictures (without distractor) and were instructed to name them. They were corrected if an inappropriate name was used in this phase. Afterwards, a training phase started in which all the target pictures paired with unrelated distractor words were administrated. None of the distractors of the training phase were included in the experimental session. After that, the 4 experimental blocks were administrated to each participant, with a short pause between blocks.

An experimental trial involved the following events: a) a fixation point (an asterisk) was shown in the center of the screen for 1000 ms; b) a blank interval of 500 ms was presented; c) the preamble scene was presented for 1200 ms and participants were required to describe it with sentences such as "*La mesa y el casco*" (The table and the helmet) starting with the left object; d) a blank interval of 2000 ms was presented; e) finally the target picture and the distractor word were presented simultaneously during 800 ms or until the participant's response; f) 1500 after participant's response a question mark appeared. A new trial began after participants pressed the spacebar. Participants of the Full noun condition were instructed to name the target picture as fast and accurately as possible with sentences such as "*Esta mesa es verde*" (This fem table is green). Participants of the Pronoun condition named the pictures with sentences like "*Esta es verde*" (This fem is green). Response latencies were measured from the onset of the target picture presentation. Stimulus presentation and reaction times were controlled by the EXPE program (Pallier, Dupoux & Jeannin, 1997). The entire experimental session lasted for approximately 40 minutes.

RESULTS

The following types of responses were scored as errors and excluded from the analyses: a) utterances that differ to those designated by the experimenter; b) recording failures; c) verbal disfluencies and d) naming latencies below 300 ms or above 3 standard deviations from a given participant's mean (7.17% of the data points). Three variables were analyzed. Two within-subject variables with two values: Phonological Relationship and Semantic Relationship (Related vs. Unrelated), and one between-subject variable: Type of Utterance (Full Noun vs. Pronoun).

Effect of the semantic distractors. In the naming latencies analysis, the main effect of Semantic Relationship was significant ($F1\ (1, 58) = 12.39$; $MSE = 6946.40$; $p < .01$; $F2\ (1, 62) = 15.14$; $MSE = 8728.50$; $p < .01$), with slower naming latencies in the Related than in the Unrelated condition. The main effect of Type of Utterance was significant ($F1\ (1, 58) = 13.55$; $MSE = 206919.07$; $p < .01$; $F2\ (1, 62) = 340.71$; $MSE = 218708.44$; $p < .01$) with slower naming latencies in the Pronoun condition than in the Full Noun condition. The interaction between these two factors was not significant (both $Fs < 1$) (see Table 1). In the error analysis, the main effect of Semantic Relationship was significant ($F1\ (1, 58) = 9.23$; $MSE = 240.83$; $p < .01$; $F2\ (1, 62) = 7.87$; $MSE = 242$; $p < .01$) with higher error rates for the Related condition than for the Unrelated one. There was

no effect of Type of Utterance (both Fs < 1). The interaction between these two factors was not significant (both Fs < 1) (see table 1).

T-tests analyses revealed that the semantic interference effect was significant in both kind of utterances (Full Noun: t1 (29) = 2.51; p < .02; t2 (31) = 3.13; p < .01; Pronoun: (t1 (29) = 2.47; p < .03; t (31) = 2.44; p < .03).

Effect of the phonological distractors. In the naming latencies analysis, the main effect of Phonological Relationship was significant (F1 (1, 58) = 16.12; MSE = 3898.8; p < .01; F2 (1, 62) = 6.26 MSE = 3894.03; p < .02), with faster naming latencies in the Related than in the Unrelated condition. The main effect of Type of Utterance was significant (F1 (1, 58) = 15.08; MSE = 208500.03; p < .01; F2 (1, 62) = 276.94; MSE = 227475.12; p < .01), with slower naming latencies in the Pronoun than in the Full Noun condition. Importantly, the interaction between these two factors was not significant (both Fs < 1) revealing that the difference between the related and the unrelated conditions was statistically similar for both utterances (13 and 10 ms for Full Noun and Pronoun, respectively). In the error analysis, the main effect of Phonological Relationship was not significant (both ps >.25). There was not effect of Type of Utterance (both ps > .3). The interaction between these two factors was not significant (both Fs < 1) (see table 1).

T-test analyses revealed that the PFE was significant in the Full Noun condition (t1 (29) = 3.323; p < .01; t2 (31) = 2.059; p <.05) while in the Pronoun condition the effect was significant in the subject analysis only (t1 (29) = 2.36; p < .03; t2 (31) = 1.547; p < .14).

DISCUSSION

In this Experiment we observed that naming latencies were affected by two factors: utterance format and type of distractor word. Naming latencies were slower for the group of participants who described the pictures with a pronominal construction (pronoun + verb + adjective) than for the group of participants who described them with a full noun construction (determinant + noun + verb + adjective). We also observed that for both kinds of utterances, semantically related distractor words slowed down naming latencies. Moreover, phonologically related distractor words sped up naming latencies in both conditions. Importantly, there was no interaction between these effects and type of utterance format; suggesting that the magnitude of the semantic and phonological effects was similar for both utterance types.

Table 1: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and type of utterance in Experiment 1.

	Type of utterance					
	Full Noun			Pronoun		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Semantically Related	582	76	9.5	664	111	9.3
Unrelated	566	64	5.9	650	95	7.3
Semantic effect	16			14		
Phonologically Related	555	58	6.5	640	102	7.1
Unrelated	568	59	5.5	649	103	6.4
Phonological effect	-13			-10		

The effect of utterance format replicates previous results (see Experiment 1 in Jescheniak et al., 2001). The slower latencies in the pronoun condition may be due to the additional costs that pronominal production entails in comparison to full noun production. Pronouns can be use only to refer information that has been previously mentioned/introduced in the conversation in which the speaker is involved. Thus, in the context of the Experiment 1, when participants named the target picture (e.g., table) through a pronominal sentence as "This is green", the other table presented in the preamble picture ("The table and the helmet"), need to be accessed. The situation is different in the case of the full noun utterance. In order to name the target through a determiner construction as "This table is green", the speaker does not need to access information of the preamble picture. Given this, it could be the case that participants do not retrieve the information presented in the preamble when they have to name the target

with a determiner construction. In sum, the slower reaction times in the pronominal condition would reflect the cost accessing previously presented information.

The PFE of this Experiment is congruent with interactive models of lexical access and it seems problematic for feed-forward models of lexical access that avoid interactions between phonological and lexical representations. However, we have to take cautiously the PFE in the pronominal task. Although the interaction between the PFE and type of utterance was not significant, revealing that the effect is similar in both kinds of utterances, the PFE in the pronominal condition was not statistically significant in the item analysis. There are at least two possible reasons why we obtained a so small phonological effect. One possible explanation comes from the data of a control experiment conducted with the same materials. In this control Experiment a group of 18 new participants were required to name the target pictures with sentences like "*La mesa verde*" (The_{fem} table green). The preamble scenes were excluded here. The magnitude of the semantic effect was of 26 ms ($t1\ (17) = 4.16$, $p < .01$; $t2\ (31) = 3.38$, $p < .01$) while the phonological effect was 17 ms ($t1\ (17) = 3.08$, $p < .01$; $t2\ (31) = 2.88$, $p < .01$). Although there was a reliable phonological effect of 17 ms, this must be considered small when compared with effects typically observed in similar picture-word naming studies (see for instance Jescheniak, Schriefers & Hantsch, 2003). This small effect would indicate that the phonological manipulation in our experimental set produces weak effects, and this would reduce the probability to observe a stronger phonological effect in Experiment 1.

A second possible reason is that the extensive repetition of the target pictures reduced the probability to obtain stronger effects. In the context of Experiment 1 target pictures were presented and named 5 times as target pictures (4 times in the experimental blocks and once in the training block) and 10 times as preamble scene (8 times in the experimental blocks and twice in the training block). This massive repetition of target pictures would reduce the probability to observe reliable phonological effects. It is also important to note that not only the phonological effect seems to decrease for the inclusion of preamble scenes (from 17 ms in the control experiment to 13 and 10 ms in Experiment 1), also the magnitude of the semantic effect suffers a reduction in Experiment 1 in comparison with the control experiment (from 26 ms in the control experiment to 16 and 22 ms in Experiment 1).

In the next Experiment we test the reliability of the PFE of the pronominal condition under different experimental conditions. In Experiment 2, Italian participants named pictures using pronominal

utterances such as "*la verde*" (the fem green one). In order to avoid a massive repetition of the target pictures that could reduce the magnitude of the phonological effect, in Experiment 2 we adopted the following strategy: a) the preamble scenes were eliminated, and b) we tested only the phonological condition. As a result, each picture was presented three times during the whole experimental session.

EXPERIMENT 2

Italian pronominal production

In Experiment 2 Italian participants were presented with colored pictures and were instructed to name them thorough construction such as "determiner + color adjective". In Italian, determiner forms depend on the grammatical gender of the referent noun (e.g., singular feminine: *la*, singular masculine: *il*)[3]. Thus, in order to retrieve the correct determiner form participants need to retrieve the lexical representation of the noun. As in Experiment 1, simultaneously with the target picture a distractor word was presented. However, in Experiment 2 we focused on the phonological condition and only two kind of distractor words were used, phonologically related or unrelated to the referent noun.

METHOD

Participants. Thirty-two native speakers of Italian students at the University of Trento took part in this experiment.

Materials. Twenty-four pictures were selected (12 with feminine grammatical gender names and 12 with masculine grammatical gender names). Half of the feminine and masculine words were depicted in green lines and the other half in blue lines. Each picture (e.g., *sedia*, chair) was paired with two distractor words of different gender: a) a phonologically related one (*secchio*, bucket), and b) a phonologically unrelated one (*campo*, field). The phonological distractor shared an average of 2.6

[3] There are some exceptions for the determiner masculine form. When the noun following the determiner begins with a vowel, a consonant cluster of the form "s + consonant" or "gn," or an affricate, the determiner form is *lo* (e.g., "*lo sgabello*", the stool). However, this only happens when the noun immediately follows the determiner. In fact, the form *lo* is not used in some pronominal adjective constructions, as for instance "*il mio sgabello*" (mine stool) or "*il grande sgabello*" (the big stool), and in determiner + adjective constructions, as "*il verde*" (the green one).

segments and always shared at least the first two segments with the picture names. As in Experiment 1, the phonological unrelated condition was created by reassigning the related distractors to the pictures (see Appendix B). In order to reduce the number of related trials, we selected a new set of 24 pictures (12 masculine and 12 feminine) and 24 words that were used as filler trials. Each filler picture was paired with two filler distractor words of different grammatical gender.

The experiment contained two different blocks of 48 trials each. Each picture and distractor appeared once per block. For each block, half of the experimental pictures were presented with phonologically related distractor words and the other half with unrelated distractor words. In sum, 25% of the trials of each block (12/48) were related. Trials inside each block were randomized with the restrictions that: a) no more than three consecutive trials with the same gender were allowed; and b) two consecutive phonological related trials were avoided. Participants were randomly and equally assigned to eight different block orders. Two pictures and two distractor words were selected as warm-up trials at the beginning of each block.

Procedure. At the beginning of the experiment, participants were presented with the 48 target pictures along and were instructed to name them. They were corrected if an inappropriate name was used. Afterwards, a training block started. A new set of 48 distractor words, not used in the experimental session, were selected and presented jointly with the pictures in this training phase. Distractor words in the training phase were of different gender of the pictures and phonologically and semantically unrelated. After the training, the 2 experimental blocks were administrated to each participant with a short pause between blocks.

An experimental trial involved the following events: a) a fixation point (an asterisk) was shown in the center of the screen for 1000 ms; b) a blank interval of 250 ms was presented; c) the target picture and the distractor word were presented simultaneously during 2000 ms or until the participant's response; f) a question mark appeared. A new trial began after participants pressed the spacebar. Participants were instructed to name the picture as fast and accurately as possible with utterances as "determiner + color" according to the gender and the color of the picture. Response latencies were measured from the onset of the target picture presentation. Stimulus presentation and reaction times were controlled by the DMDX software (Foster & Foster, 2003). The entire experimental session lasted for approximately 25 minutes.

RESULT AND DISCUSSION

Following the same criteria as in Experiment 1, 6.4% of the data points were excluded. Naming latencies analysis in the phonologically related condition were faster than in the unrelated condition ($t1\ (31) = 4.04$; $p < .01$; $t2\ (23) = 2.09$; $p < .05$). No significant differences were observed in the error analysis ($ts < .1$see table 2). The results of Experiment 2 replicated the PFE of the Experiment 1 in a new language (Italian) with a different pronominal utterance.

Table 2: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition in Experiment 2.

Type of Relationship	Mean	SD	E%
Phonologically Related	873	169	6.5
Unrelated	893	180	6.4
Phonological effect	-20		

GENERAL DISCUSSION

We reported two picture-word interference experiments in the context of noun and pronominal productions. In Experiment 1 the semantic and the phonological relationship between distractor words and target pictures was manipulated. In the context of pronominal production, we observed a semantic interference effect, suggesting that under our experimental condition participants selected lexically the referent noun. These results replicated previous observations (Jescheniak et al, 2001; Finocchiaro & Caramazza, 2006). More importantly, we obtained a PFE: pronominal latencies were faster with phonologically related distractors than with unrelated distractors. Finally, the effects on the Full Noun condition were identical to those observed in the Pronoun condition, a semantic interference effect and a PFE.

The PFE is congruent with the data reported by Starreveld and La Heij (2004) and incongruent with the lack of phonological effects in Jescheniak et al. (2001) and Finocchiaro and Caramazza (2006). Importantly, we reported the PFE in a context in which participant's response was embedded in a sentence. This fact excludes the possibility that syntactic constraints that are operating in the course of sentence production are responsible for the lack of a PFE in the studies of Jescheniak et al. (2001) and Finocchiaro and Caramazza (2006). The reliability of the PFE was tested in Experiment 2. In this Experiment we replicated the PFE using a different pronominal utterance and language.

In Experiment 1 we have used the same paradigm developed by Jescheniak et al. (2001). The PFE we found in Experiment 1 contrasts with the lack of phonological effect in their study. There are some differences between our design and theirs; 1) response language (Spanish vs. German), 2) presentation of the preamble (participants themselves described the scenes vs. a speaker described the scenes) or 3) modality of distractor presentation (visual vs. auditory). It is unclear at this point whether any (or all) of these differences can account for the discrepancy in the results.

Interactivity models of lexical access can account for the PFE we reported here. The interpretation of the effect would be the following. The presentation of a distractor word (e.g., cat) activates its phonemes ("k,æ,t"), wich in turn send activation back to all lexical representations containing such phonemes as "cat", "cap", "car", "pat". In this scenario, if the picture of a *car* is presented and a gender-marked pronominal utterance is required, the lexical representation "car" would receive part of the activation from the phonemes of the distractor word cat, facilitating its selection. Finally, a faster lexical selection would accelerate the access to the grammatical gender of the target picture and the posterior retrieval of the appropriate pronominal form.

The findings we reported here have both theoretical and empirical implications. Theoretically, our data can be explained by models of lexical access that allow feedback links between phonological and lexical representations (e.g., Dell, 1986; Harley, 1993; Rapp & Goldrick, 2000) and challenge models that do not allow these links. From an empirical point of view, it is important to note that evidence in favor of interactivity models of lexical access has been mainly collected from the performance of aphasic patients (e.g., Dell, Dell, Schwartz & Martin, 1997; Rapp & Goldrick, 2000) or from experimental paradigms that elicit speech errors (e.g., Costa, Roelstraete, & Hartsuiker, 2006, but see Baus, Costa & Carreiras, 2008). Evidence from speech errors, spontaneous or induced, has been criticized by one of the most influent models of lexical access. Concretely, Levelt,

Roelofs and Meyer (1999a) have argued that: "*Models of lexical access have always been conceived as process models of normal speech production. Their ultimate test, we argued in Levelt (1991) and Meyer (1992), cannot lie in how they account for infrequent derailments of the process but rather must lie in how they deal with the normal process itself. RT studies, of object naming in particular, can bring us much closer to this ideal*" (page 2). To this respect, our data have relevant implications because are positive evidence for interactivity models of lexical access using a normal picture naming task in non aphasic population.

RESUMEN

La denominación de pronombres marcados por género corrobora modelos interactivos de acceso al léxico. La denominación de un objeto mediante un pronombre marcado por género gramatical implica la selección léxica del nombre del objeto, con tal de poder acceder a su género gramatical. Sin embargo, la forma fonológica del nombre no es necesaria. En dos experimentos, hemos utilizando el paradigma de interferencia dibujo-palabra para explorar si las propiedades fonológicas del nombre referente afectan la selección léxica del mismo. En el Experimento 1, participantes españoles denominaban dibujos utilizando frases con el nombre del objeto o con un pronombre mientras ignoraban palabras distractoras que podían estar semántica o fonológicamente relacionadas con el referente. Se observó un Efecto de Facilitación Fonológica (EFF) en los dos tipos de producción. En el Experimento 2 el EFF fue replicado en italiano utilizando una construcción pronominal diferente. El EFF sugiere que la selección léxica del nombre referente es facilitada por la presentación de palabras fonológicamente relacionadas. Estos resultados son consistentes con las predicciones derivadas de los modelos interactivos de acceso al léxico.

REFERENCES

Abrams, L., & Rodríguez, E.L. (2005). Syntactic class influences phonological tip-of-the-tongue resolution. *Psychonomic Bulletin & Review, 12*, 1018-1023.

Abrams, L., Trunk, D.L., & Merril, L.A. (2007). Why a Superman Cannot Help a Tsunami: Activation of Grammatical Class Influences Resolution of Young and Older Adults' Tip-of-the-Tongue States. *Psychology and Aging, 22*, 835-845.

Badecker, W., Miozzo, M., & Zanuttini, R. (1995). The two-stage model of lexical retrieval: Evidence from a case of anomia with selective preservation of grammatical gender. *Cognition, 57*, 193–216.

Baus, C., Costa, A., & Carreiras, M. (2008). Neighbourhood density and frequency effects in speech production: a case for interactivity. *Language and Cognitive Processes, 23*, 866-888.

Caramazza, A., (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14*, 177–208.

Caramazza, A., & Miozzo, M. (1997). The relation between syntactic and phonological knowledge in lexical access: Evidence from the "tip-of-the-tongue" phenomenon. *Cognition, 64*, 309–343.

Costa, A., Caramazza, A., & Sebastian-Gallés, N. (2000). The cognate facilitation effect: implications for the models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*, 1283-1296.

Costa, A., Roelstraete, B., & Hartsuiker, R.J. (2006). The lexical bias effect in bilingual speech production: Evidence for interactivity across languages. *Psychonomic Bulletin and Review, 13,* 612-617.

Dell, G.S., (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review, 93*, 283–321.

Dell, G. S., Schwartz, M. F., & Martin, N. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review, 104*, 801–838.

Finocchiaro, C., & Caramazza, A. (2006). The production of pronominal clitics: implications for theories of lexical access. *Language and Cognitive Processes, 21*, 141-180.

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

Harley, T.A. (1993). Phonological activation of semantic competitors during lexical access in speech production. *Language and Cognitive Processes, 8*, 291-309.

Janssen, N., Alario, F.-X., & Caramazza, A. (2008). A word-order constraint on phonological activation. *Psychological Science, 19*, 216-220.

Jescheniak, J.D., Schriefers, H.J., & Hantsch, A. (2001). Semantic and phonological activation in noun and pronoun production. *Journal of Experimental Psychology: Learning, Memory and Cognition*, 27, 1058-1078.

Jescheniak, J.D, Schriefers, H., Hantsch, A. (2003). Utterance format affects phonological priming in the picture–word task: Implications for models of phonological encoding in speech production. *Journal of Experimental Psychology: Human Perception and Performance, 29*, 441–454.

Leek, E. C., Tainturier, M. J., & Wyn, R., (2003). Syntactic mediation is not obligatory in lexical access: Evidence from a single-case study of Welsh aphasia. *Brain and Cognition, 53*, 268–272.

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

Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999b). Multiple perspectives on word production. *Behavioral and Brain Sciences, 22*, 61–75.

Miozzo, M., & Caramazza, A. (1997). The retrieval of lexical-syntactic features. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23,* 1410–1423.

Navarrete, E., & Costa, A. (2005). Phonological activation of ignored pictures: Further evidence for a cascade model of lexical access. *Journal of Memory and Language, 53*, 359-377.

Pallier, C., Dupoux, E., & Jeannin, X. (1997). EXPE: An expandable programming language for on-line psychological experiments. *Behavior Research Methods, Instruments, and Computers, 29*, 322-327.

Oppermann, F., Jescheniak, J.D., Schriefers, H. (2008). Conceptual coherence affects phonological activation of context objects during object naming. *Journal of Experimental Psychology: Learning, Memory and Cognition, 34,* 587-601.

Rapp, B. & Goldrick, M. (2000). Discreteness and interactivity in spoken word production. *Psychological Review, 107*, 460-499.

Schmitt, B. Meyer, A., & Levelt, W.J.M., (1999). Lexical access in the production of pronouns. *Cognition, 69*, 313-335.

Schriefers, H., Meyer, A.S., & Levelt, W.J.M. (1990). Exploring the time course of lexical access in language production: picture-word interference studies. *Journal of Memory and Language, 29*, 86-102.

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory, 6*, 174–215.

Starreveld, P.A., & La Heij, W. (2004). Phonological facilitation of grammatical gender retrieval. *Language and Cognitive Processes, 19*, 677-711.

Tainturier, M.J., Leek, E.C., Schiemenz, S., Williams, C.A., Thomas, E., Gathercole, V.C. (2006). Access to lexical phonology does not predict retrieval of grammatical gender in Welsh: Implications for theories of language production. *Brain and language, 95*, 52-53

Vigliocco, G., & Franck, J. (1999). When sex and syntax go hand in hand: Gender agreement in language production. *Journal of Memory and Language, 40*, 455–478.

APPENDIXES

Appendix A: Materials used in Experiment 1

Target picture	Distractor word			
	Phonologically related	Phonologicall y unrelated	Semantically related	Semanticall y unrelated
Barco (ship)	barra (bar)	cola	furgoneta (van)	pistola
Boca (mouth)	bolo (skittles)	pato	dedo (finger)	gusano
Botella (bottle)	boleto (ticket)	lamento	jarrón (vase)	rastrillo
Brazo (arm)	brasa (grilled)	chapa	pierna (leg)	paloma
Búho (owl)	bujía (spark plug)	coleta	paloma (dove)	carpeta
Cama (bed)	carro (wagon)	jardín	sillón (armchair)	foco
Caballo (horse)	cadena (chain)	viña	vaca (cow)	chaqueta
Camisa (short)	canario (canary)	navío	jersey (jerseys)	oboe
Cañón canon	cabina (cabin)	libra	pistola (gun)	moto
Casco (helmet)	caspa (dandruff)	palma	gorra (cap)	vaca
Chaleco (vest)	chapa (sheet)	brasa	bufanda (scarf)	pierna
Coche (car)	coleta (plait)	pinza	moto (motorbike)	pulsera
Collar (necklace)	cola (tail)	barra	pulsera (bracelet)	furgoneta
Jarra (jar)	jardín (Garden)	boleto	barril (barrel)	cielo
Lámpara (lamp)	lamento (lament)	carro	foco (spotlight)	jersey
Libro (book)	libra (pound)	bujía	carpeta (folder)	bufanda
Luna (moon)	lujo (luxury)	matadero	cielo (sky)	barril
Maleta (suitcase)	macizo (solid)	veneno	bolso (bag)	portal
Mariposa (butterfly)	matadero (abattoir)	bolo	gusano (worm)	jarrón
Mesa (table)	melón (melon)	pino	taburete (stool)	bolso
Nariz (nose)	nardo (lily)	trompazo	ojo (eye)	cuchillo
Navaja (clasp knife)	navío (ship)	canario	cuchillo (knife)	taburete
Pala (shovel)	pato (duck)	lujo	rastrillo (rake)	dedo
Pan (bread)	palma (palm)	cabina	galleta (biscuit)	brocha
Pañuelo (handkerchief)	patilla (sideburns)	cadena	chaqueta (jacket)	taza

Perro (dog)	pelota (ball)	caspa	oveja (sheep)	gorra
Pincel (paintbrush)	pinza (clothespin)	valla	brocha (large paintbrush)	galleta
Pipa (pipe)	pino (pine)	melon	cigarro (cigarette)	ojo
Trompeta (trumpet)	trompazo (bump)	nardo	oboe (oboist)	sillón
Vaso (glass)	valla (fence)	patilla	taza (cup)	flauta
Ventana (window)	veneno (poison)	macizo	portal (vestibule)	cigarro
Violín (violin)	viña (vineyard)	pelota	flauta (flute)	oveja

Appendix B: Materials used in Experiment 2

Target picture	Distractor word	
	Phonologically related	Phonologically unrelated
Bandiera (flag)	banco (bank)	capo
Bicchiere (glass)	bilancia (scales)	cupola
Bottiglia (bottle)	bottone (button)	metro
Calzino (sock)	caldaia (boiler)	libreria
Camicia (shirt)	camino (track)	naso
Campana (bell)	campo (field)	pelo
Cancello (gate)	candela (candle)	lepre
Cannone (cannon)	cantina (canteen)	pala
Casa (house)	capo (boss)	foro
Castello (castle)	castagna (chestnut)	fortuna
Chiodo (nail)	chiesa (church)	pentola
Cucchiaio (spoon)	cupola (dome)	bilancia
Foglia (leaf)	foro (hole)	banco
Formaggio (cheese)	fortuna (fortune)	caldaia
Letto (bed)	lepre (hare)	castagna
Limone (lemon)	libreria (bookcase)	candela
Mela (apple)	metro (metre)	tacco
Nave (ship)	naso (nose)	pino
Pane (bread)	pala (shovel)	chiesa
Pennello (paintbrush)	pentola (pan)	cantina
Pera (pear)	pelo (hair)	secchio
Pipa (pipe)	pino (pine)	camino
Sedia (chair)	secchio (pail)	campo
Tazza (cup)	tacco (heel)	bottone

(Manuscript received: 5 November 2008; accepted: 2 December 2008)