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Contents

1 Introduction

People speak with the intention of communicating ideas. Researchers from various disciplines put effort into describing the cognitive machinery that allows speakers to arrive at a specific pattern of sounds parting from their intention to communicate a thought to their audience. Perhaps the issue most explored by psychologists interested in language production is lexical access: which processes and mechanisms are involved in the retrieval of words from the speaker's memory system? This dissertation attempts to contribute to answer this question.

Language production is one of the most astonishing abilities that humans possess. When we think about the multiple decisions that speakers have to take, we wonder how we are able to communicate our thoughts in such a quick and error-free fashion. One of the first decisions that speakers must take in language production is which word they will choose from a set of possibilities. There are many roads to Rome, many manners to express one specific thought. I can refer, for instance, to my dog as "Pluto", "my dog" or "animal". In this case, the selection of one of these possibilities allows me to present a specific conceptualization of my dog (Clark, 1997). Moreover, speaking is basically a social act, and a word's selection is also guided by the social context in which the conversation takes place. For example, some contexts may prevent the use of taboo words while others may not. These and many other factors determine which words will be finally selected (Levelt, 1989; La Heij, 2005).

When speakers have conducted all these pre-linguistic processes, they have to retrieve the words from their mental lexicon, combine them in a specific manner and finally articulate them. From their preverbal message (e.g., to inform that Sergi has a new car), speakers retrieve the words for conveying this intended message ("Sergi" "car" "new" "to have", etc.). The word selection occurs from the pool of 30.000 words that it has been estimated an adult knows (Levelt, 1989). Once the words have been selected, the next step is to retrieve the phonemes corresponding to each selected word. This phonological retrieval will then allow for the sending of the motor orders to the articulatory organ in order to elicit the speech signal. But producing connected speech entails much more than retrieving words and phonemes from memory. It also entails combining stored information and constructing syntactic relations among the words: speakers say the selected words in a specific order according to the syntactic rules of the language (e.g., "Sergi has a new car" is an allowed construction in English, but "car a new Sergi has" is not); there must be number agreement between the subject and the verb of the sentence ("Sergi has" and not "Sergi have"); etc.

Despite the complexity of the system, human beings are very efficient speakers. In normal rate conversations speakers produce 150 words per minute and make no more than two errors every 1.000 words (Bock, 1991). How do speakers access the appropriate words during their conversations? Although language production is usually rather efficient, sometimes the utterance deviates from the speaker's intention and an error is committed. The proportion of speech errors is not very high, but their analysis is very useful for studying language production. In the following paragraphs we focus on some speech errors that help to introduce the main issue of the present dissertation.

Blend errors refer to those situations in which two words are fused into one and a non-word production is generated. In most blend errors, the two blended words are synonyms or words with closely related meanings. The next examples come from the Spanish corpus collected by del Viso, Igoa and García-Albea (1987):

(a) "*A mi me gustan de ese <u>estipo</u>… de ese estilo*" (estilo/tipo)
(I like [those] of that *<u>stype</u>*… of that style [style-type])

(b) "*Debe de estar en el <u>bajón</u> de abajo*" (baúl/cajón)
(It must be in the *<u>drawnk</u>* downstairs [drawer/trunk])

Blend errors seem to emerge from a misselection of a second word simultaneous to the selection of the intended word. Thus, these errors suggest that during the lexicalization process of a word, other lexical candidates that are semantically related to the intended word are activated to some degree. More interesting to our purpose are the so-called Freudian slips. Two of the examples that Freud (1975) collected are listed below:

(c) "*If you will permit me, madam, I should like to* *insult* *you*" (accompany)

(d) "*In the case of the female genitals, in spite of many* *temptations*, *I beg your pardon,* *experiments*"

Freud attributed the cause of the lapsus linguae to the intrusion of a repressed unconscious thought. Beyond the Freudian interpretation, the existence of such errors would suggest that the lexicalization of a message could be affected by other ideas or repressed unconscious thoughts that are alien to the communicative intention of the speaker. Given so, one could argue that words that do not share any semantic relation with the intended words could also be candidates for production. Similar examples to those collected by Freud are also found in Harley's corpus (1984), the so called cognitive intrusions. In this kind of error the source of the intrusion is also external to the intended message. The construction of the current utterance receives interference from features of the extralinguistic environment, as in example (3a), or is contaminated by some simultaneous thoughts, as in example (3b):

(e) Utterance: "*She's doing…*"
Target: They're doing…
Cause: The speaker was talking while looking at a picture of a woman in the newspaper.

(f) Utterance: "*I've eaten all my library books*"
Target: I've read all my library books
Cause: The speaker was hungry and thinking about preparing some food.

Blend errors, Freudian slips and cognitive intrusions suggest that in some circumstances concepts that do not form part of the speaker's communicative intention can nonetheless interact with the lexicalization process of the intended words. Interestingly, Freudian slips and cognitive intrusions would suggest that these intruding elements are semantically unrelated to the primary communicative goal.

In addition to speech errors, some error-free speaking situations exist where it seems plausible to argue that speakers are going to activate non-communicative words. A possible example can be found in the production of a lie. Imagine for instance that your boss invites you to a party. After arriving at the party you come down with a painful headache and the horrible music that your boss has chosen to delight the party does not help to make you feel better. As you are thinking about the headache and the horrible music, your boss suddenly asks: "*How are you? Are you enjoying the party?*" Perhaps the most polite answer would be something like: "*I'm having a great time*", even going so far as to add, "*and what wonderful music!*". Throughout this exchange, it is plausible to assume that the ideas HEADACHE and HORRIBLE MUSIC are highly activated. This situation seems to require a control mechanism during the selection of the words that configure your answer. Are the words 'headache', 'horrible' and 'music' lexicalized to some degree during the production of the lie?

A related question was recently addressed by Wardlow, Groisman and Ferreira (2006). In their study, a participant (the speaker) was instructed to describe several objects to another participant (the listener). The objects were positioned between both participants in a manner that the speaker saw four objects (e.g., a triangle, a circle, a heart and a larger triangle), but the listener could only see the first three objects (the triangle, the circle and the heart). The speaker was instructed to describe one of the three common visible objects so that the listener could pick it out. When the target object was, for example, the smaller triangle, the speaker should say "*triangle*" in order to single out the target, just as "*circle*" would describe the sole circle. That is, as the listener does not see the hidden object, the adjective "*small*" does not provide any relevant information. However, in these circumstances the speaker tends to say "*small triangle*" instead of "*triangle*", as if they fail to appreciate her unique perspective (Horton & Keysar, 1996; Nadig & Sedivy, 2002). Wardlow et al. extend this observation to circumstances where a speaker is explicitly instructed to respond in such a way that the listener could not guess the hidden object. In this case, the speaker should avoid using any descriptive adjectives such as "*small triangle*" because this leaked information might suggest to the addresses the identity of the hidden shape. Surprisingly, the authors observed that in such circumstances, speakers were even more likely to refer to the additional descriptive information than when they were not instructed to conceal the hidden shape. That is, as the authors concluded, "…*being part of a communicative intention is not a necessary condition for an accessible conceptual feature to influence grammatical encoding*" (p. 276). It seems that concepts foreign to the communicative intention are nevertheless uttered, as in the speech errors previously described.

Another example of an error-free speaking situation where it seems plausible to argue that irrelevant words are activated to some extent comes from the use of idiom phrases and metaphors. Idioms and metaphors are interpretable utterances that are not directly related to the literal meaning of their individual words. That is, the relationship between the meaning of the words that make up the idiom and the meaning of the idiom is at best indirect, if there is any at all. The English idiomatic expression "*Howard kicked the bucket*" means that Howard is dead and not that Howard physically moved a bucket with his foot. Thus, when producing an idiom, the communicative goal of the speaker is to convey a figurative meaning and not the literal meaning of the words that comprise the idiom. An important question relates to the potential activation of the words that correspond to the figurative meaning of the idiom. That is, are words semantically related to the idea DEATH activated during the production of the idiom "*Howard kicked the bucket*"?[1]

Summarizing, some kinds of spontaneous speech errors and the study conducted by Wardlow et al. (2006) seem to suggest that speakers are susceptible to uttering non-intended words: i.e., words corresponding to concepts that are activated but do not form part of the message. Lies and idiomatic expressions are the most evident examples in which non-communicative concepts may be highly activated, increasing the possibility that non-intended words become activated.

1.1 Overview of the dissertation

Speaking can be considered a goal-directed behavior because speakers have to retrieve the appropriate words and phonemes from their mental lexicon. From the previous slips-of-the-tongue examples, we could argue that during the lexical and phonological retrieval processes other words than the intended ones are activated to some degree. Under this scenario, it is necessary to postulate selection mechanisms in charge of determining, among the activated representations, which ones will be prioritized and further processed in order to finally utter the speech signal. How does the control mechanism work that allows speakers to focus on the appropriate set of representations and reject the non-appropriate ones?

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[1] To our knowledge, no studies have so far addressed this question in speech production. However, some studies have observed that during idiom production the literal meaning of the words that configure the idiom also becomes activated (Cutting & Bock, 1997; Sprenger, Levelt & Kempen, 2006). That is, the concepts TO KICK and BUCKET that are not part of the communicative intention of the speaker are activated in the speaker's mind.

It is generally agreed that the most relevant parameter that guides word and phoneme selection is the level of activation of the corresponding representations, in the sense that the most activated representations at a specific moment will be the ones selected. In addition, theories of speech production agree that the selection mechanisms also take into account the activation level of other non-target representations, in the sense that the selection of one representation is more difficult the more activated other competing representations are. According to these two assumptions, the selection of a word would depend on two parameters: a) the amount of activation that this word receives from the conceptual system and b) the level of activation of other representations at the moment of selection. In order to have a clear understanding of the mechanisms that speakers employ to decide which representations to select, we first need to specify under which circumstances this selection mechanism takes place. In particular, this dissertation tries to describe the pattern of activation during lexical access. Specifically, which words and phonemes are activated during the lexicalization process of the intended concept? This is an important issue because the types of processes in charge of encoding/selecting information at each level of the system may differ depending on what other information is available at a particular moment. For instance, the selection of the word 'car' and its corresponding phonemes may depend on whether other words and phonemes are also activated or not.

The main purpose of this dissertation is to explore whether concepts outside of the communicative goal of the speaker are nevertheless activated in the process of language production. We asses whether there is lexical and phonological activation of these concepts. Instead of looking at speech errors or lie and idiomatic expressions of the type described above, we take an experimental approach and measure speakers' performance in different naming contexts. In particular, participants were instructed to name target stimuli while ignoring the presentation of distractor pictures. The semantic and phonological manipulations between target and distractor names allowed us to analyze whether participants have lexicalized the distractor picture and to what degree.

In the next chapter we introduce the functional architecture of the speech production system. In the first section we describe the architecture of the system and then we focus on describing how information is propagated between the different levels of the system. This is the main topic of the dissertation and in the rest of the chapter we introduce three theoretical proposals about the propagation of the information and also some experimental evidence. Chapter three contains the main aim and specific objectives of the thesis. Chapters four, five, six and seven contain the experimental part. Finally, in chapters eight and nine we discuss the theoretical implications that follow from our experiments.

2 Activation flow in speech production

2.1 Architecture of the speech production system

The speech production system is considered a network of different layers of processing. These layers are conceptualized as a set of representations that store specific knowledge. It is generally accepted that there are at least three layers: the conceptual, the lexical and the phonological layers. The representations of each layer both accumulate activation and pass it to other representations with which they are linked. To study how this activation is propagated between representations of different layers is the main purpose of the dissertation. However, in this section we will briefly present a general architecture of the system: the conceptual, the lexical and the phonological levels.

Broadly speaking, two approaches regarding the structure of the conceptual system can be distinguished. Decompositional theories claim that semantically complex words (words whose meaning can be further analyzed into more basic concepts) are retrieved on the basis of a combination of primitive concepts. These theories assume that the lexical-semantic (or conceptual) system represents word meanings as sets of semantic properties or features. For example, the word ‘father’ would be retrieved on the basis of features like "male", "parent", etc. (Dell, 1986; Bierwisch & Schreuder, 1992; Caramazza, 1997). The second approach is proposed by Levelt (1989) and Roelofs (1992, 1996) and adopts a holistic conception of the lexical-semantic (or conceptual) system. Word meaning is represented by a concept node and by labeled links (pointers) between that conceptual node (e.g., FATHER) and other nodes in the network (PARENT, MALE). This view assumes that there is a node in lexical-semantic memory corresponding to every lexical entry in the language; each conceptual node is directly connected to its corresponding lexical representation in a one-to-one manner. The crucial difference between both proposals lies in the fact that in decompositional theories the activation of a word begins with the activation of features (male, parent, etc) while in non-decompositional theories it starts with the activation of one specific node (FATHER).

Models of language production agree on the assumption that the translation of one conceptual representation into a specific set of phonemes is completed in two distinct stages of processing. The first process is meaning-based and involves the selection of a particular lexical item to express the conceptual representation. The second process is sound-based and involves retrieving the phonemes that correspond to the selected lexical item. Perhaps the clearest evidence in favor of the distinction between these two stages comes from speech malfunctions, such as tip-of-the-tongue states and speech errors. A tip-of-the-tongue state could be described as the familiar frustration of being unable to retrieve the sounds of a word that one knows, and that one is aware of knowing (e.g., Brown & McNeill, 1966; Brown, 1991; Burke, MacKay, Worthley, & Wade, 1991; Harley & Brown, 1998). Occasionally, speakers experiencing a tip-of-the-tongue state have access to the conceptual representations and to the lexical-syntactic features of that word (e.g., grammatical gender), but are unable to access the appropriate phonological information that corresponds to that word (see among others Miozzo & Caramazza, 1997; Caramazza & Miozzo, 1997; Vigliocco, Antonini, & Garret, 1997). This state could be interpreted as reflecting a failure in the second stage of the lexical access process.

In addition, word and sound exchange speech errors are congruent with the distinction between a lexical and a phonological level of representations. It has been observed that word exchange errors involve words of the same grammatical class but different phonological structure; whereas the sounds that enter in an exchange error typically come from words of different grammatical classes but similar phonological environments (Garret, 1980; Dell & Reich, 1981). These patterns of constraints on speech errors have been interpreted to reflect the types of linguistic structures that are processed at different stages of speech production: semantic/syntactic information at one stage of processing; phonological information at a subsequent stage of processing.

Although all theories assume at least one level of lexical representation between conceptual and phonological representations, the organization of this lexical level differs across theories. However, the debates regarding decomposed/non-decomposed conceptual system or the precise organization of the lexical level is beyond the scope of this dissertation[2]. Given that the main purpose deals with the propagation of the activation through the levels of the speech production system, we adopt a general architecture that emphasizes the commonalities among the theories (see Rapp & Goldrick, 2000). According to this account, there is a semantically decomposed level of conceptual representations followed by a lexical level. Finally, the lexical level is followed by a level of phonological representations (see Figure 1).

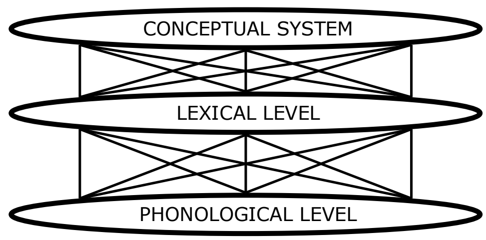

Figure 1: Schematic representation of the different stages involved in speech production. Conceptual representations spread activation to lexical representations, and lexical representations spread activation to phonological representations.

Several observational (e.g., Dell & O'Seaghdha, 1992; Dell & Reich, 1981; García-Albea, del Viso, & Igoa, 1989) and experimental studies (e.g., Sevald, Dell, & Cole, 1995; Costa & Sebastián-Gallés, 1998) have proved the existence of different types of information at the phonological encoding level (e.g., abstract frames, as word or syllables units, and phonological segments that are inserted in those frames); nonetheless in this dissertation we focus in phonological segmental activation. In particular, we will measure whether concepts alien to the communicative intention of the speaker activate their phonological segments. Evidence demonstrating this activation would suggest that these concepts are able

[2] The most accepted view is that for each word there is an amodal, lexically specific node (lemma) that represents the syntactic characteristics of that word (Dell, 1986; Cutting & Ferreira, 1999; Levelt et al., 1999). For these models, conceptual selection is followed by the selection of a syntactically specified lexical representation (lemma), which is followed by the selection of the lexical form representation (lexeme) associated with the selected lemma. Finally the phonological content of the lexeme node is selected. An alternative view proposes that there is only one step of representation between the conceptual and the phonological units. In this last model, syntactic information is represented in a separate network that does not have to be addressed in order to activate word-form information, that is, word-form information may be accessed directly from semantics (Caramazza, 1997; Caramazza & Miozzo, 1997).

to activate representations at the last layer of processing involved in lexical access, and it would allow us to characterize the activation flow through the speech production system.

2.2 Spreading activation in spoken word production

In 1975, in their proposal about semantic network, Collins and Loftus introduced the notion of spreading activation. Collins and Loftus' semantic network assumes that semantically related representations (or nodes) are connected by links which specify the relation between these representations. The activation between representations follows the spreading activation principle, which postulates that the activation that one representation propagates to other linked representations is proportionally related to its level of activation. The activation propagated from one representation to another is less than its proper activation, and for this reason the activation decays as it moves away from the original point. Thus, although different semantic representations could be activated at the same time, the most activated representation is still the original one. The concept of spreading activation in an automatic and general way has been captured by models of speech production in order to describe how activation flows through the speech production system (see for instance, Roelofs, 1992).

In the previous section we have briefly described the functional architecture of the speech production system. Here we describe how activation flows from level to level. This is a very important issue in the field of cognitive science, and especially so in the case of speech production. As we said, the speed and precision with which speakers produce speech is astonishing. During conversations, speakers produce sentences and also listen to the utterances of their interlocutors. It is therefore necessary that the processes involved in speech production be as fast and precise as possible. Thus, it becomes relevant to clarify what information is activated at each layer of processing during language production. Two aspects regarding the propagation of the activation during lexical access can be distinguished: a) the direction of the propagation and b) the constraints of the spreading activation through the system: whether the flow of the activation operates in a discrete or cascade fashion.

In relation to the direction of the activation there are different proposals. One of them assumes that the activation is propagated only from the higher levels of representations to the lower ones (top-down direction). Activation would flow from the conceptual level to the lexical level and from this one to the phonological level (see between others Caramazza, 1997, Levelt, Roelofs, & Meyer, 1999). A second proposal assumes both top-down and bottom-up direction of the activation, from higher to lower levels and also from lower to higher levels of the system. The models that embrace this second proposal are called interactive (see e.g. Dell, 1986; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997). Recently a third proposal has been adopted by Rapp and Goldrick (2000, see also Goldrick & Rapp, 2002). These authors have proposed that the activation between the semantic and lexical levels occurs in a top-down manner while activation between the lexical and phonological levels flows in an interactive way. Although the direction of the activation has important theoretical implications, we do not turn to this issue[3].

More relevant to the main purpose of the dissertation is the discrete-cascade debate. This debate refers to whether any activated representation is able to spread activation to representations of other levels, that is, whether spreading activation is the functional principle that characterizes the dynamics of lexical access. In the next paragraphs we review three different proposals regarding how activation flows in a feed-forward manner between levels of representations.

The first proposal assumes that any activated representation at a given processing level spreads some proportion of its activation to its immediately linked representation at the subsequent level (e.g., Caramazza, 1997; Costa, Caramazza, & Sebastián-Gallés, 2000; Dell, 1986; Dell et al., 1997; Griffin & Bock, 1998; Harley, 1993; Rapp & Goldrick, 2000; Starreveld & La Heij, 1995). Accordingly, all conceptual representations activated in the course of lexicalization activate their corresponding lexical nodes, which in turn spread some activation to their phonological content (see Figure 2, panel A). We will refer to this proposal as the *full-cascade proposal* because the governing principle stays constant throughout the whole system.

In contrast, the so-called discrete models restrict the flow of activation passed from level to level in various manners. There are two types of discrete models. In

[3] Another type of direction could be mentioned: the lateral direction. The lateral direction refers to the flow of the activation between representations at the same level. The two main conceptual proposals – the non-decompositional and the decompositional models – assume that the activation of one conceptual representation implies partial activation of other conceptual representations. In the non-decompositional model, activation flows between semantically-related concepts. In the decompositional model, the activation of a concept, i.e. the activation of a set of properties or features, automatically implies the activation of all the concepts which have some of these properties or features. However, most models are silent regarding whether representations at the lexical and phonological levels are laterally linked (but see Cutting & Ferreira, 1999; Johnson & Giuliani, 1999).

the influential model proposed by Levelt, Roelofs and Meyer (1999; see also Levelt, 2001) activation flows in a cascaded fashion from the conceptual to the lexical level (any activated conceptual representation spreads some activation to the lexical level). However, phonological activation is restricted to one lexical representation, the one that is selected for production. That is, this model holds both the cascade assumption and the discrete assumption: activation spreads in a cascaded manner from the conceptual to the lexical system and in a discrete manner from the lexical to the sublexical system. We will refer to this proposal as the *discrete proposal* (see Figure 2, panel B).

More recently, another discrete model has been put forward, *the Conceptual Selection model*, proposed by Bloem and La Heij (2003, see also Bloem, van der Boogard, & La Heij, 2004). These authors argued that the only conceptual representation that passes activation to the lexical level is the one included in the preverbal message (the one selected for production) (see also Damian & Bowers, 2003). However, the selected conceptual representation activates not only its lexical representation but also those of semantically related items. In short, lexical activation is restricted to the target and semantically related items (see Figure 2, panel C). This model is silent regarding whether or not activation flows in a cascade fashion from the lexical to the phonological level. However, given that it is a modification of Starreveld and La Heij's model (1995; 1996), it presumably maintains the assumption of cascade processing between these two levels of representation. At any rate, what is important here is that according to this model phonological activation would be necessarily restricted to (at maximum) the target and semantically related items.

The three proposals agree on assuming that multiple lexical representations are activated (at least the target along with semantically related items) in the course of lexical access[4]. The agreement ends here. The full-cascade model and the discrete model proposed by Levelt and colleagues (1999) allow, in principle, for any activated conceptual representations to send activation to its corresponding lexical representations (regardless of whether they are semantically related to the intended concept). In contrast, in Bloem and La Heij's model conceptual representations that are not included in the preverbal message do not activate their lexical nodes. Regarding which lexical representations send activation to the phonological level, full-cascade and Conceptual Selection models allow, in principle, for the presence of phonological activation of any activated lexical representation,

[4] To our knowledge a full-discrete model has not been proposed.

while the discrete model proposed by Levelt and colleagues (1999) restricts phonological activation to the selected lexical node. Thus, the only model that keeps constant the governing principle throughout the system is the full-cascade model. All other models are hybrids in the sense that they assume the flow of activation to be guided by different governing principles depending on the level of representation.

To summarize, discrete and cascade models disagree on which the pattern of activation is during spoken word production. That is, these models make different predictions regarding which non-target lexical and phonological representations would be activated during lexical access of the intended meaning. The description of the pattern of activation that the system holds during language production has relevant implications in the process of lexical and phonological retrieval. As we said in the previous chapter, it is generally assumed that one variable that affects the selection of lexical and phonological representations is the level of activation of other non-relevant lexical (e.g., Caramazza & Costa, 2000, 2001; Schriefers, Meyer, & Levelt, 1990; Roelofs, 1992) and phonological representations (Bock, 1987; Sevald & Dell, 1994; O'Seaghdha & Marin, 1997, 2000; Wheeldon, 2003)[5]. Below we review some experimental results that shed light on the flow of activation in the speech production system.

The revision is divided into two sections. Section 2.3 reviews studies regarding the spreading of activation from the to-be-expressed concept. That is, given for instance the communicative intention CAT: what are the lexical and phonological representations that are activated? Section 2.4 reviews studies regarding the spreading of activation of conceptual representations that do not form part of the communicative intention of the speaker. That is, given a situation in which both the communicative intention (CAT) and another concept are activated (e.g., TABLE), we may ask: what are the lexical and phonological representations that become activated by the spreading activation of the conceptual representation TABLE? In both sections we distinguish the propagation of the activation between conceptual and lexical levels and between lexical and phonological levels in order to describe all the differences between the three proposals that are under revision.

[5] In addition, some studies on sentence production have also observed influences of lexical and phonological co-activation patterns (see for instance Meyer, 1996; and Costa, Navarrete, & Alario, 2006).

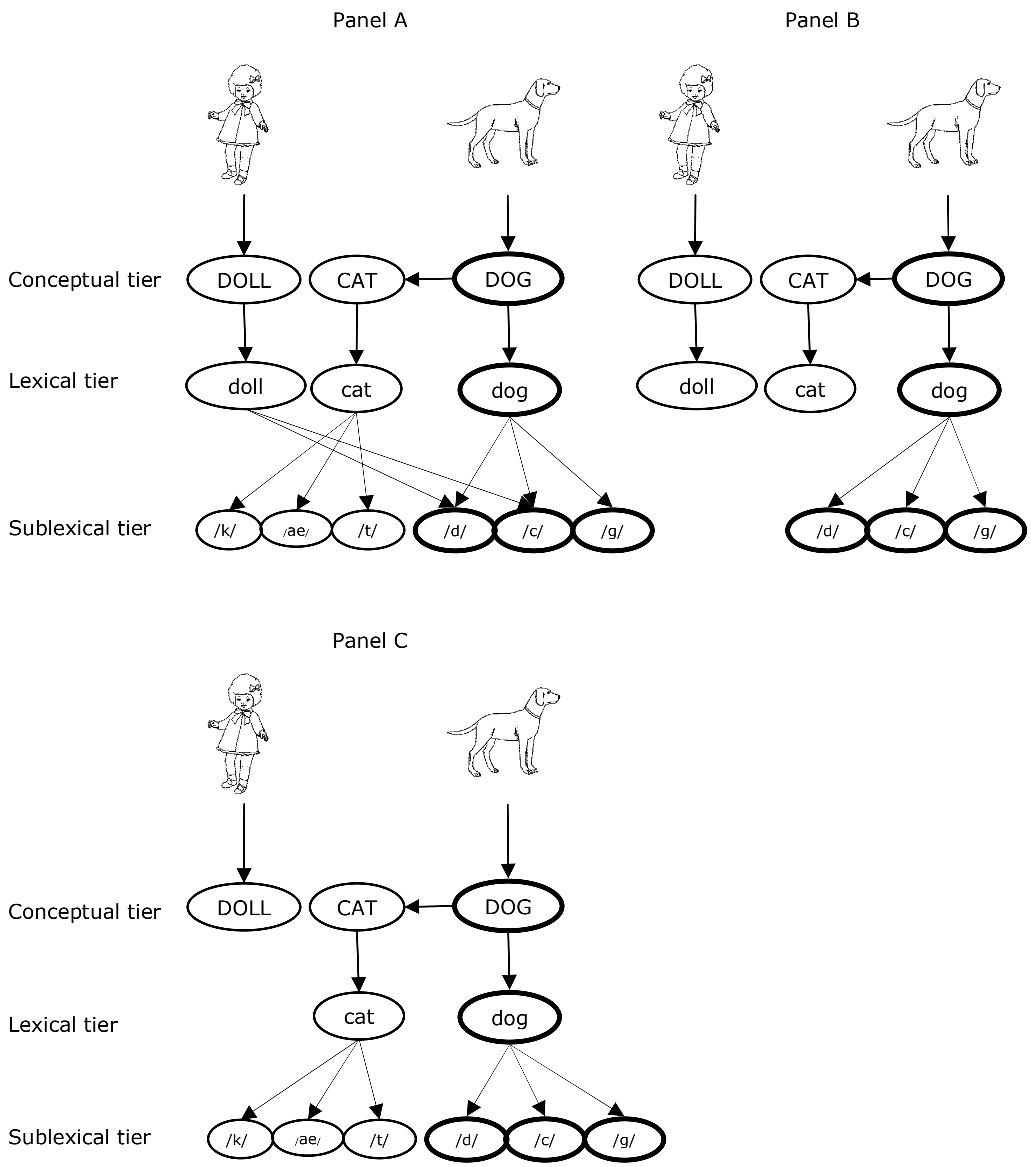

Figure 2: Schematic representation of the flow of activation in three different models. The response word is *dog* and the distractor picture is *doll*. The arrows represent flow of activation and the circles the conceptual, lexical and sublexical representations. The thickness of arrows and circles represents the magnitude of the activation. The cascade model (e.g., Caramazza, 1997; Costa, Caramazza, & Sebastián-Gallés, 2000), the discrete model proposed by Levelt et al. (1999) and the Conceptual Selection model proposed by Bloem and La Heij (2003) are described in panels A, B and C, respectively.

2.3 Spreading activation of related concepts

2.3.1 Lexical activation of semantically related concepts

As we saw earlier, there is general agreement that target conceptual representations activate multiple lexical nodes. Thus, during the lexicalization process of the word *cat*, other semantically related words also become activated (e.g., 'dog', 'horse', etc). In this section we introduce evidence that supports this lexical co-activation pattern.

One type of evidence comes from spontaneous speech errors, as blend[6] and semantic substitutions. Semantic substitution refers to the observation that the probability of substituting an intended word (*cat*) by mistake with other semantically related (e.g., *dog*) is greater than by chance rates. Like blend errors, semantic errors are explained by a malfunction during the process of lexical selection. In error-free utterances the mechanism selects the most activated lexical node that corresponds to the target word ('cat') because this node receives more activation from the conceptual system. If a malfunction occurs in the selection mechanism, the probability of selecting a semantically related lexical node ('dog') would be higher than the probability of selecting an unrelated one (e.g., 'table') because the former had been receiving activation from the conceptual level and the latter not (see for instance, Rapp & Goldrick, 2000; Caramazza & Hillis, 1990).

Another type of evidence comes from experimental studies that used the picture-word interference paradigm (PWI). In this paradigm, participants name pictures while ignoring distractor words (visually or orally presented). One of the most stable effects in PWI paradigm is the semantic interference effect: naming latencies are slower when the target picture (*cat*) and the distractor word (*dog*) belong to the same semantic category than when they belong to different semantic categories (*table*). Under the assumption that lexical selection occurs by competition, the semantic interference effect would support a lexical pattern of multiple activation. Lexical selection by competition assumes that the selection of a lexical node depends on the level of activation of the other activated lexical nodes. Thus, the lexical selection of one node is more difficult the more activated the other competitive lexical nodes are. In PWI tasks, semantically related words would interfere more because they are more activated than unrelated words. This different level of activation would arise because the conceptual representation of

[6] See previous chapter.

the picture (CAT) activates the lexical node of the semantically related distractor (‘dog’) but not the lexical node of the unrelated distractor (‘table’). As a consequence, the lexical node ‘dog’ is highly activated because it receives activation from two sources: the target picture and the presentation of the word. By contrast, the lexical node ‘table’ would receive activation from only one source: the presentation of the word (e.g., Schriefers et al., 1990)[7]. Convergent evidence for this interpretation comes from the inhibitory effect observed with the homogeneous list paradigm (see for instance Kroll & Stewart, 1994; Santesteban, Costa, Pontin, & Navarrete, 2006).

Observational (semantic substitutions, blend errors) and experimental (semantic interference effect) evidence has been brought to support the assumption that during the course of lexical access multiple lexical representations become activated. However, certain criticism casts some doubt on this interpretation. The criticism to observational evidence refers to the fact that speech errors could be reflecting a failure in channeling activation between the conceptual and lexical systems. If this were the case, it could not be argued that semantic errors or blends are reflecting a general principle in speech production. That is, it could be that the co-activation of semantically related words occurs only in speech error utterances and not in error-free utterances.

The experimental evidence assuming lexical co-activation refers to the semantic interference effect in the picture-word naming paradigm. As we said earlier, it is necessary to assume that lexical selection is by competition in order to consider that the semantic interference effect is reflecting a lexical co-activation pattern. Here, the criticism refers to observations that suggest that lexical selection does not occur by competition. According to the competition hypothesis, if a semantically related distractor word receives extra activation from the target conceptual representation (in comparison with an unrelated distractor word); a semantic interference effect should be observed any time the distractor and target are

[7] The main topic that we address here refers to the lexical representations that become activated during lexical access. This question is, however, closely related to the description of the attentional control mechanisms that allow speakers to focus on the target representations and select them for further processing (the lexical selection mechanism). This is so because the type of control mechanisms that any theory may need to postulate depends, to a certain degree, on the extent to which lexical representations are activated in the course of language production. For example, if it turns out that lexical activation is restricted to the target representation, perhaps we do not need to postulate any specific control mechanism that operates over the target representation (see Costa, La Heij, & Navarrete, 2006, for this argument in bilingual lexical access).

semantically related. However, this seems not to be the case. First, when target and distractors are related by virtue of being associates (e.g., *nest-bird*), semantic interference is not observed (Alario, Segui, & Ferrand, 2000; Lupker, 1979). Second, when target and distractor belong to the same semantic category (*dog-cat*) and the task involves categorization naming (response: "*animal*") or subordinate naming (response: "*poodle*"), facilitation instead of interference effects have been reported (Glaser & Düngelhoff, 1984; Costa, Mahon, Savova, & Caramazza, 2003; Vitkovitch & Tyrrell, 1999, but see Hantsch, Jescheniak, & Schriefers, 2005). Third, facilitation effect has also been reported when target and distractors hold a "has-a" relationship (*truck-bumper*) (Costa, Alario, & Caramazza, 2005)[8].

Some authors have recently proposed that the semantic interference effect in the PWI could be located at the semantic level of processing instead of at the lexical one (Costa et al., 2003). According with these authors, "…*categorical membership (e.g., that a dog is an animal) may be used to discriminate between the semantic representations activated by the complex stimulus composed of a picture and a distractor word in the process of deciding which semantic representation to lexicalize (…) When the picture and the distractor belong to the same semantic category (e.g., ''dog'', "mouse"), and basic-level naming is required (e.g., 'dog'), information about their categorical membership (e.g., animal) cannot be used to distinguish between the two semantic representations. Therefore, the cognitive system needs to use finer-grained information to decide which semantic representation (the target ''dog'' or the distractor cat) to select for further processing. This extra processing will, presumably, slow down the lexicalization of the target semantic representation and eventually the production of the target word"* (p. 225). See for discussion on this topic Finkbeiner and Caramazza (in press) and La Heij, Kuipers and Starreveld (in press).

Given the considerations against the evidence from speech errors and the lexical locus of the semantic interference effect, we consider that the assumption of a pattern of lexical co-activation does not have a solid enough foundation. In the

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[8] Also problematic for the assumption that lexical selection occurs by competition is the study conducted by Miozzo and Caramazza (2003). Under the assumption that the interference of a lexical node is positively correlated with its level of activation, lexical node with relatively low levels of activation (low frequency words) should interfere less than lexical nodes with higher levels of activation (high frequency words). Contrary to that prediction, Miozzo and Caramazza (2003) observed more interference from low-frequency distractors than from high-frequency distractors (see also Mahon, Costa, Peterson, Vargas, & Caramazza, submitted).

next section we introduce some experimental evidence from a different approach related to this topic.

2.3.2 Phonological activation of semantically related words

Several studies have addressed the issue of whether there is phonological activation of words that are semantically related to the target word, that is, whether during the lexicalization process of a word (e.g., *cat*) there is activation of the phonological segments corresponding to semantically related words (e.g., *dog*). Positive evidence of such activation would suggest that the lexical node 'dog' has been activated from the conceptual representation CAT. This would be so because the only way that the phonological segments /*dog*/ *c*ould be activated would be through the previous activation of the lexical node 'dog'.

The first study to address this question was conducted by Levelt, Schriefers, Vorberg, Meyer, Pechmann and Havinga (1991) in which participants were asked to name pictures. In the critical trials, however, an auditory word was presented, and participants were asked to halt their naming process and perform a lexical decision task on the presented stimulus. The auditorily presented words were: a) phonologically related to the name of the target picture, b) phonologically related to a word semantically related to the target picture, or c) unrelated. For example, if the target picture was that of a *sheep* the phonologically related word was *sheet*, and the phonologically related word to a semantically related word was *goal* (*goal* is phonologically related to *goat*). The authors argued that if the phonological content of the semantically related word *goat* was activated in the course of lexicalizing *sheep*, then it should have an effect on the ease with which the lexical decision task on *goal* is performed. The results did not support this prediction: lexical decision times for *goal* were similar to those for an unrelated word as *pool* (see Jescheniak, Hahne, & Schriefers, 2003, for convergent evidence using electrophysiological measures; but see Jescheniak, Hahne, Hoffmann, & Wagner, 2006). This result was interpreted as revealing that the phonological content of lexical items that are not selected for production (in this case items semantically related to the target) is not activated in the course of speech production. Such a result supports the notion of discrete processing.

There are however other studies in which phonological activation of lexical nodes that are not selected for production has been observed. For example, Peterson and Savoy (1998) asked participants to perform a dual task experiment. Participants had to name a set of pictures (e.g., *couch*), but on some critical trials, they were asked to halt the naming process and instead name a target word printed on the screen. The printed word could be: a) phonologically related to the picture's name (e.g., *count*), b) phonologically related to a near-synonym of the picture's name (e.g., *soda* which is related to *sofa*), c) phonologically related to a semantically related word (e.g., *bet* which is related to *bed*), or d) unrelated (e.g., *harp*). The results of this experiment replicated those of Levelt and colleagues (1991): a) words phonologically related to the picture's name (*count*) led to faster latencies than unrelated words, and b) responses to words phonologically related to a semantically related word (*bet*) were not different to unrelated words (*harp*). Importantly, participants named words phonologically related to the near-synonym's name (*soda*) faster than unrelated words (*harp*) (see also Jescheniak & Schriefers, 1998). This result was interpreted as revealing that during the retrieval of the target's name, the phonological properties of both potential target words (e.g., *couch* and *sofa*) are activated, leading to the priming effect. The fact that phonological priming was not observed for words phonologically related to a semantically related word (*bet*) was interpreted as suggesting that the phonological activation of a non-selected lexical node is only detectable when this node reaches a very high level of activation, as in the case of synonyms (see also Dell & O'Seaghdha, 1991, for a similar argument, and the recent data reported by Jescheniak, Hantsch, & Schriefers, 2005). This result supports the notion of cascade processing.

Levelt et al. (1999) tried to accommodate Peterson and Savoy's results by appealing to a malfunctioning of the lexical selection mechanism. They argued that when two lexical items are very highly activated, as in the case of synonyms, the two of them may get wrongly selected and as a consequence the two of them activate their phonological codes. Thus, the phonological co-activation of synonyms is reflecting double lexical selection rather than cascade processing. Despite the merits of such an explanation, it is unclear whether it could also account for other effects suggesting cascade processing and especially for the cognate effect observed by Costa et al. (2000) and for the data collected in the study of Colomé (2001). In the study of Costa et al. (2000) bilingual speakers named pictures whose names varied on whether their translations were phonologically similar (cognates) or dissimilar (non-cognates). Naming latencies were faster for cognates than for non-cognates. The authors argued that this result supports the notion that there is phonological activation of both the target word in the response language and of its translation, supporting the notion of cascade processing. An account of this effect in terms of double selection (e.g., selection of the target word in the response language and also of its translation in the non-response language) seems highly unlikely.

Convergent evidence with the claim of Costa et al. (2000) comes from the study of Colomé (2001). In her study, Catalan-Spanish participants were asked to decide whether a given phoneme was presented in the Catalan name of a target picture. In the critical cases, the target phoneme was present in the Spanish name of the target picture. For example, in some trials participants were asked to decide whether the Catalan name of the target picture *taula* (table) contained the target phoneme *m*; and in other trials whether it contained the target phoneme /*f*/. Both type of trials required a negative response, since neither /*m*/ nor /*f*/ are present in the target word *taula*. However, the target phoneme /*m*/ is present in the Spanish name (*mesa*) of the target picture (table) while the target phoneme /*f*/ is not. The results showed that responses in the former trials were slower than in the latter. That is, it was harder for participants to reject that a given target phoneme was not present in the Catalan name of the picture when this phoneme was present in the Spanish translation than when it was not. This observation was interpreted as revealing that the target's translation was activated in the course of retrieving the picture's name in the target language, therefore supporting the notion that there is activation of non-target phonological representations (but see Costa, La Heij, & Navarrete, 2006, for a challenge to this interpretation and to the cognate facilitation effect reported by Costa et al., 2000).

The presence of phonological activation of lexical representations that are semantically related to the target word, as synonyms and translations, is inconsistent with the discrete model proposed by Levelt and colleagues (1999). This is because in this framework the only lexical representation that passes activation to its phonological content is the selected one. However, this observation is consistent with full-cascade models and the Bloem and La Heij's discrete proposal, the Conceptual Selection model. Full-cascade models assume that any activated representation spreads part of its activation to its immediately linked representation at the subsequent level; while the Conceptual Selection model allows for activation of semantically related representations both at the lexical and phonological levels. Full-cascade models and the Conceptual Selection model make different predictions regarding whether there is lexical and phonological activation of conceptual representations that are not semantically related to the target word.

If we want to choose between the two proposals we need to evaluate whether there is phonological activation of conceptual representations that are not relevant for the communicative message and are semantically unrelated to the target one. This is the main purpose of the dissertation and evidence regarding this topic is introduced in the next section.

2.4 Spreading activation of distractor pictures

Some studies have explored the influence of communicatively-unrelated concepts on the lexicalization process. These studies analyze whether these conceptually activated representations are lexicalized and to what degree. In order to induce unrelated conceptual activation in the speaker's mind, participants are required to carry out naming tasks over the target stimuli while ignoring the presentation of distractor stimuli. Under the assumption that the distractor generates conceptual activation, the aim of these studies is to analyze whether this conceptual activation is propagated to lexical and phonological levels of the speech production system. Given that these studies are analyzing the linguistic processing of a conceptual representation, ideally the manner to induce activation into the conceptual system should not be a linguistic one. That is, distractor words should not be used because the visual or auditory processing of a distractor word has some lexical and phonological influences. One way to solve this methodological problem is to use distractor pictures[9].

As in the previous section, we review the experimental evidence distinguishing the spreading of activation between conceptual and lexical levels (section 2.4.1) and between lexical and phonological levels (section 2.4.2).

2.4.1 Lexical activation of distractor pictures

One way to examine whether distractor pictures activate their lexical representations consists in manipulating the semantic relationship between target and distractor stimuli. This section reviews the studies that have taken this approach. To advance the outcome, these studies show contrasting observations: Glaser and Glaser (1989) report semantic interference, Bloem and La Heij (2003) semantic facilitation, and Damian and Bowers (2003) and Humphreys, Lloyd-Jones,

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[9] Other possibility is to use homophones words (Cutting & Ferreira, 1999; Ferreira & Griffin, 2003), words in the non-response language in the case of bilingual participants (Costa, Miozzo, & Caramazza, 1999) or logographic words in languages with two writing systems like Chinese (Spinks, Liu, Perfetti, & Tan, 2000; Guo, Peng, & Liu, 2005).

and Fias (1995) do not report effects. We review these studies in the next paragraphs.

One of the first studies to use distractor pictures in naming tasks was Glaser and Glaser's (1989). In one experiment of their study, participants were shown two pictures that appeared sequentially and were required to name one picture and ignore the other. In half of the trials participants were instructed to name the first picture and to ignore the second one, and vice versa in the other half (the so-called sequential discrimination task). Ten stimulus onset asynchronies (SOA), ranging from -300 ms to 300 ms, were used. Furthermore, the target and the distractor pictures were randomly presented above or below a central fixation point. The two pictures of each stimulus could be of different semantic categories (*bet-cat*), of same category (*cat-rabbit*) or the same picture (*cat-cat*) yielding three experimental conditions: semantically unrelated, semantically related or identical respectively. A fourth condition was also included in which a picture was paired with a control distractor that was an empty rectangle. In comparison with naming latencies in the control condition, unrelated and related conditions showed slower latencies (interference effect) while the identical condition showed faster latencies (facilitation effect). More important for our purpose is the fact that the semantically related condition showed slower naming latencies than the semantically unrelated condition. That is, the picture of a *cat* was named slower in the context of a semantically related picture (*rabbit*) than in the context of an unrelated picture (*bed*) (see for a replication La Heij, Heikoop, Akerboom, & Bloem, 2003). This result was interpreted as evidence that "…*in the category-congruent condition, distractor and target would activate closely connected nodes in the semantic memory and therefore provide a strong Stroop-like inhibition. In the incongruent condition, on the other hand, the nodes activated by distractor and target in the semantic memory would be so far from one another that the Stroop inhibition would be markedly reduced*" (p. 36).

However, this seminal effect has been shown to be rather elusive. Other studies have obtained different results using similar tasks. The first of these was that conducted by Humphreys et al. (1995). In Experiment 2, participants were instructed to name a red picture that was accompanied by a green distractor picture. Contrary to Glaser and Glaser's observation, no semantic effect was observed here, distractor pictures semantically related to the target produced the same effect as unrelated distractor pictures. Humphreys et al. suggested as a possible reason for the discrepancy between these results the different selection mechanisms that both tasks implicate: the discrimination sequential task used by Glaser and Glaser (1989) and the pre-specified visual cue task of their study (the cue was the color of the target-distractor stimuli). The authors argued that the use of color as the selection cue makes possible an efficient selection of the target and prevents the competition of the distractor (see for instance, Boucart & Humphreys, 1994, 1997). By contrast, the discrimination sequential task could induce participants to sometimes incorrectly select the distractor rather than the target picture or make the selection task more difficult by enabling responses to be generated to distractors and targets. If participants made a mistake during lexical retrieval and selected both pictures to be verbalized instead of only one, semantic interference could be expected[10].

Interestingly, although the task used by Humphreys et al. (1995) could imply easier target selection, it does not necessarily prevent some sort of semantic processing of the distractor picture (e.g., Dean, Bub & Masson, 2001). In a study with a similar paradigm, Tipper (1985) obtained evidence of semantic processing of the distractor pictures. In particular, in Tipper's study the presentation of the picture *cat* as an ignored object led to slower naming latencies of the target picture *dog* on the subsequent probe trial in comparison to when the to-be-ignored picture in the previous trial was a semantically unrelated picture (*guitar*). This effect is called the negative-priming effect (see also Tipper and Driver, 1988; and Damian, 2000)[11].

Second, in the study conducted by Damian and Bowers (2003) target and distractor pictures differed in size. Distractors were smaller than targets and were embedded inside the target pictures. As in the previous experiments, the semantic

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[10] Is there any evidence supporting the idea that misselection can lead to a semantic interference effect? We propose that there is at least indirect experimental evidence. In other experiments of Humphreys et al. (1995), participants were presented with two pictures on every trial (one in red and the other in green). After a short interval, the pictures disappeared and a cue word was presented, the word "red" or the word "green". Participants were instructed to name the picture corresponding to the cued color. In such tasks, participants do not know which item they have to name before the cue, therefore it is likely that both items are selected and maintained as response candidates. Humphreys et al. (1995) observed slower naming latencies on the cued picture when it was presented with a semantically related picture than when it appeared with an unrelated picture. Given this semantic interference effect, we argue that if participants in the study conducted by Glaser and Glaser were selecting two pictures and then choosing one to utter, a similar semantic interference effect would be expected.

[11] Note however, that if distractor pictures are semantically processed in this kind of task, it is still an open question why Humphreys et al. (1995) did not observe semantic effects (facilitation or inhibition) while Tipper (1985) and Damian (2000) reported negative-priming effects.

relationship between target and distractor was manipulated. The results did not show differences between conditions, that is, distractor pictures semantically related had the same effect as unrelated distractor pictures on target naming latencies. Furthermore, Damian and Bowers excluded the possibility that the lack of effect was due to the use of some specific visual selection mechanism that allows participants to prevent any influence of the distractor pictures. They did so by running a control experiment in which the pairs of picture-picture stimulus were presented for a categorization task: targets were manually categorized as either man-made or natural. This control experiment showed a congruity effect, that is, faster responses in those pairs where the distractor and target pictures were semantically related that in pairs where they were unrelated. Hence, the distractor pictures were obviously processed at a conceptual level in a similar fashion as in the naming experiment.

Finally, a third study which fails to replicate Glaser and Glaser is that of Bloem and La Heij (2003). Using a word translation task, a task that is generally assumed to be similar to picture naming in that it is conceptually mediated (Kroll & Stewart, 1994; La Heij, Hooglander, Kerling, & Van der Velden, 1996); Bloem and La Heij observed a Semantic Facilitation Effect (SFE) of distractor pictures. In this study, Dutch participants were asked to translate a word from English (their second language) into Dutch (their first language) while ignoring the presentation of a distractor picture that could be semantically related or unrelated with the word. Bloem and La Heij reported a facilitatory semantic effect. Participants were faster in translating an English word (*horse*) into Dutch when it was accompanied by a semantically related distractor picture (*dog*) than when accompanied by an unrelated distractor picture (*bottle*).

The results reviewed above regarding the effects of distractor pictures are rather inconsistent. The first study that addressed this issue (Glaser & Glaser, 1989) showed a semantic interference effect. Assuming that semantic interference arises at the lexical level of processing, Glaser and Glaser's data would suggest that a distractor picture activates its lexical node. However, several studies have failed to replicate this observation with very similar naming paradigms. Humphreys et al. (1995) and Damian and Bowers (2003) did not observe any semantic effect in picture naming tasks, while Bloem and La Heij (2003) observed facilitation effects in translation tasks. Importantly, the semantic processing of the distractor in the naming tasks is guaranteed by two observations: the negative priming effect reported by Tipper (1985; see also Damian, 2000) and the semantic effect in the manual categorization task conducted by Damian and Bowers (2003). Given these contrasting results, a definitive answer to whether distractor pictures are activating their lexical representations is still not possible. One possible reason for the contrasting effects (interference, facilitation and lack of effect) could lie in the different requirements of each task. However, before speculating about the different tasks' processing demands that might be behind this contrasting pattern of results, it is important to assess the reliability of these results. One of the purposes of the present dissertation is to shed some light on this issue replicating picture naming and word translation experiments using the same experimental conditions: i.e., testing participants from the same population using the same language and laboratory.

To summarize, the evidence regarding lexical activation of distractor pictures is still not conclusive. In the next section we review more evidence regarding this topic, introducing the studies that have explored the presence of phonological activation of to-be-ignored pictures. In these studies the phonological relationship between the target and the distractor names was manipulated. It is significant for the main purpose of the dissertation that the distractor pictures in these studies are semantically unrelated to the target pictures. This experimental approach allows us to adjudicate between the Conceptual Selection model and full-cascade models. According to the Conceptual Selection model phonological activation is restricted to semantically related representations, while full-cascade models allow for phonological activation of any conceptual representation that has been activated.

2.4.2 Phonological activation of semantically unrelated distractor pictures

Two studies have evaluated whether there is phonological activation of semantically unrelated concepts using pictures as distractor stimuli. In the study conducted by Morsella and Miozzo (2002) English participants were instructed to name the picture in green and to ignore the picture in red. The distractor picture (*bed*) was either phonologically related to the name of the target picture (*bell*) or unrelated (*hat*). The results showed a Phonological Facilitation Effect (PFE), that is, naming latencies were faster in the related than in the unrelated condition. To make sure that the PFE was related to phonology and not to some other properties of the stimuli (as the visual discriminability of the pictures), Morsella and Miozzo conducted a control experiment in Italian, a language where the phonological relationship between the pictures were absent. In this control experiment no differences between the two conditions were observed, supporting the interpretation that the PFE reported in the English experiment was due to the phonological manipulation between picture names. The authors interpreted the PFE as evidence for cascade models of lexical access. They argued that words not selected for production can nonetheless, and regardless of their semantic relationship with the target, activate their phonology.

This study provides strong evidence supporting the full-cascade assumption, and is inconsistent with existing discrete models. However, there is also experimental evidence that seems to be at odds with the cascade assumption. Bloem and La Heij (2003) failed to observe phonological activation of distractor pictures in translation tasks in which participants translate words from English (L2) into Dutch (L1) while ignoring the presentation of distractor pictures. The authors argued that if the distractor pictures were to activate their phonological content then translation times should be faster in the context of pictures whose names are phonologically related [*borstel* (brush)] to the target word [*bont* (fur)] than in the context of unrelated pictures [*wiel* (wheel)]. However, no PFE whatsoever was observed. Importantly, the semantic facilitation that is observed when the distractor picture holds a semantic relationship with the target word (see above) suggests that during this task there is semantic processing of the distractor picture. The failure to observe phonological effects argues against the interpretation of the effect reported by Morsella and Miozzo (2002).

Another potential concern with Morsella and Miozzo's conclusion comes from the inconsistent results produced by semantically related distractor pictures presented above (Bloem & La Heij, 2003; Damian & Bowers, 2003; Glaser & Glaser, 1989; Humphreys et al., 1995). The presence of phonological activation of a distractor picture implies the previous activation of its semantic and lexical representations. In such a scenario, one might expect to observe semantic effects (either inhibitory or facilitatory) when the distractor picture is semantically related to the target picture. However, the studies that have explored semantic effects of distractor pictures lead to inconsistent results: semantic facilitation (Bloem & La Heij, 2003), semantic interference (Glaser & Glaser, 1989) and no effect (Damian & Bowers, 2003; Humphreys et al., 1995).

The current experimental evidence does not give a conclusive answer to the question of whether semantically unrelated conceptual information activates its corresponding phonological content. In particular, Bloem and La Heij's (2003) results question the reliability of the PFE observed by Morsella and Miozzo (2002). Indeed, Bloem & La Heij (2003) argued that this PFE does not necessarily imply that any activated conceptual representation spreads activation to the lexical level. The reasoning of Bloem and La Heij is similar to that developed by Levelt and colleagues (1999) when accounting for the presence of phonological activation of near-synonyms (Peterson & Savoy, 1998, see section 2.3.2). They argued that the PFE could be revealing a failure in the lexicalization process that selects for production the conceptual representation of the distractor picture rather than that of the target picture. As a result of this failure, the phonological properties of the distractor picture become activated. On these occasions, they further argued, participants may have halted their lexicalization processes before uttering the name of the distractor picture and starting the lexicalization of the target picture again. In this scenario, the retrieval of the phonological properties of the target word would be easier if part of these properties have already been pre-activated by the distractor's picture name (the phonologically related condition) than if they have not (the unrelated condition), leading to the presence of a PFE. According to Bloem and La Heij the experimental conditions used by Morsella and Miozzo are susceptible to such derailments in the selection of the target representation, since target and distractors are difficult to discriminate between. From this perspective, Morsella and Miozzo's PFE does not reveal cascade processing but rather a derailment in the selection of the preverbal message.

2.5 Summary of the studies and models' predictions

In this chapter we have presented three theoretical proposals regarding the feed-forward flow of the activation through the speech production system. These theories defend different approaches regarding which concepts spread activation to the lexical nodes, and which lexical nodes spread activation to the phonological segments. All three proposals predict that during the lexicalization process of one specific word, other semantically related words also become activated. However, these approaches disagree on a) whether lexical nodes of non-intended concepts become activated and b) whether any lexical node that is activated spreads part of its activation up to the phonological layer of representation.

Full-cascade models (e.g., Caramazza, 1997; Costa et al., 2000; Dell, 1986; Dell et al., 1997; Griffin & Bock, 1998; Harley, 1993; Rapp & Goldrick, 2000; Starreveld & La Heij, 1995) accept both a) and b). The discrete model of Levelt and collaborators (1999) accepts a) but refuses b). Finally, the Conceptual Selection model of Bloem & La Heij (2003) (see also Bloem et al., 2004) refuses a) but accepts b). Observational evidence has been brought forward against the three models. However, this evidence seems to show incongruent results, and for this reason we consider that it is not conclusive enough to reject any of the models.

In section 2.4 we have reviewed some studies that have addressed this question. The rationale of these studies is to explore the influence of distractor pictures in speech production tasks. In these studies the semantic or the phonological relationship between distractor and target words were manipulated. Under the assumption that distractors are conceptually activated, these manipulations allow us to explore whether the distractor's conceptual representation, that is irrelevant to the speaker's communicative purpose, activates its lexical and phonological representations. Table 1 collects a summary of these studies. As we see in the table, the observations of semantic and phonological effects seem to vary as a function of the task used, and as a consequence one could argue that a possible cause of these paradoxical results are the specific requirements involved in each task.

	Semantic manipulation			**Phonological manipulation**		
Experimental paradigm	**Observation**	**Study conducted by**	**Theoretical implications**	**Observation**	**Study conducted by**	**Theoretical implications**
Picture naming /categorization (priming paradigm)	Semantic interference	Tipper (1985) / Damian (2000)	Distractor is conceptually activated			
Picture naming (sequential discrimination task)	Semantic interference effect	Glaser & Glaser (1989)	Distractor is lexically activated			
Picture naming	No effect	Humphreys et al. (1995)	The mapping between conceptual and lexical representations is not activated	Phonological Facilitation Effect (PFE)	Morsella & Miozzo (2002)	Distractor is lexically and phonologically activated
	No effect	Damian & Bowers (2003)	Distractor is not lexically activated			
Picture manual categorization	Facilitation	Damian & Bowers (2003)	Distractor is conceptually activated			
Word translation	Semantic Facilitation Effect (SFE)	Bloem & La Heij (2003)	Distractor is conceptually activated	No effect	Bloem & La Heij (2003)	Distractor is neither lexically nor phonologically activated

Table 1: Summary of the studies on lexical access that have used distractor pictures

As we said before, the main purpose of this dissertation focuses on phonological effects. There are two apparently contrasting observations. The first has more methodological connotations, and refers to the existence of phonological effects in a task in which semantic effects are not present. The PFE reported by Morsella and Miozzo (2002) in a picture naming task implies that the conceptual, lexical and phonological representations of the distractor have been activated. One could argue that under the same circumstances semantic effects should emerge. However, Humphreys et al. (1995) and Damian and Bowers (2003) did not observe semantic effects with the same paradigm.

The second apparently contradictory observation has relevant theoretical implications. It refers to the opposite patterns reported in two apparently similar tasks: while in word translation tasks Bloem and La Heij (2003) found semantic but not phonological effects, naming tasks showed phonological but not semantic effects. Concretely, Bloem and La Heij (2003) have argued that the presence of semantic but not phonological effects in translation tasks would reject a full-cascade model.

The main purpose of the experiments reported in this dissertation is to evaluate whether there is any phonological activation of distractor pictures that are semantically unrelated with the speaker's preverbal message. We explore whether the PFE for ignored stimuli is present in other naming contexts. Furthermore, in order to have a better understanding of the incongruent results between picture naming and word translation tasks, we extend these studies.

3 Objectives and overview of the experimental part[12]

3.1 Main aim

The dissertation tries to characterize the flow of activation between the different layers of processing involved in speech production; specifically we assess two theoretical proposals regarding the feed-forward flow of activation. The cascade proposal assumes that activation flows in an automatic manner through the system. On the other hand, discrete proposals assume that the flow of activation between the different levels of the system is restricted. In order to adjudicate between these two proposals we measure whether concepts irrelevant to the speaker's communicative intention spread activation to the lexical and phonological layers of processing. In particular, we focus on the extreme situation and explore whether during speech production speakers activate the phonological segments of the name of objects that have to be ignored. Positive evidence of such activation would give support to the cascade proposal.

As we reviewed in chapter 2 there are several experimental observations relevant to our purpose that nonetheless seem to be contradictory. The first paradoxical piece of evidence refers to the failure in observing semantic effects using a picture naming task in which phonological effects have been reported. The second one refers to the apparently contradictory pattern of results observed with two seemingly similar tasks, word translation and picture naming. This dissertation also intends to assess the reliability of these observations.

[12] Part of the research presented here is published in Navarrete and Costa (2005).

3.2 Specific objectives

1. To assess whether a conceptual representation that is irrelevant to the speaker's communicative intention spreads activation to its lexical and phonological representations. To do this, we test the Phonological Facilitation Effect (PFE) in two types of tasks: naming and translation tasks.
2. To asses the original inconsistent results between similar paradigms. To that end we measure whether there are semantic effects in the same conditions where we test the PFE. We evaluate the existence of semantic effects in naming and translation tasks.
3. To explore the generalization of the PFE to naming situations where the chances of a derailment in the selection process are reduced.
4. To asses the role of syntactic constraints on the propagation of activation between the lexical and phonological layers of processing.

3.3 Experimental paradigms and predictions

In order to explore the above mentioned issues, three experimental paradigms were used: the picture naming, word translation and color naming paradigms. In the picture naming task two superimposed pictures were presented and participants were required to name one (the green one) while ignoring the other (the red one). In the word translation task, participants were instructed to translate a word while ignoring the presentation of a distractor picture. In the color naming task, participants were presented with colored pictures or colored patches above pictures and were instructed to name the color and ignore the pictures. Two critical variables were manipulated: the phonological and the semantic relationship between target word and distractor picture.

3.3.1 Phonological manipulation

In most of the experiments presented in this dissertation, participants performed naming or word translation tasks while ignoring the presentation of a distractor picture that could be phonologically related or not with the response word. The logic behind these experiments is the following. On the assumption that the ease with which the phonemes are retrieved depends on their level of activation (Meyer & Schriefers, 1991; Costa et al., 2000), if activation flows in a cascade way from conceptual representations to phonological representations, then the selection of the phonemes corresponding to the target word would be faster when distractor and target names are phonologically related than when they are unrelated (the PFE). This would be so because in the related condition they receive activation from two lexical nodes (the target and the distractor names) while in the unrelated condition activation only comes from one lexical node (the target).

The existence of such a facilitation effect would give support to cascade models of speech production. In addition, the phonological activation of a distractor picture would guarantee that the picture has activated its lexical representation. This is so because the only way a picture can activate its phonological content is through the previous activation of its lexical node. On the other hand, on the assumption that activation flows in a discrete manner, no phonological effects would be predicted.

3.3.2 Semantic manipulation

In the semantic experiments, the distractor picture could belong to the same semantic category as the target or to a different category. The predictions regarding the semantic manipulation are the following. First, assuming that the distractor picture activates its conceptual representation but not its lexical node, faster latencies would be expected when the distractor picture and target belong to the same semantic category than when they belong to different semantic categories. This would be so because in the related condition target conceptual selection should be primed by the distractor conceptual representation. Second, in the case that the distractor picture activates its lexical node and under the assumption that lexical selection occurs by competition, slower latencies should be observed in the semantically related condition than in the unrelated one. Finally, in the case that the distractor picture activates its lexical node, there is a third possibility: if the magnitude of the conceptual priming is similar to the magnitude of the lexical interference, both effects could cancel each other out and no differences between semantically related and unrelated distractors would be expected.

3.3.3 Picture-word interference paradigm

In order to asses the influence of syntactic constrains on the flow of activation (see objective 4) we also used a picture-word interference paradigm. In this task participants were instructed to name a picture while ignoring the presentation of a word. We defer the predictions stemming from the phonological and semantic manipulations in this task to chapter 7.

3.4 Overview of the Experimental Part

The experiments of the present dissertation are organized in four chapters. The experiments of chapter four assess the presence of phonological and semantic effects from distractor pictures in the picture naming task.

Experiment 1 evaluates phonological effects.

Experiment 2 evaluates semantic effects.

The experiments of chapter five assess the presence of phonological and semantic effects from distractor pictures in the word translation task.

Experiment 3 evaluates phonological effects.

Experiment 4 evaluates semantic effects.

The experiments of chapter six assess the presence of phonological effects under experimental conditions in which the target and the distractor dimensions are easier to discriminate between. In these experiments participants are instructed to do a color naming task.

Experiment 5 evaluates phonological effects.

Experiment 6 is a control experiment of Experiment 5.

Experiment 7 evaluates phonological effects with slightly different stimuli presentation.

Experiment 8 evaluates perceptual load demands on the presence of phonological effects.

The experiments of chapter seven assess the propagation of activation between the lexical and phonological layers in pronominal naming tasks.

Experiment 9 evaluates phonological and semantic effects.

Experiment 10 evaluates phonological effects.

4 Contextual effects from distractor pictures in picture naming tasks

The main issue addressed by the experiments presented in this chapter is to test the presence of the phonological and semantic effects in picture naming tasks. In Experiments 1 and 2 participants were presented with two superimposed pictures (one colored in green and another colored in red) and were asked to name the green picture while ignoring the red one. In Experiment 1 we manipulated the phonological relationship between distractor and target pictures, and in Experiment 2, their semantic relationship.

4.1 Experiment 1: Phonological effects from distractor pictures

In this experiment the phonological relationship between the target and the distractor pictures was manipulated. The presence of a Phonological Facilitation Effect (PFE) in this Experiment would support full-cascade models of lexical access. According to this view, naming latencies should be faster in the phonologically related condition than in the unrelated condition because the distractor pictures would prime the retrieval of the target phonological content. By contrast, discrete models predict no difference between conditions because these models restrict the phonological activation to the selected words (Levelt et al., 1999) or to the selected and semantically related words (Bloem and La Heij, 2003). What discrete models forbid is the phonological activation of concepts semantically unrelated with the speaker's communicative intention.

Method

Participants

Thirty-six native speakers of Spanish, students at the University of Barcelona, took part in the experiment in exchange for a course credit.

Materials

Twenty-four pictures were used as target pictures and another set of 24 pictures was used as distractors (line-drawings taken mostly from the Snodgrass & Vanderwart's set, 1980). Each target picture [e.g., *boca* (mouth)] appeared along with a distractor picture whose name was phonologically related [e.g., *bota* (boot)], and along with a distractor picture whose name was phonologically unrelated [e.g., *lápiz* (pencil)]. Furthermore, and in order to reduce the number of related items, target pictures also appeared with another set of 24 filler distractor pictures that were unrelated. Thus, the target pictures appeared 3 times each: once with a related distractor and twice with unrelated distractors. The names of the pictures included in the phonologically related condition shared an average of 2.3 segments and always shared at least the first two segments (see Appendix A). Target pictures appeared in green and distractor pictures in red. The pictures of each pair appeared simultaneously and were superimposed.

To further reduce the number of related trials, a second set of 24 filler target pictures was presented three times along with a distractor picture. None of these filler target and distractor pictures was used in the experimental conditions. In total, there were 48 target pictures (24 experimental + 24 filler) that appeared 3 times each; and 72 distractor pictures (24 experimental + 48 fillers) that appeared 2 times each.

In the overall experiment, each participant was presented with 48 experimental trials (24 trials in the related condition and 24 trials in the unrelated condition) and 96 filler trials, all of them unrelated. In this way, the percentage of related trials was quite low (16%). The experiment contained three different blocks of 48 trials each. Target and distractor pictures appeared only once per block, and the two experimental conditions were distributed equally across the blocks (8 times per block). Trials inside each block were randomized with the restriction that two phonologically related trials appeared with a minimum distance of three trials between them. The first two trials at the beginning of each block contained filler pictures. Care was taken to avoid any obvious relationship (semantic or phonological) between the pictures of two successive trials in order to prevent the emergence of negative priming (e.g., Tipper, 1985; Damian, 2000). Participants were randomly and equally assigned to six different block orders.

Procedure

Participants were tested individually in a sound-attenuated room seated approximately 60 cm from the screen. At the beginning of the experiment, participants were presented with the 48 target pictures (without distractors) and were instructed to name them. Afterwards, a training phase started in which the target pictures appeared along with unrelated distractor pictures. None of these unrelated pictures were included in the experimental session. Participants were asked to name the pictures that appeared in green (the target ones) as fast and accurately as possible, while ignoring the pictures that appeared in red (the distractor ones). An experimental trial consisted of the following events: a) a fixation point (an asterisk) was shown in the center of the screen for 1250 ms; b) a blank interval was shown for 500 ms; c) the picture-picture stimulus was presented until the subject's response or for 800 ms; d) 2000 ms after the response or after the onset of the stimulus the trial terminated; e) a question mark appeared and a new trial began after participants pressed the spacebar. Response latencies were measured from the onset of the picture-picture presentation. To check that distractor pictures elicited the expected name each participant was asked to name them after the experimental session. Given that these pictures were selected on the basis of their high name agreement, it is not surprising that all subjects produced the expected name for all pictures. Stimulus presentation and reaction times were controlled by the DMDX program (Forster & Forster, 2003). The entire experimental session lasted for approximately 35 minutes.

Results and Discussion

Three types of responses were excluded from the analyses: a) production of names that differed from those designated by the experimenter; b) verbal disfluencies (stuttering, utterance repairs, and production of nonverbal sounds that triggered the voice key); and c) recording failures. Also, naming latencies below 300 ms or above 3 standard deviations from a given participant's mean were discarded from the analyses (4.8% of the data points were excluded). Error rates and naming latencies in the phonologically related condition were compared to those in the unrelated condition.

No significant differences were observed in the analysis of error rates (all ts < 1). However, naming latencies in the phonologically related condition were 21 ms faster than in the unrelated condition ($t1$ (35) = 5.15; $p < .01$; $t2$ (23) = 2.04; $p < .06$), replicating the PFE from distractor pictures reported by Morsella and Miozzo (2002). Further support for the reliability of this phenomenon is found in the post-hoc analyses in which we compared naming latencies in the phonologically related condition to those in the unrelated filler condition ($t1$ (35) = 3.88; p = .01; $t2$ (23) = 1.97; p < .07) (see Table 2).

	Language					
	Spanish			English		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	737	73	4.7	744	80	4.4
Unrelated	758	73	4.9	749	85	4.3
Filler	756	81	6.1	747	80	4.2
Effect	-21			-5		

Table 2: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and language for Experiment 1.

The results of this experiment suggest that a phonological overlap between the name of the ignored picture and the name of the target picture facilitates naming latencies. However, before reaching this conclusion, it is important to assess whether the factor behind the PFE is actually the phonological overlap between the target and distractor, and not other uncontrolled variables (e.g., visual masking). To this end we asked a group of 36 native speakers of English, students at Harvard University, to conduct the same experiment in English. Crucially, here, phonological overlap between distractor and target names was absent in the two conditions. The results of this control group showed no significant differences across conditions (all ts < 1), revealing that the difference observed in Experiment 1 is actually due to the phonological overlap between the names of the distractors and the target names (see Table 2). A pooled analyses of the naming latencies of Experiment 1 and this control experiment showed a significant effect of the variable Phonological Relationship in the subject analysis ($F1$ (1, 70) = 19.19; MSE = 5865.31; p < .01) but not in the item analysis (p > .23). There was no effect of the variable Response Language (Fs < 1). Importantly, the interaction between both variables was significant in both analysis ($F1$ (1, 70) = 7.28; MSE = 2225.44, p < .01; $F2$ (1, 23) = 8.42; MSE = 1881.51; p < .01), revealing that the difference between the related and unrelated conditions was only present when participants named the pictures in Spanish[13].

4.2 Experiment 2: Semantic effects from distractor pictures

Given the presence of the PFE one could also expect to observe semantic effects in the same experimental situation. However, the current experimental evidence for the effects of semantically related distractor pictures in picture naming is mixed (see Table 1 in chapter 2). Semantically related distractors have led to semantic interference (Glaser & Glaser, 1989) and to null effects (Humphreys et al., 1995; Damian & Bowers, 2003). However, neither of these studies tested semantic and phonological effects under the same experimental conditions. Thus, we cannot safely conclude that there are no effects of semantically related distractors under the same experimental conditions in which phonological facilitation is observed. Experiment 2 aims at resolving this uncertainty.

The details of this experiment were very similar to those of Experiment 1. However, and given the elusive nature of semantic effects produced by distractor pictures, we wanted to make sure that our experiment was sensitive enough to detect an effect. We therefore included a condition in which the target picture appeared without a distractor. Presumably, naming latencies should be faster when the picture appears in isolation than when it appears along with a distractor.

Method

Participants

Eighteen participants from the same population as in Experiment 1 took part in this experiment.

Materials and Procedure

The design of this experiment was very similar to the previous one with the following modifications. First, the 48 target pictures (24 target, 24 filler) appeared twice along with distractor pictures and once in isolation, for a total of 144 trials. Also, target and distractor pictures in the related condition belonged to the same semantic category. When comparing the effects of semantically related distractor pictures against unrelated distractor pictures it is important to control the visual similarity between the target and the distractors in the two conditions. Several

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[13] In this control Experiment no differences in the naming latencies between the related and the filler conditions were present (*t*s < 1).

measures were taken to ensure that the visual similarity between related and unrelated picture pairs was similar. First, we avoided pairing two objects with very obvious visual overlap (e.g., *table* and *stool* were not paired). Second, we conducted a norming study in which visual similarity ratings were gathered. In this study, each target picture was paired with several distractor pictures (related and unrelated). The resulting 130 object pairs were presented to twenty-three participants, who were asked to rate the visual similarity between the two objects of the pair presented side by side (1: not similar at all; 5: very similar). Based on these ratings we selected objects to be paired with each target picture. When carrying out the selection process, we tried to equate the visual similarity between target and distractor as much as possible in the two conditions (visual similarity for related objects: 1.73; visual similarity for unrelated objects: 1.65 ($t < 1$) (see Appendix B).

Results and Discussion

Following the same criteria as in Experiment 1, 5.8% of the data points were excluded from the analyses.

Semantically related distractor pictures elicited as many errors as unrelated ones (all ts < 1). Also, naming latencies were not affected by the semantic relationship between target and distractor (all ts < 1). Finally, naming latencies were slower when the target picture appeared along with a distractor picture than in isolation (all ps < .05) (see Table 3).

The results of this experiment failed to show any measurable effect of semantically related distractor pictures in picture naming. However, before concluding that semantic effects are absent in this task it is important to assess whether the distractors were able to elicit semantic effects at all. To this end we carried out a picture-word interference experiment in which the names of the distractors were presented visually and participants were instructed to name the target pictures. In this paradigm, categorically related distractors usually lead to semantic interference (e.g., Lupker, 1979; Rosinski, Golinkoff, & Kukish, 1975). The results of this latter experiment (n = 18) revealed a reliable 23 ms semantic interference ($t1$ (17) = 2.76; $p < .02$; $t2$ (23) = 1.89; $p < .08$). Thus, the semantic relationship held by the target and distractor was strong enough to lead to measurable semantic effects in an experiment with the same number of participants (see Table 3).

	Distractor modality					
	Picture			Word		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Semantically Related	763	77	5.8	777	71	5.8
Unrelated	762	73	6.3	754	58	3.2
Isolated picture	665	67	5.3	646	56	2.3
Effect	1			23		

Table 3: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and distractor modality for Experiment 2.

4.3 Discussion of the picture naming tasks

The results of Experiments 1 and 2 revealed that: a) a phonological relationship between the name of a distractor picture and the name of a target picture speeds up naming latencies (Experiment 1), and b) a semantic relationship between the two stimuli does not affect naming latencies (Experiment 2).

The PFE of Experiment 1 strongly suggests that during picture naming distractor pictures activate their phonological code; hence supporting full-cascade models of lexical access (see also Morsella & Miozzo, 2002). The failure to obtain semantic effects from ignored pictures replicates recent observations (Damian & Bowers, 2003; Humphreys et al., 1995). In chapter two we argued that the absence of semantic effects in a context in which phonological effects were reported might seem surprising. We defer further discussion of the absence of semantic effects to the General Discussion (see chapter 8).

As we argued, the PFE is inconsistent with the two discrete models presented in chapter 2. According to the model by Levelt and colleagues (1999) only one lexical item is phonologically encoded: the one that is selected for production. Given that the distractor picture is never selected or produced, its phonological content should not be activated. According to Bloem and La Heij's model (2003), phonological activation is restricted to the target lexical node and to semantically related items. Therefore, no phonological activation of semantically unrelated pictures should be present.

However, before concluding that the PFE actually supports cascade models, we need to consider the absence of phonological effects in a seemingly similar task as word translation. In the next two chapters we focus on this issue. We do that by first evaluating the generalization of the results observed in translation experiments (see chapter 5), and second, exploring some particularities of the picture naming task that could be accountable for the presence of the PFE (see chapter 6).

5 Contextual effects from distractor pictures in translation tasks

In the experiments presented in this chapter we aimed at assessing the reliability of some results obtained in word translation tasks. Arguably, the process involved in translation tasks should be sensitive to the same variables as those involved in picture naming and, as a consequence, distractors pictures should affect the two tasks similarly (Kroll & Stewart, 1994; La Heij et al., 1996). However, some recent results reported by Bloem and La Heij (2003) using word translation tasks are in clear conflict with those reported in chapter 4. While in picture naming phonologically related distractor pictures lead to a Phonological Facilitation Effect (PFE), no phonological effect was reported in word translation. Furthermore, another inconsistency is the fact that while in picture naming semantically related pictures showed no effects, a Semantic Facilitation Effect (SFE) was reported in word translation.

In this chapter we evaluate phonological and semantic effects in word translation tasks. To do that, Spanish-Catalan bilingual participants were presented with a Catalan word (the target) and a picture (the distractor) and were asked to translate the word (the response word) into Spanish while ignoring the picture. In experiment 3 we manipulated the phonological relationship between the distractor picture and the target word. In Experiment 4 we manipulated the semantic relationship.

5.1 Experiment 3a: Phonological effects from distractor pictures

In this experiment the phonological relationship between the response word and the name of the distractor picture was manipulated. Assuming that word translation and picture naming involve similar processes of lexical access, the predictions concerning this Experiment are identical to those of Experiment 1: full-cascade models predict a PFE while discrete models do not expect phonological effects. To maximize the probability of observing phonological effects, we used two stimulus onset asynchronies (SOAs), as in the original study of Bloem and La Heij (2003).

Method

Participants

Twenty-eight participants from the same population as in Experiment 1 took part in this experiment. Participants were Spanish-Catalan bilinguals.

Materials

Thirty-two to-be-translated Catalan target words were selected. These words were not phonologically related with their Spanish translations, that is, they were non-cognates words. For each of the response words a phonologically related picture was selected to create the phonologically related condition. For instance, the picture of a *cat* (*gato* in Spanish) was paired with the Spanish response word *gafas* (glasses). The unrelated condition was created by re-pairing these pictures to unrelated response words. Semantic or associative relations between paired pictures and words were avoided. The names of the pictures and the response words included in the phonologically related condition shared an average of 2 segments and always shared at least the first two segments (see Appendix C). Furthermore, five new Catalan target words of the same characteristics and five new pictures without any relation were selected and used at the beginning of each block as warm-up trials. The to-be-translated Catalan target word was always presented in black upper case letters and superimposed on the middle of the distractor picture. To assure high legibility, the target word was presented above a white background and the picture was presented in grey. Target words and distractor pictures were positioned in the centre of the computer screen.

Eight different block orders containing 64 trials (32 Catalan target words x 2 distractor picture conditions) were created. Each participant received two different block orders, corresponding to the two different SOA conditions. Overall, each participant was presented with 128 experimental trials (32 Catalan target words x 2 distractor picture conditions x 2 SOA conditions). The first five trials at the beginning of each block contained the warm-up trials.

Procedure

At the beginning of the experiment, participants were presented with the 32 Catalan target words in isolation and were instructed to translate them in Spanish.

In the cases when participants made an error or did not know the translation the experimenter provided the correct answer. The incorrect words were repeated orally by the experimenter at the end of this familiarization phase. Afterwards, a training phase started. For each participant, this training phase was of the same SOA condition as the first experimental block. In the training phase target words were presented with related or unrelated pictures. Half of the target-picture stimuli were phonologically related, the other half unrelated. The pictures used in these training phases were taken from a different set than the pictures of the experimental series (making the training phrase identical to Experiment 1 of the study of Bloem & La Heij, 2003). In the training phase each target word was presented once. Participants were asked to translate the Catalan target word into Spanish as fast and accurately as possible while ignoring the picture. Finally, the experimental session began and participants were presented with two experimental blocks of different SOA conditions with a pause between them. Half of the participants started with SOA = 0 condition, the other half with the SOA = -250 condition. To check that distractor pictures elicited the expected name, after the experimental session participants were shown the distractor pictures alone and were asked to name them in Spanish.

An experimental trial involved the following events. A fixation point (an asterisk) was shown in the center of the screen for 500 ms and was replaced by a blank interval of 300 ms. Then in the negative SOA condition the distractor picture was presented 250 ms before the target word and the two stimuli remained on the screen for 2000 ms or until the participant's response. In SOA = 0 condition, the distractor picture and the target words were presented simultaneously and they remained on the screen for 2000 ms or until the participant's response. 2000 ms after the response or after the onset of the stimulus the trial terminated and a question mark appeared. A new trial began after participants pressed the spacebar. Response latencies were measured from the onset of the target word presentation. Stimulus presentation and reaction times were controlled by the DMDX program (Forster & Forster, 2003). View conditions and the testing room were identical to Experiment 1. The entire experimental session lasted for approximately 35 minutes.

Results and Discussion

Following the same criteria as in Experiment 1, 4.5% of the data points were excluded from the analyses. In addition, data points involving distractor pictures that were incorrectly named in the agreement test that followed the experimental session were excluded from the analyses (5.4% of the data points). The target word *bressol* (cradle in Catalan) produced a high rate of errors (29%) and the data points involving this stimulus were eliminated from analyses. Separate analyses were carried out with subject and item means as dependent variables, yielding F1 and F2 statistics, respectively. Two independent variables were analyzed: Phonological Relationship (Related vs. Unrelated) and SOA (-250 ms vs. 0 ms).

In the error analysis no significant differences were observed (all *F*s < 1). In the latencies analysis, the main effect of the Phonological Relationship was significant (*F*1 (1, 27) = 17.96; *MSE* = 8487.72; *p* < .01; *F*2 (1,30) = 10.08; *MSE* = 8456.26; *p* < .01), reflecting faster naming latencies in the phonologically related condition (790 ms) than in the phonologically unrelated condition (807 ms). The main effect of SOA was not significant (*p*s > .18). The interaction between Phonological Relationship and SOA was significant in the subject analysis (*F*1 (1, 27) = 4.83; *MSE* = 1674; *p* < .04) and marginally significant in the item analysis (*F*2 (1, 30) = 3.59; *MSE* = 1751.25; *p* < .07), reflecting a larger difference between the phonological related and unrelated distractors in the SOA = -250 ms condition (25 ms) than in the SOA = 0 ms condition (10 ms) (see Table 4).

	SOA = -250 ms			SOA = 0 ms		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	784	67	4	795	52	3.6
Unrelated	809	77	3.8	805	54	3.6
Effect	-25			-10		

Table 4: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 3a.

Having found that the phonological effect was different in both SOA conditions, *t*-tests on the naming latencies data per SOA condition were performed. For the SOA = -250 ms condition, the *t*-test showed a significant phonological facilitation effect (*t*1 (27) = 4.59; *p* < .01; *t*2 (30) = 3.31; *p* < .01). For the SOA = 0 ms condition, the phonological facilitation effect was marginally significant in the subject analysis (*t*1 (27) = 1.85; *p* < .08) and not significant in the item analysis (*t*2 (30) = 1.57; *p* > .12).

These results reveal that translation latencies were faster when the name of the distractor picture was phonologically related to the name of the response word. This PFE gives support to the cascade hypothesis of lexical access. However, before reaching this conclusion we assessed whether the high percentage of related trials used in Experiment 3a (50%) plays a role for the presence of the PFE. Due to the high percentage of related trials, the generation of strategies by the participants to retrieve the correct response cannot be excluded (e.g., Bodner & Masson, 2001). This is so because if participants noticed that a large percentage of trials were phonologically related, the name of the distractor picture could be used as a cue to retrieve the response word. In order to exclude this possibility we replicate Experiment 3a with the same materials but reducing the percentage of related trials. Furthermore, the decrease of this percentage will allow for a better comparison to Experiment 1, where the percentage of related trials was of 16%.

5.2 Experiment 3b: Is the PFE in the translation task due to the percentage of related trials?

In this experiment we assessed whether the number of related trials in Experiment 3a would have an effect on the presence of the PFE. We did this by reducing the percentage of related trials to 25%. If the PFE observed in Experiment 3a was not due to the use of strategies, we should obtain the same effect in Experiment 3b. By contrast, if the PFE was due to the use of strategies, by presenting a lower percentage of related trials, the chances to using them would be reduced and the PFE should disappear in Experiment 3b.

In this experiment, half of the phonologically related pairs (16) of Experiment 3a were re-paired creating unrelated pairs. For example, the response word *cama* (bed) that was paired with the phonologically related picture *casa* (house) in Experiment 3a appeared now with the unrelated picture *pera* (pear). The rest of the target-distractor pairs were maintained.

Method

Participants

Twenty-eight students from the same population as in Experiment 3a took part in the experiment.

Materials and Procedure

The same materials and procedure as in Experiment 3a were used here with the difference that half of the target-distractor pairs of the related condition (16) were re-paired creating unrelated pairs. As a result, 25% of the trials on each block (16/64) were phonologically related and 75% (48/64) were unrelated (see Appendix D). In addition, during the training phase, the target words were paired with unrelated pictures from another set of pictures.

Results

Following the same criteria as in Experiment 1, 5.4% of the data points were excluded from the analyses. In addition, data points involving distractor pictures that were incorrectly named in the agreement test that followed the experimental session were excluded from the analyses (4% of the data points).

In the error analysis, the main effect of the Phonological Relationship was significant in the subject analysis ($F1$ (1, 27) = 8.57; MSE = 2.89; p < .01) but not in the item analysis (p > .1), reflecting more errors in the unrelated condition (4.5%) than in the related condition (2.5%). No other effects were significant (ps > .13).

In the latencies analysis, no significant effects were observed between the two conditions in the subject analysis (Fs < 1). In the item analysis only the SOA effect was significant ($F1$ (1, 15) = 12.51; MSE = 3675.39; p < .01) (all other ps > .2) (see Table 5).

	SOA = -250 ms			SOA = 0 ms		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	759	89	3.6	770	80	1.6
Unrelated	755	94	4.9	774	86	4.2
Effect	4			-4		

Table 5: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 3b.

Joint analysis of Experiments 3a and 3b

A joint analysis of Experiments 3a and 3b was conducted with two within-subjects variables, Phonological Relationship and SOA, and the between subjects variable Experiment (Experiments 3a vs. Experiment 3b). In this analysis only the target-distractor pairs of Experiment 3a that were used in Experiment 3b were included.

In the error analysis, the main effect of Phonological Relationship was significant ($F1$ (1, 54) = 4.31; MSE = 1.44; $p < .05$) in the subject analysis, but not in the item analysis ($p > .33$). There were more errors in the unrelated condition. The main effects of the variables SOA and Experiments were not significant (ps > .27). The interaction between Phonological Relationship and Experiment variable was significant in the subject analysis ($F1$ (1, 54) = 4.31; MSE = 1.44; $p < .05$) and marginally significant in the item analysis ($F2$ (1, 15) = 3.04; MSE = 2.53; $p < .11$).

In the naming latencies analysis, the main effect of the variable Phonological Relationship was significant in the subject analysis ($F1$ (1, 54) = 6.39; MSE = 4803.87; $p < .02$) but not in the item analysis ($F2 < 1$). The SOA variable was not significant in the subject analysis ($F1 < 1$) and significant in the item analysis ($F2$ (1, 15) = 13.38; MSE = 4061.25; $p < .01$). The variable Experiment was marginally significant in the subject analysis ($F1$ (1, 54) = 2.94; MSE = 34624.42; $p < .10$) and significant in the item analysis ($F2$ (1, 15) = 7.53; MSE = 16951; $p < .02$). The interaction between Phonological Relationship and Experiment was significant in the subject analysis ($F1$ (1, 54) = 6.3; MSE = 4742.14; $p < .02$) but not significant in the item analysis ($F2$ (1, 15) = 2.74; MSE = 1914.25; $p < .12$), reflecting that the PFE depends on the variable Experiment.

Discussion

The data of the present experiment does not reveal latency differences between conditions. That is, translation latencies were unaffected by the phonological relationship between the name of the distractor and the name of the response word. The absence of a PFE in this experiment contrasts with the presence of such an effect in Experiment 3a. These contrasting results may suggest that the origin of the PFE reported in Experiment 3a could be due to the high percentage of related trials (50%). A high percentage may induce the use of strategies during response selection. Further support for the conclusion that the percentage of related trials makes the PFE appear and disappear comes from the fact that in Experiment 3a a PFE of 18 ms was observed for the same materials that did not generate effects in Experiment 3b (see Table 6).

	SOA = -250 ms			SOA = 0 ms		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	774	71	2.7	786	55	3.1
Unrelated	799	79	2.9	798	56	2.9
Effect	-25			-12		

Table 6: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for the subset of materials of Experiment 3a.

The absence of a PFE in Experiments 3b casts doubt on the interpretation of the PFE reported in Experiment 3a in terms of cascade processing. In addition, this absence raises the question of whether the SFE observed in the translation task (Bloem & La Heij, 2003) may also be affected by strategic factors. Experiments 4a and 4b assess the presence of semantic effects under identical experimental conditions to those used in Experiments 3a and 3b.

5.3 Experiment 4a: Semantic effects from distractor pictures

In this experiment the semantic relationship between the response word and the distractor picture was manipulated. The procedure of this experiment was identical to Experiment 3a. Given the presence of a PFE in Experiment 3a we expected to observe semantic effects in the present experiment.

Method

Participants

Twenty-eight students from the same population as in Experiment 3 took part in the experiment.

Materials and Procedure

Thirty-two to-be-translated Catalan words were paired with a distractor picture of the same semantic category to create the semantically related condition. The unrelated condition was created by re-pairing these pictures with unrelated response words. Phonological or purely associative relations between paired pictures and words were avoided. In order to keep the conditions as similar as possible to Bloem and La Heij's study, we selected materials from a similar number of semantic categories (nine) (see Appendix E). The procedure was the same as in Experiment 3.

Results and Discussion

Following the same criteria as in Experiment 1, 3.4% of the data points were excluded from the analyses. In addition, data points involving the target words *pèsol* (pea in Catalan) and *cigró* (chickpea in Catalan) yielded a high rate of errors (20% and 21% respectively) and were discarded form the analyses.

In the error analysis, no main effects of the variables Semantic Relationship and SOA were observed (all *F*s < 1). The interaction between these variables yielded a marginally significant difference in the subject analysis ($F1\ (1, 27) = 3.41$; $MSE = 3.22$; $p < .08$) and a significant difference in the items analysis ($F2\ (1, 29) = 5.72$; $MSE = 3$; $p < .03$).

In the naming latencies analysis, the main effect of Semantic Relationship was significant ($F1\ (1, 27) = 26.15$; $MSE = 8487.72$; $p < .01$; $F2\ (1,29) = 7.97$; $MSE = 8205.38$; $p < .01$), reflecting faster naming latencies in the semantically related condition (782 ms) than in the semantically unrelated condition (799 ms). The main effect of SOA was also significant ($F1\ (1, 27) = 4.32$; $MSE = 17127$; $p < .05$; $F2\ (1, 29) = 26.75$; $MSE = 18501.19$; $p < .01$). The interaction between Semantic Relationship and SOA was not significant (*F*s < 1) (see Table 7).

	SOA = -250 ms			SOA = 0 ms		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Semantically Related	771	78	2.6	793	83	3.7
Unrelated	785	80	3.8	814	91	2.6
Effect	-14			-21		

Table 7: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 4a.

In this experiment pictures semantically related to the response words sped up translation latencies. The presence of a SFE contrasts with the failure to observe semantic effects in very similar conditions such as the picture naming study reported in Experiment 2. Moreover, the SFE gives support to the Conceptual

Selection model proposed by Bloem and La Heij (2003). According to these authors, the SFE emerges because semantically related pictures prime part of the target conceptual representation but do not activate its corresponding lexical nodes. As a consequence of this conceptual priming process, target conceptual selection would be facilitated in the semantically related condition yielding faster translation latencies.

However, before embracing this explanation, it was important to test whether some properties of the design of Experiment 4a could be affecting the presence of the SFE. In particular, we explored whether the origin of the SFE was due to a) the high percentage of related trials or to b) the reduced number of semantic categories used throughout the experimental session. In Experiment 3, we observed that the PFE depended on the percentage of related trials throughout the experimental session. Given this, it was important to asses whether this variable also affected the SFE. In a situation with a high percentage of related trials, participants would have more possibilities of detecting the experimental manipulation between target and distractor than in a situation with a low percentage of related trials. Moreover, in the former situation participants could anticipate the response word more accurately than in the latter. For example, the presentation of the picture of a *dog* would anticipate a cohort of semantically related words (*cerdo* [pig]*, paloma* [dove]*, pato* [duck]*, rana* [frog]) as possible responses. If participants adopt an anticipatory strategy, this will turn out beneficial in 50% of the cases in Experiment 4a. But if the same strategy is used in a context whit a low percentage of related trials, it would be less adequate. This is relevant because it is plausible to think that in circumstances in which expectations are more satisfied there would be more probabilities to make use of the anticipatory strategies. In order to asses the influence of the percentage of related trials, we adopted the same procedure as in Experiment 3b and reduced the number of related trials by re-pairing some experimental pairs of the Experiment 4a.

We also assessed whether the reduced set of semantic categories used in Experiment 4a played some role in the presence of the SFE. In Experiment 4a, target words and distractor pictures were collected from a number of nine semantic categories. A reduced set of semantic categories would increase the probability that participants notice the experimental manipulation between target and distractor stimuli.

5.4 Experiment 4b: Is the SFE in the translation task due to the percentage of related trials and to the reduced set of semantic categories?

In this experiment we assessed whether the number of related trials and the reduced set of semantic categories used in Experiment 4a had an effect on the presence of the SFE. As we argue in Experiment 3b, if the presence of the SFE observed in Experiment 4a was not due to the use of anticipatory strategies, we should obtain the same effect in Experiment 4b. Conversely, if the SFE was due to the use of anticipatory strategies, the SFE should disappear in Experiment 4b.

Here we proceeded in the same manner as in Experiment 3b. In order to explore whether the high percentage of semantically related trials would account for the SFE, in Experiment 4b the percentage of related trials was reduced to 29%. The set of target-distractor related pairs (19) were extracted from pairs from Experiment 4a. Half of the participants of Experiment 4b (Group 1) were presented with filler target-distractor pairs (13) created by re-pairing the rest of the stimuli of Experiment 4a. In addition, a new group of participants (Group 2) were tested. For Group 2, a new set of distractor pictures from different semantic categories were selected and paired with the filler target words. The inclusion of Group 2 assessed whether the reduced number of semantic categories has any influence on the presence of the SFE.

Method

Participants

Fifty-six students from the same population as in Experiment 3 took part in the experiment. Half of the participants form part of Group 1 and the other half, of Group 2.

Materials

In this Experiment 19 of the target-distractor related pairs of the Experiment 4a were used as related pairs. As a result, 29% of the trials of one block (19/64) were semantically related and 71% (45/64) were unrelated for both groups. In Group 1, 13 of the target-distractor related pairs of Experiment 4a were repaired creating unrelated/filler pairs. In Group 2, filler pictures were selected from a new set. These pictures belonged to semantic categories that were not included in the experimental pairs. For instance, pictures of animals were not selected because this semantic category was still present in the experimental set (see Appendix F). As in

Experiment 3b, a new set of unrelated pictures was selected and used in the training phase.

Procedure

The procedure was the same as in Experiment 4a.

Results

In the analysis two within-subjects variables were included, Semantic Relationship and SOA, and a between subjects variable Group (Group 1 vs. Group 2). Following the same criteria as in Experiment 1, 4.3% of the data points were excluded from the analyses. In addition, data points involving the stimuli words *pèsol* (pea in Catalan) and *cigró* (chickpea in Catalan) yielded a high rate of errors (27% and 28% respectively) and were discarded from the analyses.

In the error analysis there was no significant effect in the subject analysis (all ps $< .14$). In the item analysis, the SOA = 0 condition yielded more errors than the SOA = -250 condition and this difference was significant ($F2$ $(1, 16) = 4.48$; $MSE = 2.65$; $p < .06$). No other effects were significant.

In the latencies analysis, the effect of Semantic Relationship was significant ($F1$ $(1, 54) = 9.32$; $MSE = 7388.22$; $p < .01$; $F2$ $(1, 16) = 4.24$; $MSE = 6257.78$; $p < .06$), revealing faster translation latencies in the related than in the unrelated condition (see Table 8). The variable Group was only significant in the item analysis ($F2$ $(1, 16) = 4.13$; $MSE = 5121.31$; $p < .06$). No other effects were significant.

	SOA = -250 ms			SOA = 0 ms		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Semantically Related	773	77	2.9	781	79	3.2
Unrelated	784	83	2.7	793	88	3.5
Effect	-11			-12		

Table 8: Both groups average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 4b.

Discussion

In experiment 4b we observed a SFE; word translation was faster in the context of a semantically related distractor picture than in the context of a semantically unrelated distractor. The SFE did not interact with the Group variable, suggesting that the SFE was similar in both groups.

The results of this Experiment replicated the SFE observed in Experiment 4a. This replication excludes that the SFE was due to the high percentage of related trials or to the reduced number of semantic categories that were used in Experiment 4b. In addition, the SFE reported here extend the SFE reported by Bloem and La Heij (2003).

5.5 Discussion of the translation tasks

The main aim of the above experiments was to replicate the reliability of the results observed by Bloem and La Heij (2003) under similar conditions. Our results lead to the following observations. First, a phonological relationship between distractor pictures and response words speeds up translation latencies (the PFE). Second, when the percentage of phonologically related trials decreases, the PFE disappears. Third, a semantic relationship between distractor pictures and target words speeds up translation latencies (the SFE). And forth, the SFE is still present when the percentage of related trials is reduced and the number of semantic categories used during the experiment is increased.

The most relevant experiment to the main purpose of this dissertation refers to the phonological manipulation (Experiment 3). In this respect, the PFE that we observed in Experiment 3a contrasts with the failure to observe phonological effects in the Bloem and La Heij study. However, the PFE disappeared when we reduced the number of related trials in Experiment 3b. This led us to conclude that participants could develop strategies during Experiment 3a and that the PFE is not a genuine effect revealing cascade processing.

On the other hand, the SFE that we observed in Experiment 4a replicates the previous study conducted by Bloem and La Heij. The SFE seems not to depend on the percentage of related trials or on the number of semantic categories used in Experiment 4a. Thus, from these data we can conclude that SFE is observed in similar circumstances in which phonological effects are not present (Experiment 3b).

The pattern of results we observed in Experiments 3 and 4 would suggest that distractor pictures are activating their conceptual representation but do not activate their corresponding lexical nodes. This data seems to be consistent with the Conceptual Selection model and to reject full-cascade models and the discrete proposal of Levelt and collaborators (1999). This is so because these latter models predict that any activated conceptual representation would propagate activation to the lexical level.

Finally, translation tasks showed an opposite pattern of results to that observed with picture naming tasks: in the experiments presented in chapter 4 we observed phonological effects in the absence of semantic effects. Given this apparent contradiction, the PFE reported in naming studies could be taken cautiously to support full-cascade models of lexical access. In the next section we discuss what can account for these apparent contradictory results.

5.6 Contrasting results from seemingly similar paradigms

The pattern of results observed in the translation task is in clear contradiction to the pattern observed in the context of a naming task (Experiments 1 and 2). As we saw in the previous chapter, the experimental setting in which participants are asked to name a picture and ignore a distractor object leads to two reliable observations: a) a PFE, and b) a lack of a semantic effect. Why is it that when a paradigm leads to semantic effects it does not lead to phonological effects and vice versa? An explanation for these contrasting effects may be found in the *selective attentional mechanisms* involved in translation and naming tasks. In the following paragraphs we focus on the discrepancy between the phonological results.

Selective attention refers to the mechanisms that allow participants to decide which stimulus deserves further processing and which does not. In the context of the tasks we are discussing, one important factor in selective attention refers to the visual presentation of target and distractor stimuli. In this respect, the presentation of two superimposed pictures in the naming paradigm may have led to selection problems. By contrast, the target selection in the translation tasks is presumably easier because target (word) and distractor (picture) are physically very different. The PFE would then arise in naming experiments due to the misselection of the distractor picture. That is, on some occasions, participants would select to lexicalize the distractor picture instead of the target one by mistake. This misselection would induce lexical and phonological activation of the distractor picture name. This interpretation of the PFE in naming studies has already been proposed by Bloem and La Heij (2003)[14].

[14] Note that this interpretation does not account for the lack of the SFE in the naming paradigm. According to the data reported by Humphreys et al. (1995) with the post-cue picture naming task (see footnote 11 in chapter 2), a semantic interference effect arises when two semantically related pictures

Evidence supporting the previous interpretation of the contrasting results comes from the studies developed by La Heij and co-workers using the color-color variant of the Stroop task (La Heij, Helaha, & Van Den Hof, 1993; La Heij, Kaptein, Kalff & de Lange, 1995). In the color-color task two color patches are presented and participants are instructed to name the color of one patch while ignoring the other. In the studies conducted by La Heij and co-workers, the interference effect was eliminated by facilitating the discriminability of the target color. The discriminability of the target was increased by various methods: presenting the target in a fixed position, using different forms for target and distractor or using different exposure duration for target and distractor. From the previous observation Bloem and La Heij (2003) concluded that "…*color–color interference effect reported in the literature may have been due to the incorrect selection of the context color for naming; an error that would lead to a strong activation of the name of the context color. This activation may lead either to an incorrect response or to interference in retrieving the correct color name, just as in the orthodox color-word Stroop task*" (p. 476). Turning back to the naming paradigm, the visual presentation in this paradigm (in which target and distractor picture differs in color) would induce some misselection problems and those would account for the presence of the PFE.

In line with the above, one way to reduce selection problems consists in augmenting the discriminability between target and distractor stimuli. In the experiments of the next chapter we asses the PFE produced by non-intended conceptual representations while reducing the chances of a derailment in the stimulus selection process. If the PFE in naming studies arises as a consequence of misselection problems, increasing the discriminability between target and distractor should reduce the probability of making a misselection and thus the PFE should be reduced or eliminated.

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are lexically selected and, after the cue presentation, one picture has to be lexicalized and the other one has to be rejected. If in naming paradigms participants were on some trials misselecting the distractor picture, a similar semantic effect as the one observed by Humphreys et al. should emerge. However, no semantic effect has been reported in these contexts (Experiment 2, see also Damian & Bowers, 2003; Humphreys et al., 1995).

6 Facilitating target selection: Color naming tasks

The lack of phonological effects in word translation tasks raised the issue of the generalization of such effects to experimental settings other than picture naming tasks. As discussed in the previous chapter, the picture-picture interference paradigm used as a picture naming task may cause problems in the selection of the target stimulus, leading to unwanted phonological activation of the phonological properties of the distractor pictures. Consequently, the Phonological Facilitation Effect (PFE) reported with naming studies would not be indicating cascade processing. It is then premature to accept the theory that information flows in a cascade manner through the speech production system.

The goal of the next four experiments is to explore the presence of phonological activation from ignored pictures in contexts in which the target and the distractor are easily distinguishable. We do so by: a) making the target and distractor dimensions easier to discriminate between at the physical level, and b) limiting the response set to one type of conceptual representation (color concept) which is different from the ignored one (object concept). Concretely, we explore the effect of phonologically related distractor pictures when participants name the color in which an object is presented. This experimental setting minimizes the chances that participants misselect for lexicalization the to-be-ignored dimension (the picture). Thus, the presence of PFE in this experimental situation would favor an interpretation of the phenomenon in terms of cascade processing and not in terms of difficulty in teasing apart the attended from the ignored dimension.

6.1 Experiment 5: Phonological effects from distractor pictures

In Experiment 5 participants were presented with colored pictures and they were asked to produce the names of the colors in Spanish (e.g., the picture *candle* appears in brown and participants have to say "*brown*"). In this situation, participants did not need to retrieve either the concept of the target picture or its lexical representation or phonological content. Furthermore, the conceptual dimension that needed to be lexicalized was clearly different from that needed to be ignored, making the chances of incorrect conceptual selection highly improbable. This is because participants knew in advance that they would be naming only colors. In some cases the name of the object (distractor dimension) was phonologically related to the name of the color (target dimension). For example, in the phonologically related condition the object *vela* (candle in Spanish) appeared in *verde* (green in Spanish), while in the unrelated condition it appeared in *marrón* (brown in Spanish). The predictions of the different models for this group of participants parallel those of Experiment 1. If the phonological content of the depicted object (distractor dimension) gets activated, then naming latencies in the phonologically related condition would be faster than in the unrelated condition. Alternatively, if the phonological activation is restricted to the selected conceptual (or lexical) representation (e.g., the color) then color naming latencies should be independent of the phonological properties of the object's name.

Method

Participants

Twenty-two participants from the same population as in Experiment 1 took part in this experiment.

Materials

The selection of the materials was constrained by the reduced number of picturable objects that have a phonological overlap with color names in Spanish. Also, we wanted to avoid the use of objects with obvious natural colors. We selected 4 pairs of objects [e.g., *vela* (candle)-*ventana* (window); *nariz* (nose)-*navaja* (clasp knife); *roca* (rock)-*rodilla* (knee); *maleta* (suitcase)-*mariposa* (butterfly)]. The names of the objects in each pair had a phonological overlap with one of the four colors included in the experiment (*verde*, *naranja*, *rojo* and *marrón* [green, orange, red and brown respectively]). For example, the object *mariposa* (butterfly) and *maleta* (suitcase) were phonologically related to *marrón* (brown), while the objects *vela* (candle) and *ventana* (window) were related to *verde* (green).

The eight objects appeared in each of the four colors included in the experiment, leading to 32 different target pictures. Only in eight color-object combinations were the names of the color and the object phonologically related. In the related condition, object and color names shared an average of 2.1 segments, and shared at least their first two segments (see Appendix G). In order to reduce the percentage of related trials we selected another set of 8 pictures. These pictures appeared along with the 4 colors used in the experiment. No phonological overlap between these pictures and the colors was present and we thus considered these stimuli as fillers. The inclusion of these filler trials reduced the percentage of related trials to 12.5%. Overall participants were presented with 64 stimuli (16 objects that each appeared in the 4 colors included in the experiment). However, in order to gain more experimental power, the 64 items were presented twice leading to a total of 128 trials. Participants were presented with two blocks of 64 items each (8 different blocks were constructed). All 64 object-color combinations were therefore present in each block. The order of the stimuli presentation in each block was randomized with the following restrictions: a) stimuli from the related condition were separated by at least four trials, b) stimuli containing the same object were separated by at least three trials, and c) successive trials containing the same color were avoided. The first two stimuli of each block were always filler stimuli. Each participant received two different blocks. A given combination of two blocks was never assigned to more than one participant.

Procedure

At the beginning of the experiment, participants were presented with the entire set of objects in black and white along with their written names and were instructed to name them aloud with the proper determiner form (e.g., "*la vela*", the candle). Afterwards, participants were informed that they would see the same objects but in various colors (green, red, brown and orange). Participants were instructed to name the color in which the object was depicted (e.g., "*verde*", green; "*rojo*", red) while ignoring the meaning of the object. After a training block containing the 64 items, the experiment proper started. Each trial had the following structure: a) a fixation point (an asterisk) was shown in the center of the screen for 1000 ms, followed by a blank interval of 450 ms; b) the colored picture was presented in the center of the screen until the participant's response or for 800 ms; c) a question mark appeared on the screen 1500 ms after the picture disappeared; d) the next trial began after the participant pressed the spacebar. Response latencies were measured from the onset of the stimulus to the beginning of the naming response. The experiment was controlled by EXPE software (Pallier, Dupoux, & Jeannin, 1997). Response latencies were measured by means of a voice key. The session lasted for about 35 minutes.

Results

Following the same criteria as Experiment 1, 3.3% of the data points were excluded from the analyses. One variable was analyzed: Phonological Relationship (Related vs. Unrelated). Given the limited number of items (four colors) we did not carry out an item analyses.

In the error analyses, the effect of the variable Phonological Relationship was significant (t (21) = 3.29; p < .01), reveling less errors in the related condition than in the unrelated condition. In the naming latencies analyses, the effect of the variable Phonological Relationship was also significant (t (21) = 4.06; p < .01), revealing that naming latencies in the related condition were 21 ms faster than in the unrelated condition (see Table 9).

	Language					
	Spanish			Catalan		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	540	61	1.1	551	60	3.9
Unrelated	561	57	4.1	556	65	4.4
Effect	-21			-5		

Table 9: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and language for Experiment 5.

In this experiment, naming latencies were faster when the name of the depicted object was phonologically related to the name of the color, suggesting that the phonological properties of the depicted object were activated in the course of color naming. However, as we argued in Experiment 1, before attributing such an effect to the phonological activation of the ignored stimuli, we needed to be sure that it was not due to other uncontrolled variables (perhaps, the object-color combinations in the phonologically related condition were more familiar or easier to recognize than in the unrelated condition). Following the same rationale as in Experiment 1, we assessed this possibility comparing the same object-color combinations in an experimental situation in which the phonological overlap is absent. We asked native speakers of Catalan to perform the same task with the same materials but in

Catalan. Crucially, in this language, the names of the colors and objects were phonologically unrelated. Twenty-two native speakers of Catalan took part in this experiment. We excluded the data points for the item *maleta* (suitcase) because its name in Catalan was phonologically related to the color name *marró* (brown). The results of this control experiment did not show any significant difference between the phonologically related and unrelated conditions (all *t*s < 1) (see Table 9). A pooled analyses of the results of Experiment 5 and this control experiment showed a significant interaction between the variables Phonological Relationship and Response Language in the naming latencies analyses (F (1, 42) = 3.81, MSE = 1364.87, $p < .06$), revealing that the difference between the related and unrelated conditions was only present when participants named the pictures in Spanish. The main effect of Response Language was not significant ($F < 1$).

Discussion

The facilitation effect reported in the Color Naming task, in which participants had to produce only the name of the color in which an object was depicted, suggests the existence of phonological activation of a stimulus that is irrelevant for the lexicalization process (the name of the depicted object). Crucially, when the task was conducted in Catalan, no such result emerged. This indicates that the difference between the two conditions observed was due to the phonological overlap between object and color names in the related condition. This pattern of results is consistent with the observations made in Experiment 1 and supports the notion that the flow of activation in speech production honors the cascade principle. In the next two experiments we further test the reliability of the PFE in other experimental contexts.

In Experiment 6, we assessed the impact that the familiarization phase and the extensive repetition of the stimuli may have had on the presence of the PFE observed in Experiment 5. In the latter, participants were familiarized with the names of the ignored pictures before the color naming task. One could argue that such familiarization could induce the retrieval of the to-be-ignored object name during the experimental phase (e.g., color naming), hence leading to the observed PFE. Also, in Experiment 5, the to-be-ignored pictures were repeated many times during the experimental session (12 times). It is possible that this extensive repetition of the to-be-ignored items enhances the chances for detecting a PFE[15],

[15] Note that if it were to be the case that the PFE arises as a consequence of the extensive repetition of the pictures, the only model that would be able to account for the PFE would still be the cascaded model.

an effect that under more natural conditions might be absent. Experiment 6 addresses the impact of these two variables in the detectability of the PFE.

6.2 Experiment 6: The impact of familiarization and repetitions on the presence of the PFE

The design and procedure of this experiment was very similar to that of Experiment 5 but with two major modifications: a) participants were not familiarized with the names of the to-be-ignored pictures before the experimental session and b) each picture was presented only 5 times (in comparison to 12 times in Experiment 5). If the PFE observed in Experiment 5 stems from the cascaded nature of the speech production system we should observe it in the present experiment too.

Method

Participants, Materials and Procedure

Twenty-two participants from the same population as in Experiment 5 took part in the experiment. All of them were instructed to name the color in which the object was depicted. The same materials as in Experiment 5 were used here. Unlike in Experiment 5, participants were not familiarized with the names of the to-be-ignored pictures. The training phase included only 16 trials, in which each object appeared only once, and each color 4 times. No related object-color combinations were presented in this phase. After the training phase the main experiment began. Each participant was presented with 64 trials. Stimuli presentation and blocks were the same as in Experiment 5 (however, each participant was only presented with one block and not two as in Experiment 5). To check that the distractor objects elicited the expected name, each participant was asked to name the objects after the experimental session.

Results and Discussion

Following the same criteria as in Experiment 1, 4.5% of the data points were excluded from the analyses. Before submitting the data to the statistical analyses, we checked for each participant (by assessing their performance in the naming task

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This is so because discrete models would not predict activation of the object names even after many repetitions and, therefore, these models could not account for the PFE reported in Experiment 5.

conducted after the experiment), whether the to-be-ignored picture elicited the expected name. For those items in which this was not so, we removed the corresponding naming latencies (13.5%). In total, 18% of trials were discarded from analyses.

In the error analyses no differences between the two conditions were observed ($t < 1$). In the naming latencies analyses the effect of the variable Phonological Relationship was significant (t (21) = 2.38; $p < .03$), reflecting the fact that naming latencies in the related condition were 24 ms faster than in the unrelated condition (see Table 10).

Type of Relationship	Mean	SD	E%
Phonologically Related	581	102	4.5
Unrelated	604	96	4.5
Effect	-24		

Table 10: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 6.

The results of this experiment replicated the PFE observed in Experiment 5. That is, naming latencies were faster when the name of the to-be-ignored picture was phonologically related to the name of the color than when it was not. The fact that the two experiments differed in: a) the presence of a familiarization phase and b) the extensive repetition of the to-be-ignored pictures, but that nevertheless the PFE was observed in both, suggests that neither of these factors is crucial for the detectability of the effect[16].

To recapitulate, the PFE reported in Experiments 5 and 6 strongly suggests the existence of phonological activation of a stimulus that is irrelevant for the lexicalization process (the name of the depicted object) in the course of lexical access. These results support the notion that the flow of activation in speech production honors the cascade principle. Experiment 7 further tests this hypothesis

[16] Further support for this conclusion comes from a reanalysis of Experiment 5, in which we assessed the magnitude of the PFE across the two blocks included in the experiment. The magnitude of the PFE was identical in both blocks (First block: phonologically related condition: 542 and unrelated condition: 563; second block: phonologically related condition: 539 and unrelated condition: 560). Furthermore, these magnitudes (21 ms) were similar to that observed in Experiment 6 (24 ms).

in a slightly different experimental condition that minimizes the chances that participants misselect the target dimension.

In the present experiment, we made the selection of the target representation easier by physically uncoupling the target and distractor dimensions: participants had to name a color patch that appeared in the middle of the depicted object. By physically uncoupling the attended and the irrelevant dimensions we minimized the chances that participants misselected for production the irrelevant dimension (the depicted object). The predictions were the same as the previous two Experiments, if the PFE is explained by a target misselection it should disappear when target and distractor are uncoupled.

6.3 Experiment 7: A further test of the phonological activation of distractor pictures

The same objects as in Experiment 5 were presented in this experiment, but depicted in black and white, and with a superimposed color patch. Participants were instructed to name the color patch and ignore the depicted object.

Method

Participants, Materials and Procedure

Twenty-two participants from the same population as in Experiment 1 took part in the experiment. Objects were presented along with an opaque colored rectangle of 2 x 0.8 cm. The rectangle appeared superimposed in the middle of the picture. For one given picture, the rectangles of the four different colors always appeared in the same position. All other details were identical to those in Experiment 5.

Results and Discussion

Following the same criteria as in Experiment 1, 4.9% of the data points were discarded from the analyses.

In the error analyses, no differences between the two conditions were observed ($t < 1$). Naming latencies were faster (12 ms) in the related than in the unrelated condition (t (21) = 2.02; $p < .06$) (see Table 11).

Given the similarities between Experiments 5 and 7, we conducted a joint analysis in which we declared a within-subjects variable, Phonological Relationship (Related vs. Unrelated), and a between subjects variable, Type of Format (Color Naming vs. Color Patch Naming).

Type of Relationship	Mean	SD	E%
Phonologically Related	548	60	4
Unrelated	560	60	5.2
Effect	-12		

Table 11: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition for Experiment 7.

In the error analysis, the main effect of Type of Format was significant (F (1, 42) = 7.69; MSE = 87; $p < .01$): participants of Experiment 7 (Color Patch) made more errors than participants of Experiment 5 (Color Naming). The main effect of the Phonological Relationship variable was also significant (F (1, 42) = 7.68; MSE = 95.48; $p < .01$): participants made more errors in the unrelated than in the related condition. The interaction between the two variables was not significant ($p > .26$).

In the naming latencies analysis, the main effect of the Type of Format variable was not significant ($F < 1$). The main effect of the Phonological Relationship variable was significant (F (1, 42) = 18.12; MSE = 5713.11; $p < .01$), revealing faster naming latencies in the related condition than in the unrelated condition. Importantly, the interaction between these two variables was not significant ($p > .2$), revealing that the phonological facilitation effect was comparable in the two types of formats.

The results of Experiment 7 replicated the PFE produced by ignored distractor objects observed in Experiments 5 and 6, suggesting that distractor objects activate their corresponding phonological form in the course of lexicalization. Importantly, this effect is present even under experimental conditions in which the target dimension and the distractor dimension are physically uncoupled. These data give support to cascade models of lexical access.

The PFE reported in naming tasks (Experiments 1, 5, 6 and 7) contrasts with the failure to observe phonological effects in translation tasks (Experiment 3b). Importantly, color naming experiments would reject the interpretations of the PFE in terms of distractor misselection (see Bloem & La Heij, 2003, and section 5.6). However, it remains an open question why these two relatively similar paradigms showed different phonological effects (we defer this question to chapter 8).

Selective attention involves focusing on task-*relevant* information and avoiding distraction by task-*irrelevant* information. The PFE reported in our Experiments 5, 6 and 7 showed that task-irrelevant information (distractor pictures) is processed under circumstances in which target and distractor stimuli are easy to discriminate. In the recent model of selective attention develop by Lavie and collaborators (2004, 2005) one important factor that modulates stimuli processing is perceptual capacity. According to this model, when the perceptual capacity is exhausted, the system does not have resources to process irrelevant stimuli and their effects disappear. In the next Experiment we tested this hypothesis by means of examining the phonological effect from distractor pictures reported in the color naming tasks.

The main purpose of Experiment 8 was to evaluate the role of perceptual demands on the phonological activation of distractor pictures. Furthermore, to explore whether perceptual capacity modulates the PFE could inform us about the discrepancy between the PFE observed in naming tasks and the absence of such effect in translation tasks.

6.4 Experiment 8: The role of perceptual load on the phonological activation of distractor pictures

The series of studies conducted by Lavie and co-workers (Lavie, 1995; Lavie, Hirst, Fockert, & Vidign, 2004; Lavie, 2005) are relevant to the main purpose of Experiment 8. Lavie et al. (2004) proposed a load theory of selective attention with two mechanisms. The first mechanism is a perceptual selection mechanism and the second one is a more active mechanism of attentional control. In Experiment 8 we focused on the first mechanism. Importantly, both mechanisms can be dissociated and the influence of perceptual load in selective attention while keeping constant the control mechanism can be tested (see Lavie, 2005 for a summary of the theory). According to this perceptual mechanism, "*distractors can be excluded from perception when the level of perceptual load in processing task-relevant stimuli is sufficiently high to exhaust perceptual capacity, leaving none of this capacity available for distractor processing. However, in situations of low perceptual load, any spare capacity left over from the less demanding relevant processing will spill over to the processing of irrelevant distractors*" (Lavie, 2004, p. 340).

Experimental evidence of the existence of the perceptual mechanism comes from response-competition tasks in which the perceptual load variable is manipulated (Lavie, 1995). In this kind of paradigm participants respond by pressing a button when a central letter is one of two pre-specified letters (e.g., X or N) while ignoring the presentation of a peripheral letter. Response latencies are slower when the peripheral and the central target letters are incongruent (e.g., distractor: X, target: N) compared to when the two letters are identical (e.g., distractor: X, target: X). The incongruent effect provides evidence that the distractor letter has been processed. Lavie (1995) manipulated the perceptual load by increasing perceptual processing requirements for the same physical display. In this study, an additional shape was presented next to the target letter. This shape could be a circle or a square with a red or blue color. Participants were required to make the button-pressing decision for the target letter but only in some circumstances. In one condition (Low load), the response to the target was dependent on the color of the additional shape. For instance, participants were required to make a response if the color was blue (go trials) but not if the color was red (no-go trials). In another condition (High load), participants made the responses on the conjunction of the shape and the color features. For instance, they had to respond when a red circle or a blue square appeared (go trials) but not when a red square or a blue circle appeared (no-go trials).

According to Lavie's prediction, the level of perceptual load would determine the degree of processing of the irrelevant distractor. That is, in the High Load condition the interference effect should decrease or even disappear. This would be so because in this condition, the task of recognizing the appropriate color-shape combinations should impose a much higher demand on attentional capacities, leaving considerably less resources for processing for the irrelevant distractor and hence reducing interference effects. This prediction was confirmed by the data (see also for further evidence Murray & Jones, 2002).

In Experiment 8, we extrapolated the previous attentional study to naming tasks. In particular, we tested whether the perceptual load involved in the processing of goal-relevant information had some influence on the presence of the PFE. To this end, we adapted the procedure used by Lavie (1995) to the color naming task of the Experiment 5.

Method

Participants

Forty-four participants from the same population as in Experiment 1 took part in the experiment.

Materials

The same colored objects of Experiment 5 were used here. In addition, in this Experiment a figure was added to the left or to the right of the pictures. This figure could be a circle or a triangle that could be filled (painted in black ink) or empty (painted in white ink). Half of the participants were required to pay attention to the filled/empty dimension of the figures (Low load group); the rest of participants were required to pay attention to the conjunction of the filled/empty and shape dimensions (High load group). Participants of the Low load group were instructed to name the color of the picture when the figure that appeared was empty, that is, they only needed to pay attention to the filling of the figures. Participants of the High load group were instructed to name the color of the picture when the figure that appeared was either a filled circle or an empty triangle. Thus, these participants had to pay attention to two dimensions of the figures, filling and shape.

The four possible figures (filled circle, filled triangle, empty circle and empty triangle) were presented on the left or on the right side of the pictures. They appeared the same number of times. Each of the figures appeared half of the times in each position. Note that the right/left position was irrelevant to perform the task. The same experimental block orders as in Experiment 5 were used. Half of the trials of each block were go trials and the other half, no-go trials. The same go and no-go trials were used in both groups. For example, the go trial composed by a *green window* was presented in the Low load group with an empty circle on the left, while in the High load group it appeared with a filled circle on the left (see Figure 3).

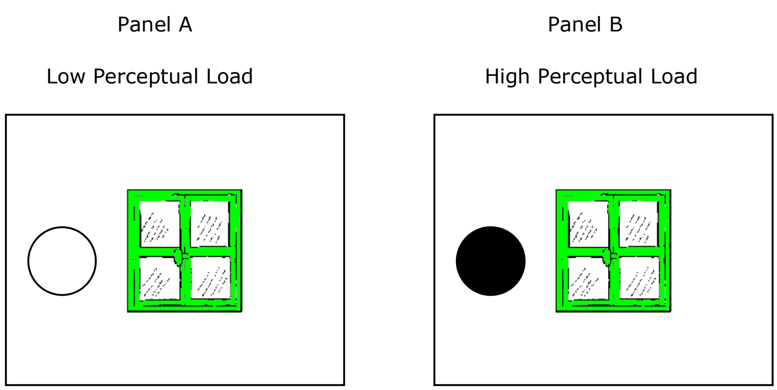

Figure 3: Examples of Go trials used in Experiment 8. Participants of the Low load group named the color of the picture when appeared an empty figure, circle or triangle (see Panel A). Participants of the High load group named the color of the picture when appeared either a filled circle or an empty triangle (see Panel B).

Procedure

The familiarization phase was the same as in Experiment 5. After this phase, participants received the instructions. Each trial had the following structure: a) a fixation point (an asterisk) was shown in the center of the screen for 1000 ms, followed by a blank interval of 450 ms; b) the colored picture was presented in the center of the screen until the participant's response or for 1500 ms; c) a question mark appeared on the screen 1500 ms after the picture's disappearance; d) the next trial began after the participant pressed the spacebar. Response latencies were measured from the onset of the stimulus to the beginning of the naming response. Stimulus presentation and reaction times were controlled by the DMDX program (Forster & Forster, 2003). Response latencies were measured by means of a voice key. The session lasted for about 35 minutes.

Results and Discussion

Following the same criteria as in Experiment 1, 4.3% of the data points were excluded from the analyses. Two variables were analyzed: Phonological Relationship (Phonologically Related vs. Phonologically Unrelated) and Perceptual Load (Low load vs. High load).

In the error analyses, the main effect of Phonological Relationship was significant (F (1, 42) = 4.059; MSE = 2.227; p = .05), revealing that participants made more errors in the unrelated condition than in the related condition. No other effects were significant in the error analysis (all Fs < 1).

In the naming latencies analyses, the main effect of Phonological Relationship was significant (F (1, 42) = 41.58; MSE = 37213.09; p < .01), revealing that naming latencies were faster in the phonologically related condition than in the unrelated condition. The main effect of the variable Perceptual Load was also significant (F (1, 42) = 112.09; MSE = 1723124.2; p < .01), revealing slower latencies for the High load condition than for the Low load condition. The interaction between these two conditions was not significant (F < 1), revealing that the PFE was similar in both conditions (see Table 12).

In both perceptual load conditions we observed a PFE (t-tests on the naming latencies per Load condition were performed, where both conditions showed a significant PFE: Low load condition, $t1$ (21) = 6.61; p < .01; and High load condition, $t1$ (21) = 3.68; p < .01). Contrary to our prediction, the PFE does not interact with the perceptual load variable: the magnitude of the effect was similar in both conditions (Low load = - 42 ms; High load= - 41 ms). Another relevant observation of Experiment 8 was the replication of the PFE. This replication would corroborate cascade models of lexical access: once a semantic representation has been activated, activation spreads in an automatic manner to related lexical representations, and further from these to phonological representations.

	Perceptual Load					
	Low			High		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	670	71	1.9	950	101	4.5
Unrelated	712	82	5.1	991	100	5.4
Effect	-42			-41		

Table 12: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and perceptual load for Experiment 8.

An interesting observation arose when we compared the magnitude of the PFE observed in Experiment 8 with that reported in Experiment 5. In Experiment 8 the magnitude of PFE was of 42 and 41 ms for the Low and High conditions respectively, while in Experiment 5 it was of 21 ms. This difference seems to suggest that distractor pictures have a larger impact in the experiments in which the perceptual load variable was manipulated than in Experiment 5, in which participants were required to name the color without paying attention to other elements of the display. Presumably, the go/no-go naming task of Experiment 8 requires a bigger cognitive control function than the naming task of Experiment 5. This would be so because in the go/no-go task participants need to pay attention to a particular cue signal in order to provide or to inhibit the oral response. Interestingly, Lavie et al. (2004) found evidence suggesting that the amount of distractor processing and the cognitive control involved in task performance are two directly related factors. That is, in situations that require high levels of cognitive control a large impact of the distractor is observed. However, this attempt to interpret the different magnitude of the PFE in Experiments 5 and 8 is very tentative and further research is needed in order to measure the influence of cognitive control mechanisms in naming tasks.

6.5 Discussion of the color naming tasks

We reported four experiments assessing the effects of distractor objects during naming tasks. The main objective was to extend the PFE observed in naming tasks (see Experiment 1) to other circumstances in which the target and the distractor were easier to distinguish. In Experiment 5 participants were instructed to name the color in which an object was depicted. Naming latencies were faster when the name of the target color was phonologically related to the object's name. However, such an effect was not present when the task was performed in a language in which no phonological relationship between the paired color-object names was present (Catalan), suggesting that the PFE observed in Experiment 5 was actually due to the phonological relationship between the color and object names. Experiment 6 revealed that neither a familiarization phase nor an extensive repetition of the experimental pictures was responsible for the presence of the PFE in Experiment 5. In Experiment 7 the PFE was observed under experimental conditions in which the discriminability of targets and distractors was enhanced. Finally, in Experiment 8 we measured whether the attentional demands required in the resolution of the main task affects the processing of the distractor. We did this by manipulating the perceptual load in color naming tasks. Contrary to our predictions, we did not observe any influence of the variable perceptual load; however we replicated again the PFE observed in previous experiments. The main contribution of our study is the demonstration of reliable phonological effects from ignored pictures in various experimental naming contexts.

The presence of the PFE produced by irrelevant pictorial stimuli in various experimental contexts highlights the reliability and reproducibility of the effect (see Figure 4). Furthermore, it makes an explanation of the PFE in terms of an error in the selection of the appropriate conceptual representation for lexicalization highly unlikely. Instead, the PFE strongly suggests that the phonological properties of pictorial stimuli which do not need to be lexicalized (which actually need to be ignored) become activated in the course of naming. This observation has important implications for models of lexical access in speech production and in particular for the dynamic processing across levels of representation.

In the Introduction we discussed three different proposals regarding the flow of activation across the different levels of representation in speech production (the conceptual, the lexical and the phonological levels). The presence of phonological activation of distractor pictures in the course of lexicalization is predicted by models that assume free spreading of activation across different processing levels (e.g., Caramazza, 1997; Dell, 1986; Dell et al., 1997). Thus, our data are inconsistent with those models that restrict the flow of activation across levels of processing; the discrete proposal of Levelt et al. (1999) and the Conceptual Selection model of Bloem and La Heij (2003).

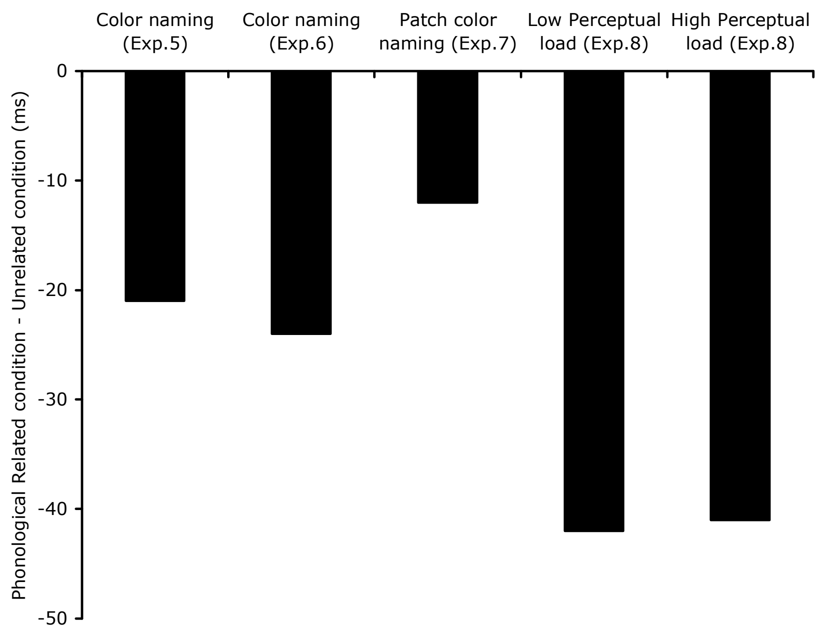

Figure 4: Magnitude of the PFE in the experiments of chapter 6.

7 Analyzing syntactic constraints in spreading activation: Pronominal tasks

The Phonological Facilitation Effect (PFE) reported in the naming experiments of chapters four and six supports the notion that activation flows in a cascade manner through the speech production system. The evidence we have collected so far is limited to single word utterances. In our experiments participants were required to name the target stimuli using a single word, a picture or a color name. However, in daily communicative interactions, speakers normally utter the words embedded in sentences. Hence, a relevant question arises here: Is activation also propagated in a cascade manner in sentence production? In principle, cascade models assume that the activation that one specific representation propagates to other representations should be independent of the format of the utterance. As a consequence, the cascade processing that we observed in single word production should also be present during sentence production. However, there are some observations that suggest that perhaps this is not the case.

First, in order to produce an appropriate sentence, speakers need to retrieve syntactic information. For instance, languages constrain word order according to syntactic rules: "The red car" is a correct construction in English, but in Spanish the order must be "The car red" (*el coche rojo*). Some recent studies have reported that syntactic features of words only have a role in lexical retrieval in those utterances that imply some syntactic processing, for instance sentence production (Pechmann & Zerbst, 2002; Pechmann, Garrett, & Zerbst, 2004) or verb inflection (Vigliocco, Vinson, & Siri, 2005). These studies are relevant because they highlight that lexical retrieval in sentence production could be affected by variables different from those in single word production. That is, having observed that syntactic influence depends on the naming context; it could be possible to argue that the spreading activation principle will be different depending on the naming context.

The second reason refers to the recent proposal of Jescheniak, Schriefers and

Hantsch (2001) according to which syntactic constraints exist for the propagation of activation (see for a related issue the study of Abrams & Rodríguez, 2005). In particular, these authors consider that during the production of a gender-marked pronominal form, the phonology of the referent noun does not need to be activated. Jescheniak and colleagues assume a discrete model with restrictions in the propagation of activation between the lexical and phonological levels. 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 "*hence, the frame would allow the system to filter out the noun competitor early in the lexicalization process*" (p. 1074). Interestingly, this syntactic proposal accounts for the evidence supporting cascade processing, as in the case of near-synonyms production (see Peterson & Savoy, 1998). According to Jescheniak and colleagues, the selection of a word entails its association with slots in a syntactic frame and in the case of selecting one of two near-synonymous nouns, both lexical competitors can enter the specific slot because they belong to the same categorical class: "…*therefore, the syntactic rule does not allow the system to discard one of the two competitors at an early point of time, such that competition continues and both candidates may become activated at the subsequent phonological level*" (p. 1074).

Given Jescheniak and collaborators' proposal, it is important to asses the possibility of syntactic factors restricting the propagation of the activation through the speech production system. This issue is even more relevant if we consider that all empirical evidence supporting cascade processing comes from studies in which intended and non-intended items belong to the same categorical class, concretely nouns. In this chapter, we assess this syntactic proposal. We do this in two pronominal naming experiments. Before presenting these experiments, in the next section we describe the studies that have already addressed this issue.

7.1 Pronominal studies

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 masc one). It is generally assumed that grammatical gender is a grammatical 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 (see for instance Navarrete, Basagni, Alario, & Costa, 2006)[17].

Two studies have measured whether there is activation of the phonological content of the referent words in pronominal utterances. These studies have shown contrasting results, but given that they have used different experimental paradigms, it is unclear what factor accounts for the discrepancy in their data. In this section we introduce these studies.

In a picture-word interference task, Jescheniak et al. (2001) asked German participants to name pictures using pronominal forms while ignoring the presentation of auditory distractor words. Participants were instructed to name pictures (e.g., *coat*, *Mantel* masc in German) with sentences as "*Er is gross*" (It masc is large) or with pronominal forms as "*Er*" (It masc). In the condition relevant here, distractor words could be phonologically related or not with the picture name. For instance, *Mantel* appeared with the phonologically related distractor *Manko* (deficit) and the unrelated one *Luder* (beast). The rationale of the manipulation was as follows: 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. By contrast, if the referent noun does not activate its phonological representation, no difference

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[17] Supporting this idea is the fact that same words have a different grammatical gender in different languages. For instance, the words moon and death are masculine in German (*Moond*, *Todt*) but are feminine in Spanish (*luna*, *muerte*). If grammatical gender were a conceptual property, we should expect that the gender of a noun to be the same across languages (however, this assumption does not exclude that conceptual information, as the sex of the referent, could be used in computing gender agreement between the subject and a predicative adjective, see Vigliocco & Franck, 1999). There is also some correlation between the phonological properties of the words and grammatical gender. For example, Spanish words ending in *-o* are predominantly masculine. In spite of this correlation, slips of the tongue studies (e.g., Caramazza & Miozzo, 1997; Miozzo & Caramazza, 1997) and the performance of some aphasic patients (Badeker, Miozzo, & Zanuttini, 1995; Leek, Tainturier, & Wyn, 2003; Tainturier, Leek, Schiemenz, Williams, Thomas, & Gathercole, 2005) show that the retrieval of grammatical gender and the retrieval of phonological information are two dissociated phenomena, giving support to the assumption that grammatical gender forms part of lexical knowledge and is stored independently of the phonological properties.

between conditions should be observed because distractor words would be activating phonological segments that do not receive extra activation from the referent noun. The results of these experiments did not show differences in naming latencies between both conditions (see also Finocchiaro & Caramazza, 2006, for similar results with clitic pronominal utterances). The lack of an interference effect led the authors to conclude that during the production of gender-marked pronominal forms the phonology of the referent noun need not become activated.

However, the null effect observed by Jescheniak et al. (2001) has to be taken cautiously because it contrasts with the data obtained by Schmitt, Meyer and Levelt (1999). In their study, Schmitt et al. used the double paradigm "lexical decision task + naming" (see Levelt et al. 1991). German speakers were presented with pairs of pictures shown on successive trials. In the condition relevant here, the same object appeared in both trials for each pair, but in different colors. For instance, participants first saw a red flower, and then saw the same flower in blue. They had to describe the sequence by saying '*Die Blume ist rot*; *Sie wird blau'* (The $_{fem}$ flower is red; It $_{fem}$ turns blue). In half of the trials (the fillers), this was their only task. In the remaining trials, an acoustic probe, a German word or pseudo-word, was presented for 100 milliseconds after the onset of the second picture (the target picture). In these cases, the participants first performed a lexical decision task and then described the second picture. On all critical trials the probes were words and could be either phonologically related or unrelated to the form of the pronominal referent. If the form of the antecedent noun is activated during the production of the pronoun, the mean lexical decision latency to the related probes should be longer than to that of unrelated probes (see Levelt et. al, 1991 for predictions with this paradigm). The data confirmed the authors' prediction: slower latencies in the lexical decision tasks were observed when the probe word was phonologically related to the name of the picture. Schmitt and colleagues concluded that in pronominal utterances, the lexical selection of the referent noun entails activation of the corresponding phonological form.

Several methodological differences between the previous studies make tracing the origin of the contrasting results difficult. The aim of the experiments reported in this chapter is two-fold. Firstly, we intended to test the reliability of the results observed by Jescheniak et al. (2001). In Experiment 9 participants were required to name pictures using a pronominal construction while ignoring distractor words. Secondly, we wanted to test the phonological activation in pronominal utterances under slightly different experimental conditions. In particular, we assessed this issue in a situation more similar to that conducted by Schmitt et al. (1999). Participants in Experiment 10 were instructed to name the colored pictures of Experiment 5 using pronominal constructions (determiner + color adjective). Participants named for instance the picture of a *green candle* with the following sentence: "*La verde*"' (The fem green one). Here, uttered responses share the initial phonological segments with the prime element (*verde-vela*). This procedure is similar to the comprehension task used by Schmitt and colleagues because in their study the probe word shared the initial phonemes with the picture's name. Thus, Experiment 10 tries to extend the effect reported by Schmitt and colleagues (1999) in a purely speech production task[18].

7.2 Experiment 9: Pronominal naming tasks (picture-word interference paradigm)

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) and another group of participants named the target with sentences such as "*Esta es verde*" (This fem is green). 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.

[18] Furthermore, there was another methodological difference between Experiments 9 and 10. While Experiment 10 looked for direct or non-mediated effects, the procedure of Experiment 9 looked for mediated effects. In Experiment 10 the pronominal form shared some phonemes with the referent noun and, in this way; part of the phonological content that participants uttered corresponded to the referent noun. This was not the case in Experiment 9, where the pronominal form did not share phonological segments with the referent noun. This latter task measured mediated effects; significant differences between the relevant conditions would indicate that the selection of the pronominal phonological segments can be influenced by the activation of other non task-relevant phonological segments. Similarly, some researchers have suggested that mediated effects are more difficult to observe than non-mediated effects (Dell & O'Seaghdha, 1991; O'Seaghdha & Marin, 1997). Such a proposal would be consistent with the pattern of results observed so far; an absence of phonological effects in the study of Jescheniak et al. (2001) and the presence of a phonological effect in the study of Schmitt et al. (1999).

Our predictions were the following. If the phonological segments of the referent noun become activated during pronoun utterances, phonologically related distractors should delay naming latencies more than phonologically unrelated distractors. By contrast, in the noun utterances the opposite pattern is expected, phonologically related distractors should yield faster naming latencies than phonologically unrelated ones. Furthermore, if pronoun and noun utterances require lexical access to the referent noun, there should be semantic interference in both utterances, that is, semantically related distractors would interfere more than unrelated distractors.

Method

Participants

Sixty native speakers of Spanish from the same population as in Experiment 1 took part in this experiment. Half of them produced full noun utterances and the other half, pronominal utterances.

Materials

Thirty-two pictures of common objects (from Snodgrass and Vanderwart's set, 1980, or similar collections) were selected (16 with masculine grammatical gender names and 16 with feminine grammatical gender names). Each picture [e.g., *mesa* (table)] was paired with four distractor words: a) a phonologically related one [*melon* (melon)], b) a phonologically unrelated one [*pino* (pine)], c) a semantically related one [*taburete* (stool)] and d) a semantically unrelated one [*bolso* (bag)]. 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 distractors to the pictures. The four distractor words that appeared with a picture were of different gender (see Appendix H). 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 and each block contained 8 distractors of each condition. 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 filler trials in the first two trials of each block.

Procedure

Participants were tested individually, seated in a sound-attenuated room. At the beginning of the experiment, participants were presented with the 32 target pictures (without distractors) 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 the target picture disappeared 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 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 EXPE software (Pallier et al., 1997). The entire experimental session lasted for approximately 40 minutes.

Results

Following the same criteria as in Experiment 1, 7.17% of the data points were excluded. 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 error analysis, the main effect of Semantic Relationship was significant ($F1$ (1, 58) = 9.23; MSE = 240.83; p < .01; $F2$ (1, 31) = 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).

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, 31) = 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, 31) = 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 13).

We conducted the t test analyses of the naming latencies of the two types of utterances. The t tests revealed that naming latencies were significantly slower in the semantically related condition than in the unrelated condition in Full Noun utterances (t1 (29) = 2.51; p < .02; t2 (31) = 3.13; p < .01) and also in Pronoun utterances (t1 (29) = 2.47; p < .03; t2 (31) = 2.44; p < .03).

Effect of the phonological distractors

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).

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, 31) = 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, 31) = 276.94; MSE = 227475.12; p < .01), with slower naming latencies in the Pronoun condition 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) (see table 13).

Despite the interaction was not significant, we conducted *t*-test analyses of the two naming conditions in order to assess whether the phonological facilitation effect was reliable in the pronominal utterances. The *t*-test analyses revealed faster naming latencies in the phonologically related condition than in the unrelated condition for both utterances. In the Full Noun condition this facilitation effect was statistically significant in both analysis ($t1$ (29) = 3.323; p < .01; $t2$ (31) = 2.059; p <.05). In the Pronoun condition the effect was statistically significant in the subject analysis ($t1$ (29) = 2.36; p < .03) but not in the item analysis ($t2$ (31) = 1.547; p < .14).

	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		

Table 13: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and type of utterance for Experiment 9.

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. More importantly, phonologically related distractor words sped up naming latencies in both conditions. Moreover, there was no interaction between these effects and type of utterance format; the magnitude and direction of the semantic and phonological effects was similar for both utterance types.

The relevant condition of Experiment 9 was the phonological manipulation in the pronominal format. In this condition, our data contrasts with the failure to observe effects in the study by Jescheniak et al., (2001) and Finocchiaro and Caramazza (2006). Which is the locus of the PFE we observed in the pronominal naming task? It has been suggested that the phonological facilitation effect in the picture-word interference paradigm has two components, one located at the lexical level and the other, at the phonological level. The explanation for the phonological component is that the distractor word primes part of the target's phonological representations that are going to be retrieved and uttered (see for instance Schriefers et al., 1990). Jointly with this component, phonological distractors should activate a cohort of similar lexical nodes. For instance, the distractor word *cat* would activate the lexical nodes 'cap', 'cat', 'car', etc. In this scenario, the lexical selection of the target word 'cap' will be facilitated by the distractor *cat*. Evidence supporting the lexical component of the phonological facilitation effect in picture-word tasks comes from the studies of Lupker (1982) and Bi and Caramazza (submitted) (see also Starreveld & La Heij, 1996; and Roelofs, Meyer & Levelt, 1996). As Spanish pronominal utterances do not require the phonological retrieval of the referent noun, we argue that the phonological facilitation effect we observed in the pronominal condition may be located at the lexical level[19].

Further support for the lexical locus of the phonological effect comes from the results observed by Starreveld and La Heij (2004). Participants of this study were required to name the Dutch article of a picture's name while ignore the presentation of distractor words. Among other conditions, the authors manipulated the phonological relation between the picture name and the distractor word. The results showed faster article naming latencies in the phonologically related condition than in the phonologically unrelated one. This effect was replicated in a new experiment in which the distractor stimuli were composed only by the initial letter of the previous distractor words. These results suggest that phonological

[19] Note that it is still an open question why the same effect is not observed in the study of Jescheniak et al., (2001). There are differences between our design and theirs. Some of them are response language (Spanish - German), presentation of the preamble (participants themselves described the scenes - a speaker described the scenes) or modality of distractor presentation (visual - auditory). It is unclear at this point whether some of these differences can account for the discrepancy in the results.

distractors have an effect in tasks that require lexical selection of words which are not produced, as is the case of the pronominal utterances used in Experiment 9.

There is, however, one observation in our data that seems to be problematic for this conclusion: the fact that we observed similar phonological effects in both pronoun and full name utterances. In a full noun utterance, in which the speaker is producing the referent noun, a phonologically related distractor word can exercise its influence at two levels, the lexical and the phonological. Thus, we should observe a bigger magnitude of the phonological effect in full noun utterances in comparison to pronoun utterances. However, this was not the case, and the difference of 3 milliseconds between both utterances was not statistically different. Why did we fail to observe a bigger phonological effect in the full noun condition? A possible explanation can be found in some recent picture-word interference studies which have observed that the magnitude of the phonological facilitation effect depends on the position occupied by the primed element in the sentence. For instance, Costa and Caramazza (2002) studied the production of three different utterance formats in English: bare noun, determiner + noun, and determiner + adjective + noun. In this study phonologically related distractors produced significant facilitation effects in all utterance formats, but interestingly, the effect tended to decrease as a function of the position of the primed element in the utterance. Thus, the size of the effect was of 39, 28 and 24 ms for the bare noun, determiner + noun, and determiner + adjective + noun respectively (see also Jescheniak, Schriefers, & Hantsch, 2003, for a replication and explanation of this phenomenon). In the full noun condition of our experiment, the primed element was located in the second position in the utterance and this may have reduced the probability of observing a bigger effect of the phonological priming component[20].

Summarizing, Jescheniak et al. (2001) argued that the lack of a phonological interference effect in pronominal tasks is congruent with the assumption that the

[20] A second possible explanation of why we did not observe bigger phonological facilitation effect in the full noun condition 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). In the control experiment the preamble scenes were excluded. 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 only 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 other picture-word studies (see for instance the above-mentioned study by Costa & Caramazza, 2002). This small effect indicates that the phonological manipulation in our experimental set produces weak effects. This could explain why we did not observe a bigger effect of the phonological component in the full noun utterance condition.

phonology of a referent noun is not activated. This interpretation is based on two premises: a) that the phonological effect in picture-word naming tasks is located mainly at the level where phonological encoding takes place; and b) that phonological retrieval is a competitive process that can be interfered by the activation of other phonological segments. The phonological facilitation effect we observed in Experiment 9 casts some doubts on the validity of premise a). Contrary to Jescheniak et al., we argue that in picture-word tasks phonological distractor words prime the accomplishment of two processes: lexical selection and phonological encoding (Lupker, 1982; Bi & Caramazza, submitted; Roelofs et al., 1996). Given this, we conclude that the picture-word interference paradigm is not adequate to evaluate the syntactic constraint hypothesis developed by Jescheniak et al. (2001).

In the next Experiment we further tested the syntactic constraint hypothesis in a different naming paradigm. In Experiment 10, Spanish participants were instructed to name the colored pictures of Experiment 5 through constructions such as "determiner + color adjective". Notice that this kind of construction examines non-mediated effects because part of the produced adjective corresponds to the phonological form of the referent noun.

7.3 Experiment 10: Determiner + adjective production

The materials and design of this Experiment are the same as Experiment 5 with the only difference that participants were asked to name the pictures by means of a gender-marked utterance in Spanish: gender-marked determiner + color adjective such as "*la verde*" (literally, "the $_{fem}$ green"). In Spanish, determiners depend on the gender of the noun. For example, when referring to a picture of a *candle* as "*the green one*" the corresponding utterance in Spanish carries a gender-marked determiner, "*la*" ("the $_{fem}$ "). The determiner referring to feminine nouns is *la* and the one referring to masculine nouns is *el*. Thus, in order to retrieve the correct determiner form participants need to retrieve the lexical representation of the noun. If spreading activation is not restricted in pronominal utterances as "*la verde*", we should observe a PFE as in Experiment 5.

Method

Participants

Twenty-two participants from the same population as in Experiment 1 took part in this experiment.

Materials and Procedure

The same materials and procedure as in Experiment 5 were used in this experiment with the difference that participants named the pictures with gender-marked determiner + adjective color constructions.

Results

Following the same criteria as Experiment 1, 10.9% of the data points were excluded from the analyses. The same analyses as in Experiment 5 were conducted here.

In the error analyses, there was no difference between conditions ($t < 1$). In the naming latencies analyses, the effect of the variable Phonological Relationship was significant (t (21) = 2.81; $p < .01$), revealing that naming latencies in the related condition were 16 ms faster than in the unrelated condition (see Table 14).

	Language					
	Spanish			Catalan		
Type of Relationship	Mean	SD	E%	Mean	SD	E%
Phonologically Related	784	69	9.9	826	137	10.4
Unrelated	800	71	11.3	828	128	10.8
Effect	-16			-2		

Table 14: Average naming latencies (Mean), standard deviations (SD) and error rates (E%) broken by condition and language for Experiment 10.

As in Experiment 5, we conducted a control Experiment. Twenty-two native speakers of Catalan took part in this experiment. The results of this control experiment did not show any significant difference between the phonologically related and unrelated conditions (*t*s < 1) (see Table 14). A pooled analysis of the results of Experiment 10 and this control experiment was conducted. The main effect of Response Language was not significant ($p > .28$). The main effect of Phonological Relationship was significant (F (1, 42) = 4.95, MSE = 1746.09, $p < .04$). The interaction between these variables was marginally significant (F (1, 42) = 2.85, MSE = 1007.03, $p < .1$).

Discussion

In this experiment, participants were required to name the colored objects used in Experiment 5 using a pronominal construction. As in Experiment 5, a PFE was observed: naming latencies were faster in the phonologically related condition than in the unrelated condition. This data suggests that during pronominal utterances the phonological segments of the referent noun become activated.

The syntactic constraint hypothesis proposed by Jescheniak et al. (2001) assumes that the phonological content of the referent word does not become activated in pronominal utterances. Our data clearly contradicts this hypothesis. On the other hand, the three other models that we have reviewed along the previous chapters could account for our facilitation effect. Full-cascade models, Conceptual Selection models and the discrete model proposed by Level et al. (1999) assume that any selected lexical item would activate its corresponding phonological segments.

7.4 Discussion of the pronominal naming tasks

In this chapter we explored whether the activation that a lexical node propagates to its associated phonological segments could be restricted by syntactic factors. Although the evidence reported in the previous chapters of this dissertation seems to support the notion that activation spreads in an automatic manner between the levels of the speech production system, Jescheniak et al. (2001) have proposed the existence of some syntactic factors modulating the propagation of the activation between lexical and phonological levels in pronominal sentences. In order to evaluate this proposal we presented two experiments.

In Experiment 9 we observed that pronominal naming constructions were facilitated by distractor words phonologically related to the referent noun. However, we argued that this effect arises during the process of lexical selection and therefore this evidence cannot be used to support the idea that the phonological segments of the referent noun are activated during pronominal utterances. Experiment 10 was conducted partially to solve these problems of interpretation. In this experiment no distractor words were used. Participants named colored pictures by means of pronominal sentences. If the referent noun activates its phonological form, faster naming latencies should be observed when the referent noun shares some phonemes with the uttered pronominal construction. The data of Experiment 10 showed a phonological facilitation effect, giving support to the assumption that in pronominal production the activation spreading from the referent word is not restricted by syntactic factors and hence rejects the proposal of Jescheniak et al. (2001).

8 General Discussion

The main purpose of this dissertation has been to characterize the flow of activation between the layers of processing involved in speech production. In particular, we have explored the course of feed-forward activation through the conceptual, lexical, and phonological levels of representation. There are two theoretical proposals regarding this topic. The full-cascade proposal assumes that any activated representation propagates activation to other representations at subsequent levels in the system. By contrast, the discrete proposal restricts the flow of activation between levels.

We have put to test the full-cascade proposal by analyzing whether distractor pictures which have to be ignored by the speaker are capable of activating their respective phonological segments. According to full-cascade models, if the distractor picture is conceptually activated, this activation may spread until the lexical and the phonological levels of the system. We have reported eight experiments assessing the effects of distractor pictures during naming tasks. Furthermore, we have also reported two experiments in which we evaluated the propagation of activation between the lexical and phonological levels of representation in pronominal naming tasks.

8.1 Overview of the results

In Experiment 1 participants named pictures (depicted in green) while ignoring the presentation of superimposed distractor pictures (depicted in red). We observed a Phonological Facilitation Effect (PFE): naming latencies were faster when the name of the distractor picture was phonologically related to the name of the target picture than when it was unrelated, replicating previous observations by Morsella and Miozzo (2002). In Experiment 2, a semantic relationship between the two objects did not affect naming latencies (see Humphreys et al., 1995; Damian & Bowers, 2003).

A different pattern of results was observed in Experiments 3 and 4. In these experiments, bilingual participants were required to ignore a distractor picture while translating visually presented words from their second language into their first language. In Experiment 3b translation latencies were unaffected by the phonological relationship between response word and distractor picture. However, in Experiment 4 translation latencies were faster in the context of semantically related pictures than in the context of semantically unrelated pictures. Our data replicated the previous observations of Bloem and La Heij (2003).

In Experiment 5 participants were instructed to name the color in which an object was depicted. Naming latencies were faster when the name of the target color was phonologically related to the object's name. Experiment 6 revealed that neither a familiarization phase nor extensive repetition of the experimental pictures was responsible for the presence of the PFE in Experiment 5. In Experiment 7 the PFE was observed under experimental conditions in which the discriminability of targets and distractors was enhanced. Finally, the PFE was also reliable in Experiment 8, in which participants were instructed to do a color naming task, but only on half of the trials. Participants named (on half of the trials) the color of the pictures according to a cue stimulus that appeared beside the target stimulus. In this Experiment we manipulated the perceptual load caused by the cue stimulus. We observed a PFE that was independent of the perceptual load variable.

In addition, we also explored the flow of activation between lexical and phonological representations during the production of gender-marked pronouns. Experiment 9 was a picture-word interference task. In this Experiment naming latencies were faster when the distractor word was phonologically related to the target than when it was unrelated, contrasting with the data reported by Jescheniak et al. (2001). In Experiment 10 participants were instructed to name color pictures using pronominal utterances. In this Experiment the naming latencies were faster when the picture names were phonologically related to the name of the color.

The most relevant data of our experiments is the observation of a PFE under slightly different experimental conditions (Experiments 1, and 5 to 8). Furthermore, this consistency enables one to reject the explanation of the PFE in terms of an error in the selection of the correct conceptual representation for lexicalization. Instead, the PFE strongly suggests that the phonological properties of pictorial stimuli that do not need to be lexicalized (they actually need to be ignored) become activated in the course of naming. This observation has important implications for models of lexical access in speech production and in particular for the processing dynamics across levels of representation. Finally, the PFE observed in the pronominal task of Experiment 10 is also consistent with the full-cascade models. We discuss the theoretical implications that follow from our experiments in the following sections.

8.2 Evidence for a cascade model of lexical access

In the Introduction we discussed three different proposals regarding the flow of activation across the different levels of representation in speech production (the conceptual, the lexical and the phonological levels). The main difference between them is the extent to which they allow activation to spread freely across these levels. Bloem and La Heij's (2003) proposal assumes that only the conceptual representation included in the preverbal message passes activation to the lexical system. This conceptual representation activates its corresponding lexical representation along with a cohort of semantically related lexical items. As a consequence, phonological activation is restricted, at maximum, to the target lexical item and semantically related ones. The other model that restricts the flow of activation across levels of processing is that proposed by Levelt and colleagues (1999), where only the selected lexical representation activates its phonological form. Despite the differences between these two proposals, they both predict that conceptual information that is not part of the preverbal message (and that is not semantically related to it) should not activate its phonological content. Our results are at odds with this prediction.

However, the presence of phonological activation of distractor pictures in the course of lexicalization is predicted by models that assume free propagation of activation across different processing levels (Caramazza, 1997; Dell et al., 1997; Dell, 1986). According to these cascade models, any activated representation spreads proportional activation to other representations with which they are linked. Thus, if a conceptual representation during speech production is activated (e.g., via the presentation of a distractor picture), then this representation would spread some of its activation to subsequent levels of processing, reaching, to some extent, the phonological level. This would be so even for conceptual representations that are not relevant for the lexicalization process (i.e., that are not included in the preverbal message) and are unrelated to the target one. Therefore, the results reported in our experiments support the notion that activation flows in a cascade manner through the whole speech production system[21].

The more relevant contribution of our study is the demonstration of reliable phonological effects from ignored pictures in various experimental naming contexts. However, we believe that for the sake of completeness, it is necessary that we attempt to reconcile the presence of this phonological activation with some experimental observations that might seem, at first sight, inconsistent. The first refers to the presence of phonological effects in a naming experimental context in which semantic effects are not present. The second refers to the contrasting results observed with relatively similar paradigms (e.g., picture naming and word translation tasks). These issues are discussed below.

8.2.1 The presence of Phonological Effects in the context of No Semantic Effects

In chapter 2 we advanced a seemingly paradoxical observation: the presence of phonological effects in the same context in which semantic effects are absent. Indeed, the results of our Experiments 1 and 2 contribute to further reaffirm the reliability of such a pattern of results. At first sight, one may be tempted to predict that in those experimental circumstances in which there is phonological activation of a distractor picture, some sort of semantic effects should also be observed when the target and the distractor hold a semantic relationship. This is because, for the phonological properties of the distractor to become activated, their corresponding conceptual and lexical representations need to have been activated previously. But does such a prediction necessarily follow from the presence of phonological activation of distractor pictures? We think it does not.

As stated above, when accounting for the PFE one is forced to assume that the conceptual and lexical representations of the distractor picture are activated. Given the activation of these two types of representation, it is then appropriate that we consider the effects that a semantic relationship may have at both of these levels of processing.

A semantic relationship between target (e.g., *lion*) and distractor pictures (e.g., *tiger*) may help the retrieval of the conceptual representation of the target picture

[21] We have discussed the implications of the PFE in the context of feed-forward not-interactive models of lexical access. However, there are several proposals in the literature arguing that the speech production system entails some interactive processing (Dell, 1986; Harley, 1993; Rapp & Goldrick, 2000), in the sense that activation of phonological representations feeds-back to higher lexical representations. The presence of the PFE is completely consistent with interactive models. In fact, the PFE could be revealing the contribution of these two principles. And, in fact, all interactive models embrace to some extent the cascade principle.

(Damian & Bowers, 2003, see below). That is, recognition of the target picture (or selection of its conceptual representation) would be faster in the context of a semantically related picture than in the context of an unrelated one, because of the priming exerted by the related distractor (see Bloem & La Heij, 2003, for the same argument). Why then, is no semantic facilitation observed for distractor pictures in the majority of picture naming experiments?

If we assume cascade processing, the semantic representation of both the target (LION) and the distractor (TIGER) would spread some activation to their corresponding lexical representations. There is wide agreement in assuming that at this level of processing the ease with which a lexical representation is selected depends on its level of activation in relation to that of other activated lexical representations that act as competitors (e.g., Caramazza & Costa, 2000; Levelt et al., 1999; Roelofs, 1992). The larger the discrepancy between the activation levels of target and competitors, the easier lexical selection is. Thus, the selection of the target lexical node 'lion' would depend not only on its level of activation but also on the level of activation of 'tiger' in the related condition and of 'chair' in the unrelated condition. Presumably, the activation level of the related distractor 'tiger' would be larger than that of the unrelated one ('chair') because of the conceptual overlap between the conceptual representations of the former distractor (TIGER) and the target (LION). In this scenario, lexical selection would be harder in the context of a semantically related distractor picture (*tiger*) than in the context of a semantically unrelated distractor.

In such a framework, the lack of observable semantic effects in this paradigm might stem from the presence of two opposite effects: a) a facilitation effect at the conceptual level [22] (*tiger* increases the activation of the conceptual representation of LION), and b) an interference effect at the lexical level (the lexical node 'tiger' competes for selection with the lexical node 'lion') (see section 3.3.2).

This account is tentative and future research needs to evaluate its appropriateness. However, following this account, the presence of phonological activation of distractor pictures is naturally explained, whereas other accounts (of the lack of semantic effects) do not seem appropriate for capturing the PFE. For example, Damian and Bowers (2003) assume that semantic effects are not present because the semantic representation of the distractor picture does not activate its

[22] Semantic facilitation effects in picture-picture tasks have been reported by Damian & Bowers (2003) in a manual categorization task (see section 2.4.1).

lexical representation (see also Bloem & La Heij, 2003). In such a framework, it is a mystery how a distractor picture can activate its phonological content.

8.2.2 Contrasting results from seemingly similar paradigms

As we argued above, the experimental setting in which participants are asked to name a picture (or a color) and ignore a distractor object leads to two reliable observations: a) a PFE, and b) a lack of a semantic effect.

However, in word translation experiments, in which participants translated printed words from L2 into L1 while ignoring the presentation of distractor pictures, semantic facilitation effects but not phonological effects are reported. This pattern of results is in clear opposition to the one observed when distractor objects are presented in the context of a naming task (experiments 1 and 2). What are the reasons for this discrepancy? Why is it that when a paradigm leads to semantic effects it does not lead to phonological effects and vice versa? An answer to these questions requires that we consider the attentional processes involved in the different tasks (naming and translation) and how they may interact with the amount of processing carried out over the distractor.

Research from different disciplines shows that the amount of processing that distractors undergo (even when these distractors are supposed to be processed automatically) is positively correlated with the amount of attentional resources left free by the primary task conducted by the participant (e.g., Ress, Russel, Frith, & Driver, 1999; Sinnett, Costa, & Soto-Faraco, 2006). Arguably, the attentional load involved in picture naming is smaller than that involved in word translation. Word translation requires a bilingual to have two lexicons activated simultaneously, keep control over them, avoid phonological interference from the to-be-translated word, and perform a cognitive task that is much less frequent than naming (see for example Kroll & Stewart, 1994, in which translation tasks took about 600 ms more than naming tasks). In such a scenario, it is possible that distractors are more fully processed in the naming task than in the translation task. That is, a task factor would modulate differently distractor processing in naming and translation tasks. This differential processing of distractor pictures in the two tasks may have important implications for the presence of semantic and phonological effects.

Shallow processing of a distractor picture in the translation task may result in partial activation of its conceptual representation. Perhaps, in this task, the distractor only activates certain semantic information (or only structural information) as, for example, categorical membership (e.g., the conceptual information extracted from the distractor object *tiger* would be ANIMAL). This activation may be enough to prime the conceptual representation of the target (leading to conceptual facilitation), but it might be insufficient to reliably activate the distractor's lexical representation. As a consequence, lexical competition from the distractor lexical node (e.g., 'tiger') would be minimal. The net result of this facilitation at the conceptual level and the lack of any (or very much reduced) lexical interference would give rise to the Semantic Facilitation Effect (SFE) observed in translation tasks. In contrast, when the attentional demands are lower, as it is the case in the picture naming task, the distractor would be more fully processed leading to the activation of its conceptual and lexical representations. This situation would lead to both conceptual facilitation and lexical interference, which will cancel each other out.

Convergent evidence that shallow processing of the distractor picture may lead to semantic facilitation comes from the studies in which the saliency of the distractor picture is manipulated. For example, when distractor pictures are presented under difficult perceptual conditions (very briefly or masked), semantic facilitation effects are observed even when the primary task is picture naming (La Heij, Heikoop, Akerboom, & Bloem, 2003; Dell'Acqua & Grainger, 1999). An interesting observation, also consistent with this idea, is that when the distractor picture is briefly presented and masked, the amount of semantic facilitation is the same for semantically related distractors as for identical distractors (Dell'Acqua & Grainger, 1999). This observation suggests that under highly demanding attentional conditions, processing of the distractor picture is rather shallow[23].

This explanation of the contrasting effects of semantically related distractors in different tasks also provides a natural account of the contrasting effects of phonologically related distractors. If semantic effects are restricted to those experimental conditions in which the distractor picture is not processed enough to activate its corresponding lexical node, then in such conditions one should not observe phonological effects. This is because lexical activation is a pre-requisite for phonological activation. In contrast, those experimental conditions that allow a more complete processing of the distractor would lead to its lexical activation and

[23] In relation to that, recent studies have shown the dependence of performance on linguistic and non-linguistic tasks. For instance, Ferreira & Pashler (2002) reported evidence suggesting that some stages of lexical access share attentional resources with tone discrimination tasks, while Kubose, Bock, Dell, Garnsey, Kramer, & Mayhugh (2006) showed that linguistic tasks, as language production and comprehension, affect driving performance. These studies would suggest that attentional resources are affecting linguistic processes.

therefore, according to the cascade principle, would lead to its phonological activation. That is the reason why phonological effects are observed in picture naming and not observed in word translation.[24]

In summary, different task demands involved in naming and translation could modulate the extent of processing of distractor pictures, and hence determine the activation levels of their corresponding conceptual, lexical and phonological representations. Figure 5 schematizes how this task-specific factor could affect the activation of representations in both tasks.

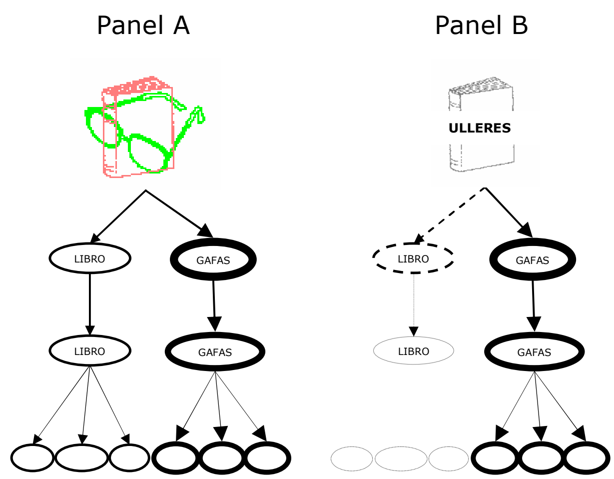

Figure 5: Schematic representation of the picture naming and word translation tasks. In both tasks the response word is *gafas* (glasses) and the distractor picture is *libro* (book). The arrows represent the flow of activation and the circles, the conceptual, lexical and sublexical representations. The thickness of arrows and circles represents the magnitude of the activation. The conceptual representation of the distractor picture book is more activated in a naming task (Panel A) than in a word translation task (Panel B). Under the assumption that the activation spread by a representation is proportional to its level of activation, the lexical representation of the picture book would be more activated in the naming task than in the translation task. Also, as a consequence of the decrease of activation, the phonological segments corresponding to the word book would be activated in the naming task but not in the translation task.

[24] This discussion refers to the effects of picture distractors in picture naming. In other experimental situations in which distractor words are presented in the context of picture naming, reliable phonological facilitation and semantic interference effects are observed. However, this observation does not undermine the arguments developed above. This would be so because distractor words and distractor pictures enter into the cognitive system from different points (the semantic and the lexical systems respectively). Hence, distractor pictures and distractor words may be affecting different levels of representation to different extents. Also, the attentional resources needed to process these two different modalities are very likely different.

This attempt to reconcile seemingly contrasting results in different tasks requires future experimentation that determines the contribution of attentional factors to the observed effects. For instance, in Experiment 8 we have observed that the magnitude of the PFE was almost the double in comparison with that reported in Experiment 5. Although the differences between the experiments make a genuine comparison impossible, we consider that further investigation may address the role of other attentional variables, such as cognitive control, on the presence of phonological activation of distractors (see Lavie, 2005).

8.3 Cascade processing during pronominal utterances

Models of lexical access agree that grammatical gender is a syntactic property that is stored at the lexical level. As a consequence, speakers need to retrieve the lexical representation of a word in order to access its grammatical gender. In languages with a grammatical gender system, some pronominal forms depend on the grammatical gender of the referent word. Therefore, in those languages, the production of a gender-marked pronoun requires the lexical selection of the referent but does not require the retrieval of its corresponding phonological content. In Experiments 9 and 10 we tested whether the phonological segments of pronominal referent words are activated.

According to full-cascade models of lexical access, such activation may exist because the activation flows in a free manner between lexical and phonological levels, that is, independently of whether a lexical item is selected or uttered. However, recently Jescheniak and co-workers (2001) have challenged this assumption. These authors proposed that the syntactic frame that is elaborated during a pronominal construction could filter activation between the lexical and phonological levels. In particular, their model assumes that those lexical items that were syntactically non-appropriate (such as a noun in a pronominal construction) are not activated at the phonological level.

In Experiment 9 we observed a phonological facilitation effect in a pronominal naming task using the picture-word interference paradigm. Our data are inconsistent with the lack of an effect in the study of Jescheniak et al. (2001). Moreover, our data would be consistent with the assumption that in picture-word naming tasks a phonologically related distractor word can exert influence over two processes: the lexical selection and the phonological encoding. Given this, we concluded that the picture-word interference paradigm is not an adequate tool to evaluate the discrete model developed by Jescheniak et al. (2001). In Experiment

10 we further tested this model with a different paradigm, where distractor words were not used. The phonological facilitation effect reported in this Experiment suggests that the phonological content of the referent noun has been activated, rejecting the proposal of Jescheniak and colleagues. Again, our data can be accounted for by full-cascade models.

9 Conclusion

In this dissertation we addressed the different views about how information is passed from one level of representation to another in speech production. In particular, we explored the activation from the conceptual system to the lexical level of representation, and from the lexical to the phonological one. The basic difference between existing views is the extent to which they assume that spreading activation is a governing principle through the production system. We have mainly focused on whether lexical and phonological representations foreign to the speaker's communicative intention are activated in the course of speech production.

We argued that the presence of phonological activation from semantically unrelated distractor pictures suggests that in the course of speech production, whenever a conceptual representation is sufficiently activated, some activation spreads to the lexical and phonological levels. That is, these results support the notion that lexical access honors the spreading activation principle at all levels of representation. Thus, the first theoretical contribution of this dissertation is that activation flows in a cascade manner through the whole production system.

We also argued that the failure to observe phonological activation in specific contexts, such as word translation, stems from the possibility that the amount of activation that one representation spreads is proportional to its own level of activation. Thus, we argued that the paradoxical results obtained with naming and translation tasks reflect the fact that distractor pictures are less activated in translation tasks than in naming tasks.

Another relevant contribution of this dissertation is the provided evidence that the spreading activation principle also governs the relation between the lexical and the phonological levels during the production of pronominal sentences. Our data reject the possibility that spreading activation between levels could be restricted by syntactic constraints.

9.1 Final remarks

In this dissertation we have reported evidence suggesting that the spreading of activation between two independent systems (the conceptual and the lexical systems) occurs in an automatic manner. Similarly, several studies have also reported evidence suggesting an automatic connection between the linguistic system and other cognitive domains, such as motor control. For instance, Gentilucci, Benuzzi, Bertolani, Daprati and Gangitano (2000) observed that the meaning of the words printed on objects modulates the actions of reaching and grasping. More recently, Glover, Rosenbaum, Graham and Dixon (2004) have observed that grip aperture of the fingers to grasp an object was larger when participants read a prime word that represents a large object (e.g., *apple*) than when the prime word represents a small object (e.g., *grape*). These observations suggest that word reading activates, through automatic semantic access, motor tendencies that can interfere with grasping actions, thereby supporting the automatic relationship between motor planning and language processes. In the authors' words, "*the reading of a word activates affordances in a similar manner to seeing the physical object the word represents (…) the present study suggests that not only physical objects and words, but a broad range of objects associations (e.g., pictures, sounds, smells, etc.) could potentially activate affordances*" (Glover et al., 2004, p. 107).

Interestingly, influences in the reverse direction, from motor movements to language processing, have also been reported. In the study of Ravizza (2003) participants were instructed to type a word as response to a definition. One group of participants was instructed to tap the index finger of both hands during their word retrieval process when they fall in a tip-of-the-tongue (TOT) state, while a second group of participants was instructed to hold down two response keys with their index finger. Participants in the tapping group obtained a higher resolution rate of the TOT states than participants in the non-movement group, suggesting the influence of non-iconic gestures during lexical retrieval.

In sum, these studies suggest the automatic connection between two systems involved in different cognitive processes. These observations would give support to the main assumption of this dissertation: that the conceptual system is in predisposition to activate the lexical system in an automatic manner, that is, independently of the communicative intention of the speaker.

The phonological activation of distractor pictures observed in our study raises the question of to what extent any information that reaches the conceptual system will pass activation to the lexical system. As discussed above, several factors may contribute to whether this is or is not the case. The fact that we were able to register phonological activation of to-be-ignored stimuli suggests that some of these stimuli activate their lexical and sublexical representations, regardless of the speaker's communicative intention. However, this does not necessarily imply that any stimulus that reaches the speaker's senses is lexically encoded. In fact, our results are silent about whether this is the case when individuals are not producing language. Furthermore, even in speech production contexts, very likely only those stimuli that reach certain levels of semantic activation would be able to affect the lexical system in some detectable manner. And the extent to which these stimuli reach the conceptual system may depend on various factors such as the attentional load devoted to other tasks and the saliency of the irrelevant information. In fact, if the speaker is very focused on the conversation and/or the task requires a lot of attentional resources (for example, when speaking in public or in a L2), it is possible that none of the irrelevant information surrounding the speaker is processed enough to affect the lexical system (see for example the inattentional blindness effect, Mack, 2003; Mack & Rock, 1998; Simons, 2000; Simons & Chabris, 1999). Thus, the conditions upon which irrelevant information can enter into the lexical system may vary considerably (see Lavie et al., 1995, for a similar argument on the degree with which distractor stimuli are processed in the context of attention theories). However, what is important for our purposes here is that when the conceptual system processes the irrelevant information to some extent, such activation spreads to subsequent levels of processing regardless of whether it is selected for lexicalization.

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11 Appendices

Appendix A: Materials used in Experiment 1

Target picture	Distractor picture	
	Related	Unrelated
Arpa (harp)	árbol (tree)	coche (car)
Bate (bat)	vaca (cow)	mesa (table)
Boca (mouth)	bota (boot)	lápiz (pencil)
Camisa (shirt)	caballo (horse)	pala (spade)
Candado (lock)	canguro (kangaroo)	bota (boot)
Casa (house)	cama (bed)	vaso (glass)
Cepillo (brush)	cebra (zebra)	tortuga (turtle)
Collar (necklace)	coche (car)	plátano (banana)
Copa (cup)	conejo (rabbit)	árbol (tree)
Corcho (cork)	corbata (tie)	pipa (pipe)
Estrella (star)	escoba (broom)	puerta (door)
Gato (cat)	gafas (glasses)	corbata (tie)
Lazo (bow)	lápiz (pencil)	plancha (iron)
Limón (lemon)	libro (book)	maleta (suitcase)
Luna (moon)	lupa (magnifying glass)	escoba (broom)
Maceta (flowerpot)	maleta (suitcase)	cebra (zebra)
Melón (melon)	mesa (table)	libro (book)
Pato (duck)	pala (spade)	lupa (magnifying glass)
Piña (pineapple)	pipa (pipe)	conejo (rabbit)
Planta (plant)	plancha (iron)	caballo (horse)
Plato (dish)	plátano (banana)	gafas (glasses)
Puente (bridge)	puerta (door)	canguro (kangaroo)
Tornillo (screw)	tortuga (turtle)	vaca (cow)
Valla (fence)	vaso (glass)	cama (bed)

Appendix B: Materials used in Experiment 2

	Distractor picture	
Target picture	Related	Unrelated
Barco (ship)	avión (plane)	mano (hand)
Coche (car)	helicóptero (helicopter)	foca (seal)
Boca (mouth)	pierna (leg)	armario (wardrobe)
Nariz (nose)	mano (hand)	sartén (frying pan)
Pie (feet)	ojo (eye)	sofá (sofa)
Botella (bottle)	plato (dish)	pierna (leg)
Cuchillo (knife)	taza (cup)	helicóptero (helicopter)
Vaso (glass)	sartén (frying pan)	alicates (pliers)
Caballo (horse)	foca (seal)	pantalón (pants)
Gato (cat)	pez (fish)	plato (dish)
Pájaro (bird)	serpiente (snake)	cama (bed)
Camisa (shirt)	sombrero (hat)	serpiente (snake)
Falda (skirt)	corbata (tie)	avión (plane)
Zapato (shoe)	pantalón (pants)	pez (fish)
Helado (ice-cream)	pastel (cake)	trombón (trombone)
Manzana (apple)	uva (grape)	sombrero (hat)
Plátano (banana)	fresa (strawberry)	guitarra (guitar)
Martillo (hammer)	alicates (pliers)	trompeta (trumpet)
Mesa (table)	armario (wardrobe)	uva (grape)
Silla (chair)	cama (bed)	ojo (eye)
Taburete (stool)	sofá (sofa)	pastel (cake)
Piano (piano)	trompeta (trumpet)	taza (cup)
Tambor (drum)	guitarra (guitar)	corbata (tie)
Violín (violin)	trombón (trombone)	fresa (strawberry)

Appendix C: Materials used in Experiment 3a

		Distractor pictures	
Target word	Translation	Related	Unrelated
Ampolla	Botella (bottle)	bota (boot)	guitarra (guitar)
Samarreta	Camiseta (shirt)	camión (truck)	pájaro (bird)
Mitjó	Calcetín (sock)	canguro (kangaroo)	tenedor (fork)
Llit	Cama (bed)	casa (house)	perro (dog)
Porc	Cerdo (pig)	cepillo (brush)	raqueta (racket)
Matalàs	Colchón (mattress)	copa (cup)	reloj (watch)
Galleda	Cubo (bucket)	cuchara (spoon)	pera (pear)
Bressol	Cuna (cradle)	cuchillo (knife)	mano (hand)
Mirall	Espejo (mirror)	escalera (stairs)	gato (cat)
Ulleres	Gafas (glasses)	gato (cat)	copa (cup)
Pèsol	Guisante (pea)	guitarra (guitar)	vaca (cow)
Pernil	Jamón (ham)	jarra (jar)	cepillo (brush)
Papallona	Mariposa (butterfly)	mano (hand)	cuchillo (knife)
Fusta	Madera (wood)	manzana (apple)	bota (boot)
Galta	Mejilla (cheek)	mesa (table)	casa (house)
Ull	Ojo (eye)	hoja (leave)	sombrero (hat)
Mocador	Pañuelo (handkerchief)	pájaro (bird)	radio (radio)
Colom	Paloma (dove)	paraguas (umbrella)	jarra (jar)
Ànec	Pato (duck)	pala (spade)	cuchara (spoon)
Arracada	Pendiente (earring)	pera (pear)	valla (fence)
Baldufa	Peonza (top)	perro (dog)	mesa (table)
Granota	Rana (frog)	radio (radio)	vela (candle)
Branca	Rama (branch)	raqueta (racket)	pala (spade)
Xarxa	Red (net)	reloj (watch)	silla (chair)
Bolet	Seta (mushroom)	serpiente (snake)	escalera (stairs)
Xiulet	Silbato (whistle)	silla (chair)	hoja (leave)
Aixella	Sobaco (armpit)	sombrero (hat)	camión (truck)

Appendix C: Materials used in Experiment 3a

		Distractor pictures	
Target word	Translation	Related	Unrelated
Sostre	Techo (roof)	tenedor (fork)	canguro (kangaroo)
Guix	Tiza chalk	tigre (tiger)	paraguas (umbrella)
Got	Vaso (glass)	vaca (cow)	manzana (apple)
Safata	Bandeja (tray)	valla (fence)	tigre (tiger)
Finestra	Ventana (window)	vela (candle)	serpiente (snake)

Appendix D: Materials used in Experiment 3b

Experimental items			
		Distractor picture	
Target word	Translation	Related	Unrelated
Ampolla	Botella (bottle)	bota (boot)	guitarra (guitar)
Samarreta	Camiseta (shirt)	camión (truck)	pájaro (bird)
Matalàs	Colchón (mattress)	copa (cup)	reloj (watch)
Mirall	Espejo (mirror)	escalera (stairs)	gato (cat)
Ulleres	Gafas (glasses)	gato (cat)	copa (cup)
Pèsol	Guisante (pea)	guitarra (guitar)	vaca (cow)
Fusta	Madera (wood)	manzana (apple)	bota (boot)
Ull	Ojo (eye)	hoja (leave)	sombrero (hat)
Mocador	Pañuelo (handkerchief)	pájaro (bird)	radio (radio)
Granota	Rana (frog)	radio (radio)	vela (candle)
Xarxa	Red (net)	reloj (watch)	silla (chair)
Bolet	Seta (mushroom)	serpiente (snake)	escalera (stairs)
Xiulet	Silbato (whistle)	silla (chair)	hoja (leave)
Aixella	Sobaco (armpit)	sombrero (hat)	camión (truck)
Got	Vaso (glass)	vaca (cow)	manzana (apple)
Finestra	Ventana (window)	vela (candle)	serpiente (snake)

Appendix D: Materials used in Experiment 3b

Filler items			
		Distractor picture	
Target word	Translation	Filler 1	Filler 2
Mitjó	Calcetín (sock)	tigre (tiger)	tenedor (fork)
Llit	Cama (bed)	pera (pear)	perro (dog)
Porc	Cerdo (pig)	mesa (taula)	raqueta (racket)
Galleda	Cubo (bucket)	tenedor (fork)	pera (pear)
Bressol	Cuna (cradle)	pala (spade)	mano (hand)
Pernil	Jamón (ham)	valla (fence)	cepillo (brush)
Papallona	Mariposa (butterfly)	casa (house)	cuchillo (knife)
Galta	Mejilla (cheek)	paraguas (umbrella)	casa (house)
Colom	Paloma (dove)	mano (hand)	jarra (jar)
Ànec	Pato (duck)	jarra (jar)	cuchara (spoon)
Arracada	Pendiente (earring)	cuchara (spoon)	valla (fence)
Baldufa	Peonza (top)	canguro (kangaroo)	mesa (table)
Branca	Rama (branch)	perro (dog)	pala (spade)
Sostre	Techo (roof)	raqueta (racket)	canguro (kangaroo)
Guix	Tiza (chalk)	cuchillo (knife)	paraguas (umbrella)
Safata	Bandeja (tray)	cepillo (brush)	tigre (tiger)

Appendix E: Materials used in Experiment 4a

		Distractor picture	
Target word	Translation	Related	Unrelated
Porc	Cerdo (pig)	cabra (goat)	acelgas (chard)
Colom	Paloma (dove)	cisne (swan)	ajo (garlic)
Ànec	Pato (duck)	vaca (cow)	queso (cheese)
Granota	Rana (frog)	perro (dog)	corbata (tie)
Vedella	Ternera (calf)	caballo (horse)	armario (wardrobe)
Safata	Bandeja (tray)	plato (dish)	limón (lemon)
Ampolla	Botella (bottle)	taza (cup)	cebolla (onion)
Ganivet	Cuchillo (knife)	espada (sword)	perro (dog)
Got	Vaso (glass)	jarra (jar)	plátano (banana)
Pernil	Jamón (ham)	queso (cheese)	nevera (refrigerator)
Galta	Mejilla (cheek)	oreja (ear)	banco (bench)
Ull	Ojo (eye)	nariz (nose)	pantalón (pants)
Genoll	Rodilla (knee)	pierna (leg)	cisne (swan)
Rentadora	Lavadora (washing machine)	nevera (refrigerator)	caballo (horse)
Maduixa	Fresa (strawberry)	pera (pear)	espada (sword)
Poma	Manzana (apple)	limón (lemon)	taza (cup)
Préssec	Melocotón (peach)	uva (grapes)	oreja (ear)
Llit	Cama (bed)	taburete (stool)	maíz (corn)
Taula	Mesa (table)	armario (wardrobe)	vaca (cow)
Cadira	Silla (chair)	banco (bench)	pera (pear)
Finestra	Ventana (window)	puerta (door)	nariz (nose)
Taronja	Naranja (orange)	plátano (banana)	pierna (leg)
Mitjó	Calcetín (sock)	pantalón (pants)	puerta (door)
Samarreta	Camiseta (shirt)	abrigo (coat)	jarra (jar)
Mocador	Pañuelo (handkerchief)	corbata (tie)	tomate (tomato)
Arracada	Pendiente (earring)	collar (necklace)	uva (grapes)
Barret	Sombrero (hat)	zapato (shoe)	plato (dish)

Appendix E: Materials used in Experiment 4a

		Distractor picture	
Target word	Translation	Related	Unrelated
Cigró	Garbanzo (chickpea)	maíz (corn)	abrigo (coat)
Pèsol	Guisante (pea)	tomate (tomato)	taburete (stool)
Enciam	Lechuga (lettuce)	cebolla (onion)	zapato (shoe)
Bolet	Seta (mushroom)	acelgas (chard)	collar (necklace)
Pastanaga	Zanahoria (carrot)	ajo (garlic)	cabra (goat)

Appendix F: Materials used in Experiment 4b

Experimental items			
		Distractor picture	
Target word	Translation	Related	Unrelated
Porc	Cerdo (pig)	cabra (goat)	acelgas (chard)
Colom	Paloma (dove)	cisne (swan)	ajo (garlic)
Granota	Rana (frog)	perro (dog)	corbata (tie)
Ganivet	Cuchillo (knife)	espada (sword)	perro (dog)
Got	Vaso (glass)	jarra (jar)	plátano (banana)
Galta	Mejilla (cheek)	oreja (ear)	banco (bench)
Genoll	Rodilla (knee)	pierna (leg)	cisne (swan)
Maduixa	Fresa (strawberry)	pera (pear)	espada (sword)
Préssec	Melocotón (peach)	uva (grapes)	oreja (ear)
Llit	Cama (bed)	taburete (stool)	maíz (corn)
Cadira	Silla (chair)	banco (bench)	pera (pear)
Taronja	Naranja (orange)	plátano (banana)	pierna (leg)
Samarreta	Camiseta (shirt)	abrigo (coat)	jarra (jar)
Mocador	Pañuelo (handkerchief)	corbata (tie)	tomate (tomato)
Arracada	Pendiente (earring)	collar (necklace)	uva (grapes)
Cigró	Garbanzo (chickpea)	maíz (corn)	abrigo (coat)
Pèsol	Guisante (pea)	tomate (tomato)	taburete (stool)
Bolet	Seta (mushroom)	acelgas (chard)	collar (necklace)
Pastanaga	Zanahoria (carrot)	ajo (garlic)	cabra (goat)

Appendix F: Materials used in Experiment 4b

Filler items

(The materials marked with the symbol * were used in the Group 1. The materials marked with the symbol # were used in the Group 2)

		Distractor picture	
Target word	Translation	Filler 1	Filler 2
Ànec	Pato (duck)	*cebolla (onion) / #bicicleta (bike)	*queso (cheese) / #bolígrafo (pen)
Vedella	Ternera (calf)	*puerta (door) / #ancla (anchor)	*armario (wardrobe) / #caja (box)
Safata	Bandeja (tray)	*nariz (nose) / #corona (crown)	*limón (lemon) / #estrella (star)
Ampolla	Botella (bottle)	*queso (chesse) / #escalera (ladder)	*cebolla (onion) / #tren (train)
Pernil	Jamón (ham)	*zapato (shoe) / #bolígrafo (pen)	*nevera (refrigerator) / #violin (violin)
Ull	Ojo (eye)	*caballo (horse) / #montaña (mountain)	*pantalón (pants) / #pozo (well)
Rentadora	Lavadora (washing machine)	*pantalón (pants) / #violín (violin)	*caballo (horse) / #ancla (anchor)
Poma	Manzana (apple)	*nevera (refrigerator) / #estrella (star)	*taza (cup) / #escalera (ladder)
Taula	Mesa (table)	*plato (dish) / #caja (box)	*vaca (cow) / #bicicleta (bike)
Finestra	Ventana (window)	*limón (lemon) / #libro (book)	*nariz (nose) / #montaña (mountain)
Mitjó	Calcetín (sock)	*vaca (cow) / #pozo (well)	*puerta (door) / #libro (book)
Barret	Sombrero (hat)	*taza (cup) / #molino (mill)	*plato (dish) / #corona (crown)
Enciam	Lechuga (lettuce)	*armario (wardrobe) / #tren (train)	*zapato (shoe) / #molino (mill)

Appendix G: materials used in Experiments 5, 6, 7, 8 and 10

Experimental items			
Spanish		Catalan (experiment 5 and 10)	
Color	Picture	Color	Picture
Verde (green)	vela (candle)	verd (green)	espelma (candle)
Verde (green)	ventana (window)	verd (green)	finestra (window)
Naranja (orange)	nariz (nose)	taronja (orange)	nas (nose)
Naranja (orange)	navaja (clasp knife)	taronja (orange)	navalla (clasp knife)
Rojo (red)	roca (rock)	vermell (red)	roca (rock)
Rojo (red)	rodilla (knee)	vermell (red)	genoll (knee)
Marrón (brown)	maleta (suitcase)	Marró (brown)	maleta (suitcase)
Marrón (brown)	mariposa (butterfly)	Marró (brown)	papallona (butterfly)

Filler items	
Spanish	Catalan (experiments 5 and 10)
Picture	Picture
Camión (truck)	camió (truck)
Cañón (canon)	canó (canon)
Casco (helmet)	casc (helmet)
Piano (piano)	piano (piano)
Sombrero (hat)	barret (hat)
Teléfono (phone)	telèfon (phone)
Tenedor (fork)	forquilla (fork)
Zapato (shoe)	sabata (shoe)

Appendix H: Materials used in Experiment 9

	Distractor word			
Target picture	Phonologically related	Phonologically unrelated	Semantically related	Semantically unrelated
Barco (ship)	barra (bar)	cola (tail)	furgoneta (van)	pistola (gun)
Boca (mouth)	bolo (skittles)	pato (duck)	dedo (finger)	gusano (worm)
Botella (bottle)	boleto (ticket)	lamento (lament)	jarrón (vase)	rastrillo (rake)
Brazo (arm)	brasa (grilled)	chapa (sheet)	pierna (leg)	paloma (dove)
Búho (owl)	bujía (spark plug)	coleta(plait)	paloma (dove)	carpeta (fólder)
Cama (bed)	carro (wagon)	jardín (garden)	sillón (armchair)	foco (spotlight)
Caballo (horse)	cadena (Caín)	viña (vineyard)	vaca (cow)	chaqueta (jacket)
Camisa (short)	canario (canary)	navío (ship)	jersey (jerseys)	oboe (oboist)
Cañón canon	cabina (cabin)	libra (pound)	pistola (gun)	moto (motorbike)
Casco (helmet)	caspa (dandruff)	palma (palm)	gorra (cap)	vaca (cow)
Chaleco (vest)	chapa (sheet)	brasa (grilled)	bufanda (scarf)	pierna (leg)
Coche (car)	coleta (plait)	pinza (clothespin)	moto (motorbike)	pulsera (bracelet)
Collar (necklace)	cola (tail)	barra (bar)	pulsera (bracelet)	furgoneta (van)
Jarra (jar)	jardín (Garden)	boleto (ticket)	barril (barrel)	cielo (sky)
Lámpara (lamp)	lamento (lament)	carro (wagon)	foco (spotlight)	jersey (jersey)
Libro (book)	libra (pound)	bujía (spark plug)	carpeta (folder)	bufanda (scarf)
Luna (moon)	lujo (luxury)	matadero (abattoir)	cielo (sky)	barril (barrel)
Maleta (suitcase)	macizo (massif)	veneno (poison)	bolso (bag)	portal (vestibule)
Mariposa (butterfly)	matadero (abattoir)	bolo (skittles)	gusano (worm)	jarrón (vase)

Appendix H: Materials used in Experiment 9

	Distractor word			
Target picture	Phonologically related	Phonologically unrelated	Semantically related	Semantically unrelated
Mesa (table)	melón (melon)	pino (pine)	taburete (stool)	bolso (bag)
Nariz (nose)	nardo (lily)	trompazo (bump)	ojo (eye)	cuchillo (knife)
Navaja (clasp knife)	navío (ship)	canario (canary)	cuchillo (knife)	taburete (stool)
Pala (shovel)	pato (duck)	lujo (luxury)	rastrillo (rake)	dedo (finger)
Pan (bread)	palma (palm)	cabina (cabin)	galleta (biscuit)	brocha (large paintbrush)
Pañuelo (handkerchief)	patilla (sideburns)	cadena (chain)	chaqueta (jacket)	taza (cup)
Perro (dog)	pelota (ball)	caspa (dandruff)	oveja (sheep)	gorra (cup)
Pincel (paintbrush)	pinza (clothespin)	valla (fence)	brocha (large paintbrush)	galleta (biscuit)
Pipa (pipe)	pino (pine)	melón (melon)	cigarro (cigarette)	ojo (eye)
Trompeta (trumpet)	trompazo (bump)	nardo (lily)	oboe (oboist)	sillón (armchair)
Vaso (glass)	valla (fence)	patilla (sideburns	taza (cup)	flauta (flute)
Ventana (window)	veneno (poison)	macizo (massif)	portal (vestibule)	cigarro (cigarette)
Violín (violin)	viña (vineyard)	pelota (ball)	flauta (flute)	oveja (sheep)

12 Activación fonológica de palabras no producidas (resumen en español)

12.1 Introducción

Hablar es, sin duda alguna, una de las capacidades más asombrosas que los seres humanos adquieren. Basta pensar en la cantidad de decisiones y procesos que el hablante debe resolver cada vez que traduce una idea en un patrón específico de sonidos para darse cuenta de ello. En primer lugar, el hablante escoge las palabras que mejor se adecuan a su intención comunicativa; después, ordena estas palabras según las reglas sintácticas de la lengua y accede a sus patrones fonológicos; finalmente, envía las órdenes motoras al órgano articulatorio para producir la señal acústica. Una de las cuestiones que más interesa a los psicólogos que estudian la producción oral del lenguaje es la descripción de los procesos y mecanismos mediante los cuales el hablante recupera las palabras de su memoria. La presente tesis está relacionada con esta cuestión.

Si bien se cometen pocos errores al hablar, entorno a uno cada 1.000 palabras (Bock, 1991), su estudio resulta de gran interés para entender los procesos y mecanismos implicados en la producción del lenguaje. A continuación, exponemos algunos ejemplos que están relacionados con el objetivo de la presente tesis. El primero es un error de fusión, donde el hablante produce una no-palabra como resultado de mezclar dos palabras, normalmente dos sinónimos:

(a) "*A mi me gustan de ese estipo… de ese estilo*" (estilo/tipo)

Otro tipo de errores relevantes son los *lapsus linguae* freudianos (Freud, 1975) y las intrusiones cognitivas (Harley, 1984), en los que el hablante produce una palabra que no tiene nada que ver con su intención comunicativa, ejemplos b) y c) respectivamente:

(b) "*Si me lo permite señora, me gustaría insultarla*" (acompañarla)

(c) "*He* <u>*comido*</u> *todo los libros de mi biblioteca*" (leído)

Los errores anteriores son interesantes porque sugieren que durante la producción del habla existe activación de palabras que son ajenas al mensaje comunicativo, y que por algún error en los mecanismos de selección léxica, el hablante acaba recuperando estas palabras en lugar de las que pretende decir. Así, en los errores de fusión resultan activadas y seleccionadas palabras semánticamente relacionadas. Mientras que, y más interesante para nuestro objetivo, en los *lapsus linguae* y las intrusiones cognitivas las palabras que finalmente se producen no guardan ninguna relación con la idea que el hablante quiere transmitir. En este caso, la activación de estas palabras proviene de representaciones conceptuales ajenas al mensaje comunicativo.

La producción del habla implica el acceso a representaciones léxicas y fonológicas muy concretas. Los anteriores ejemplos de errores del habla sugieren que durante el acceso léxico y fonológico otras palabras pueden estar activadas y llegar incluso a interferir. Dado esto, parece necesario postular un mecanismo que permita al hablante acceder a las palabras adecuadas y rechazar aquellas que, pese a no formar parte de la intención comunicativa, hayan podido ser activadas.

Los modelos de producción coinciden en postular que el parámetro que guía la selección léxica y fonológica es el nivel de activación de las representaciones, en el sentido de que la representación más activada en un determinado momento es la que finalmente resulta seleccionada. Los modelos también consideran que esta selección depende del nivel de activación de otras representaciones, en el sentido de que resulta más difícil seleccionar una representación cuanto más activadas están otras representaciones ajenas a la intención comunicativa.

Esta tesis describe las circunstancias en las que se produce la selección léxica y la recuperación fonológica durante la producción del habla. Concretamente, ¿qué palabras y fonemas están activados durante el proceso de lexicalización del mensaje comunicativo? En la tesis analizamos si conceptos que no forman parte del mensaje preverbal del hablante llegan a activar sus correspondientes representaciones léxicas y fonológicas. En los experimentos de esta tesis, los participantes nombran un estímulo a la vez que ignoran la presencia de dibujos distractores. La manipulación de la relación semántica y fonológica entre el nombre del estímulo y el distractor permite analizar hasta qué punto se ha lexicalizado el dibujo distractor.

El siguiente apartado contiene una revisión teórica de los modelos y de la evidencia sobre la propagación de la activación en el sistema de producción del habla. Como se verá, los resultados de los estudios que han tratado la activación de dibujos distractores son en gran parte incongruentes entre sí y es imposible dar una respuesta definitiva. Posteriormente, se describen los experimentos que hemos realizado. Finalmente, concluimos con las implicaciones teóricas que se pueden extraer de nuestros datos.

12.2 La propagación de la activación en el sistema de producción oral

Las teorías sobre producción del habla coinciden en afirmar que al menos tres niveles de representaciones están implicados en la producción del habla: un nivel conceptual, uno léxico y uno fonológico. Las teorías también se muestran de acuerdo en que durante el acceso a una representación conceptual concreta, otras representaciones conceptuales que están semánticamente relacionadas resultan activadas (véase por ejemplo, Caramazza, 1997; Dell, 1986; Levelt, 1989). Es decir, en el curso de por ejemplo la denominación del dibujo de un perro, no sólo la representación conceptual de PERRO se activaría, sino que otras representaciones semánticamente relacionadas como GATO o CABALLO también lo harían. En este escenario, una cuestión de interés consiste en explorar si los conceptos GATO y CABALLO activan o no representaciones léxicas y fonológicas del sistema.

Existen al menos tres propuestas teóricas sobre cuál es el flujo de la activación desde niveles superiores a niveles inferiores del sistema de producción del habla. Los *modelos en cascada* asumen que cualquier representación activada en un nivel del sistema, propaga una parte proporcional de su activación a las representaciones de los niveles inferiores con las que está conectada (Caramazza, 1997; Costa, Caramazza & Sebastián-Gallés, 2000; Dell, 1986; Dell, Schwartz, & Martin, 1997; Griffin & Bock, 1998; Harley, 1993; Rapp & Goldrick, 2000; Starreveld & La Heij, 1995). Según estos modelos, cualquier representación conceptual que resulta activada en el curso de la lexicalización activaría sus correspondientes representaciones léxicas y fonológicas (véase figura 5, panel A).

Por otra parte, los *modelos discretos* restringen el flujo de la activación entre los diferentes niveles del sistema. Existen al menos dos modelos discretos. En la influyente propuesta de Levelt, Roelofs y Meyer (1999; ver también Levelt, 2001) la activación fluye en cascada entre el sistema conceptual y el sistema léxico. Sin embargo, la activación fonológica se restringe a una única representación léxica, aquella que se selecciona para ser producida oralmente (véase figura 5, panel B). Este modelo sostiene los dos tipos de presupuestos de propagación de la activación: la información se propaga en cascada del nivel conceptual al nivel léxico y de una forma discreta entre el nivel léxico y el nivel subléxico.

Recientemente, otro modelo discreto ha sido propuesto por Bloem y La Heij (2003), el modelo de *Selección Conceptual* (véase también Bloem, van der Boogard, & La Heij, 2004). Estos autores consideran que la única representación conceptual que propaga activación hasta el nivel léxico es aquella que está incluida en el mensaje preverbal (es decir, el concepto que se selecciona para ser producido). Sin embargo, la representación conceptual seleccionada activaría no sólo su correspondiente representación léxica sino que también a todas aquellas representaciones semánticamente relacionadas (véase figura 5, panel C). Este modelo es una modificación del modelo propuesto por Starreveld y La Heij (1995, 1996), por lo que presumiblemente el modelo asume que la propagación de la activación entre el sistema léxico y el fonológico se produce en cascada.

En los siguientes párrafos se revisan algunos estudios experimentales relacionados con las propuestas teóricas que acabamos de introducir.

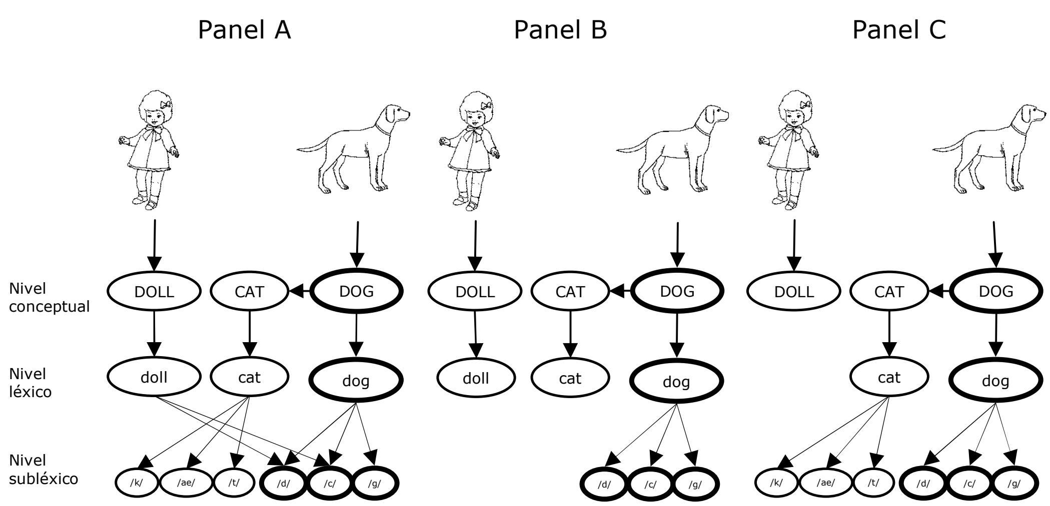

Figura 5: Representación esquemática del flujo de la activación en tres modelos diferentes. La palabra respuesta es *dog* (perro) y el dibujo distractor *doll* (muñeca). Las flechas representan la dirección de la activación y los círculos las representaciones conceptuales, léxicas y fonológicas. El grosor de las flechas y los círculos indica la magnitud de la activación. El modelo en cascada (Caramazza, 1997; Costa, Caramazza, & Sebastián-Gallés, 2000), el modelo discreto de Levelt et al. (1999) y el modelo de Selección Conceptual de Bloem y La Heij (2003) están descritos en los paneles A, B y C respectivamente.

12.2.1 Activación fonológica de palabras semánticamente relacionadas

Varios estudios han investigado cómo se propaga la activación entre los diferentes niveles de representación. Muchos de estos estudios han explorado si existe activación fonológica de representaciones conceptuales que están semánticamente relacionadas con la palabra diana. El primer estudio que analizó esta cuestión fue el de Levelt, Schriefers, Vorberg, Meyer, Pechmann y Havinga (1991). La principal conclusión de este trabajo es que palabras semánticamente relacionadas con la palabra diana (como podría ser la palabra *gato* durante el proceso de lexicalización de la palabra *perro*) no activan sus representaciones fonológicas (/gato/). Esta conclusión está a favor de una propuesta discreta, donde la activación fonológica se restringe a los segmentos correspondientes a la palabra que ha sido léxicamente seleccionada (Levelt et al., 1999) (pero véase, Jescheniak, Hahne, Hoffmann, & Wagner, 2006).

Sin embargo, otros estudios han reportado efectos fonológicos de palabras que no son seleccionadas léxicamente pero que están relacionadas semánticamente con la palabra diana. Por ejemplo, Peterson y Savoy (1998) obtuvieron evidencia de que durante la producción de una palabra, por ejemplo *sofá*, existe coactivación de la forma fonológica de un sinónimo como *sillón* (véase también Jescheniak & Schriefers, 1998). El resultado obtenido por Peterson y Savoy (1998) sugiere que cuando existe mucha relación semántica (como en el caso de dos palabras sinónimas) se produce activación fonológica de las dos palabras. En cambio, cuando la relación semántica es menor, como en el caso de dos palabras de la misma categoría semántica (*gato* - *perro*), no es posible observar la coactivación fonológica (véase para este argumento Dell & O'Seaghdha, 1991).

La observación de Peterson y Savoy no es explicable desde el modelo discreto propuesto por Levelt et al. (1999), sin embargo, sí lo es desde un modelo en cascada y desde el modelo discreto de Selección Conceptual propuesto por Bloem y La Heij (2003). Este último modelo presupone que representaciones semánticamente relacionadas con la palabra diana van a activar sus correspondientes representaciones léxicas y fonológicas. Sin embargo, lo que el modelo de Selección Conceptual no permite es la activación léxica, y por lo tanto fonológica, de palabras que no están semánticamente relacionadas con la intención comunicativa. Es por esto que si queremos discernir entre el modelo de Selección Conceptual y el modelo en cascada, debemos analizar si existe activación fonológica de representaciones conceptuales que no son relevantes para la intención comunicativa del mensaje, es decir, que no están semánticamente relacionadas con él.

12.2.2 Activación fonológica de dibujos distractores no relacionados semánticamente

Varios estudios han explorado si existe activación de representaciones conceptuales que son ajenas a la intención comunicativa del hablante. Morsella y Miozzo (2002) utilizaron un paradigma de denominación en el que se presentan dos dibujos (uno en verde y otro en rojo) y los participantes deben denominar un dibujo (por ejemplo, el verde) e ignorar el otro (el rojo). En el estudio de estos autores el dibujo distractor podía estar fonológicamente relacionado o no con el nombre del dibujo diana. Por ejemplo, el dibujo de una campana (*bell*, en inglés) aparecía con el dibujo de una cama (*bed*) en la condición relacionada y con el dibujo de un sombrero (*hat*) en la condición no relacionada. Se observaron latencias de denominación más rápidas en la condición relacionada que en la no relacionada. Morsella y Miozzo (2002) concluyen que el Efecto de Facilitación Fonológica (EFF) sugiere que conceptos ajenos a la intención comunicativa del hablante llegan sin embargo a activar sus correspondientes representaciones fonológicas, corroborando la hipótesis de los modelos en cascada y rechazando las propuestas discretas.

Sin embargo, existe evidencia experimental que parece contradecir el presupuesto en cascada de los resultados de Morsella y Miozzo (2002). Por un lado, Bloem y La Heij (2003) no observan activación fonológica de dibujos distractores en una tarea similar. En su experimento, los participantes debían traducir una palabra del inglés al holandés mientras ignoraban la presentación de un dibujo distractor. Las predicciones aquí eran las mismas que en el estudio de Morsella y Miozzo (2002); si los dibujos distractores activan sus representaciones fonológicas, las latencias de traducción deben ser menores cuando la palabra respuesta y el nombre del dibujo están fonológicamente relacionados. Sin embargo, Bloem y La Heij (2003) no observaron efecto fonológico alguno.

Otra evidencia experimental que contrasta con la conclusión de Morsella y Miozzo concierne al patrón inconsistente que se ha observado en tareas que utilizan dibujos distractores semánticamente relacionados con el estímulo diana (Bloem & La Heij, 2003; Damian & Bowers, 2003; Glaser & Glaser, 1989; Humphreys, Lloyd-Jones, & Fias, 1995). La activación fonológica de un dibujo distractor implica que haya previa activación de sus representaciones conceptuales y léxicas. Dado esto, sería de esperar algún efecto cuando en las mismas condiciones experimentales se manipulase la relación semántica (ya fuera un efecto de facilitación o de inhibición).

Esta hipótesis proviene de los efectos semánticos que se han reportado cuando en tareas de denominación de dibujos el distractor se presenta en formato de palabra escrita o auditiva (por ejemplo, Lupker, 1979). Ahora bien, los estudios que han explorado efectos semánticos de dibujos distractores han arrojado un patrón aparentemente contradictorio de resultados. Glaser y Glaser (1989) en una tarea de denominación de dibujos obtuvieron efectos de interferencia semántica; Bloem y La Heij (2003) reportaron un Efecto de Facilitación Semántica (EFS) utilizando una tarea de traducción como la descrita anteriormente; y por último, Damian y Bowers (2003) y Humphreys et al. (1995), no observaron efectos semánticos en una tarea de denominación de dibujos.

Aunque las diferencias en los diseños de estas tareas pudieran estar explicando las discrepancias entre los resultados (Bloem y La Heij, 2003), no está todavía claro qué factor es el que modula los efectos en tareas que utilizan dibujos como distractores. Es decir, la actual evidencia experimental no permite concluir si conceptos ajenos a la intención comunicativa del hablante activan o no sus representaciones léxicas y fonológicas. En concreto, la falta de un efecto fonológico en la tarea de traducción de Bloem y La Heij (2003) cuestiona la fiabilidad del EFF observado en el estudio de denominación de dibujos de Morsella y Miozzo (2002).

De hecho, Bloem y La Heij (2003) han argumentado que el EFF observado en la tarea de denominación se debe a que en algunos ensayos hay un error en los procesos de selección conceptual y la persona acaba seleccionando el distractor en lugar del dibujo diana. En aquellos ensayos en los que se produjera un error en la selección del dibujo, los participantes tendrían que detener el proceso de lexicalización sobre el distractor y empezar el proceso de lexicalización sobre el dibujo diana. En estos ensayos el dibujo distractor habría activado sus representaciones léxicas y fonológicas. De este modo, la recuperación de las propiedades fonológicas del dibujo diana en la condición relacionada sería más rápida puesto que estas representaciones ya habrían sido activadas previamente por el dibujo distractor, produciendo el EFF.

Bloem y La Heij (2003) argumentan que las condiciones experimentales utilizadas por Morsella y Miozzo (2002) son susceptibles de producir errores en los procesos de selección porque es más difícil discriminar cuál es el estímulo diana y cuál el distractor. De acuerdo con esta interpretación, el EFF reportado por Morsella y Miozzo no estaría dando cuenta de un procesamiento en cascada sino de un error en los procesos de selección del estímulo.

El principal objetivo de los experimentos de esta tesis es evaluar la activación fonológica de dibujos distractores que no están relacionados semánticamente con la intención comunicativa del hablante. Además, dado el inconsistente patrón de resultados entre la tarea de denominación de dibujos y la de traducción, es importante evaluar la fiabilidad de estos estudios.

12.3 Objetivos[25]

La presente tesis describe cómo se propaga la activación entre los diferentes niveles de procesamiento implicados en la producción del habla. Más concretamente, nos centramos en dos propuestas teóricas sobre el flujo de la activación desde niveles superiores a niveles inferiores, esto es, en una dirección "arriba-abajo". La propuesta en cascada presupone que la activación se propaga de manera automática a través del sistema. Por otra parte, la propuesta discreta restringe el flujo de dicha activación. Con tal de adjudicar entres ambas propuestas, exploramos si conceptos que son irrelevantes para la intención comunicativa del hablante activan sus representaciones léxicas y fonológicas. Concretamente, analizamos si durante tareas de producción del habla se activan los códigos fonológicos correspondientes al nombre de dibujos que no forman parte de la intención comunicativa del hablante.

Tal y como se mencionó en el apartado anterior, existen diversas observaciones experimentales que resultan aparentemente contradictorias entre sí. Por un lado, la presencia de efectos fonológicos y la ausencia de efectos semánticos con un mismo paradigma experimental (denominación de dibujos). Por otro lado, el contraste de resultados obtenidos con dos paradigmas experimentales similares, como son la denominación de dibujos y la traducción. Esta tesis también explora la fiabilidad de estas observaciones.

12.3.1 Objetivos específicos

1. Analizar si representaciones conceptuales que son irrelevantes para la intención comunicativa del hablante propagan activación hasta sus representaciones léxicas y fonológicas. Para lograr este objetivo evaluamos la presencia de un Efecto de Facilitación Fonológica (EFF) en dos tipos de tareas: denominación y traducción.
2. Explorar el origen de los resultados contradictorios obtenidos con dos paradigmas experimentales muy similares. Para ello analizamos si

[25] Parte de los experimentos reportados aquí han sido publicados en Navarrete y Costa (2005)

existen efectos semánticos en las mismas condiciones en las que se evalúa el EFF, esto es, en tareas de denominación y traducción.

3. Explorar la generalización del EFF en situaciones donde se reduce la probabilidad de cometer un error en los procesos de selección.
4. Explorar la existencia de restricciones sintácticas en la propagación de la activación entre los niveles léxico y fonológico.

12.3.2 Presentación de los experimentos

En la mayoría de los experimentos de la tesis, los participantes denominan o traducen palabras a la vez que ignoran la presentación de un dibujo distractor que puede estar fonológicamente relacionado o no con la respuesta. Bajo el presupuesto de que la recuperación de los fonemas depende de su nivel de activación (Meyer & Schriefers, 1991; Costa et al., 2000), se observará un EFF si la propagación de la activación ocurre de manera automática. Esto seria así porque en la condición relacionada los fonemas recibirían activación de dos fuentes (de la palabra diana y del distractor), mientras que en la condición no relacionada recibirían activación de una fuente (de la palabra diana). El EFF daría apoyo a los modelos en cascada. Por contra, de acuerdo con un modelo discreto, dibujos distractores no deberían activar sus códigos fonológicos por lo que no se esperan efectos.

En los experimentos que manipulan la relación semántica entre la respuesta y el distractor, las predicciones son las siguientes. Si el distractor activa su representación conceptual pero no su representación léxica, la presentación de un dibujo distractor semánticamente relacionado podría facilitar la recuperación conceptual de la respuesta y se observaría un efecto de facilitación semántica. En el supuesto de que el dibujo distractor activase su representación léxica, esta podría interferir en el proceso de selección léxica sobre la palabra diana y producir un efecto de interferencia semántica. Finalmente, si los efectos de facilitación conceptual y de interferencia léxica se producen conjuntamente y con una magnitud similar, ambos efectos podrían cancelarse mutuamente y no se observarían diferencias entre las condiciones.

En los experimentos 1 y 2 se utilizó el paradigma de denominación de dibujos y en los experimentos 3 y 4 una tarea de traducción. Los experimentos 1 y 3 midieron cuestiones fonológicas y los experimentos 2 y 4 cuestiones semánticas. En los experimentos 5, 6, 7 y 8 los participantes realizaron una tarea de denominación de color. Por último, los experimentos 9 y 10 evaluaron la propagación de la activación en tareas de producción de pronombres.

12.4 Efectos contextuales de dibujos distractores en tareas de denominación

El objetivo principal de los experimentos de esta sección es evaluar la presencia de efectos fonológicos y semánticos en tareas de denominación de dibujos. En los experimentos 1 y 2 se presentó a los participantes dos dibujos superpuestos (uno en verde y otro en rojo) y se les pidió que denominasen el dibujo verde e ignorasen el rojo.

12.4.1 Experimento 1: Efectos fonológicos

En este experimento se manipuló la relación fonológica entre los dibujos. En la condición relacionada los dibujos diana se presentaban con un distractor fonológicamente relacionado (*boca-bota*), mientras que en la condición no relacionada los dibujos no estaban relacionados (*boca-lápiz*). Además, se seleccionó otro grupo de dibujos que se utilizaron en ensayos de relleno, de esta manera, sólo el 16% de los ensayos del experimento fueron de la condición relacionada.

Se compararon los errores y las latencias de respuesta en las condiciones relacionada y no relacionada. En el análisis de errores no se apreciaron diferencias significativas. Sin embargo, en el análisis de las latencias, las respuestas en la condición relacionada fueron en promedio 21 milisegundos más rápidas que en la condición no relacionada, siendo esta diferencia significativa estadísticamente. Este resultado sugiere que el solapamiento entre el dibujo distractor y el dibujo objetivo acelera las latencias de denominación. Sin embargo, para descartar que otras variables pudieran estar dando cuenta del efecto (como por ejemplo el solapamiento visual entre los dibujos), se pasó un experimento control en inglés. En inglés no había relación fonológica entre los nombres de los dibujos, por lo que si el efecto reportado es debido al solapamiento fonológico, el efecto debería desaparecer en el experimento control. Los datos del experimento control no mostraron diferencias significativas entre las condiciones (véase tabla 2 del apartado 4.1).

12.4.2 Experimento 2: Efectos semánticos

En este experimento se manipuló la relación semántica entre los dibujos. El diseño y el procedimiento fueron muy similares a los del experimento 1. En la condición relacionada los dos dibujos pertenecían a la misma categoría semántica, mientras que en la condición no relacionada los dibujos no guardaban ninguna relación. Además, dada la incongruencia en los datos de los estudios que hasta la fecha han analizado la influencia semántica de dibujos distractores, se incluyó una condición control en la que los dibujos objetivos fueron presentados aisladamente. La condición control nos permite valorar si nuestro experimento es suficientemente sensible para detectar algún efecto.

En el análisis de errores las dos condiciones produjeron un número similar de errores. Igualmente, en el análisis de las latencias de denominación no se observaron diferencias significativas entre las dos condiciones. Finalmente, las latencias de denominación fueron mas rápidas en la condición control que en las condiciones en las que aparecía un dibujo distractor (véase tabla 3 del apartado 4.3).

Los resultados de este experimento no muestran ningún efecto de relación semántica entre los dibujos diana y distractor. Sin embargo, antes de concluir nada, es necesario demostrar que la relación semántica entre los pares de dibujos de nuestro experimento es susceptible de producir efectos semánticos. Para ello se realizó un experimento de interferencia palabra-dibujo con los mismos materiales. Los resultados de este experimento control mostraron un efecto de interferencia semántica de 23 milisegundos, mostrando que la relación semántica entre dibujos diana y distractores es suficiente para producir efectos.

12.4.3 Discusión de los experimentos de denominación

Los resultados de los experimentos 1 y 2 muestran que a) una relación fonológica entre el nombre del dibujo diana y el dibujo distractor acelera las latencias de denominación (el EFF del experimento 1), y b) que una relación semántica entre los dos dibujos no produce ningún efecto (experimento 2).

El EFF sugiere que dibujos distractores que no forman parte de la intención comunicativa del hablante activan sus códigos fonológicos, este efecto apoya los modelos en cascada (véase también Morsella & Miozzo, 2002). La ausencia de efectos semánticos replica estudios previos (Humphreys et al. ,1995; Damian & Bowers, 2003). Sin embargo no es posible concluir a favor de los modelos en cascada por dos motivos. El primero es la ausencia de efectos semánticos en las mismas condiciones donde dibujos distractores están activando sus representaciones léxicas y fonológicas (como muestra el EFF). Esta cuestión se retomará en el apartado 12.8. El segundo aspecto se refiere a la ausencia de efectos fonológicos en una tarea muy similar como es la traducción. En las dos siguientes secciones nos centramos en este aspecto. Concretamente, en la sección 12.5 evaluamos la generalización de los resultados obtenidos en tareas de traducción y en la sección 12.6 exploramos algunas particularidades de la tarea de denominación de dibujos que podrían estar dando cuenta del EFF observado en el experimento 1.

12.5 Efectos contextuales de dibujos distractores en tareas de traducción

En un principio, los procesos implicados en la traducción de una palabra deberían ser sensibles a las mismas variables que afectan la denominación de un dibujo (Kroll & Stewart, 1994; La Heij et al., 1996). Sin embargo, los recientes datos obtenidos por Bloem y La Heij (2003) contrastan con los resultados de los experimentos 1 y 2. Concretamente, en tareas de traducción con dibujos distractores, estos autores no observaron efectos fonológicos y sí un Efecto de Facilitación Semántica (EFS). En este aparatado evaluamos la fiabilidad de estos resultados.

Se presentaron palabras catalanas a bilingües español-catalán y se les pidió que las tradujeran al castellano. Junto a la palabra se presentaba un dibujo que el participante debía ignorar.

12.5.1 Experimentos 3a y 3b: Efectos fonológicos

Para este experimento se seleccionaron como estímulos diana palabras catalanas no cognadas respecto al español. Para cada respuesta (*gafas*), se seleccionó un dibujo que estaba fonológicamente relacionado, creándose así la condición relacionada (*gato)*. La condición no relacionada se creó reasignando los dibujos a otras palabras con las que no guardaban ninguna relación. Para aumentar la probabilidad de encontrar efectos se utilizaron dos asincronías entre estímulos (AEE), -250 y 0 milisegundos.

En el análisis por errores no se observaron diferencias significativas. En el análisis de las latencias, las latencias en la condición relacionada fueron más rápidas que en la condición no relacionada. La interacción entre Relación Fonológica y AEE fue significativa, reflejando el hecho de que el EFF fue mayor en la condición AEE = -250 que en la condición AEE = 0 (véase tabla 4 del apartado 5.1.).

El EFF encontrado en el experimento 3a coincide con los datos del experimento 1 y sugiere que dibujos distractores activan sus códigos fonológicos, apoyando las teorías de procesamiento en cascada. Sin embargo, antes de alcanzar esta conclusión, en el siguiente experimento evaluamos si el alto porcentaje de ensayos relacionados en el experimento 3a (50%) tiene algún papel en la presencia del EFF. En el experimento 3b la mitad de los ensayos relacionados del experimento 3a se volvieron a emparejar formando ensayos no relacionados.

En el análisis de los errores del experimento 3b el efecto de Relación Fonológica fue significativo en el análisis por participantes, reflejando más errores en la condición no relacionada que en la condición relacionada. Sin embargo, el efecto de Relación Fonológica no fue significativo en el análisis de las latencias. En un análisis conjunto de los experimentos 3a y 3b se observó una interacción entre las variables Relación Fonológica y Experimento*,* lo cual sugiere que el EFF no fue igual en los dos experimentos (véase tabla 5 del apartado 5.2).

Los resultados del experimento 3a muestran un EFF de dibujos distractores en tareas de traducción, este dato contrasta con la ausencia de efectos en el estudio de Bloem y La Heij (2003) en similares condiciones experimentales. En el experimento 3b el EFF desaparece y no hubo diferencias de denominación entre las condiciones fonológicamente relacionada y no relacionada. La desaparición del EFF en el experimento 3b sugiere que el efecto observado en el experimento 3a podría deberse al uso de estrategias por parte de los sujetos. Además, no excluye la posibilidad de que los resultados semánticos obtenidos por Bloem y la Heij (2003) se deban también al uso de estrategias. Los experimentos 4a y 4b evalúan efectos semánticos en similares condiciones a las de los experimentos 3a y 3b.

12.5.2 Experimentos 4a y 4b: Efectos semánticos

En el experimento 4a las condiciones experimentales fueron las mismas que en el experimento 3a con la única diferencia de que se manipuló la relación semántica entre los dibujos en lugar de la fonológica. En el análisis de los errores no se detectó efecto alguno de la variable Relación Semántica. Sin embargo, este efecto fue significativo en el análisis de las latencias, los participantes tradujeron las palabras más rápidamente en el contexto de un dibujo relacionado semánticamente que en el contexto de un dibujo no relacionado (véase tabla 7 del apartado 5.3).

Tal y como hicimos en el experimento 3, se evaluó si el EFS era debido al uso de estrategias por parte de los participantes. Por un lado, se redujo el número de ensayos relacionados siguiendo la misma estrategia que en el experimento 3a. Por otro lado, se evaluó la influencia en el EFS del reducido número de categorías semánticas utilizadas en el experimento 4a. En el experimento 4a las palabras y los dibujos provienen de 9 categorías semánticas, este reducido número aumenta la probabilidad de que los participantes detecten la manipulación experimental.

Para la mitad de participantes (grupo 1) 19 dibujos de la condición relacionada fueron emparejados de nuevo con otras palabras con las que no había relación alguna. Para la otra mitad de participantes (grupo 2), los mismos 19 dibujos fueron reemplazados por un nuevo grupo de dibujos que pertenecían a otras categorías semánticas de aquellas utilizadas en el experimento 4a.

El efecto de Relación Semántica no fue significativo en el análisis de los errores. Sin embargo, en los análisis de las latencias, el efecto de Relación Semántica fue significativo, reflejando latencias de traducción más rápidas en la condición relacionada que en la no relacionada. Además, no hubo interacción entre este efecto y la variable Grupo, sugiriendo que el EFS fue similar en ambos grupos de participantes (véase tabla 8 del apartado 5.4)

12.5.3 Discusión de los experimentos de traducción

Hemos obtenido los siguientes resultados: a) una relación fonológica entre el nombre del dibujo y la respuesta facilita las latencias de denominación, un EFF, b) cuando el porcentaje de ensayos relacionados disminuye el EFF desaparece, c) una relación semántica entre el dibujo y la palabra a traducir acelera las latencias, un EFS, y d), el EFS se mantiene cuando se reduce el número de ensayos relacionados o aumenta el número de categorías semánticas.

El experimento más importante para el objetivo de la presente tesis se refiere a la manipulación fonológica (experimento 3). A este respecto, la desaparición del efecto en condiciones en las que se disminuye el número de ensayos relacionados sugiere que el EFF del experimento 3a se debe al uso de estrategias por parte de los participantes, por lo que no se puede concluir a favor de los modelos de procesamiento en cascada. Por otra parte, la presencia del EFS no depende del porcentaje de ensayos relacionados. En resumen, nuestros resultados arrojan un EFS en las mismas circunstancias experimentales en las que no se observan efectos fonológicos.

Estos datos contrastan abiertamente con los datos reportados en los experimentos 1 y 2, donde se observó un EFF pero no efectos semánticos. ¿A qué se debe esta discrepancia? Una posible explicación pasa por considerar los mecanismos de selección en cada uno de los paradigmas. Concretamente, en el paradigma de denominación la presentación de dos dibujos superpuestos puede inducir problemas en el proceso de selección del estímulo diana. Por contra, en el paradigma de traducción, donde los estímulos diana y distractores son físicamente diferentes, la selección del estímulo diana no estaría sujeta a estos problemas de selección.

Recientemente, Bloem y La Heij (2003) han sugerido que los problemas de selección del estímulo diana en el paradigma de denominación puede inducir que en algunos ensayos se seleccione por error el dibujo distractor. Como consecuencia de este error de selección, el dibujo distractor se lexicalizaría hasta el nivel fonológico provocando de esta manera el EFF reportado en los experimentos de denominación. En los experimentos del siguiente apartado evaluamos directamente si el EFF en tareas de denominación es debido a problemas de selección del dibujo diana. Concretamente, en estos experimentos reducimos los posibles problemas de selección aumentando la discriminación entre el estímulo diana y el distractor.

12.6 Tareas de denominación de color

El objetivo de los experimentos de este apartado fue explorar la presencia de un EFF para dibujos distractores en condiciones en las cuales el estímulo diana y el estímulo distractor fueran muy fáciles de distinguir. En estos experimentos, la dimensión física del estímulo diana y del distractor son físicamente muy diferentes, y además, la representación conceptual que debe ser atendida (color) es distinta de la representación conceptual que debe ser ignorada (objeto). Concretamente, exploramos el efecto de dibujos relacionados fonológicamente en tareas donde los participantes denominan el color en el que los dibujos son presentados. Esta manipulación experimental reduce las posibilidades de que por error se lexicalice el elemento distractor. La presencia de un EFF en este contexto apoyaría los modelos de procesamiento en cascada.

12.6.1 Experimento 5: Activación fonológica en tareas de denominación de color

En este experimento se presentaron dibujos en color y los participantes debían nombrar el color e ignorar el dibujo. Por ejemplo, ante el dibujo de una vela en color marrón los participantes debían responder "marrón". Nótese que en esta condición experimental la dimensión que se debe lexicalizar (el color) es muy distinta de la que se debe ignorar (el dibujo), lo cual reduce la probabilidad de que los participantes seleccionen por error el nombre de los dibujos. En algunos casos el nombre de los dibujos estaba relacionado fonológicamente con el nombre del color (*vela-verde*) mientras que en otros casos no (*vela-marrón*). Al igual que en los experimentos 1 y 3, si el dibujo distractor logra activar sus representaciones fonológicas, debería observarse un EFF. En este experimento hubo un 12,5% de ensayos relacionados.

En los análisis de errores el efecto de Relación Fonológica fue significativo, se cometieron menos errores en la condición relacionada que en la condición no relacionada. En los análisis de las latencias, el efecto fonológico fue también significativo reflejando latencias de denominación mas rápidas en la condición relacionada que en la no relacionada (véase tabla 9 del aparatado 6.1).

El EFF reportado en el experimento 5 sugiere que dibujos distractores activan sus correspondientes segmentos fonológicos. Sin embargo, para asegurarse que el efecto sea debido a la variable fonológica y no a otras variables, se pasó un experimento control. En este experimento, participantes de lengua materna catalana denominaron los mismos ensayos experimentales en catalán. Crucialmente, en catalán no había solapamiento fonológico entre el nombre de los colores y el de los dibujos. Los análisis de este experimento control no mostraron ninguna diferencia significativa entre la condición relacionada y la no relacionada.

El EFF obtenido en la tarea de denominación de color apoya las teorías de procesamiento en cascada, que sostienen que cualquier representación que resulta activada propaga parte de su activación hacia otras representaciones con las que está conectada. En los experimentos 6 y 7 extendemos el EFF a otros contextos.

12.6.2 Experimento 6: El impacto de la familiarización y la repetición en el EFF

En este experimento evaluamos el impacto de la familiarización y de la repetición de los dibujos en el EFF obtenido en el experimento anterior. En el experimento 5, antes de la sesión experimental los participantes eran familiarizados con el nombre de los dibujos. Esto puede inducir que durante la sesión experimental los participantes recuperen el nombre de los dibujos juntamente con el nombre del color, produciendo así el EFF. Por otra parte, en el experimento 5 cada dibujo era repetido un total de 12 veces a lo largo del experimento (4 en una fase previa de entrenamiento y 8 en la experimental). Esta repetida exposición a los dibujos puede también inducir que se recupere el nombre de los dibujos. Con tal de medir la influencia de estas dos variables, en el experimento 6 se utilizó el mismo procedimiento con las siguientes modificaciones: a) se eliminó la fase de familiarización y b) cada dibujo se presentó sólo 5 veces (1 en la fase de entrenamiento y 4 en un único bloque experimental). Si el EFF reportado en el experimento 5 es debido realmente al procesamiento en cascada del sistema de producción, deberíamos observar el mismo efecto en el experimento 6.

En el análisis de los errores no se encontraron diferencias significativas entre las condiciones. En el análisis de las latencias de denominación la variable Relación Fonológica fue significativa, reflejando latencias de denominación mas rápidas en la condición relacionada que en la no relacionada (véase tabla 10 del apartado 6.2). Los datos del experimento 6 corroboran pues el EFF reportado en el experimento 5.

12.6.3 Experimento 7: Extendiendo el EFF

El experimento 7 evalúa la presencia del EFF en unas condiciones experimentales en las que la selección del estímulo diana resulta más fácil. Concretamente, los participantes nombraban el color de unos rectángulos que aparecían encima de los dibujos en blanco y negro. Separando las dimensiones físicas del objeto diana (el color del rectángulo) y el elemento distractor (el dibujo) se reducen las posibilidad de cometer un error durante el proceso de selección del estímulo a lexicalizar.

Se utilizaron el mismo procedimiento y materiales que en el experimento 5, con la diferencia de que se presentaron rectángulos coloreados encima de dibujos en blanco y negro. La tarea consistía en denominar el color de los rectángulos. En el análisis de los errores no se apreciaron diferencias significativas entre las condiciones. Sin embargo, en el análisis de las latencias se obtuvo un efecto fonológico, en el que la denominación del color fue más rápido en la condición relacionada que en la no relacionada (véase tabla 11 del apartado 6.3). Así pues, los datos del experimento 7 replican el EFF del experimento 5 y lo extienden a una situación en la que es muy improbable la selección del distractor por error.

La presencia de EFF en los experimentos 5, 6 y 7 coincide con los resultados del experimento 1. Sin embargo todavía esta por aclarar por qué en una tarea de traducción no se observan efectos fonológicos (experimento 3b). Una posible explicación de esta discrepancia radica en las diferentes demandas atencionales que suponen las tareas de traducción y de denominación. Diferentes investigaciones en el campo de la atención han sugerido que la cantidad de procesamiento sobre un elemento distractor depende directamente de la cantidad de recursos atencionales que la tarea principal deja libre (Lavie, 2005). En el siguiente experimento evaluamos directamente la contribución de los factores perceptivos-atencionales en el EFF reportado en el experimento 5.

12.6.4 Experimento 8: El papel de la carga perceptiva sobre la activación fonológica de dibujos distractores

Recientemente, en su propuesta teórica sobre la atención selectiva, Lavie y colaboradores (véase para una revisión Lavie, 2005) sostienen que el procesamiento sobre un elemento distractor depende de los procesos perceptivos implicados en la realización de la tarea principal. Ante aquellas tareas que requieren un gran nivel de procesamiento perceptivo los elementos distractores apenas son procesados y sus efectos sobre la realización de la tarea principal se ven reducidos. Por contra, en aquellas tareas en las que el procesamiento perceptivo es menor, el sistema dispone de más recursos para procesar el estímulo distractor y sus efectos aumentan. En el experimento 8 extrapolamos la propuesta de Lavie a una tarea de denominación de colores. En este experimento se evaluó si las demandas perceptivas implicadas en la realización de una tarea de denominación tenían alguna influencia en la presencia del EFF.

En el experimento 8 se usaron los mismos materiales que en el experimento 5. La variable carga perceptiva se manipuló en una tarea de respuesta-no respuesta (véase Lavie, 1995, para detalles). La tarea de los participantes era denominar el color de los dibujos e ignorar el dibujo, como en el experimento 5. Sin embargo, en el experimento 8 una figura aparecía a la derecha o a la izquierda del dibujo. La figura podía ser un circulo o un triángulo que podían aparecen rellenos (pintados en negro) o vacíos (pintados en blanco). La carga perceptiva se manipuló incrementando los requisitos del procesamiento perceptual sobre la figura. En el experimento 8, la mitad de los participantes debían dar la respuesta (nombrar el color) sólo cuando aparecía una figura vacía. Estos participantes formaron el grupo de Baja Carga Perceptiva, ya que sólo debían prestar atención a una dimensión de la figura para dar o inhibir la respuesta de denominación. Por contra, la otra mitad de participantes fueron instruidos a nombrar el color cuando aparecía un círculo lleno o un triángulo vacío. Este grupo de participantes formaron el grupo de Alta Carga Perceptiva porque debían prestar atención a dos dimensiones de la figura.

De acuerdo con la propuesta de Lavie y colaboradores, en situaciones de alta carga perceptiva el dibujo distractor no es procesado. Por lo tanto, en el experimento 8 el EFF debe desaparecer o disminuir en la condición de Alta Carga Perceptiva en comparación con la condición de Baja Carga Perceptiva.

En el análisis de los errores, el efecto de Relación Fonológica fue significativo, reflejando un menor número de errores en la condición relacionada que en la no relacionada. A la vez, el efecto fonológico fue también significativo en el análisis de las latencias. El efecto de la variable Carga Perceptiva fue también significativo revelando latencias más rápidas en la condición de Baja Carga Perceptiva. Sin embargo, y contrario a nuestras predicciones, el efecto fonológico y la Carga Perceptiva no interactuaron y la magnitud del EFF fue el mismo en las dos condiciones (42 y 41 milisegundos para la condición Baja y Alta respectivamente) (véase tabla 12 del apartado 6.4).

En el experimento 8 hemos replicado el EFF reportado en los experimentos anteriores. Sin embargo, la manipulación de la carga perceptiva que incluimos no moduló el EFF.

12.7. Analizando la existencia de restricciones sintácticas en la propagación de la activación

El EFF que hemos observado en los experimentos 1, 5, 6, 7 y 8 corrobora la hipótesis de que la activación se propaga de manera automática a través del sistema de producción oral. Este efecto puede ser explicado por los modelos en cascada, pero no por las propuestas discretas de Levelt y colaboradores (1999) y el modelo de Selección Conceptual de Bloem y La Heij (2003).

Hasta ahora la evidencia que hemos aportado en favor de los modelos en cascada se refiere a situaciones donde el hablante produce palabras aisladas, como nombre de dibujos o nombre de colores. Sin embargo, en sus interacciones cotidianas los hablantes recuperan y producen las palabras en el contexto de oraciones. A este respecto, cabe preguntarse si el principio de propagación de la activación que hemos observado en denominación de palabras aisladas también se observa durante la producción de oraciones.

A este respecto, los modelos en cascada no hacen predicciones específicas sobre si el tipo de producción (palabra aislada u oración) modula la propagación de la activación. Por esto, los modelos en cascada predecirían que también durante la producción de oraciones la activación se propaga de manera automática entre los diversos niveles de representaciones. Sin embargo, la reciente propuesta de Jescheniak, Schriefers y Hantsch (2001) sugiere que existen restricciones sintácticas en la propagación de la activación. En concreto, estos autores presuponen que durante la producción de formas pronominales marcadas por género, la forma fonológica de la palabra que actúa como referente del pronombre no llega a activarse. La producción de un pronombre implica la construcción de una estructura sintáctica que indica que el elemento que debe ocupar cierto lugar en la estructura es un pronombre. Según Jescheniak y colaboradores, es la construcción de esta estructura la que permite al sistema filtrar la información que proviene de elementos gramaticales diferentes a los esperados. Es decir, durante la producción de pronombres, el sistema filtraría la activación fonológica de la palabra que actúa como referente porque es un nombre, mientras que el elemento permitido por la construcción sintáctica es un pronombre.

En lenguas como el español o el alemán, la forma de los pronombres marcados para género depende del género gramatical del referente. Por ejemplo, en español la forma pronominal *esta* corresponde a nombres de género gramatical femenino, mientras que la forma gramatical *este* corresponde a nombres masculinos. Los modelos de producción del lenguaje asumen que el género gramatical es una propiedad sintáctica de las palabras y que, por tanto, la recuperación de género implica la selección léxica de la palabra. De esta manera la producción de un pronombre supone una situación en la que una palabra que es seleccionada léxicamente no acaba siendo producida (véase por ejemplo, Navarrete, Basagni, Alario, & Costa, 2006).

En su estudio, Jescheniak et al. (2001) utilizan un paradigma de interferencia palabra-dibujo para medir la activación fonológica del referente durante la producción de pronombres. En su estudio, hablantes alemanes describen dibujos utilizando construcciones pronominales mientras ignoran distractores que podrían estar fonológicamente relacionados con el referente o no. Los autores argumentan que si el referente activa su fonología, debería observarse un efecto de interferencia fonológica. Esto sería así porque en la condición relacionada, la fonología de la palabra referente recibiría activación de dos fuentes, del distractor y de la representación léxica del referente, interfiriendo más en el proceso de codificación fonológica del pronombre que en el caso de un distractor no relacionado. En su estudio no se observaron efectos fonológicos, y los autores concluyeron a favor de un modelo discreto con restricciones sintácticas. En los experimentos 9 y 10 evaluamos esta propuesta.

12.7.1 Experimento 9: Producción pronominal (paradigma de interferencia dibujo-palabra)

En el experimento 9 se presentaron dos dibujos de diferente género y el participante debía nombrarlos con frases del tipo: "*La mesa y el casco*". Poco después aparecía uno de los dos dibujos pintado en azul o en verde y el participante debía nombrarlo utilizando un determinante ("*Esta mesa es verde"*) o un pronombre ("*Esta es verde"*). Simultáneamente a este segundo dibujo, aparecía un distractor escrito que podía estar fonológicamente relacionado (*melón*), fonológicamente no relacionado (*pino*), semánticamente relacionado (*taburete*) o semánticamente no relacionado (*bolso*).

Efectos semánticos. El efecto de Relación Semántica fue significativo en el análisis de errores y en las latencias de denominación, reflejando más errores y respuestas más lentas en la condición relacionada que en la no relacionada. *Efectos fonológicos.* No hubo efectos significativos en el análisis por errores. El efecto de Relación Fonológica fue significativo en el análisis de las latencias, reflejando respuestas más rápidas en la condición relacionada que en la no relacionada. Interesantemente no hubo interacción entre las variable Tipo de Producción y Relación Fonológica (véase tabla 13 del apartado 7.2).

En este experimento se observó un efecto de facilitación fonológica en la producción de pronombres. Este dato contrasta con la falta de efecto del estudio de Jescheniak et al. (2001) (ver también Finocchiaro y Caramazza, 2006) y es congruente con el reciente estudio de Starreveld y La Heij (2004). Por otra parte, existe evidencia en la literatura que sugiere que parte del efecto fonológico en el paradigma de interferencia palabra-dibujo ocurre a nivel léxico, véanse por ejemplo los estudios de Lupker (1982) y Bi y Caramazza (sometido). Así, consideramos que el uso de este tipo de paradigma no es el más adecuado para investigar la propagación de la activación fonológica durante la producción pronominal. En el experimento 10 se utilizó un paradigma de denominación de colores que evita el uso de palabras como distractores.

12.7.2 Experimento 10: Producción de determinante + adjetivo

Se utilizaron los mismos materiales y procedimiento que en el experimento 5. Los participantes denominaron los dibujos utilizando construcciones del tipo: "*La verde*". De acuerdo con Jescheniak et al. (2001), el nombre referente no activaría su forma fonológica y por tanto no deberían observarse diferencias entre las condiciones relacionada y no relacionada. Por el contrario, de acuerdo con un modelo en cascada, debería observarse un efecto de facilitación fonológica.

En los análisis de los errores no hubo efecto fonológico. En el análisis de las latencias se observó un efecto de facilitación fonológica, reflejando que las latencias fueron más rápidas en la condición relacionada que en la no relacionada (véase tabla 14 apartado 7.3).

El efecto del experimento 10 sugiere que durante una producción pronominal los segmentos fonológicos de la palabra referente reciben activación. Esta observación rechaza la reciente propuesta de Jescheniak et al. (2001).

12.8 Conclusión

El objetivo principal de esta tesis era el de caracterizar el flujo de la activación entre los diferentes niveles de representación implicados en la producción del habla. Concretamente, hemos analizado el curso de la activación desde el nivel conceptual al léxico y de este último al fonológico. Existen dos propuestas teóricas. Por un lado, los modelos en cascada asumen que cualquier representación que resulta activada, propaga parte de esta activación a otras representaciones con las que está conectada. Por otra parte, la propuesta discreta restringe la propagación de la activación entre los diferentes niveles del sistema.

El resultado más relevante de nuestros experimentos es la réplica del Efecto de Facilitación Fonológica (EFF) en diferentes condiciones experimentales. Nuestros datos rechazan la interpretación de que el EFF reportado en tareas de denominación sea debido a un error en la selección del estímulo como consecuencia del formato visual de presentación (Bloem y La Heij, 2003). Por último, los datos del experimento 10 rechazan la propuesta de que existen constricciones sintácticas en la propagación de la activación (Jescheniak et al., 2001).

Hay dos resultados que parecen contradictorios entre sí. El primero es la falta de efectos semánticos bajo las mismas circunstancias en las que ha sido observado un efecto fonológico. Como se indicaba en el aparatado 12.3.2 la falta de efectos podría deberse a la presencia de dos factores opuestos: a) un efecto de facilitación a nivel conceptual y b), un efecto de interferencia a nivel léxico.

El otro resultado aparentemente contradictorio se refiere al diferente patrón de resultados observado entre dos tareas similares como son la denominación de dibujos y la traducción. Respecto a este último punto, es importante mencionar que investigaciones de diferentes disciplinas sugieren que la cantidad de procesamiento sobre un distractor correlaciona positivamente con la cantidad de recursos atencionales dejados libres por la tarea principal que está realizando la persona (véase por ejemplo, Ress, Russel, Frith, & Driver, 1999; Sinnett, Costa & Soto-Faraco, 2006). Podría suceder que las demandas atenciones implicadas en la traducción de una palabra dejara menos recursos atencionales disponibles para procesar el distractor. Si esto fuera así, sería de esperar un efecto de facilitación conceptual, porque el dibujo llega a activar su representación conceptual, y una falta de efectos léxicos y fonológicos porque el dibujo no llega a activar estas representaciones (véase figura 6). El patrón de resultados observados en los experimentos de traducción estaría de acuerdo con esta interpretación.

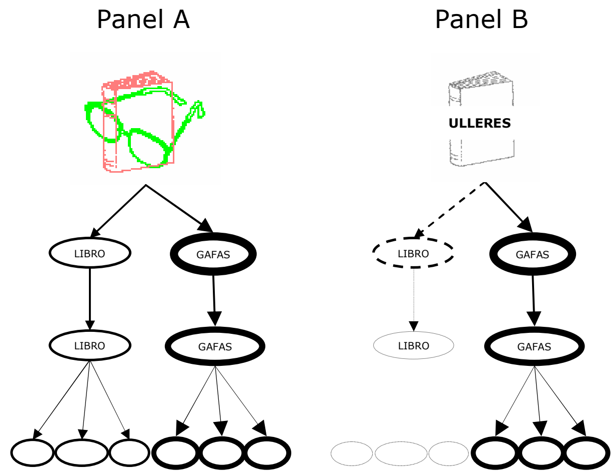

Figura 6: Representación esquemática de las tareas de denominación de dibujos y de traducción de palabras. En ambas tareas la respuesta es la palabra *gafas* y el distractor el dibujo *libro*. Las flechas representan la dirección de la activación y los círculos las representaciones conceptuales, léxicas y fonológicas. El grosor de las flechas y los círculos indica la magnitud de la activación. La representación conceptual del dibujo distractor *libro* está más activada en la tarea de denominación (panel A) que en la tarea de traducción (panel B). Bajo el presupuesto de que la activación que propaga una representación es proporcional a su nivel de activación, el nodo léxico *libro* estaría más activado en la tarea de denominación que en la de traducción. Además, como consecuencia del decaimiento de la activación, las representaciones fonológicas correspondientes a la palabra *libro* estarían activadas en la tarea de denominación pero no en la de traducción.

En general, nuestros resultados muestran que la activación fluye de manera automática a través del sistema de producción del lenguaje, corroborando las predicciones de un modelo de acceso léxico en cascada, que además tiene la virtud de ser la propuesta más parsimoniosa pues aplica el mismo principio de propagación en todo el sistema.