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Bilingual Lexical Processing in Single Word Production

Swedish learners of Spanish and the effects of L2 immersion

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Abstract
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Bilingual speakers cannot suppress activation from their dominant language while naming pictures in a foreign and less dominant language. Previous research has revealed that this cross-language activation is manifested through phonological facilitation, semantic interference and between language competition. This research is based exclusively on highly proficient bilinguals. The present study investigates cross-linguistic activation in Swedish learners of Spanish, grouped according to their length of Spanish immersion, and one of the groups is in its very initial stages of acquisition. Participants named pictures in Spanish in two picture-word interference experiments, one with only non-cognates, and one including cognates. The study addresses the following research questions; (1) do the two groups of participants differ significantly from one another in terms of cross-linguistic activation, (2) what does cross-language activation look like in initial stages of L2 acquisition, (3) how does cognate status affect cross-linguistic activation and does this differ between participants depending on their length of immersion?

The experiments show that cross-linguistic influence is dependent on length of immersion. The more immersed participants performed very similarly to what is usually the case in highly proficient bilinguals while the less immersed participants did not. The results of the less immersed participants are interpreted as manifestations of lexical processing in initial stages of L2 acquisition. Since this type of learner has never been tested within the picture-word-interference paradigm before, there are no previous online results to compare to. The results are discussed in relation to the large tradition of offline research which has shown that beginning learners predominantly process their L2 phonologically, and that conceptual processing is something requiring more L2 development. These findings are discussed in terms of a developmental ladder of L2 processing stages.

Furthermore, the cognate word induced longer naming latencies in all participants and it turned out that the cognate words were highly unfamiliar. Hence all participants are sensitive to word-frequency effects, and this sensitive is greater in early stages of learning. Finally this study suggests that more research must be conducted to establish cross-linguistic influence between the many languages of multi-lingual subjects, even when these languages may not be present in the testing situation.

Keywords: Bilingualism, second language acquisition, psycholinguistics, the bilingual lexicon, bilingual lexical processing, bilingual lexical access, word-frequency effect, cognate effect, picture-word interference.

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1 Introduction

There are more bilingual and multilingual speakers than monolingual speakers in the world today. Being bilingual has gone from being considered the abnormal case to be seen as the normal case. For instance, in Levelt's (1989; Levelt et al., 1999) influential model of monolingual speech production, knowing two languages is compared to knowing two dialects, or two registers, which is something all monolingual possess.

It is a common perception of bilinguals that balanced bilinguals are able to keep their languages perfectly separate. Yet, everybody with any experience of two languages knows that they influence each other, a phenomenon known as cross-linguistic influence. This influence can be manifested through the use of elements from one language while speaking in another language. The elements can be sounds, words, or grammatical structures. This is usually spoken about in terms of L2 transfer. However, there also occurs a lot of influence between the languages of a bilingual (or a multilingual) which is not noticeable to a partner of conversation. This is cross-linguistic influence in language processing, and the focus of this thesis.

Psycholinguistic research contributes with new insights into how speakers knowing more than one language handle and process their languages. When a bilingual subject is speaking in one language, the other language (or languages) are always active to some extent, and may exert influence. Depending on both internal factors (such as proficiency level) and external factors (such as the situational context of the speech event, or the context of learning) determine how and to what extent the languages of a bilingual influence each other.

There is a general perception that language learning benefits from experiencing the language in its natural setting, through *immersion*. However, immersion has been somewhat neglected in experimental research of language processing. This thesis attempts to discern processing differences between bilinguals with differing length of L2 immersion. More importantly, one of the participant groups in this study is in beginning stages of acquisition. This type of learner is almost absent in the experimental research of second language processing.

Insights will contribute to our understanding of how L2 processing develops. More research concerning these questions will lead to a broader understanding of what a bilingual goes through in acquiring an L2 in terms of processing. And since language learning is a long-term process, it will give us a deeper understanding of what processing demands are required from a bilingual person.

1.1 The present study

This study examines the naming latency patterns in bilingual lexical access of two groups of participants based on their length of Spanish immersion. It is investigated whether subjects display cross-linguistic phonological facilitation, semantic interference, between-language competition and cognate facilitation. Furthermore, it is investigated whether the latency patterns are predicted by length of immersion. The design of the study will be listed below.

(1) It is not common in experimental studies of bilingual processing to look at participants with different proficiency levels. However, when this is done, participants are divided into groups based on scores on a target language proficiency test. Usually, a well established proficiency test is used, making the results comparable across studies. The language proficiency test in this study was composed for the present study alone, thus the scores cannot be used to compare participants across studies. This is why test scores were not used for grouping of bilingual participants.

Another common approach is to group participants according to course levels at university, a way to reflect proficiency differences. This is not possible with the present participants since it is quite common among young people to travel to Spanish-speaking countries and study the language in a natural environment. Because of this, some of the participants who are in their first semester of university level Spanish lived in Spain for a year, and some participants in their third semester might never have been to a Spanish-speaking country.

Participants in the present study are grouped according to length of Spanish immersion.[1] Twenty-three participants have experienced 12 or fewer months of Spanish immersion, and fourteen have experienced more than one year of Spanish immersion.

(2) Usually, studies within the picture-word-interference paradigm (PWIP) do not examine picture word-interference across proficiency at all. It is more usual just to look at one group of bilinguals, and this group is always highly proficient in their L2, even native-like according to test scores. The participants of the present study are in different stages of their L2 development. The participant group with more L2 immersion is fair to hgh

[1] The term *immersion* can be used somewhat differently in different research paradigms. Often, l*anguage immersion* refers to a method of teaching a second language in which the target language is used for instruction. These instructional programs are based on the French immersion programs founded in Canada during the 1960s. In this thesis, *length of Spanish immersion* equals time spent in a Spanish-speaking country.

proficiency. Participants with less Spanish immersion are unique in experimental research, because they are at their beginning stages of L2 development. The results of the present study can thus give us important insights into lexical processing at the very early stages of L2 acquisition.

(3) Most bilingual experimental studies are performed in a permanent university laboratory, and participants are recruited several times during the course of their studies.[2] Such participants are highly familiar with everything about an experimental setting. All participants in the present study had no to very little prior experience of experiments. Only three participants report ever participating in any experiment before and these were very different from the present experiment. The rest of the participants have never been in an experimental situation before.

(4) Most studies within the PWIP are based on language pairs which are typologically close to one another to such a high extent that they are referred to as cognate languages. Many studies involve English and Dutch (Hermans et al., 1998). Others involve Spanish and Catalan (Costa & Caramazza, 1999). There are very few studies on English and Spanish (Sunderman & Schwartz, 2008) and only one on English and Chinese (Hoshino & Kroll, 2008).

The language pair in the present study is unique in two ways. First, there is no previous bilingual experimental study involving Swedish and Spanish. Secondly, Spanish and Swedish are typologically distant. In addition to objective typological distance, Kellerman (1983) speaks of perceived distance between languages. He argues that this can affect how a second language is processed.

(5) Studies within the PWIP are based on exclusively bilingual participants. Experimental research on multilingual subjects is advancing, however, up until today there is no PWI study involving multilingual participants. All participants in the present study are highly proficient in English, 32.4% of them are proficient in one additional language, and 18.9% are proficient two additional languages. This adds further complexity to the study, since multilingual competence is not the mere sum of instances of monolingual competence.

1.2 Research questions

Cross-linguistic activation in bilingual production is an uncontroversial issue. The research focuses on different activational aspects and on factors in the experimental setting which may influence test results. Too little research has investigated how different participant groups differ on the same tasks

[2] Usually there is a limitation as to how often students are allowed to participate in experiments. This is to ensure that no experimental effects are transferred between studies.

and no previous PWI study has compared participants in the initial stage of acquisition with further developed learners. In pursuing this line of inquiry, this thesis investigates cross-language influence of different stimuli pairings in a bilingual picture-word setting by testing two groups of participants based on their varying lengths of Spanish immersion. This is to shed light on how L2 lexical access differs between early and later stages of acquisition.

Two cross-modal picture-word interference tasks were designed to address the research questions. Participants name pictures in Spanish (their weaker language) while being distracted in Swedish (their stronger language). The results will indicate possible differences in lexical processing as a consequence of word type effects (in terms of cross-linguistic phonological facilitation, semantic interference, between language competition and effects of cognate status) and participant groups with varying length of Spanish immersion. The following specific research questions are explored:

A. Word-type effects:
   - Do the participants manifest cross-linguistic phonological facilitation, semantic interference and between-language competition?
   - Is there a significant difference in naming latencies for picture names depending on cognate status?

B. Is there a difference in bilingual lexical processing depending on length of L2 immersion?

Both experiments have an overtly bilingual design as they were performed in Spanish, the Swedish participants' L2. Experiment 1 includes concrete, non-cognate nouns. Experiment 2 consists of stimuli from Experiment 1, as well as Swedish/Spanish cognate words. These experimental designs address research question A. Participants have spent differing amounts of time in a natural L2 setting. By examining two groups divided according to their length of natural L2 exposure counted in months, research question B will be answered.

1.3 Structure of the thesis

The present section is followed by a survey of theoretical perspectives and basic concepts which form the basis for the present study (Chapter 2). The workings of bilingual lexical processing and pertinent evidence for word-type effects are outlined. Research questions of specific importance to the present study will be continuously addressed in the discussion of results in Chapters 4 and 5 and especially in the general discussion in Chapter 6.

Chapter 3 describes the present study in terms of participants and method. A detailed description is given of bilingual participants' language background as well as the Swedish comparison participants. The experimental task design, analysis, material and procedure used in the present investigation are outlined and justified.

In Chapter 4, Experiment 1 is outlined, the picture-word-interference experiment including only non-cognates. Results from accuracy scores and naming latencies are presented for both bilingual and Swedish comparison participants. Post hoc analyses present the effects of cross-linguistic activation and between-language competition. Results are discussed in the light of previous research.

In Chapter 5, Experiment 2 is outlined, the picture-word-interference experiment including both non-cognates and cognates. Results from accuracy scores and naming latencies are presented for both bilingual and Swedish comparison participants. Post hoc analyses present the effects of cross-linguistic interference and between-language competition. Results are discussed in the light of previous research.

Chapter 6 presents a general discussion of the results in light of the theoretical perspectives outlined in Chapter 2. Directions for future research are outlined.

2 Theoretical perspectives

2.1 Introduction

This section reviews the theoretical preliminaries underlying the present investigation. Factors influencing bilingual lexical processing will be outlined, and theories of the bilingual lexicon will be discussed. Furthermore, basic preliminaries involved in language learning will be discussed, such as proficiency and automaticity.

2.2 Cross-linguistic influence

One of the most studied factors explaining second language acquisition patterns is cross-linguistic influence. This factor has been affected by shifts of paradigms over the years. The term *transfer* was first used in *contrastive analysis*, which attributed the influence from the L1 on L2 production to the difficulty to suppress L1 language habits. This influence was manifested through the transfer of L1 elements (sounds, morphemes, words or syntactical structures) into L2 production (Lado, 1957).

Later, since the 1970s and especially the 1980s, research has also started to address the influence from the L2 during L1 use (Kecskes & Papp, 2000). It is only recently that it has become generally accepted that all the languages we know are activated simultaneously, and influence production in all directions. During L3 production for example, influence is considered to be bidirectional both between L1 and L3 and between L2 and L3 (for a survey, see Cenoz et al., 2008).[3]

The nature of the cross-linguistic influence is determined by a number of factors which can mainly be summarized as typology, recency, L2 status, and proficiency, which determine the strength and direction of the influence. The research field is still young and it is too early to establish the relative importance of these factors, but I will summarize them briefly here. The principal factors influencing cross-linguistic influence in bilingual and multilingual production will be described here.

[3] Bilingual and multilingual learning are treated together here since it is generally assumed that the processes involved in learning an L3 are similar to those involved in learning an L2 (Hamarberg, 2008; Cenoz, 2008), although somewhat more complex (Clyne, 1997).

2.2.1 Psychotypology and the "foreign language effect"

More related languages tend to influence each other than distant languages do. Kellerman (1983) uses the term *psychotypology* and suggests that the second language learner's perception of the typological distance between two languages influences the extent to which the learner will transfer elements from one language to another. The elements can include phonology, grammar, or lexicon. This means that the learner has a notion of the degree of typological relatedness between languages; this develops naturally in the learner as part of the metalinguistic awareness and determines transferability.

Kellerman (ibid.) cites a number of studies as evidence for psychotypological constraints on transferability, mainly observing the influence of L1 on L2 production. One example comes from the situation on the border between Sweden and Finland, where people are mainly Swedish/Finnish bilingual and learn English in school. Researchers at Åbo University compared English learners with Swedish as their dominant language and English learners with Finnish as their dominant language. Swedish and Finnish are typologically very distant, but the learner group is very homogenous in terms of education and culture.

Sjöholm (1976) found that the Swedish-dominant learners made more errors traceable to the L1 than the Finnish-dominant group. According to Kellerman (1983) this difference in source language for learner errors can be attributed to the learner's sensitivity to the relatedness between L1 and L2. The Finnish-dominant group realizes "that their mother tongue is not a useful basis for making predictions about the forms of English utterances" (Kellerman, 1983:114).

Kellerman (1977) does recognize that psychotypological constraints apply in trilingual situations where more cross-linguistic influence occurs from one L2 to another L2, if the L1 is typologically distant from these two languages. Several studies describe a situation where Asian speakers of English who acquire French (see the survey in Cenoz, 2000) or German (Vogel, 1992) tend to borrow between the Indo-European languages rather than from their native language. The psychotypological constraints are very important when it comes to the L2 lexicon. If the L2 and the L3 are related, the learner can identify cognates, which means that they can make use of the L2 foundation in early stages of L3 acquisition (Ringbom, 2001).

Lexical transfer can be of either form or meaning. Transfer of form is when the learner code switches (sometimes the switched word is modified to suit the L3 phonology but fails). Other form transfers can be when the learner uses an L2 form which is similar to an L3 word, but not the intended one (a deceptive cognate) such as *embarazada* (Spanish word for *pregnant*) instead of *embarrassed*. These errors are caused because the learner is influenced by a formally similar word, and according to Ringbom (ibid.)

they are most frequent when the languages are related and share many cognates.

Transfers can also be meaning based; these are more complex and almost exclusively occur from L1 to L2 and not in the opposite direction. These transfers include loan translations of compounds, phrasal verbs, and idioms, and consist of two or more lexical elements. These elements are combined to form a meaning which has a corresponding meaning unit in the L3, but it is a different one. A meaning-based transfer can also consist of semantic extension errors. These are words that the learner assumes are polysemous in L1 and L3. Thus the meaning-based errors originate from L1.

Several studies have indicated that language learners can use L2 or any other foreign language as the source of influence in L3 production (Meisel, 1983; Clyne, 1997; Hammarberg, 2001; Williams & Hammarberg, 1998). Cenoz (2001) investigated Speakers of Basque and Spanish learners of English; one group was Basque-dominant and one group was Spanish-dominant and a few were balanced. The learners were students in the second, sixth, and ninth grades. Although Spanish and Basque are Romance languages and English is a Germanic language, Spanish is more closely related to English than to Basque. Cenoz (ibid.) let the students tell the frog story and analysed the oral productions in code switches and transfer.

The results reveal that Spanish is the most common source language in cross-linguistic influence for all learners, and Cenoz (2001) concludes that this lends further support to the notion of psychotypology. The Basque-dominant group use Spanish as the source language to a higher extent than the Spanish-dominant group does. This lends further support to the idea that L3 learners make use of their L2 in the learning process. The Spanish-dominant group transfer more elements from Basque than the Basque dominant group, but they still use Spanish as their main source language for transfer. There are two forces at work here, language relatedness and L2 status. And the results from the Spanish dominant group reveal that language relatedness is a stronger factor than L2 status, because they transfer more elements from Spanish which is target-language related, even though it is their L1.

2.2.2 Proficiency

Language proficiency affects cross-linguistic influence. In L2 acquisition, less proficient learners transfer elements from their dominant language. In third language acquisition, proficiency in both non-native languages must be considered and there is evidence that only learners who are proficient in their L2 can transfer elements from this language to their L3.

Williams & Hammarberg (1998) performed a longitudinal study of learners of related L2 and L3 and found that L2 influence is the strongest in the earliest stages of the L3 acquisition. And this influence gradually diminishes as the acquisition progresses. The learners' L2 proficiency is another factor influencing the acquisitional process. If the L2 proficiency is very high, or even near native, the L2 influence will be similar to the influence originating from L1; i.e., the higher the L2 proficiency, the more meaning-based transfer will occur in L3 production. The Swedish-dominant learners of English make lexical errors of a type usually originating in the L1. This means that the cross-linguistic influence affects form in early stages, and both form and meaning in later stages of acquisition.

2.2.3 L2 status

There is a tendency among multilingual subjects to activate a second language instead of the first language. Hammarberg (2001) follows one learner, Sarah Williams; her L1 was English, her principal L2 was German, her additional L2s were French and Italian, and her L3 was Swedish. Hammarberg describes that the learner activates her L1 and L2 knowledge to a large degree during L3 production.

There was a strong tendency for the learner to ascribe different roles to the L1 and the L2s. The L1 dominates in functional language shifts during conversation to support interaction, and the L2s are used in constructing new L3 words (for example through morphophonological transfer). The L2 influence is mainly from German, the learner's principal L2. This influence clearly decreased as the L3 proficiency level increased.

2.2.4 Mode

Dijkstra and Van Hell (2001) also found cognate facilitation in a lexical decision task performed with trilingual subjects. They found that recognition was faster for L1 target words with cognates in L2 relative non-cognates. They also found a small facilitation effect for L1 target words with cognates in L3 relative non-cognates. In a word association experiment with the same population, the authors also found that L1 words with cognates in L2 were responded to faster relative non-cognates, and L1 words with cognates in L3 were responded to somewhat faster than non-cognates.

2.2.5 Recency

Cross-linguistic influence can also be related to recency. Hammarberg (2001) argues that learners are more likely to borrow elements from a language they are actively using other languages they know but are not using actively. Hammarberg (ibid.) found that the learner uses the most recently acquired language (German) as source language. It can be argued that this cross-linguistic influence from German is caused by other factors such as higher proficiency compared to other languages of the learner or a larger degree of relatedness (psychotypology) between German and the target language. It may also be the case that these factors coincide and work in an interconnected way to influence the learner in target language production.

2. 3 Notions of language development

In this section basic preliminaries of language development will be discussed. Factors usually discussed in relation to language development are: proficiency and age, automaticity, use, practice, and processing.

2.3.1 Proficiency and Age

In second language research, proficiency is closely related to when the learning started, the age of onset of the L2. Ever since Lenneberg (1967) addressed the issue, researchers are talking about an optimal time period, within which a subject must be exposed to a second language in order to acquire native-like proficiency. There is a strong correlation between early onset and high levels of ultimate attainment, especially of grammar and phonology.

Different opinions about this correlation surface in the literature. One salient debate concerns the nature of the decline in learning ability. Some relate L2 proficiency to maturational milestones. For example, Pinker (1994) defines the age effect as the consequence of maturational changes in the brain. Because of these maturational changes, normal acquisition is guaranteed up to the age of six. After the age of six the learning ability declines steadily, and after puberty it is considered rare. In this context, the age of exposure to the L2 is crucial and determines the level of ultimate attainment. However, the relation between L2 proficiency and maturational milestones has been questioned due to lack of compelling evidence for an abrupt time limit when learning abilities decrease. Flege (1999) discusses the linear relationship of for example L2 pronunciation and age. Several studies have failed to find significant discontinuity of proficiency (Flege et al., 1999; Hakuta et al., 2001).

Some researchers point to the fact that there are incidences of native-like attainment among late learners (see Birdsong, 1999, for a review). Although these studies involve many different L1s, and has covered a range of language features, the evidence are ambiguous. Some of the studies has dealt with relatively young learners (early teens) and a very small part of the participants actually score native-like (Flege et al., 1995).

Recently, the prevalence of becoming native-like in L2 proficiency has been questioned. Abrahamsson & Hyltenstam (2009) find that native-like ultimate attainment is not just a rare phenomenon among adult L2 learners, but also extremely uncommon among child learners.

2.3.2 Automaticity

It is frequently emphasized that repetition and practice are essential in L2 learning. Learning L2 words means building mental representations for them in the bilingual mental lexicon. Practising these words means practising the process of mapping the L2 segments onto their corresponding mental representations. In this sense, it is the L2 processing skills that improve as a result of practice and repetition. The improvement referred to here is called *automaticity*.

When some degree of automaticity is obtained, a cognitive activity can be performed without any attentional control (Segalowitz, 2003). Attentional control means some involvement of attention, and possibly awareness. A good example of this process is reading. When we start learning to read we must put conscious effort into every step of the process, from recognizing individual letters, to linking them together into words, and understanding the sentence meaning as well as the contents of the whole text. As we practise, the recognition of individual letters becomes automatic, as does as the recognition of entire words. As more of the steps in the reading process become automatic, we can cease paying attention to them and focus on other things. When the processes of recognizing the forms of letters and words are automatized, we can pay attention to meaning on both sentence level and text level.

Automatic skills are said to be fluent, unconscious, effortless, and they run smoothly. This is opposed to attention-based processing which requires consciousness, attentional control, and effort and usually take more time. In lower levels of L2 development, more processes are attention-based. Finding words is an example which can be time consuming. In early stages of L2 development, the production is slow, sometimes stuttering and generally considered non-fluent. As the learner practises, more processes become automatic, leading to more fluent and effortless production. This holds for all development of complex skills, and hence for L2 learning.

Anderson & Lebiere (1998) hold that early stages of skill development involve conscious control and rely on declarative knowledge (see also Anderson, 1983). As the learner practises, sequenced components of the skill become chunked and automatic. When components are "chunked" they are processed as wholes, and hence become unavailable to awareness in the processing. This means that they become fast and fluent. In Anderson's terms, the declarative knowledge has become proceduralized. In the case of an L2 learner then, (s)he must not just establish mental representations for each L2 segment (declarative knowledge). In order to attain high levels of L2 proficiency, (s)he must also practise enough to make the use of these segments automatically and fluently (procedural knowledge).

L2 experience typically leads to faster processing. This is visible as faster lexical decision times, faster word recognition, faster rates of speaking and reading and the ability to process rapid speech (ibid.). Generally, automaticity develops as L2 levels of proficiency increase. Hence, higher levels of L2 proficiency are assumed depend on automatic processing to a greater extent than lower levels of L2 proficiency. While written L2 proficiency tests measure the declarative knowledge, experiments on L2 production and comprehension measuring response times or accuracy scores during interference tap into the relative degree of procedural knowledge. This is the approach taken in the present study.

Within the bilingual experimental paradigm, different processing aspects of language use are investigated. And the aim of many investigations is to related different processing skills to different levels of proficiency, or developmental stages in bilingual subjects. This way, psycholinguistic research can depict the processing development involved in language learning. This kind of research demands a language proficiency test which is balanced over different language skills, to get an overall and valid measure of the participants' language proficiency.

2.3.3 Effects of study-abroad learning contexts

Some studies have investigated the correlation between L2 development and differing learning contexts, and it is generally held that learning an L2 learning in its natural setting is a very successful way to learn a second language. Segalowitz and Freed (2004) compared English learners of Spanish and their production on varying cognitive processing abilities in differing learning contexts. One group was tested before and after a study-abroad experience, and one group was tested before and after classroom learning. The cognitive processing abilities they tested were speed and automaticity of lexical access, and speed and efficiency of attention control.

Segalowitz and Freed (ibid.) conclude that, certain L2 learners who experienced learning in a natural L2 setting benefitted more from the immersion context in learning compared to the participants who learned in a classroom setting. However, this did not hold for all individuals, which the authors discuss in terms of readiness. If learners have not reached a certain level of readiness, the immersion experience will be overwhelming for them and they will not be able to benefit to the fullest extent. This has started a debate on the relation between cognitive skills and learning-context experiences. Two main questions arise; namely, which of these factors is more likely to determine success in L2 development, and can all learners benefit from L2 immersion?

O'Brien, Segalowitz, Freed, and Collentine (2007) studied the role of phonological working memory and concluded that this cognitive ability outperformed learning-context experience (as in formal vs. informal learning context). Tokowitz et al. (2004) came to a similar conclusion. They investigated the role of the relationship of WM (measured in L1) and L2 learning context and concluded that learners with large WM capacity were able to take advantage of L2 immersion to a greater extent than learners with lower WM capacities.

Kroll and Sunderman (2009) came to a similar conclusion in their study of WM resources in lexical comprehension (a translation recognition task) and production (a picture naming task) for learners with and without an immersion experience. They found that participants who do not reach a certain threshold of WM capacity do not benefit from the immersion experience.

The research within this area is inconclusive, and much more needs to be done before any conclusions can be drawn. So far, the overall results indicate that L2 development benefit more from an immersion context compared to classroom context, if the learner has reached a certain level of readiness (in terms of WM capacity).

2.3.4 The processing of form and meaning

Ellis (1997) has pointed out that learning the semantic aspects of words is a more demanding task than learning the formal aspects of the same words. According to Ellis (ibid.), learning the form of words requires only implicit and unconscious processes, while learning the meaning of words to some extent requires conscious and explicit process. Singleton (1999:152) formulates the same idea in other terms when he states that formal aspects of word learning are more prominent in the earlier stages of acquisition and that later acquisitional stages are associated with the long-term, and more challenging task of learning word meanings.

There is a large body of offline research using very different tasks supporting the claim that meaning processing is harder to acquire than formal processing, in L2 development. In *the revised hierarchical model* (Kroll & Sholl, 1992; Kroll & Stewart, 1994), the links connecting the three components are asymmetrical in strength and co-exist within the same speaker. See Figure 1 for an illustration of the model.

In the revised hierarchical model, L1 words have strong links to conceptual information, while second language words have strong links to corresponding L1 words at the lexical level. As level of L2 proficiency increases, conceptual links are assumed to replace or weaken the lexical links. According to this, learners should go from predominantly processing their L2 by means of word-association to processing by means of concept mediation as a function of increased proficiency (But see Altarriba & Mathis, 1997, for evidence that even beginning learners can mediate L2 words conceptually).

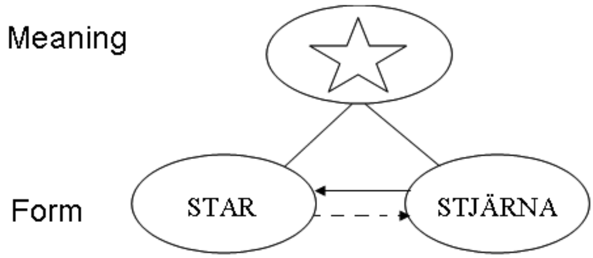

Figure 1: The revised hierarchical model

Meara (1978) and Söderman (1993) draw similar conclusions concerning the processing of form and meaning in different L2 developmental stages. They both base their research on bilingual word-association studies and contend that form-based associations are the manifestations of a phonologically based organization of the mental lexicon in the early stages of L2 acquisition. More advanced stages of acquisition are characterized by a semantically based organization of the mental lexicon, and this is manifested in the word-association studies by a larger amount of meaning-based associations.

Namei (2001) performed a word-association study with Persian-Swedish bilinguals and she found that form-based association is an acquisitional feature of each individual word, in any language. She concludes that form-based associations are produced for less familiar words and meaning-based associations for more familiar words. Namei (ibid.) concludes that words that are unfamiliar are connected to other words in the mental lexicon through phonologically based connections, while well-known words are connected to other words in the lexicon through semantically based connections. This gives a view of the mental lexicon as being organized through both phonologically as well as semantically based connections in all bilingual subjects.

Tokowitz et al. (2004) investigated the role of the relationship of WM (measured in L1) and L2 learning context (informal vs. formal context). They concluded that learners with large WM capacity were able to take advantage of L2 immersion to a higher extent than learners with lower WM capacities. And, more importantly, the learners with high WM, who benefited greatly from the immersion experience, also made more meaning-based errors in L2 translation, compared to other learners who had larger numbers of non-responses.

2.4 General architecture of the bilingual mental lexicon and L2 lexical processes

2.4.1 Introduction

In this section the underlying processes involved in using the L2 lexicon are described, and research concerning the organization of the bilingual memory is discussed.

2.4.2 Spreading activation and lexical access

Towards the end of the 1980s, two major strands of research began to influence questions and models of the bilingual lexicon and lexical access - the first is the account of activation spreading, stemming from the connectionist paradigm (Rumelhart & McLelland, 1986), and the second is Levelt's (1989) model of speech production.

Models of activation spreading retain the idea of network architecture of the mental lexicon. Words are represented as nodes in the network, and depending on the excitatory or inhibitory nature of the signal, words are activated or suppressed. When sufficient activation is achieved, the threshold is exceeded, and the item with the highest activation level is selected and retrieved. The links connecting the nodes are based on semantic, phonological, and associative information. A stimulus activates a node in the network, and activation spreads by means of the links to other concepts and gradually diminishes (Dell, 1986).

Paradis (1987, 2004) accounted for the bilingual lexicon in spreading activation terminology in his *subsystem* (or *subset*) *hypothesis*. According to this hypothesis, words from the two languages are stored together in one single system. But because items of the same language tend to appear in the same contexts, links between them will be reinforced through prolonged usage. This results in semi-independent language networks that can be activated and inhibited separately by a language-independent conceptual system. The intention to speak in one language (rather than the other) raises the activation level of all nodes in this language network, while decreasing the activation level of words in the other network. This organization eases selection and retrieval within one language.

Further, the degree of deactivation depends on how frequently a language is used. A language that is used frequently can never be completely deactivated. Thus, speakers can restrict usage to one language at a time because the activation level of words in that language is higher relative to the activation level of words in the other language. Several models of the bilingual mental lexicon and lexical access adopt the subsystem hypothesis

(De Bot, 1992; De Bot & Schreuder, 1993; Green, 1993, 1998) (see Poulisse & Bongaerts, 1994, for a different proposal).

The second source of influence on research into bilingual processing is Levelt's (1989; Levelt et al., 1998) model of speech production. This is a model of monolingual speech production, but it has also been highly influential on bilingual models. It was directly adapted by De Bot (1992; see also De Bot and Schreuder, 1993) to bilingual speech production. Poulisse and Bongaerts (1994) also based their bilingual model on Levelt's monolingual model.

The Speaking model depicts the production process as passing through a series of stages: conceptualization, formulation, and articulation. Formulation consists of two stages, one where semantic and syntactic information (i.e. a *lemma*) is encoded, and one where phonological information (i.e. a *lexeme*) is encoded. Lexical access occurs at the lemma level. Bock and Levelt's (1994) model of the mental lexicon is a spreading activation model, which includes phonological, syntactic, and morphological information. Thus, though the overall architecture of this production model is serial, it incorporates a spreading activation account of lexical access. The stage of lexical access is crucial to the theory: this is where the target lexical node is selected, and it is assumed that lexical selection is performed by means of competition. According to the principle of competition, the probability of the target lexical node being selected is a function of its level of activation divided by the levels of activation of all lexical nodes in the lexicon.

As the spreading activation account has become the basic framework for modelling the mental lexicon, the research questions have changed compared to those posed in earlier bilingual research. The issue of one versus two storages has become irrelevant. New questions arise, such as which factors influence lexical organization, and if items in the two lexicons can be activated simultaneously. And if simultaneous activation is the case, then what parts, or what items does this include? Focus has shifted towards the mental processes underlying the production of words.

Word encoding occurs in two processing stages,[4] a lemma and a lexeme encoding stage. Serial approaches assume that lemma selection precedes lexeme encoding. This means that only the selected lemma is sent to the lexeme encoding stage (Levelt, Schriefers, Vorberg, Meyer, Pechmann, & Havinga, 1991; Levelt, Roelofs & Meyer, 1999). Parallel approaches assume that lexeme encoding can start before lemma selection is completed. This means that any lemma considered for selection is automatically encoded phonologically. This is referred to as the *cascade view* (Humphreys, Riddoch & Quinlan, 1988; Peterson & Savoy, 1998).

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[4] See Caramazza & Miozzo (1997) for a different proposal.

Some researchers further assume that in addition to the processing overlap of lemma and lexeme encoding, the processing at the lexeme level can exert influence on processing at the lemma level. Thus, phonological encoding can influence lemma selection. This is referred to as the *interactive view* (Dell, 1986; Dell, Schwartz, Martin, Saffran, & Gagnon, 1997). Many studies have investigated this issue of seriality versus interaction in production. During the 1990s, this was investigated with the picture-word interference paradigm, which was refined for this purpose by manipulation with stimuli onset asynchronies (SOA). This is based on the assumption that the effects of semantically related distractor words are located at the lemma level and the effects of phonologically related distractor words are located at the lexeme level of processing. Based on these assumptions, serial and interactive models predict different results concerning the effects and their respective time lapses.

The studies that support a strictly serial view have observed an absence of phonological effects at early SOAs (Schriefers, Meyer, & Levelt, 1990; Schriefers & Meyer, 1990). But studies supporting a cascaded or interactive processing view are in the majority (Damian & Martin, 1999; Dell et al., 1997; Peterson & Savoy, 1998; Starreveld & La Heij, 1999). In short, these studies have not found evidence of a serial time course corresponding to semantic and phonological effects. Starreveld (2000, Experiments 2 and 6), however, demonstrates that onset of phonological effects can be manipulated. He argues that experimental results of the time course of phonological and semantic effects cannot be taken to reflect stages of processing.

2.4.3 Bilingual memory organization; - Language independent or language specific?

Much research has addressed the issue of how a bilingual's two languages are represented in the mind.[5] Early research, mostly during the 1960s and 1970s, posed the question in terms of one versus two separate stores and some researchers proposed completely separate language stores (Kolers, 1963). Others focused on switching mechanisms in mixed bilingual production (Penfield & Roberts, 1959), comprehension (Grainger & Beauvillian, 1987) or both (MacNamara & Kushnir, 1971). Some studies finding evidence for language selective processing can be dismissed methodologically because they include language specific orthography (Scarborough, Gerard & Cortese, 1984). Today, cross-linguistic activation is not a controversial issue.

[5] The research reviewed in this section all refer to the bilingual mental lexical organization on a functional level, not a neurological one.

Studies indicating language-independent organization make use of L2 lexical decision tasks (Nas, 1983), masked phonological priming experiments, phonological priming (Brysbaert et al., 1999), translation priming (Gollan, Forster & Frost, 1997) and eye tracking (Marian & Spivey, 2003). These studies all have in common that they use techniques to activate phonological aspects in the non-target language. They all conclude that phonological information can activate lexical segments in the non-target language. This supports the idea that when processing word recognition in the target language, the non-target language phonology is activated and exerts influence on processing.

Grosjean (1997) argues that language selectivity need not be an "either-or-affair". Rather, language selectivity should be seen as a matter of degree and dependent on several factors. One factor is the L2 proficiency level. This assumes that L2 lexical access is interfered with L1 words at lower levels of L2 proficiency. And as L2 proficiency increases, this interference diminishes. A second factor is similarity of stimulus across the bilingual's two languages. A high degree of similarity, of both form and meaning, is expected to induce strong effects on processing. Similarly, language-specific encoding of a non-target word is expected to result in weak influence on processing. Especially if the language specific encoding is structurally forbidden in the target language. This claim is supported by a large body of research on cognates and interlingual homographs (See De Groot, 2002, for a survey).

A third factor that may affect language selectivity is the experimental task design (Grosjean, 1997). Particularly important is the distinction between data-driven and concept-driven tasks. A data-driven study focuses on structural properties of stimuli; some examples are *word fragment completion* and *letter search tasks*. Concept-driven tasks, on the other hand, focus on semantic properties of the stimuli; some examples are *free recall* and *categorization of words*. Durgunoglu and Roediger (1987) found that data-driven tasks result in response patterns which indicate language selectivity, while concept-driven tasks tend to induce response patterns indicating a language-non selective organization.

As a fourth factor, Grosjean (1997) mentions the presence of one or two of the bilingual's languages in the experimental situation. This determines the degree of activation of the two languages. If an experiment includes word stimuli from both languages, then both languages are active. This may result in a higher degree of cross-linguistic influence, and hence, the response patterns may reflect non-selective access processing. Grosjean (1985, 1989, 1997) considers this last aspect in what he refers to as the *bilingual language mode continuum*. One important point about the bilingual mode continuum is that the non-target language varies in degree of activation across the continuum but is never completely switched off. This implies that we can expect some degree of interference even in the most monolingual situation.

De Groot (2002) suggests a model in which a word's meaning representation is distributed over several components. This model of how words are represented in the mind puts focus on the overlapping or divergence of meaning components.

2.4.4 Word-type effects - cognate status and word frequency

Some word types are processed with ease by bilinguals compared to other word types. Concrete words are translated faster, and induce higher accuracy than do abstract words in a variety of tasks (De Groot 1992; Van Hell & De Groot, 1998). Interlingual homographs (words sharing written form but not meaning) display a processing advantage over non-homograph words (Beauvillian & Grainger, 1987; De Groot, Delmaar, & Lupker, 2000; Dijkstra, Grainger, & Van Heuven, 1999). This section will focus on the two word types pertinent to the present study; cognate status and frequency.

2.4.4.1 The cognate effect

Cognates are words sharing meaning and phonological (and sometimes orthographical) form in different languages. Cognates can be historically related, or be borrowed into one of the language from the other, or from a third language. In this thesis, cognates will be defined as "lexical items from different languages which are identified by bilinguals as somehow being 'the same thing'" (Carroll, 1992:94).

Traditionally, cognates have been of interest for second-language research because they appear to facilitate long-term learning (Carroll, ibid.). Recently, there has been renewed interest in cognates because of their special status in terms of processing effects in bilingual production and comprehension. When building a model of the bilingual lexicon, cognates play a central part because they raise the issue of cross-linguistically shared representations.

Cognates have proven to have an effect on cognitive processing in many different tasks. It is well established in the research literature that there is a processing advantage associated with cognate words, involving both production and comprehension (See De Groot & Van Hell, 2005 for a survey). This advantage is generally called the *cognate facilitation effect* (CFE); bilinguals produce and recognize cognates faster compared to non-cognates.

The cognate facilitation effect is evident in a variety of tasks such as priming (Gollan, Forster & Frost, 1997), translation (De Groot, 1992; De Groot, Dannenburg & Van Hell, 1994), word association (Van Hell & De Groot, 1998) and lexical decision (Dijkstra, Grainger & Van Heuven, 1999).

In a picture-naming study, Costa, Caramazza and Sebastian-Gallés (2000) let Catalan-Spanish bilinguals and Spanish monolinguals name pictures which were either cognates (e.g. Spanish *gato* and Catalan *gat* for "cat") or non-cognate names (e.g. Spanish *mesa* and Catalan *table* for "table"). The bilingual group named cognates faster than non-cognates, and this effect was not present in the monolingual group. In a subsequent experiment they let two groups of bilinguals, one dominant in Catalan and one dominant in Spanish, name pictures in Spanish. Both groups named cognates faster than non-cognates, but this effect was larger for the group dominant in Catalan, i.e. the non-dominant group. These results relate the CFE to proficiency, proving that the facilitation is larger in lower stages of L2 development.

Dijkstra, Grainger, and Van Heuven (1999) interpret the CFE within an extension of the Bilingual Activation Model (BIA). They explain the cognate facilitation as the result of shared lexical and sublexical orthographic representations across languages. Because these words share representations at the orthographic level, there is a stronger activation of these representations, and this leads to faster response latencies. They follow De Groot (1992, 2005) in assuming that the meanings of words are represented as distributed semantic features. The cognate facilitation effect is then explained by the activation of shared semantic features The longer response latencies associated with phonological overlap are explained as a consequence of the activation of two different representations at the lexical level which compete for selection.

The degree of semantic and phonological overlap correlates with the extent of the CFE (Fang, Tzeng & Alva 1981, Cristofanini et al. 1986), and a larger overlap causes more facilitation compared to cognates with incomplete overlap. Sherkina (2003, 2004) discusses the cognate effect in relation to the word-frequency effect. She argues that, given that the frequency of a cognate word is increased because it shares components across a bilingual's languages, then the frequency of each cognate is the sum of its frequency in each language. This way, the cognate effect should depend on frequency, and especially on its frequency in the non-target language. The higher the frequency, the larger the facilitation effect. Sherkina (ibid.) has demonstrated that bilinguals do perceive cognates as having higher frequency. In a frequency-rating task, bilinguals rated cognates' frequency higher than monolinguals.

Strijkers et al. (2010) investigate the frequency effect and the cognate effect with ERP methodology. They wish to establish the locus of these two effects in bilingual picture naming.

2.4.4.2 The word-frequency effect

The frequency effect is a word-type effect repeatedly which has been repeatedly proven in studies using different types of bilingual tasks. It is not always as robust as the concreteness and cognate effects, and sometimes it is rather small. But when the frequency effect occurs, it surfaces as improved performance for high frequency words, compared to low frequency words in almost any task; lexical decision, reading aloud, semantic categorization, and picture naming (De Groot & Keijzer, 2000; De Groot & Van den Brink, 2004; De Groot & Van Den Brink, 2010).

The frequency effect is explained by higher default values of activation in lexical entries compared to low frequency words in the mental lexicon. This allows the mental representations of high frequency words to reach the threshold and be selected faster compared to low frequency words (but see Murray& Forster, 2004 for a different proposal). Several studies have studied frequency effects in unbalanced bilinguals and found larger effects in the non-dominant language (Gollan, Montoya, Cera & Sandoval, 2008; Duyck, Vanderlst, Desmet & Hartsuiker, 2008). This is in line with the general architecture of the bilingual mental lexicon, which yields lower resting values of activation for L2 words described in section 2.2.

Some studies with cognates have manipulated the frequency variable. There is evidence that the relative frequency of cognates in the bilingual's two languages affects lexical access. Dijkstra, Timmermans and Schriefers (2000) demonstrated that cognates show patterns of response reflecting language non-selective lexical access when the words had low frequency in the target language and high frequency in the non-target language (see also Gerard and Scarborough, 1989).

2.5 How to study the bilingual mental lexicon

2.5.1 Introduction

There are many different types of tasks which can be used to investigate the nature of the bilingual mental lexicon in production and comprehension. One frequently used method is the picture-word interference task. This section describes this method, its limitations, and summarizes the research which has used it.

2.5.2 The picture-word interference paradigm

Hermans (2000) performed a series of experiments with picture naming in the weaker language paired with within- and between-language distractor words that were either identical, semantically related, or phonologically related to the picture. Hermans based his thesis on a language-non selective perspective and expected to find an interference effect in the identity condition as presupposed by Costa et al. (1999).

However, Hermans (ibid.) found that between-language identical distractors produced significant facilitation effects in three out of four experiments (experiments 4.1, 4.2, and 4.3). In one experiment (experiment 4.4), target language varied with a cue preceding each picture-naming trial. This mixing of language was assumed to make it impossible for the subjects to predict the name of the picture, and consequently, this experiment resulted in interference effects. Hermans (2000) argued that this is evidence that the between-language identity facilitation is not automatic. Rather, it seems to be the result of the experimental context.

Hermans (2000) also found interference effects in trials with a between-language semantic distractor (Experiments 4.1, 4.4). Semantic interference was also found by Costa et al. (1999), who explain this within a language-selective model (see previous chapter). According to this model, a semantically related between-language interfering stimulus word activates its translation equivalent in the target language via the language-independent conceptual system.

Hermans (2000) points out that this proposal could theoretically be correct. However, the semantic interference in Hermans's data does not differ in time-course and magnitude in within- and between-language trials. It is reasonable to assume that an L1 distractor activates the lexical representation of its translation equivalent as quickly and as strongly as does the L2 word itself. If the language-selective account was correct we should observe some differences in within- and between-language conditions, and there is no such difference. Therefore, Hermans concludes that the semantic interference is true evidence of between-language competition.

2.5.3 Limitations of the picture-word interference paradigm

The classic picture-word interference paradigm effects are semantic interference and phonological facilitation in both monolingual-, bilingual single-word production. The interference effect is only captured when the interfering stimuli is from the same semantic category as the target word. When the interfering stimuli is associatively related to the target, but is a member of a different category, no interference effect is observed (Costa et al., 2003). This pattern is problematic for models of the bilingual lexicon because according to these models, selection is by competition and this competition should not be restricted to categorical relations.

When a semantically related IS is a member of the same category as the target word (i.e. mouse-dog) there is a semantic interference effect. But when the IS and the target word are associatively related (i.e. mouse-cheese) there is a facilitation effect. When participants have to give a category name to pictures of objects (for example saying "animal" when presented with a picture of a dog) and the IS is semantically related to the target word (i.e. mouse) there is a facilitation. There is also evidence that subordinate target words (poodle) are not interfered with by basic-level ISs (dog), but by subordinate-level ISs (spaniel) (Vitkovitch & Tyrrell, 1999).

Costa et al. (2003) tested a monolingual group of native speakers of English in picture naming with unrelated distractors. They found a greater interference effect in category naming (animal) when the IS was also a category name (vehicle) compared to a basic-level name (car). This leads to the conclusion that semantic interference effects are restricted to instances in PWI experiments when target word and the IS are both from the same category level and belong to the same semantic category. Costa et al. (2003) restates the semantic interference effect as a "semantic coordinate interference effect".

The importance of category-level information can be interpreted as follows. When the IS is a coordinate from the same category, there is no category information that discards the IS as a competitor. The semantic representation of the target word would receive activation from both the picture and the IS which leads to a faster response relative to an unrelated condition. This line of reasoning suggests that lexical selection is categorically restricted since an IS from a category different from the target word does not spread activation to its semantic representation.

One alternative explanation to the differences in experimental effects of same-category ISs and different-category ISs is that these two experiments are very different in design (Roelofs, 1992). Roelofs concludes that the experiments in which the participant names the category of the picture usually have much fewer response items and these are repeated more times during the experiment, compared to a basic-level naming experiments. To test this possibility, Costa et al. (2003) performed a category-naming experiment which was identical in design to an experiment based on category naming which produced interference effects.

The results of this experiment showed that category naming of a picture (i.e. the picture of a dog is named "animal") when combined with a semantically related basic-level distractor (cat) produced facilitation effects. This is very different from the interference effects induced by the experiment with identical design but requiring basic-level responses. Hence, the semantic interference in category-naming experiments is not the consequence of experimental design.

Costa et al. (2003) conclude that category information exerts influence on lexical access in the PWI paradigm, the assumption being that category-level information is used in the process of determining which semantic representations compete for selection. According to this, only representations at the target-category level compete for selection, and hence, target-category-level information has the function of restricting the competition among lexical items. These findings can lead to the conclusion that the picture-word interference paradigm suppresses the expression of the category constraint in single-word production. Further research is needed to understand exactly what processes the picture-word interference experiment investigates.

The picture-word interference paradigm operates on the assumption that lexical selection is a process in which activation is spread to the target representation and related representations. The IS activates semantically related representations to such an extent that they compete for selection with the target word, and longer naming latencies are observed. There is actually an alternative view to this, presented by Mahon et al. (2007), according to which lexical selection must not be by competition.

Mahon et al. (ibid.) show that monolingual participants name pictures faster (horse) when the IS is semantically close and overlap categorically (zebra) compared to ISs which overlaps categorically but are semantically more distant to each other (whale). Interpreted within the PWI, these results suggest that as ISs are becoming semantically closer to the target name, naming latencies are facilitated. According to Mahon et al. (ibid.), this requires us to rephrase two fundamental operating principles of the PWI; that lexical selection is not by competition, and that semantic interference effects do not reflect a process at the lexical level.

2.6 Summary

The architectural principles in the bilingual lexicon result in cross-linguistic activation, processing differences of phonologic and semantic information, and effects of specific word types (cognate status and frequency). Studies show that processing is the result of internal factors (such as proficiency), situational factors (such as L2 status), mode, and recency), linguistic features (such as psychotypology) and learning context (such as immersion).

3 Outline of the present study

3.1 Terminology

There are many aspects to the term *bilingual.* It is not unusual to find the term used in reference to participants who actually are language learners. This is common, in psycholinguistic research with a focus on the cognitive processes involved in language use. In this context the term *bilingual* is used simply because the participants know two languages (Grainger, 1993).

Other terms used to describe bilingualism are also not as straightforward as they might seem. The term *second language* is used in different ways by different researchers. Sometimes a *second language* means the language learned after a first language is established (usually the first language is considered to be established around three years of age).[6] But usually it is used in a wider sense to refer to any language learned subsequent to the first, regardless of whether the subject has learned additional languages in between. This usage of the term is the one adopted in the present thesis.

Another important terminological distinction is that between *dominant* and *weak* (or *non-dominant)* languages. Quite often the term *second language* refers to the *weak language*, and *first language* refers to the *dominant language*, regardless of their acquisitional order. Early onset does not necessarily equal dominance. In fact, it is very common that a subject is exposed early in life to a language which is not the language spoken by the majority in that society. The language used in school and among classmates and friends then quickly becomes the dominant language. For this person, the second language (in terms of acquisitional order) becomes the first (in terms of dominance).

[6] When a language is introduced after the first language is established, around the age of three, it is referred to as *successive bilingualism*. *Simultaneous bilingualism*, on the other hand, is when a subject has learned two languages simultaneously (or the age of onset of both languages is before the age of three).

3.2 Participants

3.2.1 Bilingual participants

In this thesis, *bilingualism* will be taken to mean that the participants are tested in a bilingual version of the experiments. All bilingual participants have Swedish as their dominant language, they are all highly proficient in English, and they are acquiring Spanish.

All participants in the present study were recruited from three Swedish universities.[7] They were students of Spanish at different levels and were approached during class hours, but experimental sessions were scheduled outside of class time.[8] In total, 57 bilingual participants were tested. Twenty of these participants, however, had to be eliminated. Two were excluded because it turned out that their strongest language was not Swedish (was raised in Finland and one in Russia). Six were excluded because they could not participate in the second experimental session (for personal reasons).

Four participants were eliminated because they failed to complete and send in the language proficiency test. An additional eight participants were eliminated because their results had too low accuracy scores. These eight participants display very different patterns in terms of self assessment of Spanish proficiency, Spanish language test score, age of Spanish onset, length of Spanish immersion, and mean use of Spanish during a regular day. The only characteristic which links them together is their low accuracy on one or both of the two experiments in the present study. Error percentages for these participants were between 10 and 30, on at least one of the experiments. The remaining 37 participants are referred to as the bilingual participants throughout this thesis.

To be accepted to study Spanish at university level, studies at compulsory school or upper-secondary school are required, and these include English training from an early age.[9] The Swedish primary and secondary school system consists of nine years of regular compulsory schooling, between the ages of 7 and 16.[10] Before the year 2000, English training was introduced in

[7] The author is deeply grateful to the universities of Uppsala, Stockholm, and Gothenburg for assistance concerning data collection.

[8] All bilingual participants received one cinema ticket for both experimental sessions. An additional ticket was sent to them after they sent in the L2 proficiency test. Only a few students did not complete the language proficiency test. These were not included in the study.

[9] This description of the foreign language training previous to university studies is based on information taken from the website of the Swedish National Agency for Education (www.skolverket.se).

[10] Most students continue onto three years of upper-secondary school which is non-compulsory.

the fourth grade; this was the case for all participants in this study.[11] In seventh grade (at 13 years of age), Spanish is offered as an optional language, among other subjects. The languages offered as optional studies differ between schools, but the most common languages are Spanish, German, and French. Since by this time, the students' English is well established, Spanish must be considered their third language. Students can also choose to start studying Spanish later, in upper-secondary school, and for students who have already studied a third language, Spanish becomes their fourth language.

The point to be made here is that although Spanish is referred to as an L2 throughout this thesis, it is actually a third or fourth language for the successive learners. Since English is introduced so early in school, it has proved impossible to find enough participants who have Spanish as their true second language (in terms of acquisitional order). It has also proved difficult to find enough participants who only know English and Spanish, apart from their dominant language (Swedish). Some of the participants know other languages as well. This will be discussed in detail later in this section.

Compulsory and upper-secondary school offer language studies in Spanish from levels 1 to 7. To be admitted to Spanish courses at the basic university level students are required to have attended courses corresponding to level 3. An estimation of hours of instruction corresponding to level 3 is between 250 and 300 (one hour equals 60 minutes).[12] The university offers courses from basic to advanced levels, which are distributed over four academic semesters. During the last two semesters, all students write papers which grant them a university degree such as a Bachelor of Arts and/or Master of Arts.

It is very common among Swedish students of Spanish to spend time in Spain or South America as part of their university studies, or in order to improve their proficiency outside of course requirements. This leads to a situation where there is no correspondence between university course level and proficiency level. A student might have spent a year working in Spain before starting studies of university level studies of Spanish in Sweden. This student will be at the same course level as a student who comes directly from upper-secondary school and who has never been to a Spanish speaking country. The proficiency level of these two students, however, can differ to a large extent, especially from a processing point of view. Because of this, it is not a fruitful approach to divide the learners into groups according to their corresponding course levels.

It is widely accepted within the psycholinguistic research field that immersion in an environment with rich natural input enhances L2 processing

[11] Today it is generally introduced as early as the second grade, but this does not apply to any of the participants in the present study.
[12] The curricula differ somewhat between schools depending on the local authorities.

in terms of fluency and automaticity (see section 2.1 for an overview). Since Swedish university students of Spanish frequently travel to Spanish-speaking countries, this participant group fits perfectly to investigate the impact of L2 immersion in an experimental setting. For this purpose, the present study divides the bilingual participants into two groups, depending on their length of L2 immersion, counted in months. Twenty-three of the participants have spent 12 months or less in a Spanish speaking country; they constitute the less immersed group. Fourteen of the participants have spent more than 12 months in a Spanish-speaking country; they constitute the more immersed group.

A very influential study, by Segalowitz and Freed (2004), looked at English learners of Spanish before and after one semester of L2 studies in Spain. It would not have been possible to study the participants in the present study after only 6 months of immersion. This is because there were so many participants in their very initial stages of acquisition. The participants with only 6 months of immersion or less, who were able to complete the experiment were too few. Thus, a decision was taken and the immersion time dividing the groups was set at 12 months.

The bilingual participants in this study are quite heterogeneous when it comes to age of onset of Spanish. The majority of the participants (30) were brought up in monolingual Swedish-speaking homes, and have learned Spanish as a foreign language at school. Six of the participants were exposed to Spanish very early on; they have one Spanish speaking parent and were exposed to Spanish and Swedish simultaneously, from birth (one was exposed to Swedish from birth and Spanish from the age of three). At the time of the present study, all early bilinguals report Swedish to be their dominant language regardless of age of onset of Spanish.

Age of L2 onset does correlate with degree of ultimate attainment, i.e. the highest level of proficiency an L2 learner can reach, and this is a common way to relate proficiency and age. However, recent research has proven that this is not as straightforward as it is commonly depicted. Abrahamsson & Hyltenstam (2009) contend that native-like ultimate attainment of an L2 is much more unusual among child learners than has been assumed in the research. Because this study investigates L2 attainment in terms of fluency in the production process, participants with different ages of onset are distributed fairly equally in both groups.

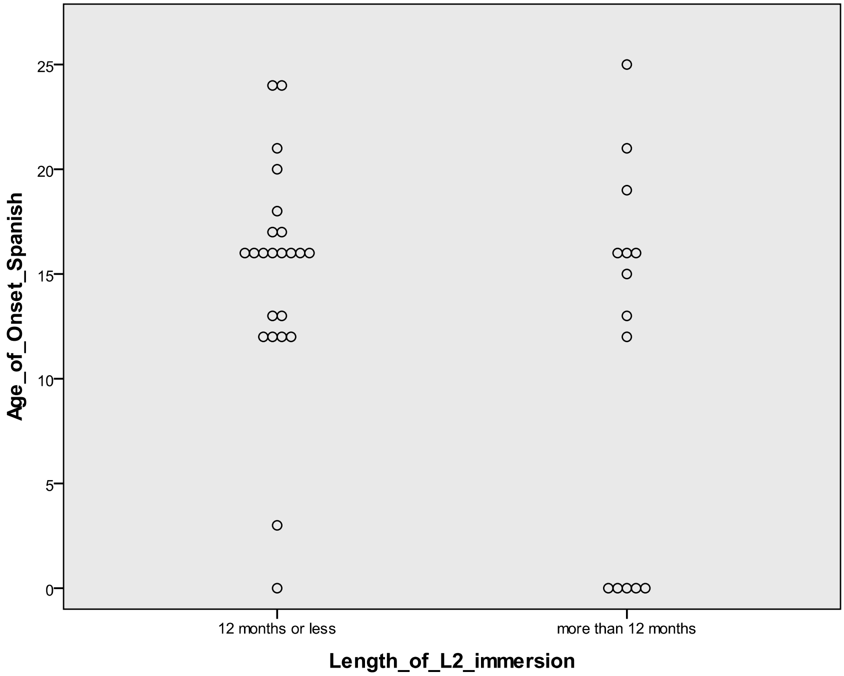

Figure 2: Scatter plot of age of onset across groups based on length of Spanish immersion

To obtain a full understanding of the participants' individual language backgrounds, they were subjected to a language background questionnaire to assess prior language experience and proficiency (see Appendix A for an English translation of the questionnaire). The participants' ages ranged from 19 to 40, with a mean of 24.65 (SD = 4.62), and the majority were females (83%).[13] The biographical information is summarized in Table 1. The information is presented for the two bilingual groups, based on length of Spanish immersion counted in months.

[13] This is only natural since in general the majority of language students are female.

Table 1: Summary of biographical information, bilingual participants

Language background	**Less immersed group**	**More immersed group**
Mean AoO[a]	15.04 (range[b]: 0–24, median: 16.00)	10.93 (range: 0–25, median: 14.00)
Mean Spanish use[c]	19.52 (range: 1–70, median: 20.00)	26.79 (range: 10–45, median: 27.50)
Mean self-rating[d]	2.52 (range: 1–4, median: 3.00)	3.64 (range: 3–4, median: 4.00)
Mean test score[e]	45.78 (range: 27–59, median: 45.00)	54.43 (range: 42–60, median: 55.00)
Mean length of immersion	4.52 (range: 0–12, median: 4.00)	37.57 (range: 13–144, median: 18.00)

[a]Mean age of onset to Spanish.
[b]Range gives minimum and maximum numbers of each measure.
[c] Self assessed mean use of Spanish in percentage during a regular day.
[d]Mean self-rating refers to self-assessed proficiency ratings on a scale from 1 to 5, 1 being the lowest and 5 the highest score.
[e]Mean score on Spanish proficiency test. Maximum test score is 64.

Language proficiency was measured in two different ways: self-assessed proficiency ratings and a language proficiency test. The proficiency test was distributed at the last experimental session, and participants were requested to complete the test at home and send it back to the researcher. They were encouraged to complete the test individually, in a quiet room, and not to exceed a time limit of 60 minutes. The test was composed of different parts of tests available online from language websites (see Appendix B for the proficiency test). The test measures grammar, vocabulary, and reading comprehension in four different sections.

Test scores differed significantly between the two bilingual groups based on length of immersion (F (1, 35) = 11.93, p = .001), revealing that the group with more Spanish immersion (mean test score: 54.43) have a higher level of proficiency in Spanish than the group of participants with less Spanish immersion (mean test score: 45.78). This corroborates the claim that immersion in a natural setting increases proficiency level.

As part of the language background questionnaire, participants had to rank their overall proficiency in all their languages from 1 to 5 (5 being the highest ranking). All learners ranked their proficiency in Swedish as 5. The rating in Spanish differed significantly between the two groups of participants based on length of Spanish immersion (F (1, 35) = 22.58, p = .000), revealing that the group with more Spanish immersion (mean self rating: 3.64) perceived themselves as more proficient than the group of participants with less Spanish immersion (mean self rating: 2.52). See Figure 3 for an illustration of self-proficiency ratings in the two bilingual groups.

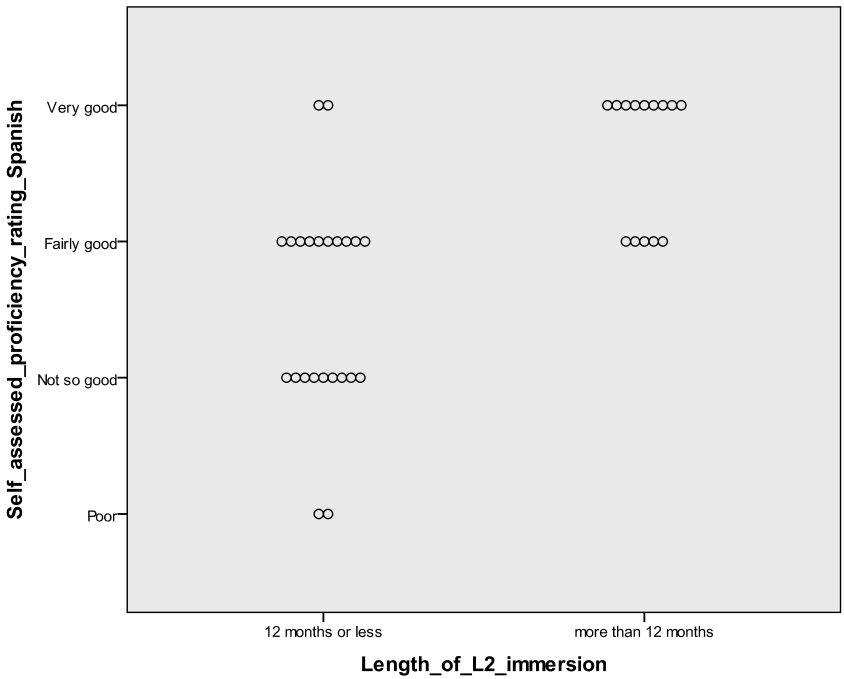

Figure 3: Scatter plot of self-assessed Spanish proficiency-ratings across groups based on length of Spanish immersion

Participants were asked to indicate the extent of their regular use of Spanish, including both Spanish class time and during the rest of their day. The question was: *Try to estimate your total use of Swedish and Spanish in percentage.* The answers show that all participants used Spanish on a daily basis at the time of this study. It also reveals that the group who had spent more time in a Spanish-speaking country used Spanish slightly more per day in their everyday life. See Figure 4 for an illustration of Spanish language use for participants in the two bilingual groups.

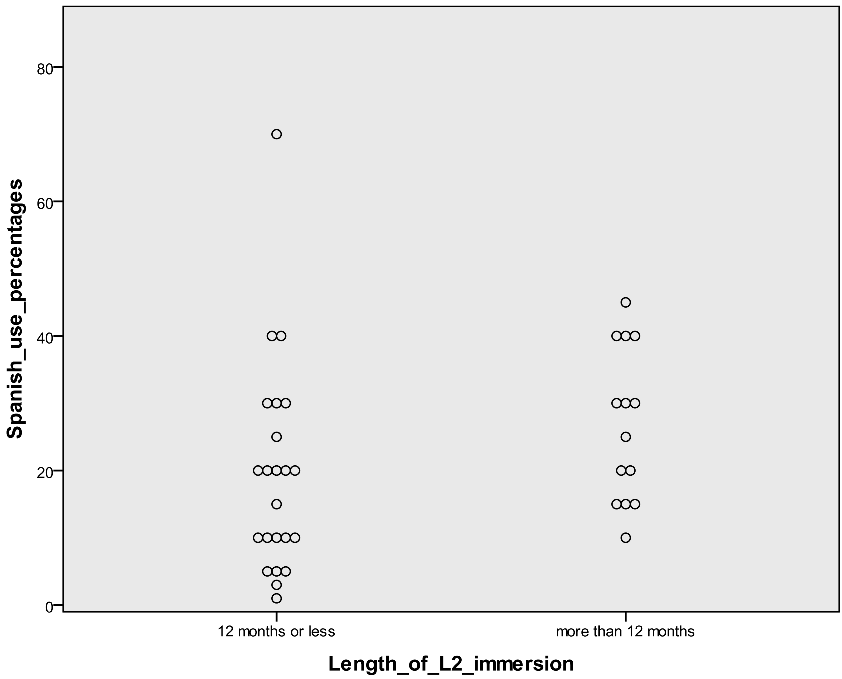

Figure 4: Scatter plot of Spanish use during a regular day, by percentage, across groups based on length of Spanish immersion

To summarize this background information, several factors indicate that the two participant groups, based on length of immersion differ, in level of Spanish attainment. The group with more Spanish immersion is more proficient in Spanish both according to the proficiency test and according to the self-rating. The amount of time the participants in the two groups use Spanish on a daily basis also provides an indication pointing in this direction. Thus, three language background variables are interconnected and indicate that participants in the group with more immersion have attained a higher level of fluency in Spanish.

Since the bilingual population in this study is actually multilingual, one important piece of information to gather in the language background questionnaire is how many languages each participant knows and how well they perceive themselves to know each language. Out of the 37 participants, 18 know no other language than Swedish, English and Spanish. Twelve participants know one additional language, and 7 know two additional languages. These additional languages are French, German, Portuguese, Norwegian, Italian, and Hebrew. Since the most common optional languages offered in secondary school, apart from Spanish, are German and French, it is natural that these languages are the most common additional languages among the population (see Appendix C for detailed information about the participants' additional languages and their self-assessed proficiency ratings).

Eleven participants (29.7%) report knowing German. Their mean subjective proficiency ranking is 2 in German. Nine participants (24.3%) report knowing French. Their mean ranking of proficiency is 2.3 in French. Only two participants know both German and French. Out of the 20 participants who know one or two additional languages, 17 report having lower proficiency in their additional language/languages than in Spanish, 1 reports the same proficiency level in Spanish as in the additional languages, and 4 report their proficiency in one of their additional languages to be somewhat higher than Spanish.

3.2.2 Swedish comparison group

Eighteen subjects participated in the Swedish comparison group. They are native speakers of Swedish, and they reported having no knowledge of Spanish, Catalan, French, Italian, or Portuguese. They were recruited at the Faculty of Languages, Uppsala University, during class hours, but the experiments were conducted outside of class time.[14] The mean age in the Swedish comparison group is 25.72 (range: 20–61, SD: 9.37). Since the bilingual participants are tested in Spanish, and the comparison group is tested in Swedish, the results of the bilingual groups and the comparison group are not directly comparable. Nevertheless, they serve as a monolingual comparison of the experiment and the picture stimuli.

It is important to note that the Swedish comparison group is not at all monolingual. Since they were all subjected to the Swedish school system, they are all highly proficient in English. Eight of them are also proficient in German, and several know additional languages, such as Arabic, Chinese, Norwegian, and Swahili. It is therefore important to scrutinize their test results for possible cross-linguistic effects. Pertinent post hoc analysis will be performed for this purpose.

3.3 The experimental task design

Interference paradigms have been popular in psychological research for many years, and experimental psycholinguistic research on language production has started to make increasing use of the picture-word interference task. This type of task is easy to administer and requires only single word production from the participants. The picture-word interference task is a modified version of the Stroop task. It has been developed to include stimuli from different languages in order to investigate the single

[14] All comparison participants received a cinema ticket for their participation.

word production process in bilingual subjects. Naming latencies are measured and are assumed to vary as a function of the relationship between the interfering stimulus (IS) and the picture name.

When the test is performed with only visual stimuli, the IS word is written across the picture (see Figure 5 for an illustration). When it is performed in a cross modal fashion, the IS word is presented over headphones (see Figure 6 for an illustration). When presenting the IS in written form, it is necessary to account for the reading process. There is no such additional process to account for when the IS word is presented auditorily, which makes the cross modal version more favorable.

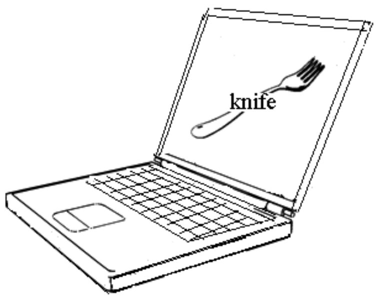

Figure 5: A picture-word interference task with a written interfering stimulus

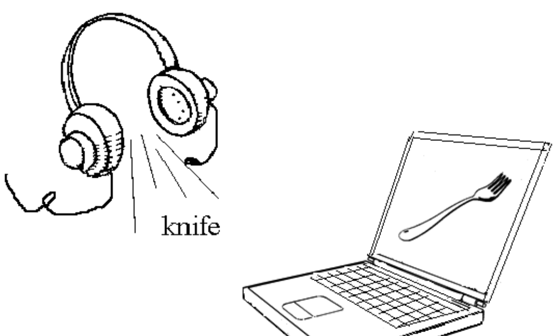

Figure 6: A picture-word interference task with an auditorily presented interfering stimulus

Normally, the data consists of response times and error rates (or accuracy scores). In a comprehension task, subjects respond by pressing a button to react to something, for example whether the picture and the interfering stimuli are congruent. For example, if the IS word and the picture name are the same, the participant presses a yes-button; if the IS and the picture name are different words, the participant presses a no-button. In a mixed modal task, subjects respond by producing the name of the picture in the instructed language while being auditorily exposed to the IS. This kind of task combines production and comprehension.

The present study is bilingual and cross-modal. The experiments used are two cross-modal picture-word interference tasks with different compositions of picture stimuli: one with only non-cognate words (Experiment 1) and one with non-cognate and cognate words mixed (Experiment 2). Participants are presented with pictures and are required to name them in Spanish. At the same time, they hear words in Swedish over headphones. Picture names and IS are related in different ways; this will be referred to as different IS types. This is the first PWI study to investigate Swedish/Spanish learners, and that groups the participants according to length of Spanish immersion.

In Experiment 1, each picture is presented once with a semantically related word, once with a word which is phonologically related to the target word (the Spanish picture name), once with a word which is phonologically related to the name of the picture in the non-target language (the Swedish picture name), and once with a word which has a neutral relationship to the word. See Table 2 for examples of picture names and related IS words in Experiment 1. Experiment 2 includes Swedish/Spanish cognate words, and since this word type is characterized by form similarity, there is only one phonologically related IS.

Table 2: Examples of picture names and ISs, Experiment 1; non-cognates

Picture name	**Four types of interfering stimuli (ISs)**			
	Phonological, target word[a]	Unrelated	Semantic	Phonological, non-target word[b]
Muñeca/Docka (doll)	Morot	Lampa	Nalle	Dolk
Nube/moln (cloud)	Nos	Gaffel	Himmel	Måltid

[a]An IS which is phonologically related to the target name of the picture
[b]An IS which is phonologically related to the L1 translation equivalent of the picture name

The naming latency patterns predicted by the picture IS-pairs, as supported by previous research, are illustrated in Figure 7. The vertical axis gives naming latencies in milliseconds, and the horizontal axis gives the different types of ISs. These naming latencies are fictional; the graph is created to illustrate how the naming latency patterns differ between different types of ISs in previous research in general. The semantically related IS word is assumed to generate longer naming latencies, compared to an unrelated condition. The IS which is phonologically related to the target word is assumed to shorten the naming latency, compared to an unrelated condition.

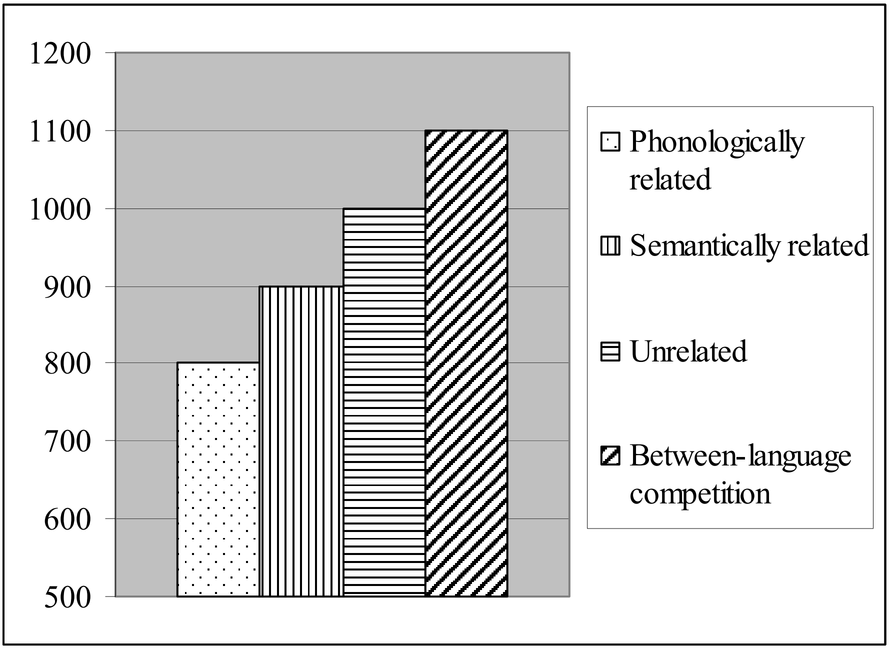

Figure 7: Expected naming latency patterns, Experiment 1

The theoretical explanations of the predicted naming latency patterns are based on the spreading activation account of the mental lexicon (see section 2.2 in the research overview). The semantically related IS induces longer naming latencies compared to the unrelated condition because the lexical node of the semantically related IS competes for selection with the target word. The lexical node of the unrelated IS receives less activation because it is not related to the target word, hence it does not receive enough activation to compete for selection.

The rationale behind expecting shorter naming latencies in the phonologically related condition than by the unrelated IS depends on the fact that several lemmas are encoded phonologically. The lemma of the phonologically related IS is encoded phonologically, and since there is a phonological overlap between the IS and the target word, the target phonemes are activated to a higher extent compared to the condition with the unrelated IS. When the phonological units receive more activation, production is enhanced, and this is why we predict shorter latencies.

A non-target phonologically related IS activates the Swedish picture name, i.e. the translation equivalent of the target word, which then competes for selection. This condition is assumed to increase naming latencies even more than the semantically related condition. This is because the translation equivalent shares more meaning with the target word (compared to a semantically related lexical item) it receives more activation from the picture which leads to greater competition.

Experiment 2 has three different IS types with the pictures: one phonologically related, one semantically related, and one unrelated. Since half of the pictures in this experiment consist of cognate words, only one phonologically related IS word is possible. Table 3 gives an example of picture and IS-pairings in Experiment 2.

Table 3: Examples of picture names and IS types, Experiment 2

Picture name	**Three types of interfering stimuli (ISs)**		
	Phonological	Unrelated	Semantic
Muñeca[a]/Docka (doll)	Morot	Lampa	Nalle
Nube/moln (cloud)	Nos	Gaffel	Himmel

[a]Underlined segments indicate phonological overlap

The predicted naming latency patterns produced by the experimental conditions in Experiment 2 are illustrated in Figure 8. The vertical axis gives naming latencies in milliseconds, and the horizontal axis gives the different types of IS words. These naming latencies are fictional; the graph is intended to illustrate how the naming latency patterns differ between different types of IS words in previous research in general.

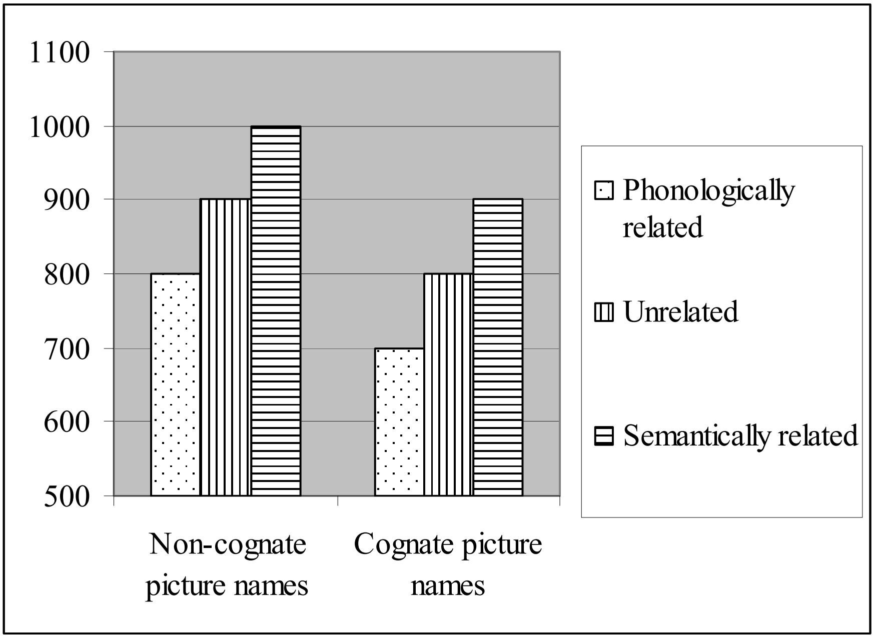

Figure 8: Expected naming latency patterns, Experiment 2

It is important to be careful when predicting results from Experiment 2, mainly because there hardly are any reports from such an experiment. There is one picture-word interference experiment that includes cognates, performed by Hoshino & Kroll (2008) and tested on Japanese/English and English/Japanese bilinguals. This experiment mixed cognate and non-cognate words, and the results revealed classic picture-word interference results: shorter naming latencies for the phonologically related condition than for the unrelated condition, and longer naming latencies for the semantically related condition than for to the unrelated condition. In addition, target words with cognate status were named faster than target words with non-cognate status. The expected naming latency patterns in Figure 8 above are based on these results.

However, extra caution should be taken when expected result patterns from both experiments in this thesis. The major reason for this is that the participants tested in the present study are unique in several ways (see section 3.1.1 for a detailed description of the bilingual participants). All previous research in the present paradigm is performed with highly proficient bilingual subjects. And the group of participants with less Spanish immersion in this study are in their beginning stages of acquisition and this is likely to affect the results in unexpected directions.

3.4 Experimental material

Pictures in both experiments were chosen from the battery of 290 pictures compiled by Pérez & Navalon (2003). These are standardized for Spanish according to the four criteria proposed by Snodgrass & Vanderwart (1980): name agreement, image agreement, familiarity, and visual complexity. Snodgrass & Vanderwart (1980) had a total of 219 participants judge the pictures according to these criteria.[15] By testing name agreement, the name which is most frequently assigned to each picture is established. Image agreement establishes that each picture has a close resemblance to the mental images they evoke. By assessing familiarity, subjects rate how usual or unusual subjects find the pictures. Visual complexity refers to how detailed the drawing appears to the subjects.

Pictures were selected from this battery because they are simple line drawings with standardized names. This was to avoid longer naming latencies for ambiguous pictures. However, the criteria were not applied in the strict sense that only pictures with very high values for each criterion were chosen. Rather, only a small set of pictures was at all possible to use. The picture name had to be matched with a semantically related word, which was not phonologically related to the name of the picture in either Swedish or Spanish. The phonologically related word could not be semantically related to the picture.

Pictures names and IS words were selected from the same category level. For example, *blomma* (flower) was selected as an IS word semantically related to ARBOL (tree)[16] because these are at the same category level. *Blomma* (flower) would not be matched with the picture ABEDUL (birch). Words were also matched as much as possible for word length. This is proved difficult, but care was taken that one syllable words would not be matched with three syllable picture names. When taking all these factors into consideration, it all came down to a small set of pictures which were possible to use. See Appendix F and G for the pictures chosen for the two experiments.

The related IS words were chosen carefully to match the picture names as much as possible in terms of concreteness, word length, and in cases of phonological overlap, phonetic similarity. It was a challenge to find Swedish

[15] Pérez and Navalon (2003) added a fifth criterion to their study which describes age of acquisition for each picture. Age of acquisition refers to the fact that different words are learned at different ages. Pérez & Navalon quantified this by testing 760 children on a battery of 328 pictures (286 from Snodgrass & Vanderwart (1980) and 82 new pictures. Children of differing ages were tested as to whether or not they knew the name of the picture.

[16] When picture names and ISs are described, the following conventions are adopted. A target word is presented in capital letters: RANA, this is followed by the English translation in parentheses (frog). The IS is presented in lower-case italics: *rabatt*, followed by the English translation in parentheses (flower bed). Phonological overlap is marked by underlined segments.

words which would match the Spanish picture names on this criterion. Some IS words are abstract, such as *morgon* (morning), *himmel* (sky), and *hjälte* (hero), because there were no concrete words that matched the picture on the relevant criteria.

To establish variation in familiarity with the picture names, subjective measures are used. These depend on participants' ratings of how well they know the words included in the experiment (see Appendix D for the familiarity rating questionnaire). Participants were given a list of all the target words together with a rating scale from 1 to 7. They were asked to rate their familiarity with each word from 1, if they had never heard the word before, to 7, if it was a word they use quite often. This way of establishing word familiarity is thought to be more reliable in bilingual studies than using large language corpora (Van Hell, personal communication).

No picture name has a familiarity mean below 3. Some pictures were rated 1, and were thus unfamiliar to the participant. These pictures were not deleted because that would lead to there being too few pictures in the test, and the resulting lack of statistical power would eliminate any possibility of finding significant effects. See Appendix E for a presentation of the subjective familiarity ratings for each target word, summarized for the two bilingual groups of participants based on length of Spanish immersion.

Originally, 24 pictures were chosen for the non-cognate experiment. Eight pictures had to be eliminated from the original set because they induced too many errors (between 20% and 30%) in the bilingual data. The eliminated pictures were ALICATES (pliers), RANA (frog), FLECHA (arrow), REGLA (ruler), CESTA (basket), MOCHILA (backpack), CARA (face), and CAMA (bed). It is not clear why they induced so many errors, and there might be several reasons. ALICATES (pliers), CESTA (basket), REGLA (ruler), and FLECHA (arrow) were given relatively low familiarity rates by the bilingual group with less Spanish immersion. See Table 4 for the familiarity rates of the deleted pictures.

Table 4: Mean familiarity ratings for deleted pictures in Experiment 1

Picture name	**Less immersed group**	**More immersed group**
Alicates (pliers)	1.87 (SD 1.18)	2.64 (SD 1.95)
Cesta (basket)	2.65 (SD 1.15)	4.36 (SD 1.45)
Regla (ruler)	3.13 (SD 1.36)	5.29 (SD 2.01)
Flecha (arrow)	3.39 (SD 2.04)	5.50 (SD 1.56)
Mochila (backpack)	4.22 (SD 2.11)	6.29 (SD 1.14)
Rana (frog)	4.48 (SD 1.83)	5.57 (SD 1.45)
Cara (face)	6.78 (SD .52)	7.0 (SD .0)
Cama (bed)	6.87 (SD .344)	6.93 (SD .27)

The experiments in this thesis are built in such a way that the pictures (along with their respective IS) are automatically fed forward with a time limit for each picture of 3000 ms. This creates a time limit for the participants to produce the Spanish word which demands a relatively high degree of automaticity of the production process of the intended Spanish words. The participants must not only know the Spanish words for the target pictures; they must also be able to produce them within a time limit while at the same time being distracted by hearing a word in their dominant language.

This means that some picture names may be well known to the participants but not familiar enough to be produced under pressure. The process by which words become easier to use rests on automatization (see section 2.1) and is considered a consequence of hearing and using the word many times. Thus, it is not strange that the group with less Spanish immersion rated some of the pictures lower for familiarity, and that this correlates with high error rates (as is the case with ALICATES and CESTA).

The pictures MOCHILA (backpack) and RANA (frog) were not rated very low for familiarity. It is not clear why these pictures induced so many errors. However, it seems that the participants were not familiar enough with these words to be able to produce them correctly in an experimental setting such as this one. The familiarity ratings for CARA (face) and CAMA (bed) are high, suggesting that the large numbers of errors for these pictures is not caused by familiarity. A different explanation is strictly technical. Both these picture names have an initial velar plosive. The experimental equipment used in this study is very sensitive, and it reacts to hard breathing and sharp sounds. The initial plosive in these picture names might have induced a technical error.

During the training session, participants became aware of the sensitivity of the equipment. If the participant sighed or coughed during the experiment, this affected the software and pictures were left out, producing a null response. The picture presented on the screen at the time of the cough disappeared and the following picture was presented. This is probably what happened with the picture names of CARA (face) and CAMA (bed). There are picture names in the experiment which begin with a plosive but did not score this low on accuracy. In the case of CAMA (bed), however, since it was well known by all participants, I can find no alternative explanation. Concerning CARA (face), however, an alternative explanation may be in play here. The word CARA has a well-established and highly frequent synonym, ROSTRO. This might have confused some of the participants. In Experiment 2, CAMA (bed) and MOCHILA (backpack) did not induce as many errors as in Experiment 1, so they were not deleted from Experiment 2.

Concerning phonologically related ISs, overlap with the target word consists of the first two phonemes (RANA (frog) - *rabatt* (flower bed)), or in the case of initial consonant clusters, three phonemes (FLECHA (arrow) – *fläkt* (fan). This was observed as much as possible. However, when it was not possible to find IS words fitting the criteria, more overlap has been allowed, as in the following: PANTALÓN (pair of pants) – *panna* (frying pan), TENEDOR (fork) – *tändsticka* (match), LÁMPARA (lamp) – *lamm* (lamb).

Concerning the semantically related ISs, a strong associative relation has been avoided as much as possible. Associative relations between words are established through frequent use of two words in the same sentence or context. The words *cat* and *dog* are linked semantically and associatively, because they occur together in sentences more often than, for example, *cat* and *bird*. There are also idioms that include these words, which strengthens the associative relationship, such as *it's raining cats and dogs* (for a description of the problems involved in cases of strong associative strength between semantically related IS words and the name of the picture, see La Heij, Dirkx & Kreamer, 1990).

Care was taken that the semantically related IS words were not phonologically related to the picture name in either Swedish or Spanish. Care was also taken not to include pictures with high-frequency synonyms in either Swedish or Spanish. One of the picture names does have a common synonym. A common synonym to CARA (face) is *rostro*, but this synonym has a somewhat more literary sense (visage). Semantically related ISs were never phonologically related to any synonyms of the names of the pictures.

Swedish and Spanish are typologically quite different from one another concerning the structure of words. Swedish has fairly high tolerance of consonant clusters, while Spanish hardly allows them at all. This phonotactic difference between the languages generates a considerable difference in word length. Swedish has many monosyllabic and bisyllabic words while Spanish has hardly any monosyllabic words at all, but many bi-, tri-, and quadrosyllabic words. This makes it difficult to match picture names and interfering words for number of phonemes or syllables. The ISs are matched so as to differ only by one syllable, as much as this is possible.

The words from the semantically and phonologically related conditions were re-paired with other pictures in order to serve as the unrelated condition. This means that the Swedish word *morot* (carrot) is used as an IS phonologically related to the picture MUÑECA (doll) and is then re-paired with the picture REINA (queen) as the unrelated condition. Care was taken that there was no semantic or phonological relation to either the Swedish or the Spanish picture name and the unrelated IS words.

Experiment 1 consist of 16 pictures with non-cognate names, paired with 4 different IS types, yielding 64 experimental items. Experiment 2 consists of 18 pictures, half non-cognates and half Swedish/Spanish non-cognates. These are paired with 6 IS types, yielding 108 experimental items. See Appendix F and G for all experimental pictures.

3.5 Apparatus

The experiment is programmed using Superlab Pro 2 software, developed by Cedrus Corporation (**www.cedrus.com**). The experiment is run on an IBM T40 notebook, the same computer was used for all participants. Auditory stimuli are presented over headphones at a comfortable listening level. The subjects name the pictures into a microphone attached to the headset. The stimuli pairs of pictures and words are synchronized and the response time is measured from the stimuli onset until the onset of the subjects' naming response. Naming latencies are measured by means of a voice key with an accuracy of 1ms. Words and pictures are presented simultaneously and the pictures remain on the screen for 3000 msec. After 3000 msec the next picture and IS appear automatically.

3.6 Procedure

Participants were tested individually in a quiet room. Before the experiments, all participants filled out the language background questionnaire. They were then seated in front of a lap top computer for their first experimental session. It was decided to provide oral instructions in Swedish, because the majority of the participants were not used to taking part in experiments, and it was thought that oral instructions would create an environment that would help the subjects relax (see Appendix K for an English translation of the instructions).

Only a handful of the participants had ever participated in an experiment of any kind before, and none in any kind of experiment even closely related to this study. Participants were told that they would be presented with pictures on the computer screen and at the same time they would hear single words in Swedish in the headset. They were instructed to name the pictures by their pre-specified name in Spanish as quickly and as accurately as possible while ignoring the distractor words.

Before starting each test, all pictures were presented offline and the participant was asked to name them in Spanish. This was to make the participant aware of which pictures would appear in the experiment and establish their correct names. After this offline familiarization, participants were familiarized with the online task in a short warm-up training session consisting of 8 trial pictures paired with unrelated Swedish distractor words. None of the pictures or distractor words in the warm-up session were included in the actual experiments.

During the test session, participants were made aware of the extreme sensitivity of the experimental equipment. The voice key (which the participants perceived as a microphone) was very sensitive to loud and sharp noises and hard breathing. If the participant coughed or sighed during the experiment this would affect the software and the pictures presented during these noises would be left with no responses. The voice key had to be adjusted very carefully to each participant individually, so that the participant did not breathe directly into it or touch it with pieces of clothing or hair.

Additional instructions were provided during or after the practice session if required. The experimenter remained in the room throughout the experiment. The order of experiments was counterbalanced such that half of the participants concluded Experiment 1 (with only non-cognates) in their first experimental session and Experiment 2 (which included cognates) in the second session. The other half concluded the experiments in the reverse order. Following the second experimental session, participants filled out the form for familiarity assessment of all the Spanish picture names included in both experiments.

The non-cognate experiment took 7 minutes and the cognate experiment took 5 minutes to complete. Together with the questionnaire and frequency assessment, each session took about 15 to 20 minutes for each participant. At the end of the second experimental session, the participants received a Spanish proficiency test. They were asked to complete the test at home, in a quiet room, within the time limit of one hour. They were given pre-addressed envelopes, and were asked to post them as soon as they could.

4 Experiment 1, non-cognates

4.1 Introduction

Experiment 1 investigates if length of Spanish immersion is a predictor of lexical processing in terms of speed and accuracy. Do the naming latency patterns for the different experimental conditions reflect phonological facilitation, semantic interference and between-language competition? And most importantly, is this dependent on the participants' varying length of Spanish immersion.

4.2 Participants

Thirty seven bilingual participants took part in Experiment 1.[17] Twenty three of these participants have spent 12 months or less in a Spanish-speaking country, and these will be referred to as the less immersed group. Fourteen of the participants have spent more than 12 months in a Spanish-speaking country; they will be referred to as the more immersed group. Eighteen native speakers of Swedish, with no knowledge of Spanish, Portuguese, French, or Italian participated in a Swedish test version of the experiment.[18] They are referred to as the Swedish comparison group.

4.3 Materials

The experiment consists of 16 pictures each of which is presented 6 times in the course of the experiment. An auditorily presented IS word is presented in a headset simultaneously with each picture. The IS is related to the picture in three ways: phonologically related to the target name, semantically related, or phonologically related to the non-target picture name (i.e. between-language competition). These three types of IS words are re-paired to create unrelated filler conditions.

Care was taken that the unrelated conditions should include no semantic relation to the picture or any phonological similarity between the IS and the

[17] For a detailed description of the bilingual participants, see section 3.1.1.
[18] For a detailed description of participants in the control group, see section 3.1.2.

picture name in either Swedish or Spanish. This yields 96 trials for each participant: 16 semantically related, 16 phonologically related to the target picture name, 16 phonologically related to the non-target picture name, and 48 unrelated. Picture-IS pairs were arranged in a semi-randomized order, the same for all participants. No word or picture was repeated with less than 6 intervening items.

To enable comparison between the unrelated filler items and the related items, fillers were reduced to equal the related items in number. All items in the experiment were divided into three sections, based on the trial order in which they appeared: beginning, middle, and end. The same number of filler items were randomly deleted within each section. A list was generated of randomized numbers which was used to delete 32 unrelated items equally distributed over the three sections (http://www.random.org/integers/). Once the fillers were numerically reduced, comparisons could be made between them, and appropriate ANOVAS could be performed comparing all experimental conditions. All analysis of Experiment 1 is based on 64 trials, 16 X 4 conditions.

4.4 Procedure

The participants were tested individually in a quiet room at the university. The pictures were first presented offline and their respective target names were established. Instructions were given orally. Because all participants were highly unfamiliar with experiments of any kind, this strategy was chosen to help subjects relax and create a comfortable environment.

Participants were asked to name the pictures as quickly and as accurately as possible, while ignoring the IS words. If they could not remember a certain picture name, they were instructed to not give any response and wait for the following picture. They were then presented with an online test session to familiarize them with the experimental equipment. No pictures or ISs from the test session were included in the actual experiment. In the online test session, the ISs and the picture names were exclusively unrelated.

The bilingual participants were asked to name the pictures in Spanish, while ignoring the Swedish IS words. The comparison group were asked to name the pictures in Swedish, while ignoring the Swedish IS words. This created one bilingual version and one monolingual version of the same test.

4.5 Design and analysis

Experiment 1 examines one between- and one within-subject variable. The between-subject variable is length of Spanish immersion, counted in months.

This variable divides the bilingual participants into two groups, those who have spent less than 12 or fewer months in a Spanish-speaking country, and those who have spent more than 12 months in a Spanish-speaking country. The within-subject variable is the relation between target picture name and IS (either semantically or phonologically related, or unrelated), called IS type. Group (1, 2) and IS type (1, 2, 3, 4) yields a 2 X 4 ANOVA.

Since some word-type factors known to affect monolingual and bilingual processing were not completely controlled for in this study (such as word length and frequency) an extra source of variability is expected in the data. This will be controlled for by means of an ANOVA with item as random factor. Hence, separate analyses were conducted with participants and items as the dependent variable, yielding $F1$ and $F2$ statistics, respectively. Planned comparisons were conducted to establish significance among levels of the within- and the between-subject variables.

4.6 Results

4.6.1 Results of the bilingual participants, grouped according to length of Spanish immersion

4.6.1.1 Accuracy scores

All trials with null responses were eliminated. Some of these were true errors, others were due to technical problems caused by the software. A qualitative analysis of the raw data was conducted to determine which null responses were technical errors and which were true errors. Technical errors are caused by the high sensitivity of the experimental software, which omits pictures as the result of heavy breathing or coughing. The omitted pictures are left with null responses. True errors are caused by the participant being silent as a result of not finding the name for the picture in time. Mouth clicks and stuttering were included in this category.

It was fairly easy to disentangle these two error types. In short, technical errors come in series of null responses. True errors tend to appear in isolation, and usually recur in all or several instances of the same picture. Knowing a word is not an either-or affair. When the processing of a lexical item has not been completely automatized, it can take time to retrieve the word, especially when the subject is under pressure.[19] When true errors were clustered, a detailed comparison was made between all responses to the same picture throughout the whole experiment. If the same picture name is more than half of its appearances, it is classified as a true error, if not it is

[19] See section 2.1 for a review of the research on acquisitional processes.

classified as a technical error. Offline notes made by the experimenter during the experimental sessions corroborate this analysis.

In addition to true errors and technical errors, naming latencies deviating more than 2 SDs from the item mean in the relevant condition were deleted. The total percentage of eliminated data is 14.9%, of which 3% are outliers, 5.8% technical errors, and 6.1% true errors. The remainder is treated as accuracy scores, 85.1%, of all naming responses. Table 5 summarizes accuracy score percentages for the two bilingual groups.

Table 5: Mean accuracy percentages, bilingual groups, Experiment 1

IS type	**Bilingual groups**	**Mean accuracy %**
Phonologically related to target word	Less immersed group	83.7
	More immersed group	88.8
Unrelated	Less immersed group	81.8
	More immersed group	88.8
Semantically related	Less immersed group	84.2
	More immersed group	89.3
Between-language competition	Less immersed group	81.5
	More immersed group	88.8

Analysis of variance was conducted on accuracy scores. All analyses are based on Arcsine transformed values of accuracy score percentages.[20] A main effect of IS type reached significance in the item analysis only, ($F1$ (3, 33) = .56, p = .644, Z1 .049, $F2$ (1, 60) = 17.17, p = .000, Z2 .222) with higher accuracy for the semantically related IS (86.15%), followed by the target-language phonologically related (85.64%), followed by the unrelated IS (84.46%), and the lowest accuracy for the between-language phonologically related IS (84.29%).

No main effect of group was observed in either analysis ($F1$ (1, 35) = 1.51, p = .288, Z1 .041, $F2$ (3, 60) = .096, p = .962, Z2 .005). No interaction effect emerged in either analysis ($F1$ (3, 33) = .24, p = .867, Z .021, $F2$ (3, 60) = .15, p = .929, Z .008). Figure 9 illustrates the difference in accuracy scores, given in percentages, between the bilingual groups.

[20] To obtain data with a normal distribution, all analyses of accuracy in this thesis are based on Arcsine transformed values of accuracy score percentages, following Howell (2002). The following formula was used in Excel: =ASIN(SQRT(cell/100)).

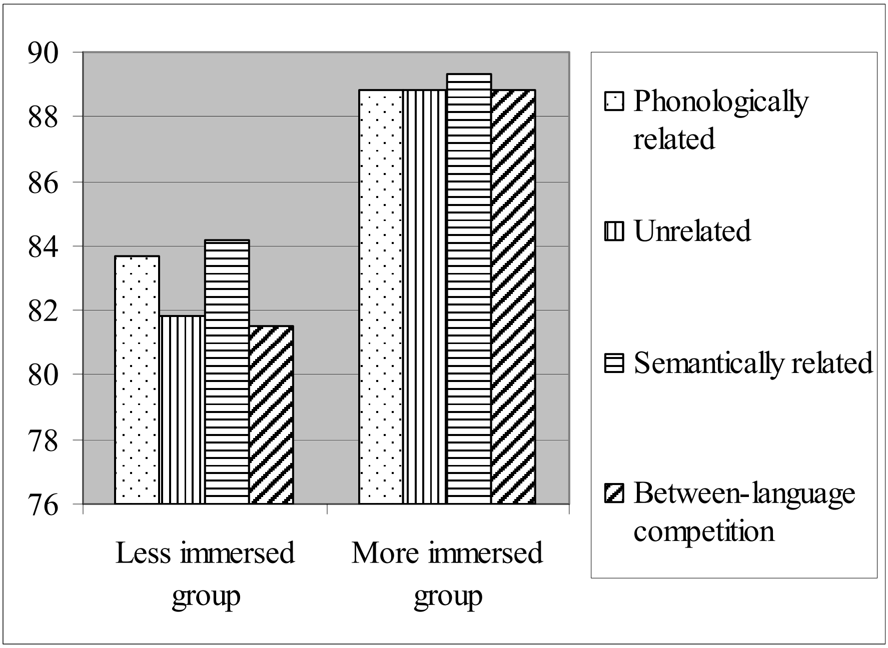

Figure 9: Accuracy score percentages, bilingual groups, Experiment 1

Planned comparisons were performed to further investigate the main effect of accuracy scores on IS type. Since there was no interaction effect of accuracy and bilingual group, the analyses are performed on all participants. However, there was no significant difference between the different IS types. Table 6 displays planned comparison results for accuracy for the bilingual groups.

Table 6: Planned comparisons of accuracy scores, bilingual groups, Experiment 1

Planned comparison	**MSE**[a]	**T**	**Df**	**Sig. (2-tailed)**
Phon1[b]-BetweenComp[c]	.21	.775	36	.444
Phon1-Unrelated	.03	.759	36	.453
Phon1-Semantic	.04	-.180	36	.858
BetweenComp-Unrelated	.03	-.124	36	.902
BetweenComp-Semantic	.03	-1.10	36	.279
Unrelated-Semantic	.03	-1.11	36	.299

[a]MSE = mean standard error
[b]Phon1= phonologically related to the target picture name
[c]BetweenComp= phonologically related to the non-target picture name

Although the analysis of accuracy scores does not reach significance, there are some interesting trends to mention. The more immersed bilingual group has a numerically higher accuracy for all experimental conditions than the less immersed group. This follows the expected pattern. Furthermore, accuracy scores for the more immersed group are equal across conditions, with one exception. The condition with a semantically related IS has slightly higher accuracy scores than the other conditions. This tendency is also present in the less immersed group, though somewhat smaller. For the less immersed group, accuracy scores for conditions with ISs which are phonologically and semantically related to the target picture name are somewhat higher compared to the unrelated IS and the IS which is phonologically related to the L1 picture name.

Given that higher accuracy scores can be interpreted as reflecting facilitated processing, we should expect shorter naming latencies in all experimental conditions for the more immersed group. Also, we should expect shorter naming latencies in experimental conditions with a semantically related IS in both groups. The same should be observed in conditions with the IS which is phonologically related to the target picture name in the less immersed group. Analysis of the naming latencies will reveal whether these predictions are corroborated.

Summary: The bilingual participants were grouped according to length of Spanish immersion, and an analysis of accuracy scores revealed a main effect of IS type. Although not statistically significant, the more immersed group had slightly higher accuracy scores on all IS types than the less immersed group, and the semantically related IS has the highest accuracy score in both groups. The IS which is phonologically and semantically related to the target picture name has slightly higher accuracy scores in the less immersed group, compared to other ISs, however this was not statistically significant.

4.6.1.2 Naming latencies

All analyses of naming latencies are based on accurate naming responses only. Analysis of variance was conducted with participants and items as random factors. IS type is treated as the within-subject variable and amount of Spanish immersion is treated as the between-subject variable. A main effect of IS type was observed ($F1$ (3, 33) = 3.66, p = .022, Z1 .250, $F2$ (1, 60) = 20.52, p = .000, Z2 .255) with the shortest latencies for the unrelated IS (964.19), followed by the semantically related IS (966.47), followed by the between-language competition (974.36). And the longest naming latencies was observed for the IS which is phonologically related to the non-target picture name (1003.21).

No main effect of group was observed in either analysis ($F1$ (1, 35) = 1.05, p = .313, Z1 .029, $F2$ (3, 60) = 1.71, p = .174, Z2 .079). The interaction effect between IS type and bilingual group was significant in the participant analysis and nearly significant in the item analysis ($F1$ (3, 33) = 3.15, p =

.038, Z1 .223, $F2$ (3, 60) = 2.58, p = .062, Z2 .114). Table 7 summarizes the mean naming latencies for the two bilingual groups.

Table 7: Mean naming latencies, bilingual groups, Experiment 1

IS type	**Bilingual groups**	**Mean naming latencies**	**SD**
phonologically related	Less immersed	999.30	92.31
	More immersed	933.37	123.21
Unrelated	Less immersed	980.55	105.79
	More immersed	937.33	133.93
Semantically related	Less immersed	969.42	94.01
	More immersed	961.63	131.11
Between-language competition	Less immersed	1012.88	110.74
	More immersed	987.34	129.39

To further investigate the two-way interaction, planned comparisons were performed with a Bonferroni correction. Results of the planned comparisons are summarized in Table 8.

Table 8: Planned comparisons, bilingual groups, Experiment 1

Comparison	**MSE**[a]	**T**	**Df**	**Sig. (2-tailed)**
MorePhon[b]-MoreSemantic	8.28	-3.411	13	.005*
LessBC[c]-LessSemantic	17.70	2.455	22	.022*
MorePhon-MoreBC	21.52	-2.508	13	.026*
LessBC-LessUnrelated	15.58	2.075	22	.050
LessPhon-LessSemantic	14.64	2.041	22	.053
MoreBC-MoreUnrelated	25.27	1.979	13	.069
LessUnrelated-MorePhon	40.70	1.532	13	.150
LessBC-MorePhon	47.25	1.564	13	.142
LessBC-MoreUnrelated	48.01	1.457	13	.169
LessPhon-LessUnrelated	14.02	1.337	22	.195
MoreBC-MoreSemantic	19.04	1.350	13	.200
LessUnrelated-MoreUnrelated	43.85	1.332	13	.206
LessPhon-MoreBC	44.44	1.300	13	.216
LessPhon-LessBC	12.19	-1.114	22	.227
MoreUnrelated-MoreSemantic	20.44	-1.189	13	.256
LessPhon-MoreUnrelated	47.03	1.144	13	.273
LessSemantic-MorePhon	45.32	1.073	13	.303
LessBC-MoreSemantic	47.48	.962	13	.354

LessSemantic-MoreUnrel	51.52	.867	13	.401
LessUnrelated-MoreSemantic	42.28	.806	13	.432
LessPhon-MoreSemantic	44.91	.657	13	.523
LessUnrelated-LessSemantic	18.04	.617	22	.544
LessBC-MoreBC	39.25	.508	13	.620
LessSemantic-MoreSemantic	47.71	.427	13	.676
LessUnrelated-MoreBC	33.32	.251	13	.805
MorePhon-MoreUnrelated	23.64	-.167	13	.870
LessSemantic-MoreBC	46.92	-.113	13	.911
LessPhon-MoreBC	39.33	.097	13	.925

[a]MSE = mean standard error
[b]MorePhon = naming latencies for the more immersed group for pictures paired with the IS which is phonologically related to the target picture name
[c]LessBC = naming latencies for the less immersed group for pictures paired with the IS which is phonologically related to the non-target picture name which induces between-language competition
* = marks statistical significance

For the group with less immersion, naming latencies for the semantic condition (969.42) were significantly shorter than for the IS which is phonologically related to the non-target picture name (1012.88) (t (22) = 2.455, p = .022). For this participant group, two other condition pairings nearly reached significance: naming latencies for IS which is phonologically related to the non-target picture name (1012.88) were longer compared to the unrelated condition (980.55) (t (22) = 2.075, p = .050) and the naming latencies for the IS which is phonologically related to the target picture name (999.30) were longer compared to the semantic condition (969.42) (t (22) = 2.041, p = .053).

For the group with more L2 immersion, the between-language phonologically related IS (987.34) had significantly longer naming latencies compared to the phonologically related IS (933.37) (t (13) = -2.508, p = .026). Figure 10 summarizes naming latencies for all experimental conditions for the two bilingual groups based on their length of Spanish immersion.

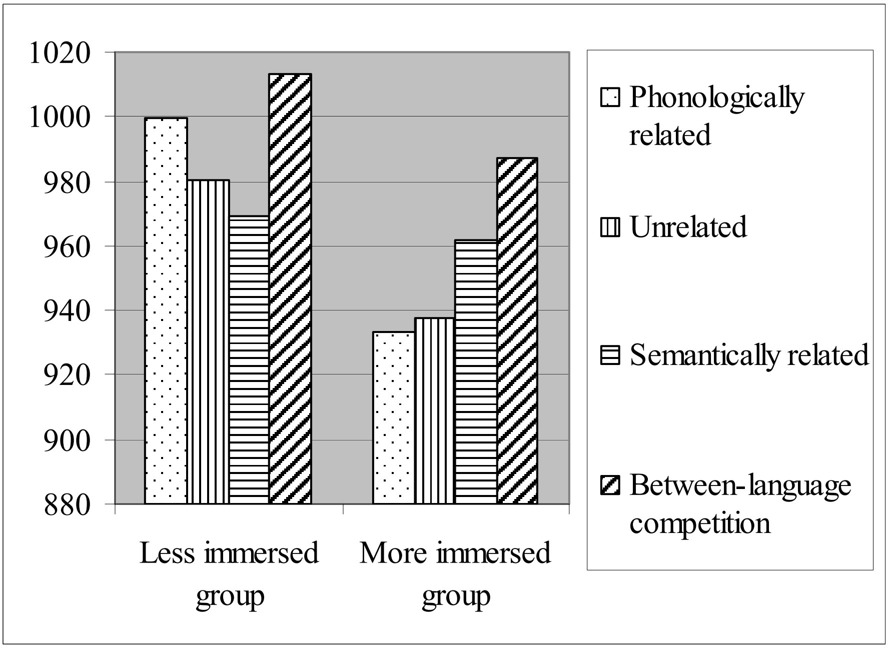

Figure 10: Bilingual naming latencies, Experiment 1

However not statistically significant, one important trend is that the less immersed group produces longer naming latencies overall compared to the more immersed group. This corroborates the findings in the analysis of accuracy scores where there was a tendency for higher accuracy scores in the more immersed group in all experimental conditions compared to the less immersed group. There was also a tendency in the accuracy score analysis which indicated that we should expect shorter naming latencies for the semantically related condition in both groups. This is exactly what we find in the analysis of naming latencies, but only for the less immersed group. In this group, the semantically related condition has induced the shortest naming latencies and the difference is significant, in contrast to the condition in which the IS is phonologically related to the non-target picture name.

It is important to proceed cautiously here. It is easy to interpret the more rapid naming latencies in the semantic condition, compared to the non-target phonological condition, as due to facilitated processing. However, the difference between the semantic condition (969.42) and the unrelated condition (980.55) is rather small (11.13) and not even marginally significant. This means that it must be assumed that these two conditions are processed equally by the less immersed participants. In other words, the less immersed participants are not affected by the semantic relation between the IS and the target name.

The only trend present in the latency pattern of the less immersed group which follows the expected pattern is that the IS which is phonologically related to the non-target picture name is the longest, similar to the more immersed group. This is expected because this IS (*dolk* (dagger)) is related to Swedish picture name (*docka* (doll)) of the target picture name (MUÑECA ((doll)). There are two reasons why this IS induces the longest latencies. First, the lexical item competing for selection is from the dominant language and therefore has a higher degree of default value of activation. Second, the lexical item competing for selection is also the translation equivalent; hence it shares all the meaning components with the target word which in turn activates it to a large extent. This IS induces the longest latencies in both groups, even in the less immersed group. That this is the only IS to induce an expected latency pattern in the less immersed group is not strange, since it is the stronger language which is causing the latencies in this condition.

Participants in the less immersed group produce longer naming latencies in the phonological condition (999.30), compared to the semantic condition (969.42), and this difference reaches near significance. The phonological relation between the IS and the picture affects the less immersed participants and causes delay in picture naming. Hence, these participants are processing phonological information.

The more immersed group produces a naming latency pattern which is often associated for proficient bilinguals (as presented in Figure 3, section 3.2). This pattern has repeatedly been associated with highly proficient bilinguals in the research literature. According to this pattern the phonologically related IS is the shortest, followed by the unrelated IS, followed by the semantically related IS; and the naming latencies for the between-language phonologically related IS are the longest. In the few studies in which this type of IS has been used the response pattern resembles the present one (Hermans et al., 1998). This indicates that the more immersed participants in the present study have attained lexical processing of both semantic and phonological information, as well as between-language competition.

It is important to note that this naming latency pattern in the more immersed group is mainly based on trends, but the overall pattern is what can be expected from highly proficient bilinguals. The differences between the conditions are not all statistically significant. It is only the difference between the IS which is phonologically related to the target word (933.37) and the IS which is phonologically related to the non-target word (987.34) that reached statistical significance. This lack of statistical significance might be due to the large degree of variability in the data. Since the participants in the present study are quite multilingual, post hoc analyses are performed to investigate the possible influence from other languages apart from Swedish and Spanish.

Section 4.5.1.3 investigates the presence of within-participant variability by testing whether Swedish/English cognate status of picture names has a statistically significant effect on naming latencies. Section 4.5.1.4 investigates possible between-participants variability by testing whether a new participant grouping based on how many languages the participants know affects naming latency patterns in a significant way. If this new participant grouping has large effects on the naming latency patterns, we could consider the lack of significance in the present section (based on length of immersion) to be caused by between-subject variability due to the differing degree of multilinguality in the participant group.

Summary: Analyses of naming latencies in Experiment 1 for the bilingual participants grouped according to length of Spanish immersion reveal different patterns for the two groups. The more immersed group produces shorter naming latencies than does the less immersed group. The more immersed group is able to process both semantic interference and phonological facilitation, as well as between-language competition.

Even though the naming latency pattern in the more immersed group resembles the established bilingual pattern within the PWIP, this is mainly based on tendencies. This lack of statistically significant effects of IS type may be due to within-participant variability (due to English form similarity of many picture names) and/or between participant variability (due to multilingual aspects). These possible effects of within- and between-participant influence are scrutinized in respective post hoc analyses below.

The less immersed group produces longer overall naming latencies compared to the immersed group. The less immersed group has a highly unexpected latency pattern, compared to the research literature. This pattern reveals that the less immersed participants do process between-language competition and phonological facilitation, but they do not process semantic interference.

4.6.1.3 Post hoc analysis of within-participant variation

Some of the experimental pictures have names which are cognates in Swedish and English (See Appendix H). To investigate possible cross-linguistic influence from English, an analysis of variance was performed with Swedish/English cognate status as between-subject variable. See Table 9 for Swedish picture names and Swedish/English cognate status.

Table 9: English cognate status for target picture names, Experiment 1

Picture names grouped according to English cognate status	**Bilingual groups**	**Mean naming latency**	**SD**
English non-cognates (34)	Less immersed	969.46	54.40
	More immersed	943.68	74.98
English cognates (30)	Less immersed	1002.40	66.98
	More immersed	946.35	78.70

There was no main effect of iS-type (*F* (1, 62) = 2.80, *p* = .099, Z .043). However, there is a trend in the naming latency pattern revealing longer naming latencies for the less immersed group for target picture names with Swedish/English cognate status (1002.40) compared to naming latencies for picture names with Swedish/English non-cognate status (969.46). This suggests that English exerts some degree of influence on lexical processing in Spanish, but only in the less immersed group.

Summary: The analysis of Swedish/English cognate status is not statistically significant. However, there is a small trend towards longer naming latencies for pictures with Swedish/English cognate names in the less immersed group. This suggests that English may be interfering in the lexical processing of Spanish for the less immersed participants.

4.6.1.4 Post hoc analysis of between-participant variation

As described in section 2.3, recent research has successfully demonstrated that a third language can exert some degree of influence on the processing of a second language (See Cenoz, 2001 for a review). Since so many of the participants in the present study know German (a Germanic language just like the participants' L1: Swedish) and so many know French (a Romance language, just like Spanish, the target language of the study), possible cross-linguistic influences from French, and German must be examined. Therefore, participants were divided into three groups to ascertain whether there might be some influence from a third and a fourth language during Spanish lexical processing.

A post hoc analysis of the bilingual naming latencies was carried out with the same bilingual participants as above but reorganizing them into three new groups depending on how many languages they know in total. In the language background questionnaire, participants stated how many languages they knew besides Swedish, English, and Spanish (see Appendix C). Eighteen participants knew no other language than Swedish, English, and Spanish. Twelve participants knew one additional language, and seven knew two additional languages.

This post hoc analysis examines one between- and one within-subject variable. Similar to the previous analysis, the within-subject variable is the relation between picture target name and IS, which can be either unrelated, semantically related, phonologically related to the target picture name, or phonologically related to the Swedish picture name. The between-subject variable is based on the new grouping of bilingual participants according to how many additional languages they know. This variable divides the bilingual participants into three groups. Eighteen participants know no additional language; in Tables 10 and 11 below this group will be referred to as G0. Twelve participants know one additional language (referred to as G1). Seven participants know two additional languages (referred to as G2). See Table 10 for mean naming latencies for the post hoc bilingual groups.

Table 10: Mean naming latencies, post hoc bilingual grouping, Experiment 1

IS type	**Bilingual group**	**Mean naming latencies**	**SD**
Phonologically related	G0	983.72	129.72
	G1	1040.20	109.18
	G2	989.93	92.59
Unrelated	G0	939.59	129.81
	G1	1038.15	76.93
	G2	900.67	80.98
Semantically related	G0	920.48	93.80
	G1	1039.27	90.60
	G2	959.93	113.23
Between-language competition	G0	961.41	116.39
	G1	1020.91	87.15
	G2	927.83	103.78

Group (1, 2, 3) and IS type (1, 2, 3, 4) yield a 3 x 4 ANOVA. Separate analyses were conducted with participants and items as the dependent variables, yielding *F*1 and *F*2 statistics, respectively. Planned comparisons were conducted to establish significance among levels of the within- and between-subject variables. A main effect of IS type was observed in both participant and item analysis (*F*1 (3, 32) = 3.97, *p* = .016, Z1 .271, *F*2 (2, 59)

= 42.87, *p* = .000, Z2 .592) with the shortest naming latencies for the unrelated IS (964.19), followed by the semantically related IS (966.47), followed by the phonologically related IS (974. 36), and with the longest latencies being induced by the between-language phonologically related IS (1003.21).

A main effect of group was observed in the participant analysis (*F*1 (2, 34) = 3.14, *p* = .056, Z1 .156, *F*2 (3, 60) = 1.82, *p* = .153, Z2 .083) with the shortest naming latencies for participants who know zero additional languages (940.00), followed by the participants who know two additional languages (941.69), and with the longest naming latencies observed for the participants who know one additional language (1028.98). An interaction effect was also observed in both analyses (*F*1 (6, 64) = 2.74, *p* = .020, Z1 .204, *F*2 (6, 118) = 2.99, *p* = .009, Z2 132). Figure 11 summarizes the pattern of naming latencies according to the post hoc bilingual grouping.

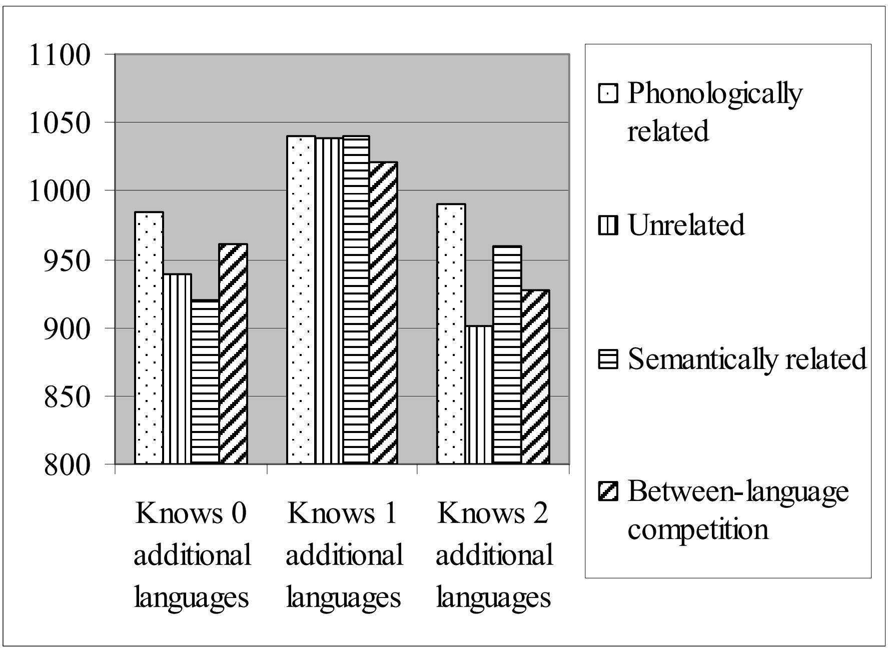

Figure 11: Naming latencies for the post hoc bilingual grouping, Experiment 1

These results reveal that the number of additional languages that the participants know in total has a large effect on their single-word lexical processing in Spanish. To further investigate the three-way interaction, planned comparisons were performed with a Bonferroni correction. Results of the planned comparisons are displayed in Table 11.

Table 11: Planned comparisons, post hoc grouping of bilinguals, Experiment 1

IS type group-comparison	MSE[a]	T	Df	Sig. (2-tailed)
G0BC-G0Semantic	16.35	3.868	17	.001*
G2BC-G2Unrelated	18.13	4.922	6	.003*
G0Phon-G0Semantic	14.64	2.796	17	.012*
G1Unrelated-G2Unrelated	34.36	3.256	6	.017*
G1Phon-G2Unrelated	36.61	3.155	6	.020*
G1Semantic-G2Unrelated	38.87	3.034	6	.023*
G1BC-G2Unrelated	39.46	2.734	6	.034
G0Semantic-G2Semantic	40.74	-2.424	11	.034
G0BC-G0Unrelated	19.77	2.233	17	.039
G0Semantic-G1Unrelated	43.57	-2.241	11	.047
G0Semantic-G1Phon	37.58	-2.140	11	.056
G0Semantic-G1BC	48.10	-2.073	11	.062
G1Unrelated-G2Phon	39.20	2.161	6	.074
G2Phon-G2BC	29.10	-2.134	6	.077
G0Unrelated-G2Unrelated	59.58	1.984	6	.094
G0Phon-G2Unrelated	59.95	1.955	6	.098
G0Phon-G0BC	14.94	-1.493	17	.154
G0Phon-G0Unrelated	16.21	1.346	17	.196
G0Phon-G1Phon	40.12	-.539	11	.600
G0Phon-G1BC	49.40	-.828	11	.425
G0Phon-G1Semantic	43.63	-.917	11	.379
G0Phon-G1Unrelated	45.44	-.856	11	.410
G0BC-G2Phon	64.72	1.391	6	.214
G0Phon-G2BC	54.65	.511	6	.628
G0Phon-G2Semantic	60.24	.961	6	.373
G0BC-G1Phon	42.77	-.332	11	.746
G0BC-G1BC	51.67	-.648	11	.530
G0BC-G1Semantic	46.30	-.703	11	.497
G0BC-G1Unrelated	48.37	-.650	11	.529
G0BC-G2Phon	82.62	1.214	16	.270
G0BC-G2BC	78.12	.489	6	.642
G0BC-G2Semantic	82.32	.829	6	.439
G0BC-G2Unrelated	77.88	1.637	6	.153
G0Semantic-G0Unrelated	17.41	-1.098	17	.288
G0Semantic-G2Phon	64.03	.764	6	.474
G0Semantic-G2BC	56.86	-.232	6	.824
G0Semantic-G2Semantic	62.46	.269	6	.797
G0Semantic-G2Unrelated	58.44	1.302	6	.241
G0Unrelated-G1Phon	39.72	-1.007	11	.336
G0Unrelated-G1BC	46.12	-1.285	11	.225

G0Unrelated-G1Semantic	42.68	-1.367	11	.199
G0Unrelated-G1Unrelated	44.76	-1.279	11	.227
G0Unrelated-G2Phon	65.33	1.394	6	.213
G0Unrelated-G2BC	59.98	.483	6	.646
G0Unrelated-G2Semantic	67.55	.873	6	.416
G1Phon-G1BC	21.33	-.904	11	.385
G1Phon-G1Semantic	11.97	-1.535	11	.153
G1Phon-G1Unrelated	27.50	-.627	11	.544
G1Phon-G2Phon	47.39	1.865	6	.111
G1Phon-G2BC	35.41	.742	6	.486
G1Phon-G2Semantic	54.73	1.028	6	.344
G1BC-G1Semantic	21.35	.043	11	.966
G1BC-G1Unrelated	23.66	.086	11	.933
G1BC-G2Phon	44.08	1.832	6	.117
G1BC-G2Semantic	54.36	.895	6	.405
G1Semantic-G1Unrelated	24.52	.046	11	.964
G1Semantic-G2Phon	51.32	1.768	6	.127
G1Semantic-G2BC	39.27	.729	6	.493
G1Semantic-G2Semantic	64.02	.916	6	.395
G1Unrelated-G2BC	45.57	.496	6	.637
G1Unrelated-G2Semantic	51.58	1.020	6	.347
G2Phon-G2Semantic	25.25	-1.271	6	.251
G2Phon-G2Unrelated	16.91	1.606	6	.160
G2BC-G2Semantic	36.83	.815	6	.446
G2Semantic-G2Unrelated	34.02	1.742	6	.132

[a]MSE = mean standard error
G0 = bilingual participants who know no additional languages apart from Swedish, English, and Spanish.
G1 = bilingual participants who know 1 additional language apart from Swedish, English, and Spanish.
G2 = bilingual participants who know 2 additional languages apart from Swedish, English, and Spanish.
Phon = an IS which is phonologically related to the target picture name.
BC = an IS which is phonologically related to the non-target picture name inducing between language competition
* = marks statistical significance

Participants who know zero additional languages produce significantly shorter naming latencies for the semantically related IS (920.48) compared to the phonologically related IS (961.41) (t (17) = 2.796, p = .012) as well as compared to the between-language phonologically related IS (983.72) (t (17) = 3.868, p = .001). Participants who know one additional language produce significantly longer naming latencies for the phonologically related IS

(1020.91) compared to the naming latencies for the unrelated IS produced by the group with two additional languages (900.67) (t (6) = 3.155, p = .020).

Naming latencies for the semantically related IS produced by the group with one additional language (1039.27) are significantly longer than the naming latencies for the unrelated IS produced by the group with two additional languages (900.76) (t (6) = 3.034, p = .023). Naming latencies for the unrelated IS were significantly longer for the group who know one additional language (1038.15) compared to the naming latencies for the same IS produced by the group who know two additional languages (900.67) (t (6) = 3.256, p = .017). Participants who know two additional languages produced naming latencies for the unrelated IS (900.67) which are significantly shorter than for the between-language phonologically related IS (989.93) (t (6) = 4.922, p = .003).

Some comparisons reached near significance. Naming latencies for the semantically related IS produced by participants who know zero additional languages (920.48) are shorter compared to those for the phonologically related IS produced by participants who know one additional language (1020.91) (t (11) = -2.140, p = .056) as well as for the between-language phonologically related IS produced by the group with one additional language (1040.20) (t (11) = -2.073, p = .062). Naming latencies for the semantically related IS produced by participants who know zero additional languages (920.48) is also shorter compared to latencies for the semantically related IS produced by participants who know two additional languages (959.93) (t (11) = -2.424, p = 034), and compared to latencies for the unrelated IS produced by participants who know one additional language (1038.15) (t (11) = -2.241, p = .047).

Naming latencies for the unrelated IS produced by participants who know two additional languages (900.67) are shorter than naming latencies for the between-language phonologically related IS produced by participants who know one additional language (1040.20) (t (6) = 2.734, p = 034). The phonologically related IS produced by participants who know two additional languages (927.83) is shorter compared to unrelated IS produced by participants who know one additional language (1038.15) (t (6) = 2.161, p = 074) as well as compared to the between-language phonologically related IS produced by participants who know two additional languages (989.93) (t (6) = -2.134, p = 077).

These results indicate that participants who know zero additional languages display a similar pattern to the less immersed group in the previous section (see section 4.5.1.2). Participants who know one additional language process all experimental conditions fairly similarly, except for the phonologically related IS, which gives slightly shorter naming latencies compared to the other ISs. Participants who know two additional languages display a pattern which is similar to the more immersed group in section 5.4.1.2, except for the unrelated condition which is shorter for participants who know two additional languages (900.67) compared to the more immersed group (937.33), (see Figure 13 for a comparison).

A question that logically follows is whether the group of participants who know zero additional languages consists exclusively of participants from the less immersed group, and whether the group of participants who know two additional languages consists exclusively of more immersed participants. Table 12 summarizes how the bilingual participants are divided between these two different groupings. The table reveals that the participants are distributed evenly over the different groups, except for the group with participants who know zero additional languages. This group has a slight overrepresentation of participants from the less immersed group (13) compared to the more immersed group (5).

Table 12: Distribution of bilingual participants across the different groupings

Post hoc bilingual groups	**Less immersed participants**	**More immersed participants**	**Total:**
G0	13	5	18
G1	6	6	12
G2	4	3	7
Total:	23	14	37

This overrepresentation of less immersed participants in the group of participants who know zero additional languages might be causing the similarity in naming latency patterns between these two participant groups. But participants in the remaining groups are distributed evenly. This means that the latency differences between participants who know one and two additional languages can not be dismissed as a manifestation of greater or lesser immersion. The difference in naming latencies between the groups is clearly significant and must be the result of the new participant grouping.

The results of this analysis suggest that degree of multilinguality affects lexical processing. The results of the participants who know zero additional languages will be interpreted as reflecting small amounts of Spanish immersion, since this group is dominated by less immersed participants. The conclusions about multilingual processing will be limited to the remaining two groups. And it seems that knowing one additional language induces a different kind of lexical processing compared to knowing two additional languages. Given that longer naming latencies signify interference in the lexical processing, these results suggest that knowing one additional language interferes with Spanish lexical processing. And given that shorter naming latencies signify facilitated processing, these results suggest that knowing two additional languages facilitates Spanish lexical processing.

This aspect of how multilinguality affects Spanish lexical processing in this experiment in fact contains several dimensions. The following issues are raised: (1) *what* language/languages do the participants know and, (2) how are these languages related to the participants' dominant language (Swedish) and the target language in the present investigation? (3) What level of proficiency have the participants acquired in this/these additional languages? (4) What is the relation between the proficiency level in the additional language/languages compared to Spanish; is the additional language stronger compared to Spanish or not? All of these questions cannot be answered within the scope of this thesis, mainly because these variables were not initially controlled for. Hence there is too much between-participant variation in the present population. This is for future studies to investigate. Nevertheless these aspects will be briefly commented on here.

Concerning what additional languages the participants know, German seems to dominate somewhat among the participants who know one additional language. And French seem to dominate to some extent in the group of participants who know two additional languages (see Appendix C for a summary of additional languages). Table 13 summarizes the information about which languages the participants in the two groups know.

Table 13: Additional languages

Post hoc groups	Knows German	Knows French	Knows both	Knows a different language	Total
G1	8	3	0	1	12
G2	1	4	2	0	7
Total:	9	7	2	1	19

German is a Germanic language, just like Swedish, the dominant language of all participants in the present study. Hence the relatedness between these languages should yield a psychotypological similarity. French is a Romance language, just like Spanish, the target language in the present study. Hence the relatedness between these languages should yield a psychotypological similarity.

Thus, there is one group of participants of whom the majority (8 out of 12) know a language related to the dominant language, and this group produce significantly longer naming latencies overall compared to the participants who know two additional languages. This group has no significant difference between naming latencies of any condition, hence they process all IS types equally. They are not affected by any phonological or semantic information, and they do not manifest any between-language competition.

And the second group consists of participants of whom the majority (6 of 7) know a language closely related to the target language. These participants produce significantly shorter naming latencies overall compared to the participants who know one additional language. These participants manifest phonological facilitation and semantic interference, as well as between-language competition. These participants process both phonological and semantic information in an expected way, considering previous bilingual studies within the PWIP.

Concerning the level of proficiency in the additional languages and Spanish, only self-assessed proficiency ratings will be applied. In the language background questionnaire (see section 3.1.1 for a survey of the questionnaire and Appendix C for a summary of the proficiency ratings), participants were asked to state their subjective appreciation of language proficiency in all their languages, on a scale from 1 to 5 (5 being the highest ranking). See Table 14 for a summary of mean self-ratings for Spanish and additional languages according to the post hoc bilingual grouping.

Table 14: Mean self-rating of languages, post hoc bilingual groups, Experiment 1

Group	**Spanish**	**Additional language**	**Additional language**
G1	3.1	2.1	-
G2	3.4	2.8	1.5

First of all, participants who know one additional language perceive themselves as slightly less proficient in Spanish (3.1) compared to the participants who know two additional languages (3.4). Second, participants who know one additional language perceive themselves as less proficient in this additional language (2.1) than in Spanish (3.1). Participants who know two additional languages also perceive themselves as less proficient in their strongest additional language (2.8) than in Spanish (3.4). But the difference is smaller between Spanish and the strongest additional language in the group of those who know two additional languages (0.6) compared to the difference among participants who know one additional language (1.0).[21]

Although the question of the role of number and type of other languages known cannot be conclusively answered here, the results suggest important empirical questions to be addressed in future research.

Summary: The bilingual participants were divided according to how many languages they know, yielding three groups: one in which participants know

[21] The second additional language known by participants who know two additional languages is rated for very low self-assessed proficiency (1.5). It is very unlikely that this language exerts any degree of influence on Spanish lexical processing.

zero language besides Swedish, English, and Spanish; one with participants who know one additional language; and one whose members know two additional languages. The analysis revealed that this participant grouping evokes larger effects both within and between groups.

The group of participants who know zero additional languages is dominated by less immersed participants, and accordingly, their naming latency pattern is, accordingly interpreted as a manifestation of less immersion. The group that knows one additional and the group that knows two additional languages differ significantly in two respects. Participants who know one additional language produces longer naming latencies overall and they do not display semantic or phonological processing or any between-language competition. Participants who know two additional languages produce shorter naming latencies overall and they process phonological and semantic information as well as between-language phonological information in an expected manner.

4.6.2 Swedish comparison group

4.6.2.1 Accuracy scores

Participants in the comparison group named the pictures in Swedish. This creates a monolingual test version, which is not directly comparable to the bilingual version administered to the bilingual participants. Data from the comparison group was given the same treatment as the bilingual data in terms of elimination of true errors, technical errors and outliers. A total of 15.6% of the data was eliminated, of which 2.6% are outliers, 10.5% are technical errors,[22] and 2.5% are true errors. The remainder part is treated as accuracy scores, 84.4% of all naming responses. Table 15 summarizes accuracy score percentages for the Swedish comparison group.

Table 15: Mean accuracy percentages, Swedish comparison group, Experiment 1

IS type	Mean accuracy %
New unrelated[a]	87.2
Unrelated	81.3
Semantically related	84.7
Phonologically related	84.4

[22] This high number of technical errors mainly originates from a small set of picture names: BOK (book), KAM (comb) and to some extent also from BYXA (pair of pants). Due to the high sensitivity of the equipment, it is possible that the technical errors were caused by the initial plosive.

[a]The IS type called New unrelated is the IS which in the bilingual test version has a phonological similarity to the Spanish picture name and which becomes an unrelated condition in this monolingual test version.

Analysis of variance was conducted with participants and items as random factors. IS type is used as within-subject variable. The analysis is based on Arcsine transformed values of accuracy score percentages. There was no significant main effect of accuracy on IS type in either participant or item analysis, ($F1$ (3, 15) = .904, p = .462, Z1 .153, $F2$ (3, 60) = 1.18, p = .325).

Accuracy scores from the Swedish comparison group are similar across experimental conditions. In other words, the type of relation between picture and IS does not affect processing to such an extent that it influences accuracy in the Swedish comparison group. Based on these results, we can not expect large differences in monolingual naming latencies.

Summary: Analyses of accuracy scores in the Swedish comparison group reveal no significant effects for IS type. Participants process the different picture name and IS pairings very similarly in terms of accuracy. According to these results we should not expect any differences in naming latencies depending on IS type.

4.6.2.2 Naming latencies

Table 16 summarizes the distribution of mean naming latencies as a function of the relation between the target picture names and IS type for the participants in the Swedish comparison group. The IS type called "new unrelated" is the category of ISs which were phonologically related to the Spanish picture name (to the target picture name) in the bilingual version of Experiment 1. Since this version is monolingual, the relation between this IS type and the picture name has become neutral.

Table 16: Mean naming latencies, Swedish comparison group, Experiment 1

IS type	Mean naming latency	SD
New unrelated	941.00	144.59
Unrelated	947.59	160.87
Semantically related	940.40	120.97
Phonologically related	979.41	174.24

Analysis of variance was conducted with participants and items as random factors and type of IS as the within-subject variable. No effect of IS type was observed in either analysis ($F1$ (3, 15) = 1.199, p = .344, Z .193, $F2$ (3, 60) = 1.08, p = .364, MSE 7.75). This is in line with the analysis on accuracy scores. The Swedish comparison group does not differ in lexical processing depending on target word and IS pairing. In the research literature, a phonologically related IS in monolingual picture-word interference experiments is expected to induce shorter naming latencies, and a semantically related IS is expected to induce longer naming latencies compared to an unrelated IS, contrary to the present trend in the monolingual version of Experiment 1.

These unexpected results could possibly be attributed to within- or between-participant variations. As we saw in the analysis of the bilingual participants, some of the picture names have Swedish/English cognate status. And as was mentioned in section 3.1.2, the Swedish comparison group is not at all monolingual, but rather bilingual, since they all know English, and in some cases even trilingual. Cross-linguistic effects within- and between-participants might blur the results, and subsequent analyses were conducted to probe probable effects.

Summary: The analysis of accuracy scores and naming latencies in the Swedish comparison group reveals no effect of IS type. This might be due to large between-participant variability in the data. Thus subsequent analysis of cross-linguistic effects is carried out in the next two sections.

4.6.2.2.1 Post hoc analysis of cross-linguistic effects on naming latencies

To investigate possible cross-linguistic influence from English on naming latencies, experimental pictures were divided into two groups according to Swedish/English cognate status. Thirty four of the picture names are Swedish/English cognates and 30 are non-cognates (see Appendix H). See Table 17 for an example of form similarity between Swedish and English picture names. There is a large variation in degree of phonological similarity between different picture names. Picture names with varying degrees of phonological similarity are collapsed into the same category in this analysis.

Table 17: Swedish/English cognate status, Swedish comparison group, Experiment 1

Target picture name	**Non-cognates**	**Swedish/English cognates**
Drottning	Queen	
Docka[a]		Doll
Bok		Book

[a] Underlined segments indicate phonological overlap

The two examples of Swedish/English cognates (DOCKA – *doll*, TRÄD – *tree*) are representative of the differing degrees of phonological overlap. *Doll* overlaps with the two initial phonemes. The phonological overlap between BOK and *book* consists of the initial phoneme *b* and the final phoneme *k*, the middle phoneme being similar but not similar enough to completely overlap.

See Table 18 for a summary of mean naming latencies for picture names depending on Swedish/English cognate status.

Table 18: Mean naming latencies for picture names depending on Swedish/English cognate status, Swedish comparison group, Experiment 1

Similarity to English	Number	Mean naming latency	SD
Swedish/English cognate	34	929.52	56.00
Swedish/English non-cognate	30	962.44	64.68

Analysis of variance was conducted with naming latencies as dependent variable and Swedish/English cognate status as between-subject variable, yielding a 1 x 2 ANOVA. There was a significant effect of Swedish/English cognate status (F (1, 62) 2.76, p = .033, MSE 7.75) with shorter naming latencies for pictures names with Swedish/English cognate status (929.52) compared to picture names with Swedish/English non-cognate status (962.44). This reveals that the Swedish comparison group manifests cross-linguistic facilitation from English in native-language lexical processing.

Summary: A post hoc analysis was conducted to probe within-participant variation in terms of cross-linguistic effects from English. Target picture names were divided into two groups according to their Swedish/English cognate status. The analysis revealed a cognate facilitation effect suggesting that cross-linguistic influence might be one of the reasons for the lack of significant effects of IS type in the previous analysis.

4.6.2.2.2 Post hoc analyses of between-participant variation

Since many of the participants are trilingual, additional cross-linguistic effects must be investigated. Eight of the eighteen Swedish comparison participants are proficient in German (44.4% of all comparison participants). Appropriate analyses were performed with participant group (1, 2), and IS type (1, 2, 3, 4) as random factors yielding a 2 x 4 ANOVA.

A main effect of IS type was observed in the items analysis only ($F1$ (3, 14) = 1.06, p = .399, Z1 .184, $F2$ (1, 60) = 68.73, p = .000, Z2 534) with the shortest naming latencies for the semantically related condition (940.40), followed by the new unrelated condition (940.99), followed by the unrelated condition (947.59), and with the longest naming latencies being induced by the phonologically related condition (979.41).

A main effect of group was marginally significant in the participant analysis and not significant in the item analysis ($F1$ (1, 16) = 3.93, p = .065, Z1 .197, $F2$ (3, 60) = .913, p = .440, Z2 .044) with shorter naming latencies for the group of participants who do not know German (886.51) compared to the group of participants who know German (1021.78).

No interaction effect was observed in either analysis ($F1$ (3, 14) = 1.40, p = .283, Z1 .231, $F2$ (3, 60) = .775, p = .513, Z2 .037). See Table 19 for mean naming latencies for the different IS types as produced by the participants who know German and those who do not know German.

Table 19: Mean naming latencies for Swedish comparison participants grouped according to whether or not they know German, Experiment 1

IS type	**Participant groups**	**Mean naming latency**	**SD**
New unrelated	Knows German	1046.23	160.81
	Doesn't know German	925.96	173.47
Unrelated	Knows German	1015.85	168.52
	Doesn't know German	891.64	142.56
Semantically related	Knows German	1001.39	127.61
	Doesn't know German	890.12	90.71
Phonologically related	Knows German	1022.84	132.81
	Doesn't know German	875.52	122.68

The participants do not differ significantly as to how they handle the different IS types depending on whether they know German. However, there is an interesting trend revealing that the participants who know German consistently produce longer naming latencies across all IS types.

Summary: The comparison participants were divided into two groups according to whether they know German to investigate possible effects on naming latencies. No significant effect was observed. However, a small trend reveals that participants who know German produce longer naming latencies across IS types.

4.7 Summary of results and discussion, Experiment 1

The experimental results showed that length of Spanish immersion significantly influenced bilingual accuracy scores and naming latencies. Participants who have spent more than 12 months in a Spanish-speaking country produce (somewhat) higher accuracy scores and shorter naming latencies overall than participants who have experienced 12 or fewer months of Spanish immersion. Hence, immersion is an external factor which can predict bilingual lexical processing in terms of speed and accuracy in a PWI setting.

Furthermore, length of immersion also influences Spanish lexical processing of phonological and semantic information. Participants with more Spanish immersion manifest a naming latency pattern which is similar to that documented within the bilingual PWIP, namely phonological facilitation, semantic interference and between-language competition. The naming latency pattern of this group is based mainly on tendencies; it is therefore important to exercise caution when interpreting these results. The mean naming latency for the phonological condition was the shortest, but not significantly shorter than the unrelated condition. This suggests a tendency towards a classic phonological facilitation effect. The semantic interference effect however, is significant compared to the unrelated condition. Thus, the more immersed participants reveal predominantly semantic lexical processing. This means that the more immersed participants process their bilingual lexicon predominantly by means of cross-linguistic interaction, rather than phonological interaction. The between-language competition is also significant, and proves to be the strongest effect.

The less immersed participants produce significantly longer naming latencies in the phonologically related condition compared to all other conditions. This means that the less immersed participants are affected by phonological information in their lexical processing. However, the way in which they process this information is somewhat unexpected. Studies within the PWIP consistently report a phonological facilitation effect. However, these studies exclusively test highly proficient bilinguals (with native-like performance on proficiency tests). The less immersed participants in the present study instead produce prolonged naming latencies in the phonological condition, a pattern which has never been seen before. Arguably, this is because the type of bilingual tested in the current study has never been tested before within this paradigm.

The less immersed participants have not had the practice required to build up their Spanish lexical processing system to equal that of highly proficient bilinguals reported in the research. The PWI experiment requires a rather high extent of automatization of lexical processing. The less immersed participants are barely testable, and therefore, their naming latency pattern are taken to reflect the most initial stages of automatization of lexical processing in a second language.

In the less immersed group, the semantically related IS type is processed similarly to the unrelated condition. That is, the semantic relationship between the IS and the picture does not affect these participants; they do not process this information. This is unexpected when comparing with the PWIP studies, which report semantic interference. Again, these reports are based on highly proficient bilinguals, and the less immersed participants in the present study are in their beginning stages of automatizing L2 lexical processing. Thus, their lack of semantic interaction effects in processing is unexpected only when compared to previous research in this specific online paradigm. Looking at offline research, they follow the expected pattern.

In studies using very different types of tasks, it is repeatedly reported, that the results of low proficient bilinguals are characterized by mainly phonological processing (see section 2.2.3 for a survey). Advocates of the revised hierarchical model (Kroll & Stewart, 1994) argue that form processing links dominate the bilingual mental lexicon at early stages of acquisition, and that meaning based links are developed as acquisition progresses. Similarly, researchers working with word association tasks (Söderman, 1998) mean that lexical items in the bilingual mental lexicon are initially linked by form and only later become semantically linked. Namei (2002) means that this is a feature of each lexical entry and that semantic processing is developed word-by-word.

Post hoc analyses further investigated whether within- and between participant variation could be due to cross-linguistic influence. In one post hoc analysis, picture names with English cognate status were contrasted to picture names with non-cognate status in English. The results revealed that the less immersed group was affected by this cross-linguistic influence since they revealed a tendency to produce longer naming latencies for the picture names with English cognate status. English is a stronger language compared to Spanish for all participants in this group. These results are in line with research on Spanish learning which states that a stronger L2 can influence the learning of an L3 in initial stages (see section 2.3). This cross-linguistic influence from English might explain longer naming latencies for the phonologically related condition in the less immersed group. Importantly, this interference effect of English cognate status is not present in the more immersed group. The more immersed participants seem to have achieved such a high degree of fluency in Spanish that they are not affected by another second language in their lexical processing.

A second post hoc analysis regrouped the bilingual participants based on how many languages they know in addition to Swedish, English, and Spanish: zero, one, or two. This analysis reveals three different naming latency patterns. Participants who know zero additional languages have a latency pattern similar to the one produced by the less immersed group, this pattern might be caused by an overrepresentation of less immersed participants in this group. Participants who know one additional language has the longest naming latencies across IS types of all three groups. It seems that knowing one additional language slows down the lexical processing. Participants who group who know two additional languages reveal a latency pattern which is similar to the known pattern for highly proficient bilinguals (this group is not dominated by more immersed participants).

The group of participants who know zero additional languages is dismissed from comparison, because the results from this group reflect a less immersed pattern. Importantly, closer examination of how the remaining two groups intertwine revealed that there was an equal division of less and more immersed participants in the groups who know one and two additional languages. Hence the difference in naming latency patterns must be due to the new grouping. When scrutinizing what languages they know, it turned out that the participants who know one additional language are dominated by participants who know German. And all of the participants who know two additional languages know French.

Knowing German might reinforce the activation of the L1, and cancel out the effects of the experimental conditions. The opposite happens in the group of participants who know two additional languages. For the majority of these students, the additional language is a language close to the target language. This might reinforce the activation of the target language and enlarge the effects induced by the experimental conditions. This group displays a naming latency pattern which is very close to that reported in the research literature for highly proficient or balanced bilinguals. This group consists of four participants with one year or less of Spanish immersion, and three participants with more than one year of Spanish immersion.

It is not within the scope of the present investigation to establish the reasons for the differences in naming latency patterns between the post hoc groups. But it is suggestive of the lack of significance in the analysis based on length of immersion. It might be that the true processing difference is actually based on the multilingual aspects of these participants. If so, this is an important result, and strongly suggests that (additional) multilinguality aspects must be taken into consideration in experimental research of this type.

The monolingual comparison group does not differ significantly in lexical processing of semantically, phonologically or unrelated features. One possible ground for this is the fact that, again, the group is not truly monolingual. The comparison group is bilingual and multilingual to a large extent and this brings significant variability to the data. One important trend in the naming latencies is the fact that target words which have some amount of phonological similarity to the English picture name are named somewhat faster than the target words with no such cross-linguistic overlap. This suggests the existence of some amount of cross-linguistic influence from English in this experiment. A large part of this participant group is proficient in German which might influence the data even further.

The comparison group displays a tendency for between-language cognate facilitation effect for picture names with Swedish/English cognate status. Even though English is not part of the experimental setting, it exerts some degree of influence on Swedish lexical processing. This finding is expected, since previous research has reported that a strong L2 can influence processing even in a highly monolingual context. This corroborates that the Swedish comparison group are highly proficient in English.

5 Experiment 2, cognates and non-cognates mixed

5.1 Introduction

Experiment 2 investigates if length of Spanish immersion is a predictor of the lexical processing of cognates in terms of speed and accuracy. Do the naming latency patterns for the different experimental conditions reflect phonological facilitation, semantic interference and between-language competition? And how does the naming latencies differ in these conditions depending on cognate status?

5.2 Participants

Thirty-seven bilingual participants took part in Experiment 2, the same participants as in Experiment 1.[23] Twenty-three of these participants had spent 12 months or less in a Spanish-speaking country and they will be referred to as the less immersed group. Fourteen of the participants had spent more than 12 months in a Spanish-speaking country, and they will be referred to as the more immersed group. Eighteen native speakers of Swedish, with no knowledge of Spanish, Portuguese, French, or Italian participated in a Swedish test version of the experiment.[24] They are referred to as the Swedish comparison group.

5.3 Materials

The experiment consists of 9 non-cognate pictures, taken from Experiment 1, and 9 pictures with Swedish/Spanish cognate names. Each picture is presented 6 times throughout the experiment, each time with an auditorily presented IS. The interfering stimulus is presented in a headset at the same time as the picture. The ISs are related to the picture either semantically or phonologically. Other ISs are unrelated: these function as filler items.

[23] For a detailed description of the bilingual participants, see section 3.1.1.
[24] For a detailed description of participants in the comparison group, see section 3.1.2.

The filler items consist of the same ISs as in the semantically and phonologically related conditions but re-paired with other pictures. Hence, all ISs appear twice in the same experiment but with different pictures, once as a related IS and once as a filler. Care was taken that the filler items did not overlap semantically with the picture name or phonologically with the name of the picture name in either language. Picture-IS pairs were arranged in a semi-randomized order, the same for all participants. No word or picture reappeared with fewer than 4 items intervening.

These picture-IS pairings yield 72 trials for each participant: 18 semantically related, 18 phonologically related, and 36 unrelated. The related conditions are twice in number as the filler conditions. To enable comparison between the filler condition and the related conditions, this distribution was adjusted by reducing the number of the unrelated filler condition to equal the related items. All experimental items were divided into three sections, based on the trial order in which they appeared in the experiment: beginning, middle and end.

The same number of filler items was randomly deleted within each section. A list was generated with randomized numbers which was used to delete 18 items, equally distributed over the three sections (http://www.random.org/integers/). Once this had been done, comparisons could be made, and ANOVAS could be performed for all experimental conditions. All analyses of Experiment 2 are based on 54 trials: 18 X 3 conditions.

Half of the picture names consist of Spanish/Swedish non-cognates, taken directly from Experiment 1, and half consist of Spanish/Swedish cognate words. The cognate words shared 4.3 phonological segments on average (range = 3–7) between languages. All cognates (but one) shared at least the entire first syllable. One cognate did not; the second phoneme in *zebra* is different in Spanish and Swedish, but the rest of the word is similar. There was no obvious phonological overlap between translation words of the non-cognate words in the experiment. None shared their first phoneme and only 1 out of 18 shared the first vowel (TALLRIK - plato (plate)). See section 3.2 for a more detailed description of the experimental design.

5.4 Procedure

The participants were tested individually in a quiet room at the university. The pictures were first presented offline and their respective target names were established. Instructions were given orally (Appendix K). Because all participants were highly unfamiliar with experiments of any kind, this strategy was chosen to help subjects relax and create a comfortable environment.

Participants were asked to name the pictures as quickly and as accurately as possible, while ignoring the auditorily presented IS words presented together with each picture. If they could not remember a certain picture name in time, they were instructed not to give any response and wait for the next picture. They were then presented with an online training session to familiarize them with the experimental equipment. No pictures or IS words in the test session were included in the actual experiment. In the online training session, the IS words and the picture names were exclusively unrelated.

The bilingual participants were asked to name the pictures in Spanish, while ignoring the Swedish IS words. The Swedish comparison group were asked to name the pictures in Swedish, while ignoring the Swedish IS words. This created one bilingual version and one monolingual version of the same test.

5.5 Design and analysis

Experiment 2 examines one between- and one within-subject variable. The between-subject variable is length of Spanish immersion, counted in months. This variable divides the bilingual participants into two groups, those who have spent 12 or fewer months in a Spanish-speaking country, and those who have spent more than 12 months in a Spanish-speaking country. The within-subject variable is the relation between target picture name and IS (either semantically or phonologically related, or unrelated, these three conditions occur once with cognate picture names and once with non-cognate picture names), called IS type. Group (1, 2) and IS type (1, 2, 3, 4, 5, 6) yields a 2 X 6 ANOVA.

Since some word-type factors known to affect monolingual and bilingual processing were not completely controlled for in this study (such as word length and frequency), an extra source of variability is expected in the data. This will be controlled for by means of an ANOVA with item as random factor. Hence, separate analyses were conducted with participants and items as the dependent variable, yielding $F1$ and $F2$ statistics, respectively. Planned comparisons were conducted to establish any relationships between levels of the within- and between-subject variables.

5.6 Results, Experiment 2

5.6.1 Bilingual participants grouped by length of Spanish immersion

5.6.1.2 Accuracy scores

All trials with null responses were eliminated. Some of these were true errors, others were due to technical problems caused by the software. A qualitative analysis of the raw data was conducted to determine which null responses were technical errors and which were true errors. Technical errors are caused by the high sensitivity of the experimental software, which omits pictures as the result of heavy breathing or coughing. The omitted pictures are left with null responses. True errors are caused by the participant being silent as a result of not finding the name for the picture in time. Mouth clicks and stuttering were included in this category. The same procedure as in Experiment 1 was used to distinguish technical errors from true errors (cf. 4.6.1.1).

The total percentage of eliminated data is 22.1%, of which 4.3% are outliers, 8.1% technical errors, and 9.7% true errors. The remainder part is treated as accuracy scores: i.e. 77.9%, of all naming responses. See Tables 20 and 21 for accuracy score percentages for the two bilingual groups.

Table 20: Accuracy score percentages, less immersed group, Experiment 2

	Non-cognates		**Cognates**	
	Mean accuracy %	SD	Mean Accuracy %	SD
Phonologically related	69.0	24.38	77.8	25.69
Unrelated	77.3	23.33	77.8	23.69
Semantically related	74.4	22.83	75.9	24.31
Total:	**73.6**	**21.84**	**77.1**	**22.30**

Table 21: Accuracy score percentages, more immersed group, Experiment 2

	Non-cognates		**Cognates**	
	Mean accuracy %	SD	Mean accuracy %	SD
Phonologically related	81.8	23.71	88.1	14.1
Unrelated	81.8	22.9	81.0	24.04
Semantically related	76.2	23.81	83.3	19.37
Total:	**79.9**	**22.30**	**84.1**	**18.05**

An analysis of variance was conducted on Arcsine transformed values of accuracy score percentages. A main effect of IS type reached significance in the item analysis only ($F1$ (5, 31) = 1.36, p = .267, Z1 .180, $F2$ (1, 48) = 13.00, p = .001, Z2 .213) with the highest accuracy scores for the phonologically related cognate IS (81.68%), followed by the unrelated cognate IS (78.98%), followed by the unrelated non-cognate IS (78.98%), followed by the semantically related cognate IS (78.68%), semantically related non-cognate IS (75.08%), and the lowest accuracy for the phonologically related non-cognate IS (73.87%).

No main effect of group reached significance ($F1$ (1, 35) = .985, p = .328, Z1 .027, $F2$ (5, 48) = .766, p = .579, Z2 .074). A marginal interaction effect was found in the participant analysis only ($F1$ (5, 31) = 2.26, p = .073, Z1 .267, $F2$ (5, 48) = .93, p = .471, Z2 .088). Figure 12 summarizes the difference in accuracy scores, given in percentages, between the two bilingual groups.

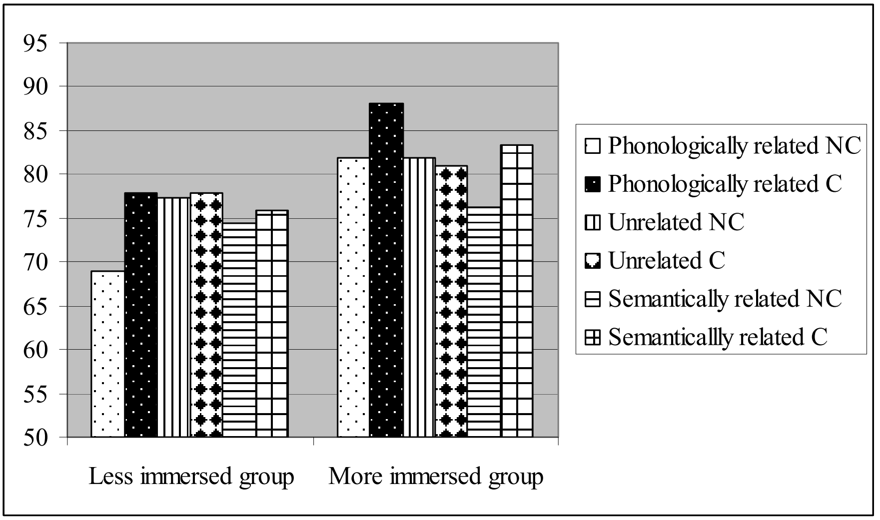

Figure 12: Accuracy score percentages, bilingual groups, Experiment 2

Planned comparisons were performed to further investigate the main effect of accuracy scores on IS type. The comparisons are performed by group. But since the main effect of group on accuracy was only marginally significant, the results must be trated with caution. Table 22 illustrates the planned comparison results for accuracy scores for the less immersed group.

Table 22: Planned comparisons of accuracy scores, less immersed group, Experiment 2

Picture IS-relation	**Df**	**T**	**Sig. (2-tailed)**
NC phon. - C unrelated	22	-2.91	.008*
NC phon. – C semantic	22	-2.68	.014*
NC phon. – NC semantic	22	-2.65	.015*
NC phon. – NC unrelated	22	-2.41	.025*
NC phon. – C unrelated	22	-2.28	.032
C phon. – C semantic	22	-2.17	.041
C phon. – NC unrelated	22	2.10	.047

NC = non-cognate, C = cognate
Phon. = phonologically related
* = marks statistical significance

The results revealed that the less immersed group had higher accuracy scores for the unrelated non-cognate condition than for the phonological non-cognate condition (*t* (22) = -2.41 *p* =.025), as well as the semantic non-cognate condition compared to the phonological non-cognate condition (*t* (22) = -2.65 *p* =.015). The unrelated cognate condition also had higher accuracy relative to the phonological non-cognate condition (*t* (22) = -2.91, *p*

=.008) as did the semantic cognate condition compared to the phonological non-cognate condition (t (22) = -2.68, p =.014). Although only marginally significant, it might be worth mentioning that the phonological cognate condition had lower accuracy than the semantic cognate condition (t (22) = -2.17 p =.041), the unrelated cognate condition (t (22) = -2.28, p =.032), and the unrelated non-cognate condition (t (22) = 2.10, p =.047).

The more immersed group had a marginally higher degree of accuracy in the phonological cognate condition compared to the semantic non-cognate condition (t (13) = -2.47, p =.028). The unrelated cognate condition induced higher accuracy which reaches marginal significance compared to the semantic non-cognate condition (t (22) = -2.21 p =.046), and the semantic cognate condition compared to the semantic non-cognate condition (t (22) = -2.20, p =.046). Table 23 illustrates the results for the more immersed group.

Table 23: Planned comparisons of accuracy scores, more immersed group, Experiment 2

Target word IS-relation	**Df**	**T**	**Sig. (2-tailed)**
NC semantic – C phon	13	-2.47	.028*
NC semantic – C unrelated	13	2.21	.046
NC semantic – C semantic	13	2.20	.046

NC = non-cognate
C = cognate
Phon = phonologically related
* = marks statistical significance

Summary: The more immersed group has higher overall accuracy scores in Experiment 2 than the less immersed group. Accuracy scores for neither group follow the expected pattern. The less immersed group has the lowest accuracy scores for the phonologically related non-cognate IS, which differs statistically from all the other IS types. Given that lower accuracy scores indicate processing difficulties, we should expect the longest naming latencies for this IS.

In the more immersed group, the non-cognate semantically related IS has the lowest accuracy, this is statistically significant, compared to the phonologically related cognate IS, which has the highest accuracy in this group. Given that higher accuracy scores indicate ease of processing, we should expect the analysis of naming latencies to reveal significantly shorter latencies for the non-cognate semantically related IS than for the phonologically related cognate IS, in the more immersed group.

5.6.1.3 Naming latencies

Naming latency analyses are based exclusively on accurate naming responses. An analysis of variance was conducted with participants and items as random factors, and type of IS as within-subject variable, and amount of L2 immersion as the between-subject factor. A main effect of IS type was observed ($F1$ (5, 31) = 11.92, p = .000, Z1 .658, $F2$ (1, 48) = 25.76, p = .000, Z2 .349) with the shortest latencies for the non-cognate semantically related condition (950.77), followed by the non-cognate unrelated condition (991.94), followed by the cognate phonologically related condition (1020.25), followed by the non-cognate phonologically related condition (1023.90) which is followed by the cognate semantically related condition (1044.40). And the longest naming latencies was observed for the IS which is cognate unrelated (1056.34).

A main effect of group reached marginal significance in the participant only ($F1$ (1, 35) = 3.15, p = .085, Z1 .083, $F2$ (5, 48) = 1.46, p = .222, Z2 .132) with shorter naming latencies for the more immersed group (966.37) than for the less immersed group (1030.30). A significant interaction effect between IS type was found in the participant analysis and marginally so in the item analysis ($F1$ (5, 31) = 3.35, p = .016, Z1 .350, $F2$ (5, 48) = 2.07, p = .085, Z2 .178). Tables 24 and 25 summarize mean naming latencies for the two bilingual groups.

Table 24: Mean naming latencies, less immersed group, Experiment 2

IS type	**Non-cognates**		**Cognates**	
	Mean	SD	Mean	SD
Phon.	1037.19	133.93	1031.35	127.43
Unrelated	994.72	120.81	1090.78	137.47
Semantic	991.71	100.46	1090.09	155.60
Total mean:	1003.53	69.55	1057.07	90.89

Table 25: Mean naming latencies, more immersed group, Experiment 2

IS type	**Non-cognates**		**Cognates**	
	Mean	SD	Mean	SD
Phon.	1002.07	176.60	1002.00	162.16
Unrelated	987.37	112.82	999.75	121.76
Semantic	883.52	112.02	969.34	116.04
Total mean:	952.17	90.46	980.57	96.95

To further investigate the interaction, planned comparisons were performed with a Bonferroni correction. Results of the planned comparisons are summarized in Table 26.

Table 26: Planned comparisons, bilingual groups based on length of Spanish immersion, Experiment 2

Comparison	MSE[a]	T	Df	Sig. (2-tailed)
LessCsem-LessNCunrel	21.67	4.40	22	.000*
LessCunrel-LessNCsem	19.74	5.02	22	.000*
LessCunrel-LessNCunrel	22.55	4.26	22	.000*
MoreCunrel-MoreNCsem	21.34	5.45	13	.000*
MoreNCsem-MoreNCunrel	22.80	-4.56	13	.001*
MoreNCsem-MoreNCphon	26.87	-4.41	13	.001*
LessCsem-LessNCsem	25.60	3.84	22	.001*
MoreCphon-MoreNCsem	30.97	3.83	13	.002*
LessCunrel-MoreNCsem	52.61	3.51	13	.004*
MoreCsem-MoreNCsem	28.70	2.99	13	.010*
LessCphon-MoreNCsem	40.57	2.801	13	.015*
LessNCsem-MoreNCsem	42.66	2.80	13	.015*
LessCunrel-LessNCphon	21.39	2.50	22	.020*
LessCunrel-lessCphon	24.33	2.44	22	.023*
LessNCphon-MoreNCsem	51.00	2.29	13	.039
LessCsem-MoreCsem	53.46	2.23	13	.044
LessCunrel-MoreCsem	48.72	2.03	13	.063
LessNCunrel-LessNCphon	22.28	-1.91	22	.070
LessNCunrel-MoreNCsem	52.67	1.96	13	.072
LessNCsem-LessNCphon	24.40	-1.86	22	.076
LessCphon-LessNCsem	21.76	1.82	22	.082
LessCsem-MoreCunrel	49.84	1.78	13	.098
LessCsem-MoreCphon	50.11	1.73	13	.108
LessCsem-MoreNCunrel	58.82	1.72	13	.109
LessCsem-LessCphon	35.53	1.65	22	.112
LessCunrel-MoreNCunrel	55.25	1.47	13	.166
LessCsem-MoreNCphon	60.56	1.43	13	.176
LessCphon-LessNCunrel	26.66	1.37	22	.183
LessCunrel-MoreCphon	48.69	1.36	13	.196
LessCunrel-MoreCunrel	52.55	1.306	13	.214
LessCunrel-MoreNCphon	54.51	1.216	13	.245
MoreCsem-MoreNCphon	36.97	-.885	13	.392
MoreCsem-MoreCunrel	34.33	-.886	13	.392
MoreCsem-MoreCphon	39.98	-.817	13	.429
MoreCsem-LessNCsem	45.01	-.744	13	.470
MoreCsem-LessNCphon	40.75	-.709	13	.491

LessCphon-MoreCsem	46.08	.603	13	.557
MoreCsem-MoreNCunrel	32.47	-.555	13	.588
MoreCunrel-MoreNCunrel	27.69	.447	13	.662
MoreCphon-MoreNCunrel	34.64	.42	13	.680
MoreNCunrel-MoreNCphon	34.97	-.42	13	.681
LessNCsem-MoreNCunrel	40.85	.378	13	.711
MoreCsem-LessNCunrel	49.80	-.348	13	.734
MoreCphon-LessNCunrel	52.41	.293	13	.744
LessCphon-MoreNCunrel	35.16	.278	13	.786
MoreCunrel-LessNCunrel	50.08	.262	13	.798
LessNCunrel-MoreNCphon	61.72	-.250	13	.807
LessCphon-LessNCphon	26.71	-.219	22	.829
LessNCphon-MoreNCunrel	49.75	.218	13	.831
LessNCsem-LessNCunrel	18.74	-.161	22	.874
LessCphon-MoreCphon	47.08	-.103	13	.919
LessCphon-MoreNCphon	52.02	-.095	13	.926
MoreCunre-MoreNCphon	26.78	-.087	13	.932
MoreCphon-LessNCphon	47.68	.079	13	.938
MoreCunrel-MoreCphon	30.69	-.073	13	.943
LessNCphon-MoreNCphon	54.03	-.071	13	.944
MoreCunrel-LessNCsem	42.58	-.072	13	.944
LessCphon-MoreCunrel	41.84	-.062	13	.951
MoreCunrel-LessNCphon	48.77	.031	13	.976
LessCsem-LessCunrel	27.89	-.025	22	.981
MoreCphon-LessNCsem	44.87	-.018	13	.986
LessNCsem-MoreNCphon	51.49	.015	13	.989
LessNCunrel-MoreNCunrel	51.06	-.014	13	.989
MoreCphon-MoreNCphon	26.94	-.003	13	.998

[a]MSE = mean standard error
Less = the less immersed group
More = the more immersed group
C = Swedish/Spanish cognate words
NC = Swedish/Spanish non-cognate words
Unrel = unrelated IS, Sem = semantically related IS, phon = phonologically related IS

For the group with less Spanish immersion, the naming latencies for the cognate semantic condition (1090.09) were significantly longer compared to the non-cognate unrelated condition (994.72) (t (22) = 4.40, p = .000), as well as compared to the non-cognate semantically related condition (991.71) (t (22) = 3.84, p = .001). The cognate unrelated condition (1090.78) for the same group was significantly longer compared to the non-cognate semantically related condition (991.71) (t (22) = 5.02, p = .000), as well as compared to the non-cognate unrelated condition (994.72) (t (22) = 4.26, p =

.000), and compared to the non-cognate phonologically related condition (1037.19) (t (22) = 2.50, p = .020), and compared to the cognate phonological condition (t (22) = 2.44, p = .023). The cognate unrelated condition for the less immersed group is also significantly longer compared to the non-cognate semantically related condition produced by the more immersed group (883.52) (t (13) = 3.51, p = .004).

For the group with more Spanish immersion, one condition differs significantly from all other IS types within this group, and for some conditions compared to the less immersed group. It is the non-cognate semantically related condition (883.52) which induces the shortest naming latencies in the experiment for the more immersed group. This condition was significantly shorter compared to the cognate unrelated condition (999.75) (t (13) = 5.45, p =.000), the non-cognate unrelated condition (987.37) (t (13) = -4.56, p =.001), the non-cognate phonological condition (1002.07) (t (13) = -4.41, p =.001), the cognate semantic condition (969.34) (t (13) = 2.99, p =.010), all produced by the same group. The non-cognate semantically related condition (883.52) is also significantly shorter compared to the cognate phonologically related condition produced by the less immersed group (1031.35) (t (13) = 2.80, p = .015), and the non-cognate semantically related condition produced by the less immersed group (991.71) (t (13) = 2.80, p = .015).

Some comparisons reached near significance. The non-cognate semantically related condition produced by the more immersed group (883.52) is shorter compared to the non-cognate phonologically related condition produced by the less immersed group (1037.19) (t (13) = 2.29, p = .039) as well as compared to the non-cognate unrelated condition produced by the less immersed group (994.72) (t (13) = 1.96, p = .072). The cognate semantically related condition produced by the more immersed group (969.34) is shorter compared to the cognate semantically related condition produced by the less immersed group (1090.09) (t (13) = 2.23, p = .044) as well as compared to the cognate unrelated condition produced by the less immersed group (1090.78) (t (13) = 2.03), p = .063).

The non-cognate unrelated condition produced by the less immersed group (994.72) is shorter compared to the non-cognate phonologically related condition produced by the same group (1037.19) (t (22) = -1.91, p = .070). The non-cognate phonologically related condition produced by the less immersed group (1037.19) is longer compared to the non-cognate semantically related condition produced by the same group (991.71) (t (22) = -1.86, p = .076). Figure 13 summarizes naming latencies for all experimental conditions across groups based on length of Spanish immersion.

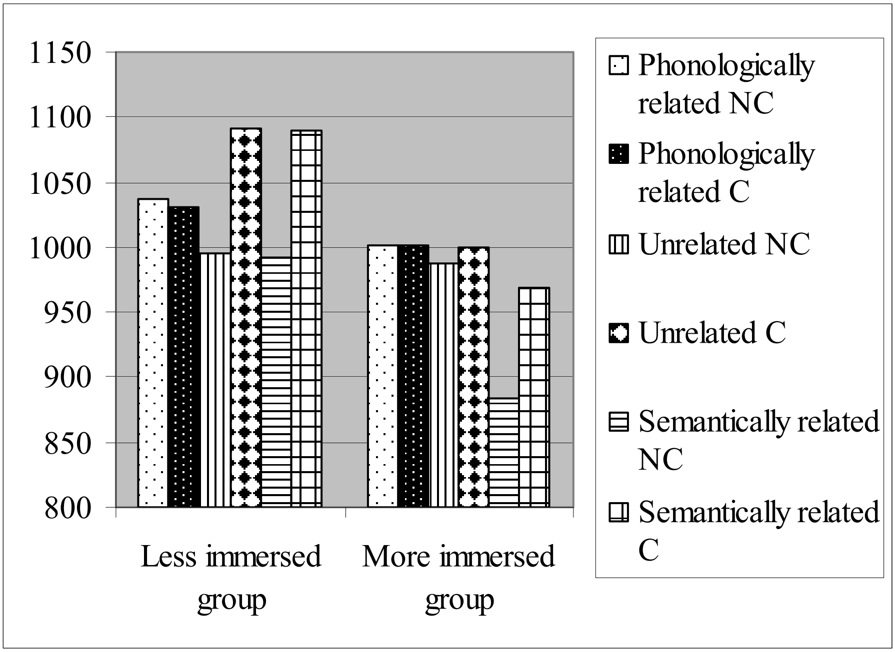

Figure 13: Naming latencies, bilingual groups based on length of Spanish immersion, Experiment 2

Similar to Experiment 1, the less immersed participants produce longer overall naming latencies, compared to the more immersed participants. In the accuracy analysis, we saw that the phonologically related non-cognate IS had the lowest accuracy and we should expect the longest naming latencies for this IS. This was not corroborated. This will be further discussed in Chapter 6.

A highly unexpected result of this experiment is that cognate picture names generate longer response latencies compared to non-cognate picture names in the semantically related and the unrelated conditions in the less immersed group. The phonologically related condition, however, is not affected by cognate status. The longer naming latencies in the unrelated and the semantically related conditions might be the result of two word type effects at work, confounding the results. The cognates might be highly unfamiliar for the less immersed participants. If this is the case, the reverse cognate effect in this experiment is in fact the result of a word-frequency effect. Subsequent analyses will examine whether this is the case.

In the more immersed group, a different pattern appears. In this group, all conditions are processed equally, except the semantically related non-cognate condition. This condition has induced significantly shorter naming latencies compared to all other conditions. This is contradictive compared to the analysis on accuracy scores which revealed remarkably high accuracy for this IS. It is unclear why this is so. These conditions were directly taken from Experiment 1, and in that experimental context they did not induce such short naming latencies (rather, it generated the second longest latencies, see section 4.5.1.2). Therefore, the short latencies generated in this experiment must be an experimental effect. It seems that Experiment 1 and 2 put different processing demands on the participants. Whether this difference is the result of a cognate effect or a frequency effect is unclear. It remains to investigate whether the reverse cognate effect is in fact an effect of word frequency in the subsequent section.

Summary: Just as Experiment 1, Experiment 2 reveals marginally significant differences among participants depending on length of Spanish immersion. The two bilingual groups produce very different results patterns. The less immersed group has longer overall naming latencies compared to the more immersed group. In the less immersed group, the unrelated and the semantic conditions are highly sensitive to cognate status. This sensitivity results in longer naming latencies for the cognate conditions, compared to the non-cognate conditions. In the next section a post hoc analysis of familiarity effect will be performed to examine whether the reverse cognate effect in fact relies on the effects of familiarity.

In the more immersed group, all conditions are processed equally except for the semantically related non-cognate condition, which induce remarkably shorter latencies compared to all other conditions. Hence, in the more immersed group, the semantically related condition is highly sensitive to cognate status. It is clear that Experiment 2 provide completely different task demands from the participants compared to Experiment 1.

5.6.1.3.1 Post hoc analysis of the familiarity effect

The Swedish/Spanish picture names with cognate status have generated significantly longer naming latencies, mainly in the less immersed group. This is very contradictory to the results of the bilingual experimental literature where it is repeatedly found that cognates are processed faster than non-cognates. This motivates a re-examination of this group of words.

The frequency effect is a well-established word-type effect shown to generate longer latencies for words that are less familiar compared to words which are more familiar. Therefore, an analysis will be performed to investigate if the picture names with cognate status are less familiar to the subjects in this study. Participants had to mark all picture target names for familiarity (see section 3.3) by rating the pictures from 1 to 7 (1 being the lowest and 7 being the highest). Table 27 summarizes the familiarity ratings for the two bilingual groups.

Table 27: Familiarity ratings for cognates vs. non-cognates, Experiment 2

Cognate status	**Bilingual groups**	**Mean familiarity rating**	**SD**
Non-cognates	Less immersed	5.8	.85
	More immersed	6.4	.56
Cognates	Less immersed	5	1
	More immersed	5.8	.75

This post hoc analysis examines one between- and one within-subject variable. The within-subject variable is the familiarity rating of cognate words and non-cognate words. The between-subject variable is the bilingual group divisions based on length of immersion counted in months. Group (1, 2) and familiarity ratings (1, 2) yield a 2 x 2 ANOVA. Separate analyses were conducted with participants and items as the dependent variable, yielding $F1$ and $F2$ statistics, respectively.

A main effect of cognates status on familiarity rating was observed in both analyses ($F1$ (1, 35) = 40.97, p = .000, Z1 .539, $F2$ (1, 48) = 53.12, p = .000, Z2 .525) with lower familiarity for the cognate picture names (5.3) than for the non-cognate picture names (6.0). A main effect of group reached significance but was not significant in the item analysis ($F1$ (1, 35) = 7.57, p = .009, Z1 .178, $F2$ (5, 48) = 1.68, p = .158, Z2 .149) with lower familiarity ratings in the less immersed group (5.3) compared to the more immersed group (6.1). No interaction effect was found in either analysis ($F1$ (1, 35) = 1.53, p = .225, Z1 .042, $F2$ (5, 48) = .376, p = .863, Z2 .038).

It is apparent that degree of familiarity differs significantly between cognate picture names which are rated lower on familiarity, and non-cognate picture names which are rated higher on familiarity. There is no significant interaction effect revealing that both groups identify the cognate picture names as less familiar. This cast light on the reverse cognate effect found in the previous section and we can conclude that it in fact was a disguised word-frequency effect.

The lack of an interaction effect indicates that all participants are equally unfamiliar with the cognate words in this experiment. However, this is manifested more clearly in the naming latency pattern of the less immersed group. The more immersed participants are sufficiently fluent in Spanish to be able to process these words with less of a word-frequency effect. This is in line with previous research findings, which indicate that the word-frequency effect is larger in lower levels of L2 proficiency (see section 2.2.4.2).

Summary: The results of this post hoc analysis of the effect of familiarity ratings on cognate versus non-cognate picture names reveal that familiarity differs significantly for the two word types. Cognate words are significantly less familiar than non-cognate words, across participant groups. This explains the longer naming latencies for cognate picture names in the previous experiment, and we can conclude that this is a manifestation of the well-known word-frequency effect. The effect is larger in the less immersed group, indicating lower levels of fluency in the Spanish lexical processing in this group.

5.6.1.3.2 Post hoc analysis of between participant variability

A post hoc analysis of the bilingual naming latencies was carried out with the same bilingual participants as above but, reorganizing them into three new groups based on how many languages they know in total. This follows the same procedure as in Experiment 1 (see section 4.6.1.4). In the language background questionnaire, participants stated how many languages they knew besides Swedish, English, and Spanish. Eighteen participants knew no other language, twelve participants knew one additional language, and 7 knew two additional languages (see Appendix C).

This post hoc analysis examines one between- and one within-subject variable. Similar to the previous analysis, the within-subject variable is the relation between picture target name and IS, which can be either unrelated, semantically related, or phonologically related to the Swedish picture name. The between-subject variable is based on the new division of bilingual participants according to how many additional languages they know. This variable divides the bilingual participants into three groups. One group of 18 participants know no additional language (referred to as G0 in Table 28). Twelve participants know one additional language (referred to as G1). Seven participants know two additional languages (referred to as G2).

Table 28: Mean naming latencies, post hoc groupings, Experiment 2

IS type	Bilingual group	Mean naming latencies	SD
Phonologically related	G0	978.22	136.11
NC	G1	1094.58	160.63
	G2	1020.21	138.11
Phonologically related	G0	984.47	117.97
C	G1	1044.43	156.01
	G2	1070.77	160.38
Unrelated NC	G0	938.89	127.32
	G1	971.87	95.15
	G2	1047.05	118.75
Unrelated C	G0	1035.03	155.76
	G1	1079.14	100.68
	G2	1072.06	153.03
Semantically related	G0	970.11	114.70

NC	G1	936.69	93.17
	G2	925.17	160.32
Semantically related C	G0	1051.07	155.49
	G1	1034.30	151.76
	G2	1044.58	167.46

Group (1, 2, 3) and IS type (1, 2, 3, 4, 5, 6) yields a 3 x 6 ANOVA. Separate analyses were conducted with participants and items as the dependent variable, yielding F1 and F2 statistics, respectively. Planned comparisons are conducted to establish significance among levels of the within- and between-subject variables. A main effect of IS type was observed in the participant analysis only (F1 (5, 30) = 17.18, *p* = .000, Z1 .741, F2 (2, 47) = 2.23, *p* = .119, Z2 .087) with the longest naming latencies for the unrelated cognate IS (1056.34), followed by the semantically related cognate IS (1044.40), followed by the phonologically related non-cognate IS (1023.90), followed by the phonologically related cognate condition (1020.25), followed by the unrelated non-cognate condition (991.94) and the shortest latencies was induced by the semantically related non-cognate IS (950.77).

A main effect of group was not significant in the participant analysis and only marginally significant in the item analysis (*F*1 (2, 34) = .271, *p* = .764, Z1 .016, *F*2 (5, 48) = 1.758, *p* = .139, Z2 .155) with the longest naming latencies for group of participants who know one additional language (1019.33), followed by the group that knows two additional languages (1010.25), followed by the group that knows zero additional languages (992.66).

An interaction effect was also observed, again in the participant analysis only (*F*1 (10, 60) = 2.99, *p* = .004, Z1 .333, *F*2 (10, 94) = 1.19, *p* = .308, Z2 .112). See Figure 14 for an illustration of the naming latency patterns for the three bilingual groups.

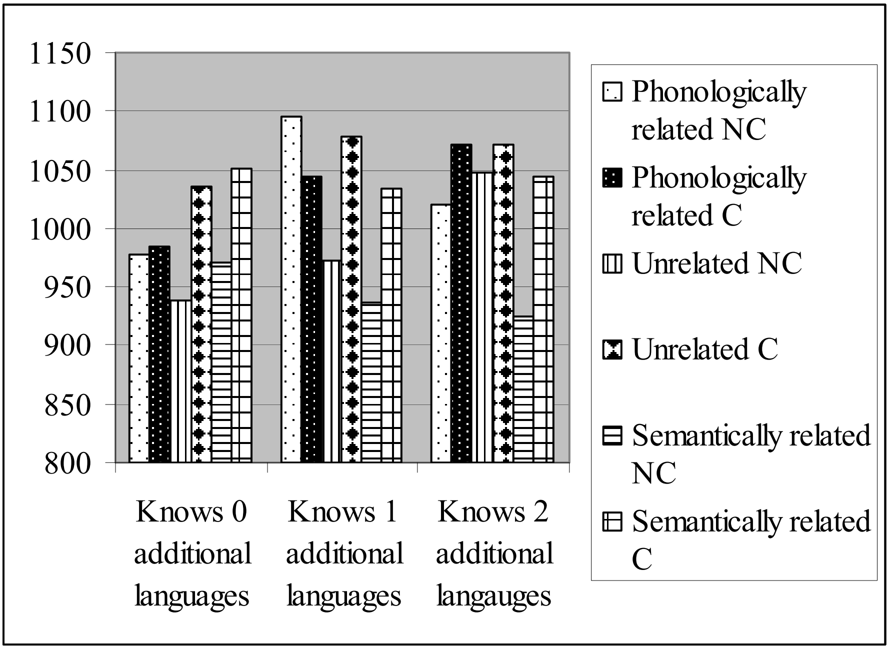

Figure 14: Naming latencies for the post hoc bilingual grouping, Experiment 2

Similar to Experiment 1, these results reveal that the total number of additional languages that the participants know influences Spanish single word lexical processing. To further investigate the interaction, planned comparisons were performed with a Bonferroni correction. Results of the planned comparisons are displayed in Table 29.

Table 29: Planned comparisons, post hoc grouping of bilinguals, Experiment 2

IS type and group comparisons	MSE[a]	T	Df	Sig. (2-tailed)
G1 NC P – G1 NC S	31.01	5.091	11	.000*
G0 NC P – G0 C U	16.37	-3.471	17	.003*
G0 C S – G0 C U	19.19	-3.383	17	.004*
G1 NC P – G1 NC U	33.97	3.612	11	.004*
G0 NC U – G1 C U	36.48	-3.240	11	.008*
G0 NC S – G0 C S	30.37	-2.665	17	.016*
G0 C P – G1 NC P	36.39	-2.832	11	.016*
G0 NC U – G1 NC P	47.24	-2.829	11	.016*
G0 C S – G1 NC S	49.48	2.688	11	.021*
G0 NC S – G1 C U	33.89	-2.666	11	.022*
G0 NC P – G0 C S	29.50	-2.470	17	.024*
G0 NC S – G1 NC P	41.10	-2.575	11	.026
G0 C P – G1 C U	34.15	-2.565	11	.026

G0 C U – G1 NC S	43.93	2.528	11	.028
G0 NC U – G0 C S	29.25	-2.297	17	.035
G0 NC P – G1 C U	44.12	-2.374	11	.037
G1 NC P – G1 C S	27.70	2.176	11	.052
G0 NC U – G2 C P	63.48	-2.398	6	.053
G0 NC P – G1 NC P	56.24	-2.137	11	.056
G0 NC P – G2 C P	55.34	-2.345	6	.057
G0 NC U – G0 C U	25.32	-2.020	17	.059
G1 NC P – G2 NC S	83.29	2.257	6	.065
G0 C P – G0 C S	35.24	-1.890	17	.076
G0 NC U – G2 NC U	61.62	-2.085	6	.082
G0 C S – G2 C P	34.74	-2.024	6	.089
G0 C P – G1 NC S	29.56	1.855	11	.091
G0 NC S – G1 NC S	28.20	1.846	11	.092
G0 NC S – G2 C P	46.70	-2.002	6	.092
G0 NC U – G2 C U	78.75	-1.949	6	.099
G0 C S – G1 NC U	54.97	1.780	11	.103
G0 C P – G0 C U	29.43	-1.718	17	.104
G1 NC U – G1 C P	42.79	-1.696	11	.118
G0 C U – G2 C P	37.25	-1.785	6	.125
G0 NC P – G2 NC U	61.86	-1.714	6	.137
G0 NC U – G1 C P	52.22	-1.599	11	.138
G0 NC P – G2 C U	77.56	-1.690	6	.142
G1 NC U – G1 NC S	22.39	-1.696	11	.145
G0 NC U – G2 NC P	60.79	-1.672	6	.146
G1 NC P – G1 C P	32.07	1.564	11	.146
G0 NC U – G1 C S	47.02	-1.561	11	.147
G0 C U – G1 NC U	50.79	1.494	11	.163
G0 C P – G1 C P	36.82	-1.437	11	.179
G1 NC P – G2 NC P	65.50	1.418	6	.206
G0 NC U – G2 C S	92.32	-1.365	6	.221
G0 NC S – G1 C P	44.22	-1.259	11	.234
G0 NC S – G1 C S	36.35	-1.253	11	.236
G0 C S – G2 C U	55.24	-1.296	6	.243
G0 NC S – G2 C U	73.49	-1.290	6	.245
G0 NC P – G1 C S	49.24	-1.217	11	.249
G0 NC P – G2 NC P	62.75	-1.262	6	.254
G0 NC P – G1 C P	55.33	-1.266	11	.232
G0 NC S – G2 NC U	53.17	-1.312	6	.237
G0 C P – G2 C P	50.16	-1.285	6	.246
G0 C S – G2 NC U	36.76	-1.267	6	.252
G0 C P – G1 C S	39.81	-1.074	11	.306
G0 NC P – G2 C S	93.80	-1.104	6	.312
G0 C U – G2 NC S	75.19	1.052	6	.333

G0 C P – G2 NC S	78.53	1.033	6	.341
G0 NC P – G1 NC S	40.87	.923	11	.376
G0 C U – G2 C U	71.71	-.945	6	.381
G1 NC P – G2 NC U	71.37	.926	6	.390
G0 NC S – G0 C P	17.64	-.814	17	.427
G0 C P – G2 C U	77.60	-.847	6	.429
G0 C U – G1 NC P	58.32	-.803	11	.439
G0 NC S – G2 C S	87.68	-.768	6	.472
G0 C U – G2 NC U	56.82	-.752	6	.480
G0 C U – G1 C U	43.04	-.730	11	.481
G0 C P – G2 NC U	54.51	-.747	6	.483
G0 NC S – G2 NC P	62.69	-.685	6	.519
G1 NC P – G2 C S	102.92	.666	6	.530
G0 NC U – G1 NC S	37.50	.646	11	.531
G0 NC S – G2 NC S	78.32	.655	6	.531
G0 C U – G0 C S	25.36	-.633	17	.535
G1 NC P – G2 C P	65.48	.647	6	.542
G0 C S – G1 C S	56.91	.622	11	.547
G0 NC U – G0 NC S	24.29	.567	17	.578
G0 C P – G1 NC U	34.73	.566	11	.583
G0 C S – G2 C S	76.86	-.574	6	.587
G0 NC S – G1 NC U	32.46	.521	11	.613
G1 NC P – G2 C U	83.57	.491	6	.641
G0 C S – G2 NC P	41.67	-.474	6	.652
G0 C U – G2 C S	91.95	-.438	6	.677
G0 C S – G1 NC P	60.01	-.415	11	.686
G0 C S – G1 C P	61.53	.411	11	.689
G0 NC P – G0 NC S	20.01	.405	17	.690
G1 NC P – G1 C U	40.05	.386	11	.707
G0 C P – G2 C S	97.29	-.393	6	.708
G0 NC P – G0 NC U	20.86	-2.272	17	.789
G0 NC U – G1 NC U	33.36	-.328	11	.749
G0 C U – G1 C S	52.76	.255	11	.804
G0 C U – G2 NC P	62.10	-.256	6	.806
G0 NC P – G0 C P	25.91	-.241	17	.812
G0 C P – G2 NC P	59.10	-.235	6	.822
G0 C S – G1 C U	49.01	-.193	11	.851
G0 NC P – G2 NC S	82.78	.191	6	.855
G0 NC U – G2 NC S	81.12	-.081	6	.938
G0 NC P – G1 NC U	43.29	.059	11	.954
G0 C U – G1 C P	56.88	.058	11	.955
G0 NC U – G0 C P	28.06	-.021	17	.984

[a]MSE = mean standard error

G0 = bilingual participants who know no additional languages, apart from Swedish, English, and Spanish.
G1 = bilingual participants who know 1 additional language, apart from Swedish, English, and Spanish.
G2 = bilingual participants who know 2 additional languages, apart from Swedish, English, and Spanish.
C = a picture with a Swedish/Spanish cognate name
NC = a picture with a Swedish/Spanish non-cognate name
P = phonologically related IS, S = semantically related IS, U = unrelated IS
* = marks statistical significance

The group who knows one additional language produces significantly shorter naming latencies for the non-cognate semantically related IS (936.69) compared to the non-cognate phonologically related IS (1094.58) (t (11) = 5.091, p = .000) as well as compared to the cognate semantically related IS produced by the group who knows zero additional languages (1051.07) (t (11) = 2.688, p = .021). The non-cognate phonologically related IS produced by the group who knows zero additional languages (978.22) is significantly shorter compared to the cognate unrelated IS (1035.03) (t (17) = -3.471, p = .003) as well as compared to the cognate semantically related IS (1051.07) (t (17) = -2.470, p = .024) produced by the same group.

Naming latencies for the semantically related cognate IS produced by the group who knows zero additional languages (1051.07) is significantly longer than the latencies for the unrelated cognate IS produced by the same group (1035.03) to (t (17) = -3.383, p = .004) as well as compared to the semantically related non-cognate IS produced by the same group (970.11) (t (17) = -2.665, p = .016).

The non-cognate phonologically related IS produced by the group who knows one additional language (1094.58) is significantly longer compared to the non-cognate unrelated IS produced by the same group (971.87) (t (11) = 3.612, p = .004) as well as the cognate phonologically related IS produced by the group who knows zero additional languages (984.47) (t (11) = -2.832, p = .016) and the non-cognate unrelated IS produced by the same group (938.89) (t (11) = -2.829, p = .016). The cognate unrelated IS produced by the group who knows one additional language (1079.14) is significantly longer compared to the non-cognate unrelated IS produced by the group who knows zero additional languages (938.89) (t (11) = -3.240, p = .008) as well as the semantically related IS produced by the group who knows zero additional languages (970.11) (t (11) = -2.666, p = .022).

Some comparisons reached near significance. The non-cognate semantically related IS produced by the group who knows one additional language (1094.58) is longer compared to the non-cognate semantically related IS produced by the group who knows zero additional languages (970.11) (t (11) = -2.575, p = .026) as well as compared to the cognate semantically related IS produced by the same group (1034.30) (t (11) = 2.176, p = .052) as well as compared to the non-cognate phonologically related IS produced by the group who knows zero additional languages (978.22) (t (11) = -2.137 = .056). The cognate unrelated IS produced by the group who knows one additional language (1079.14) is longer compared to the cognate phonologically related IS (984.47) (t (11) = -2.565 = .026) and the non-cognate phonologically related IS produced by the group who knows zero additional languages (978.22) (t (11) = -2.374 = .037).

The non-cognate semantically related IS produced by the group who knows one additional language (936.69) is shorter compared to the cognate unrelated IS produced by the group who knows one additional language (1035.03) (t (11) = 2.528 = .028). The non-cognate unrelated IS produced by the group who knows zero additional languages (938.89) is shorter compared to the cognate semantically related IS (1051.07) (t (17) = -2.297 = .035) produced by the same group, and also compared to the cognate phonologically related IS produced by the group who knows two additional languages (1070.77) (t (6) = -2.398 = .053) as well as compared to the cognate phonologically related IS produced by the group who knows two additional languages (1070.77) (t (6) = -2.345 = .057).

The non-cognate unrelated IS produced by the group who knows zero additional languages (938.89) is shorter compared to the cognate unrelated IS produced by the same group (1035.03) (t (17) = -2.020 = .059). The non-cognate semantically related IS produced by the group who knows two additional languages (925.17) is shorter compared to the non-cognate phonologically related IS produced by the group who knows one additional language (1094.58) (t (6) = 2.257 = .065). The cognate phonologically related IS produced by the group who knows zero additional languages (984.47) is shorter compared to the cognate semantically related IS produced by the same group (1051.07) (t (17) = -1.890 = .076).

These results reveal that participants who know zero additional languages have the shortest mean naming latencies of the two groups, followed by participants who know two additional languages, while the longest mean naming latencies are produced by participants who know one additional language. In Experiment 1 this was also the group with the longest naming latencies.

The groups also differ in their naming latency patterns. One trend which is present in all groups is that the cognate conditions induce longer response latencies than the non-cognate conditions. There are two exceptions to this. The cognate phonologically related condition in the group who knows zero additional languages did not induce longer naming latencies than the non-cognate conditions. And among participants who know one additional language, the non-cognate phonologically related condition induced the longest latencies of all. Apart from these exceptions, the cognate conditions seem to generate the longest naming latencies, regardless of IS type.

Summary: Patterns of naming latencies between participants differ significantly depending on how many languages they know in total. Participants who know zero additional languages are dominated by less immersed participants, hence it is unclear whether the naming latency pattern produced by this group reflects length of immersion or degree of multilinguality. The two remaining groups, however, participants who know one and two additional languages, are balanced across length of immersion and the naming latency patterns associated with each group must therefore be a result of how many languages they know.

These two groups differ in one important aspect. Participants who know one additional language produce significantly longer latencies across IS types compared to participants who know two additional languages. The cognate conditions induce longer naming latencies in both groups, across IS types, with one exception: the phonologically related non-cognate condition induces the longest naming latencies of all IS types among participants who know one additional language.

5.6.2 Results, Swedish comparison group

The Swedish comparison group performs a monolingual test version of Experiment 2. Since the test is completely in Swedish the cognate dimension is eliminated. Hence, all analyses of the comparison group will only consider the three IS types: semantically related, phonologically related and unrelated.

5.6.2.1 Accuracy scores

Data from the Swedish comparison group was given the same treatment as the data for the bilingual groups in terms of elimination of null responses and outliers. A total of 7.4% of the data were eliminated, of which 2.8% were outliers, 2.6% technical errors, and 2.0% true errors. The remainder was treated as accuracy scores, 92.6%, of all naming responses. Table 30 summarizes the accuracy score percentages for the comparison group.

Table 30: Mean accuracy percentages, Swedish comparison group, Experiment 2

Picture IS-relation	Mean accuracy %	SD
Phonological	91.1	9.16
Unrelated	93.5	7.44
Semantic	92.6	7.62

An analysis of variance was conducted on Arcsine transformed values of accuracy score percentages. There was no significant effect of IS type in either analysis (*F*1 (2, 16) = .742, *p* = .492, Z .085, *F*2 (2, 50) = .283, *p* = .755 MSE .023).

Summary: Results of the accuracy scores analysis reveal that the Swedish comparison participants treat phonologically related, unrelated and semantically related ISs equally, in terms of accuracy.

5.6.2.2 Naming latencies

Naming latency analyses are based exclusively on accurate naming responses. Table 31 summarizes the distribution of mean naming latencies as a function of target word and IS pairing for the Swedish comparison group. Since the Swedish comparison group does not know Spanish, the cognate dimension is removed from this analysis. The picture names with Swedish/Spanish cognate status are treated as regular Swedish picture names with non-cognate status.

Table 31: Mean naming latencies, Swedish comparison group, Experiment 2

IS type	Mean naming latency	SD
Phonologically related	997.44	153.85
Semantically	983.22	124.26
Unrelated	1018.44	124.14

An analysis of variance was conducted with participants and items as random factors and type of IS as the within-subject variable. No significant effect of word type was observed (*F*1 (2, 16) = 2.397, *p* = .123, Z .231, *F*2 (2, 51) = .454, *p* = .638, MSE 11.75). In the research literature, a phonologically related IS in monolingual picture-word interference experiments is expected to induce shorter naming latencies, and a semantically related IS is expected to induce longer naming latencies compared to an unrelated IS, contrary to the present trend in the monolingual version of Experiment 2. The trend is contrary to the expected pattern of semantically related conditions inducing the shortest naming latencies.

As was mentioned in section 3.1.2., the Swedish comparison group is not actually monolingual, but rather bilingual, since they all know English, and in some cases even trilingual. All picture names with Swedish/Spanish cognate status also have Swedish/English cognate status, and some of the non-cognate pictures are also Swedish/English cognates (see Appendix I). This makes 13 of the 18 pictures Swedish/English cognates. Since there are so many English cognates in this experiment, no post hoc analysis will be performed investigating this probable influence. Thus, subsequent analyses were conducted to probe probable effects from subjects knowing additional languages.

Summary: The analysis of naming latencies in the Swedish comparison group reveals no effect of IS type. This might be due to large between-participant variability in the data. Subsequent analyses of effects caused by between-participant variability are carried out in the next section.

5.6.2.2.1 Post hoc analysis of cross-linguistic effects on naming latencies

Since many of the participants are trilingual, additional cross-linguistic effects must be investigated. Eight of the 18 Swedish comparison participants are proficient in German (44.4%). Since there was no significant effect for cognate status, IS types are collapsed across cognate status. Hence, appropriate analyses were performed with participant (1, 2) and item (1, 2, 3) as random factors yielding a 2 x 3 ANOVA.

A main effect of IS type was observed in the item analysis only ($F1$ (5, 12) = 1.415, p = .287, Z1 .371, $F2$ (1, 47) = 23.87, p = .000, Z2 337) with the shortest naming latencies for the semantically related non-cognate IS (959.86), followed by the phonologically related non-cognate IS (994.01), followed by the phonologically related cognate IS (1000.87), followed by the semantically related cognate IS (1006.57), followed by the unrelated non-cognate IS (1013.18), followed by the unrelated cognate IS (1023.70).

A main effect of group was marginally significant in the participant analysis ($F1$ (1, 16) = 3.166, p = .094, Z1 165, $F2$ (5, 47) = .604, p = .697, Z2 060) with shorter naming latencies for participants who do not know German (956.40), compared to participants who know German (1049.09). No interaction effect was observed in either analysis ($F1$ (5, 12) = 1.415, p = .287, Z1 .371, $F2$ (5, 12) = .540, p = .743, Z2 .184). See Table 32 for mean naming latencies for the different IS types as produced by the participants who know German and those who do not know German.

Table 32: Swedish comparison participants grouped according to whether they know German, Experiment 2

IS type	**Participant groups**	**Mean naming latency**	**SD**
Phonologically related	Knows German	1061.41	141.13
	Doesn't know German	946.26	150.57
Semantically related	Knows German	1045.38	138.14
	Doesn't know German	933.49	90.24
Unrelated	Knows German	1057.87	149.76
	Doesn't know German	986.89	95.79

The participants do not differ significantly as to how they handle the different IS types depending on whether they know German. However, there is an interesting trend revealing that the participants who know German produce longer naming latencies across all IS types. It is apparent that being proficient in German slows down the lexical processing in this experimental setting.

Summary: When the comparison participants are divided into two groups according to whether or not they know German, no significant effect was found, however, there was a small trend towards longer naming latencies across IS types for participants who know German. It seems that knowing German slows down native language lexical processing in this experimental setting.

5.7 Summary of results and discussion, Experiment 2

Similar to Experiment 1, the results of Experiment 2 suggest a significant difference between participants depending on their length of Spanish immersion. The less immersed participants produce lower accuracy scores and longer naming latencies with marginal significance, compared to the more immersed group. This again proves the hypothesis valid, that Spanish immersion is an external factor which determines Spanish performance in this online experimental setting.

The bilingual participant groups based on length of Spanish immersion differ significantly in how they process Spanish words depending on cognate status. Naming latencies for the less immersed participants differ significantly in two out of the three IS types depending on cognate status. Naming latencies for the more immersed participants differ significantly in one out of the three IS types depending on cognate status. This suggests that the less immersed participants are more affected by cognate status than are the more immersed participants.

In section 5.5.1.3.1 it was established that the cognate words were rated significantly lower on familiarity compared to the non-cognate words across bilingual groups. And it was concluded that the reverse cognate effect is an effect of low word-familiarity. It is completely in line with previous research that all participants are affected by the word-frequency effect, and that the less immersed participants are more affected.

However, there is something in play here as well. The word familiarity effect cannot alone be responsible for the naming latency patterns in this experiment. This is indicated by the fact that it does not have the same impact on all experimental conditions. In the less immersed group, the semantically related and the unrelated conditions are sensitive to cognate status. In the more immersed group, only the semantically related condition has this sensitivity.

Again, the semantically related condition is processed similarly to the unrelated condition in the less immersed group. These conditions induced the longest latencies for the cognate picture names, and the shortest for non-cognate pictures. In Experiment 1, these two conditions also induced the shortest naming latencies. And we have concluded that the longer latencies for cognate picture names depend on the familiarity effect. Therefore, the question which should be posed is: why does familiarity not affect the phonologically related cognate condition?

It seems that this is another manifestation of form-prone lexical processing in the less immersed participants. Again, the naming latency pattern of the less immersed participants this experiment suggest a phonologically based architecture of the bilingual mental lexicon. The fact that cognate status affects high- and low-familiarity words differently supports the statement made by Namei (2002), that a transition from lexically based processing to conceptually-based processing is a word-by-word process.

In the more immersed group, the phonologically related cognate condition does not have shorter naming latencies. Participants in the more immersed group are mainly conceptually driven; i.e. their lexical processing is dominated by conceptual links, which means that the form similarity does not have the same effect on their lexical processing. The fact that the semantic non-cognate condition induced the shortest naming latencies for the more immersed group could be a manifestation of the dominance of conceptual processing in these participants.

It is important to note what processing demands this experiment puts on the participants. One third of the ISs are phonologically related to the target picture name, and half of the pictures are cognates, i.e. adding another dimension of form similarity to the experiment. This makes the experiments dominated by form-related conditions and becomes lexically driven.

In line with this type of reasoning, the interpretation of the naming latency patterns in Experiment 2 comes down to what processing demands the bilingual is exposed to and how they respond to this. A bilingual with little L2 immersion has not yet developed enough conceptually driven processing links between conceptual and lexical representations in L2, this person processes his L2 mainly by means of lexical links. And especially in low frequency words and words which are similar in form. When such a person is exposed to a situation which prompts lexical processing, these processing links cannot be suppressed.

When a more immersed subject is subjected to this experiment, the naming latency pattern reveals that they compensate for stronger conceptual processing to such an extent that the condition including the most conceptual processing and the least processing of form (the semantically related non-cognate IS) is facilitated. This facilitation effect is interpreted as a clear task effect.

Again, the post hoc grouping of bilinguals, depending on how many additional languages they know in total, induces significant differences in naming latency speed. Again, the group of participants who know one additional language produces the longest naming latencies of all three groups. Cognate status affects all IS types in both groups, except for the phonologically related non-cognate condition which induces the longest naming latencies of all in participants who know one additional language.

The monolingual comparison group revealed no effect of IS type. Post hoc analyses investigated the between-participant variability in the data and it was apparent that when the participants were divided into two groups according to whether or not they know German there was a small trend towards longer naming latencies across IS types for participants who know German. Similarly to Experiment 1, it seems that knowing German slows down native language lexical processing in this experimental setting.

6 General discussion

One of the most important findings in this thesis is that initial stages of language processing are characterized by the lack of automaticity and this is reflected in the unexpected naming latency pattern produced by the less immersed group. Lexical processing in this group is slightly influenced by English (a stronger L2 than Spanish).

A second important finding is that after the initial stages of learning are passed, there is a large difference in lexical processing depending on how many languages the bilingual participants know. The Swedish comparison group also reveals cross-linguistic effects as a source of variability in the naming latency data. All bilingual participants were affected by word-familiarity, but the less immersed group was more affected.

The results of both experiments in this study suggest that initial stages of L2 acquisition is characterized by predominantly phonological processing, while the more immersed participants display more conceptual processing. The less immersed participants have not had the practice required to build up their Spanish lexical processing system to equal that of highly proficient bilinguals as reported in the research. And their naming latency pattern is taken to reflect the most initial stages of automatization in L2 lexical processing. Since this learner type has not been tested experimentally, we need to turn to offline research for explanations.

Offline research has shown that beginning learners have a lexically based architecture of their lexicon. They give more phonologically based associations (Söderman, 1993), they translate slower (Kroll & Stewart, 1994), and they have a larger number of non-responses in L2 translation compared to further developed learners who give more meaning-based errors (Tokowitz et al., 2004). According to the revised hierarchical model, conceptual links are assumed to replace or weaken the lexical links as level of L2 proficiency increases.

This predicts that the learners should go from predominantly processing their L2 by means of word-association to processing by means of concept mediation as a function of increased proficiency. This, in turn, predicts that the phonologically related condition in a picture-word-interference experiment should become shorter, as proficiency increases. If we compare the results of the two participant groups, we can see that this is exactly what happens. Naming latencies in the phonologically related condition are the shortest of all conditions in the more immersed group. Thus, the participants in this group have gone from form-based processing to concept mediation.

Furthermore, the fact that the word-familiarity effect influences semantically and phonologically related conditions differently supports Namei's (2002) findings. She contended that early bilinguals go from lexically based links in the lexicon to conceptually based links in a word-by-word manner. Thus, the present study captures what has since long been reported in offline research: i.e. early stages of L2 development is characterized by predominantly phonologically based processing.

It is interesting that the less immersed participants produce longer latencies in the phonologically related condition. This might very well be an initial stage of phonological processing, preceding a facilitation effect. The phonological information is certainly being processed; this is indicated by the significantly longer naming latencies compared to the unrelated condition. But it is not processed in the same way as by highly proficient bilinguals. Thus, these findings suggest a pre-facilitation processing stage of phonological information in the very initial stages of L2 lexical access.

Furthermore, there are inconsistencies between accuracy scores and naming latency patterns. For example, the phonologically related non-cognate condition induced the lowest accuracy score and relatively short naming latencies for the less immersed participants in Experiment 2. This suggests that the less immersed participants do not process phonological information in a stable and controlled way. This might be evidence for the developmental stage where processing is characterized by uncontrolled processing as suggested in the developmental ladder above.

Similarly to the more immersed group, the less immersed participants reveal sensitivity to between-language competition. This is the interference between the L1 and the L2 picture names, induced by the IS which is phonologically related to the Swedish picture name. This is the only IS type following the expected naming latency pattern in the less immersed group. Thus it seems like between-language competition is established before cross-linguistic phonological facilitation effects, and certainly before cross-linguistic semantic interference. This suggests a series of developmental stages in L2 lexical processing: between-language competition > uncontrolled phonological processing > phonological facilitation > semantic interference. This developmental ladder will obviously need further testing and corroboration by future studies.

If we want to interpret these findings within a three-store lexical model founded on activation spreading, we would assume that the long response latencies in the phonologically related condition indicate that non-selected lexical-level representations are not activated. However, this does not explain why the semantically related condition induces the shortest latencies of all conditions (by the less immersed participants in Experiment 1). There not only seems to be a lack of phonological facilitation, but there appears to be phonological interference. The findings of the present study therefore do not fit such models. One reason that these results have never appeared in the research literature can be that the less immersed group is at a very early stage of acquiring their L2, and such a participant group has not been investigated within this research paradigm before.

The challenge for all bilingual models should be to include the earliest stages of acquisition in order to account for what happens at the beginning of L2 learning. According to the findings in the present study, this development needs to incorporate the ideas behind the revised hierarchical model into the three-store spreading activation models. Learning starts with a form-prone stage, in which lexically based links are established and dominate L2 processing. This domination of lexical processing gradually diminishes as the semantic processing takes over. The revised hierarchical model describes this in terms of lexical links weakening and conceptually related links getting stronger, but with both processing types still co-existing within the same speaker. This should be incorporated in spreading activation models.

So how do we incorporate findings from offline research into a bilingual model of processing flows? To account for the findings within a processing paradigm, we can adopt several perspectives. First, the longer naming latencies could be caused by the longer path for the signal to travel. The revised hierarchical model assumes that this is what happens in early stages of L2 learning, when the participant has no direct link between the conceptual level and the L2 word form. The signal must therefore travel from the conceptual representation, via the L1 form, before the L2 form representation is accessed. This explains the findings in Experiment 1, where the phonologically related condition produces longer latencies than the semantically related and the unrelated conditions.

The semantically related condition produces shorter response latencies because there is no need to activate the L1 form representation of the L2 target word. The L2 target word receives activation from its semantically related IS and hence is responded to faster than the phonologically related. In the latter, there is some delay because an additional representation (the L1 form) is activated consuming processing effort and time. The delay is therefore explained by the activation of additional components, which is in line with the spreading activation account. The answer could be to reinterpret offline findings of a developmental ladder, running from form to meaning, into processing flows within a spreading activation paradigm.

According to the revised hierarchical model, form-based processing and concept-based processing co-exist within the same speaker. I assume that the less immersed group is prone to form-based processing. What happens in these experiments is that the different ISs are activating the two types of processing. The phonologically related IS induces lexical processing and the semantically related IS induces conceptual processing. The bilingual, at this early stage, is unstable from a processing point of view, and when manipulating form-based ISs, this activates processing via word-association links. And it has been repeatedly shown in the literature that data-driven tasks, which focus on form, tap phonological processing (see Chapter 2). The results from Experiment 2 in the present study support this.

Experiment 2 included cognates, which alter the experimental task because it becomes form-dominated. The less immersed participants are too unstable to be able to suppress phonological processing. This means that evidence from any experiment is the conjoint result of the specific task demands, and how the L2 participant to respond to this. The factors influencing how the participant respond to the task demands can be attained level of proficiency, and automaticity.

The patterns of results appearing in the post hoc analyses reveal the importance of cross-linguistic influence. The participant group who knows no additional languages has a naming latency pattern which is identical to the participant group with less L2 immersion. The group who knows one additional language (mostly German) has the longest naming latencies of the three groups. These participants process all four word types equally, except for the phonologically related IS type, but this difference is not close to reaching significance. And the third group of participants, who know two additional languages (mostly French) has a pattern which is identical with the more immersed group, except that this group has slightly longer naming latencies in the unrelated condition.

The longer naming latencies for the group who knows German suggests interference. Since German is perceived as close to L1, this additionally activates the L1 representations, and the expected differences in naming latencies among word types are cancelled out. For the participants who know French, the representations of their L2 are additionally activated, and this magnifies the differences in processing speed among the word types. It is possible that knowing a language which is perceived as close to the L2 facilitates L2 processing (Kellerman, 1983).

The evidence in the present investigation is inconclusive concerning the possible influence from specific languages in multilingual subjects. But the results of the post hoc groupings clearly suggest that this dimension of lexical access does influence L2 processing. Future research must take additional languages of multilingual subjects into consideration in experimental research of this type.

The monolingual comparison group does not differ significantly in lexical processing of semantically related, phonologically related or unrelated features, which would be expected. One possible explanation lies in the fact that this group is actually not monolingual. The comparison group is bilingual and multilingual to a large extent and this brings significant variability to the data. One important trend in the naming latencies is the fact that target words which have some amount of phonological similarity to the English picture name are named somewhat faster than target words with no such cross-linguistic overlap. This suggests that there is some amount of cross-linguistic influence from English in this experiment. A large part of this participant group is proficient in German; these participants tend to name pictures somewhat slower. This also influences the data and evens out processing effects of experimental conditions.

The fact that the cognate effect in the present study is overridden by a familiarity effect shows that when L1 and L2 are not closely related, cognate words tend to be low frequency words. It is often stressed, that models of the bilingual lexicon must incorporate cognate words. Findings from the present study question this, and stress the importance of frequency. It appears that the cross-linguistic effect of cognate words have relative importance depending on which languages are involved. It might be that the degree of relatedness between languages determines the frequency of cognates, and that this in turn, determines how they are processed.

6.1 Future directions

Future research must further examine initial stages of L2 lexical access to discern possible stages of automaticity attainment. Furthermore, more research is required in detecting influence from additional languages in multilingual subjects. The importance of psychotypology must be taken into consideration. What determines the cross-linguistic influence; is it the number of additional languages a subject knows, or the relative relatedness between target languages? Some of the variables that should be controlled are for the number of languages the participants know, relatedness between additional language and the target L2, as well as participants' proficiency in all languages. It may be difficult to control variation in such a study. But this type of subject is not at all rare.

6.2 Conclusion

Length of immersion is a factor which can influence bilingual lexical processing. Evidence from the present study reveals small effects of length of L2 immersion on speed and accuracy in two PWI experiments. More interesting is that the two groups differ in naming latency pattern, i.e. they differ in processing of semantic and phonologic information. The more immersed group produces cross-linguistic phonological facilitation, semantic interference and between-language competition.

Similar to what offline research has contended, the less immersed participants in the present study reveal signs of phonological processing, but no semantic interference. The phonological processing is not manifested as a facilitation effect. Rather, it is inconsistent and unstable suggesting an initial stage of uncontrolled phonological processing preceding phonological facilitation. The semantic information is not processed at all. This suggests that there is an even earlier stage of processing, before phonological facilitation is attained.

Furthermore, Swedish/Spanish cognate words are unfamiliar to such an extent for the participants that they induce a classic word-frequency effect in all bilinguals in the present study. This disputes the importance of accounting for cognate words in models of the bilingual lexicon.

In the present investigation it was also apparent that cross-linguistic effects of additional languages known to the participants must be taken into account when studying the bilingual lexicon. In the Swedish comparison group, this was especially evident. Expected effects of phonological facilitation and semantic interference were cancelled out by variability caused by the fact that half of the pictures (in Experiment 1) were Swedish/English cognates and they induced a facilitation effect. There was also a large variability among participants since about half of the subjects know German, and they consistently produced longer naming latencies throughout the two experiments.

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Appendix A: Language background questionnaire

Name……………………………………

Telephone number………………………………………………..

When were you born? (year, month) ………………….

In what country were you born? If you were not born in Sweden, state what year you arrived in Sweden.

____

At what age did you start to learn Spanish? How? Where?

____

Did you speak Spanish with your parents while growing up?

____

At what level do you study Spanish at the university?

____

Have you studied Spanish at any other university or school (for example high school)?

____

Have you been to a Spanish speaking country? Which country? How long and when were you there?

____

Have you been to any other country for a longer period of time? Which? When and for how long?

How well do you judge your Spanish proficiency to be, compared to other languages you know? The language you consider to be your strongest should be a 5 on the scale. The language you consider to be your mother tongue should be rated 5.

Swedish

1 2 3 4 5

Spanish

1 2 3 4 5

English

1 2 3 4 5

Other (write what language)

1 2 3 4 5

Other (write what language)

1 2 3 4 5

Do you speak Spanish outside university classes? With whom?

A lot____ A little____ Nothing____

Do you watch a lot of Spanish TV or Spanish movies? Do you listen to Spanish music?

Circle the best alternative. 1 is the lowest score and 5 is the highest.
Estimate you level of comprehension of spoken Spanish.

1	2	3	4	5

Estimate you level of speaking Spanish.

1	2	3	4	5

How well do you read in Spanish?

1	2	3	4	5

How well do you write in Spanish?

1	2	3	4	5

Further information

____

Circle the best alternative on a scale from A to F how many hours you read, write, speak and listen in Spanish. The amount of hours should comprise both university course time and the time outside of class. Try to estimate an average for the whole semester. The values on the scale equal the following number of hours:

A = 1-2 hours/week
B = 2-5 hours/week
C = 5-8 hours/week
D = 8-11 hours/week
E = 11-14 hours/week
F = 14 or more hours/week

Read	A	B	C	D	E	F
Write	A	B	C	D	E	F
Speak	A	B	C	D	E	F
Listen	A	B	C	D	E	F

Try to estimate your total use of Swedish and Spanish in percentage. For example, if you don’t use Spanish to a great extent, write ”Swedish 90%” and “Spanish 10%”. If you use Spanish a lot, both in class and with you friends/family, maybe you can write ”Swedish 45%” and ”Spanish 55%”. Try to state an average over the whole semester.

Swedish _______________ Spanish_________________

ADMISSION

I consent to participate in the study on vocabulary development carried out by PhD student Ulrika Serrander at Uppsala University. I hereby give my approval for the results to be used in research and education on language and language acquisition, with the right to anonymity. PhD student Ulrika Serrander, Department of linguistics and philology (ulrika.serrander@lingfil.uu.se) at Uppsala University, guarantees that the data is stored, handled and used in accordance with the ethical principles of research for social sciences and humanities stated by the Swedish research council (www.vr.se).

____
Date

____
Signature

____
Clarification of signature

Appendix B: Language proficiency test

Part I: Spanish grammar and vocabulary

Fill in the gaps to complete the sentences. In some cases it requires one word to complete the sentence, sometimes several.

1. ¡ __________________sed tengo!

2. Cuando eran más jóvenes siempre _________________a fútbol, ahora ya no juegan.

3. Hoy hemos ido a trabajar. Ayer no__________________________.

4.____________________, buscaste, buscó, buscamos, buscasteis, buscaron.

5. Ayer ____________________yo la mesa, hoy te toca ponerla a ti.

6. ¿A ______________________gente habían invitado?

7. Nació ___________________________1925.

8. Las sillas de mi abuela eran _________________________madera.

9. Pasaremos ______________________tu casa cuando salgamos de la oficina.

10. Marta y Pablo ______________________________de su luna de miel.

11. Lamentablemente ________________________podemos quedarnos cinco minutos.

12. Cuando llegué, ellos ___________________________en el sofá.

13. Tengo un piso muy pequeño. No sé si _____________________todos.

14. Cuando trabajaba en Londres, siempre _a casa por Navidad.

Circle the correct choice of word to complete the sentence. You can only circle one word per sentence.

1. ¿Qué __________ Uds.?
A. hacéis
B. hago
C. hacen
D. haces

2. Rosa y Miguel van __________ cine.
A. al
B. de la
C. del
D. a la

3. Yo __________ el hermano de Pepe.
A. eres
B. soy
C. estoy
D. es

4. Hace un año que trabajo en __________ fábrica.
A. esto
B. esta
C. ese
D. este

5. Tomás dijo que __________ a correos pero no tiene tiempo.
A. va
B. iría

C. iba
D. ir

6. ¿Dónde vivían los aztecas a __________ venció Cortés?
A. quienes
B. que
C. los cuales
D. quien

7. Juan quiere que __________ temprano.
A. llegan
B. llegaron
C. llegar
D. lleguen

8. Las niñas __________ jugando en la calle.
A. son
B. somos
C. están
D. está

9. El otro día yo __________ Tomás.
A. veía
B. vi a
C. viste
D. vieron

10. Ayer __________ buen tiempo.
A. era
B. hacía
C. había
D. estaba

11. Era probable que él lo __________ .
A. tenga
B. tuvo
C. tenía
D. tuviera

12. Todas mis amigas __________ a la fiesta por Marcos.
A. han sido invitadas
B. han sido invitado
C. están invitado
D. son invitadas

13. Rosa me __________ ayer.
A. visitasteis
B. visité
C. visitaste
D. visitó

14. Pepe toca __________ guitarra.
A. los
B. la
C. lo
D. el

15. ¡ __________ Uds.!
A. Se levanten
B. Levántense
C. Levántanse
D. Levántese

Part II: Spanish grammar
Every sentence contains a couple of underlined words. Circle the word which is incorrect. You can only circle one word per sentence.

1. Ayer yo ella escribí una carta.
A. Ayer
B. ella
C. una
D. carta

2. El campesino venden frutas.
A. El
B. campesino
C. venden
D. frutas

3. Dirigimos uno negocio importante.
A. Dirigimos
B. uno
C. negocio
D. importante

4. Poco a poco los estudiantes van aprendendo.
A. a
B. los

C. van
D. aprendendo

5. Ellos fueron al teatro los sábados.
A. Ellos
B. fueron
C. los
D. sábados

6. El médico era un hombre dedicaba a la numismática.
A. era
B. dedicaba
C. a
D. la

7. ¿Saludan Uds. al profesor al entra en la clase?
A. Saludan
B. Uds.
C. al
D. entra

8. ¿Quien las va a arreglar?
A. Quien
B. las
C. va
D. a

9. Pagó diez dólares para el libro.
A. Pagó
B. dólares
C. para
D. el

10. Le lo dijo hace mucho tiempo.
A. Le
B. lo
C. dijo
D. hace

11. ¿De dónde viene todo esto ruido?
A. dónde
B. viene
C. todo
D. esto

12. Si tenía mucho dinero, me compraría un coche nuevo.
A. tenía
B. me
C. compraría
D. un

13. Mañana por la mañana he terminado con mi trabajo.
A. por
B. he
C. terminado
D. mi

14. Andrés no quiso discutir y le fue a Madrid.
A. quiso
B. discutir
C. le
D. a

15. La ciudad fue destruido por el huracán.
A. La
B. fue
C. destruido
D. por

Part III. Vocabulary
Choose the word which best fits in the sentence. Circle one word only.

1. Los___________ ayudan a los médicos.
A. enfermos
B. enfermeros
C. enero
D. entrenadores

2. Es una broma: yo te estoy tomando ___________.
A. el pelo
B. el codo
C. el chiste
D. la pierna

3. Yo voy a la playa porque____________ calor.
A. hago
B. estoy
C. soy
D. tengo

4. ¿A qué hora llega el avión __________ Miami?
A. a
B. en
C. para
D. con

5. Este abrigo es muy chico: no te __________ bien.
A. coloca
B. lleva
C. queda
D. cabe

6. Rafa tiene ___________ estudiar esta noche.
A. a
B. de
C. con
D. que

7. Hace mal tiempo hoy: está lloviendo a __________
A. gatos y perros
B. cántaros
C. mucho
D. relámpago

8. Ellos __________ la guitarra.
A. juegan
B. actúan
C. tocan
D. interpretan

9. Yo no entiendo ____________ tú dices eso: es mentira.
A. que
B. por qué
C. qué
D. porque

10. No entiendo la tarea así que le _________ una pregunta al profesor.
A. pregunto
B. pido
C. hago
D. contesto

Part IV. Reading comprehension
Read the Spanish texts and choose the best answer to the questions that follow.

Todos los pueblos tienen, sin duda, una serie de fórmulas prácticas para la vida, consecuencia de la raza, de la historia, del ambiente físico y moral.

Miguel de Unamuno, Del sentimiento trágico de la vida

1. Según el contexto de esta narración, ¿qué quiere decir la palabra "pueblo"?
A. gente
B. aldeas
C. tribus
D. países

2. ¿A qué clase de fórmula se refiere el fragmento?
A. a una fórmula química
B. a una fórmula urbana
C. a una fórmula social
D. a una fórmula matemática

¿Dónde estás, señora mía,
que no te duele mi mal?
O no lo sabes, señora,
o eres falsa y desleal.

Miguel de Cervantes, Don Quixote

3. ¿A quién le habla el narrador en esta estrofa?
A. a sí mismo
B. al lector
C. a una mujer
D. al autor

4. ¿Cómo describe el narrador a la "señora"?
A. contenta
B. leal
C. desleal
D. triste

Para Rodolfo Otto la presencia de lo Otro - y podríamos añadir, la sensación de "otredad"- se manifiesta "como un misterio tremendum, un misterio que hace temblar." Al analizar el contenido de lo tremendo, el pensador alemán encuentra tres elementos. En primer término el terror sagrado, esto es, "un terror especial," que sería vano comparar con el miedo que nos produce un peligro conocido. El terror sagrado es pavor indecible, precisamente por ser experiencia de lo indecible.

Octavio Paz, El arco y la lira

5. ¿A qué se refiere "otredad" en este fragmento?
A. al plagio
B. a una falta de comunicación
C. a una disparidad entre un punto de vista alemán y otro punto de vista español
D. a algo más allá del mundo que percibimos

6. ¿Qué quiere decir Paz cuando escribe "pavor indecible?"
A. Es un pavo que tiene miedo.
B. Es un miedo que no se puede explicar.
C. El terror es algo sagrado.
D. La experiencia es indecible.

7. Según Paz, ¿cuáles son las dos ideas que serían vanas comparar?
A. Rodolfo Otto y Octavio Paz
B. el contenido y los elementos del relato
C. el miedo y el terror
D. la experiencia y la ira

Habló del Yucatán, donde habían construido catedrales suntuosas para ocultar las pirámides paganas, sin darse cuenta de lo que los aborígenes acudían a misa porque debajo de los altares de plata seguían vivos sus santuarios. Habló del batiburrillo de sangre que habían hecho desde la conquista: sangre de español con sangre de indios, de aquéllos y éstos con negros de toda laya, hasta mandingas musulmanes, y se preguntó si semejante contubernio cabría en el reino de Dios.

Gabriel García Márquez, Del amor y otros demonios

8. ¿Cuál es el tema de este fragmento?
A. la Conquista del Yucatán
B. asombro por una existencia mutua de indígenas y españoles después de la conquista

C. las catedrales del Yucatán
D. la religión en tiempos precolombinos

9. ¿Quién será el protagonista de este fragmento?
A. un español
B. un conquistador radio
C. un arqueólogo
D. un locutor de dias indígenas

10. ¿Qué es una cosa de la cual el protagonista NO habla en este fragmento?
A. la mezcla de razas desde la Conquista
B. las fechas de la conquista del Yucatán
C. las catedrales del Yucatán
D. las pirámides del Yucatán

Appendix C: Subjective ratings of language proficiency

Participant ID:	English:	Spanish:	Other:	Other:
21	4	3	-	-
32	3	1	-	-
33	3	4	-	-
34	4	2	-	-
18	4	3	-	-
28	4	2.5	-	-
16	4	2	-	-
15	3	3	-	-
14	3	3	-	-
11	2	3	-	-
63	4	3	-	-
58	3	2	-	-
42	4	2	-	-
44	3	2	-	-
46	4	3	-	-
47	4	3	-	-
25	4	4	-	-
10	4	3	-	-
35	4	2	1 (German)	-
13	4	3	2 (German)	-
22	4	3	2 (German)	-
24	4	4	1 (German)	-
62	4	3	4 (German)	-
59	3	4	1 (German)	-
17	4	3	2 (German)	-
53	5	2	3 (German)	-
51	4	1	3 (French)	-
5	4	4	2 (French)	-
19	3	4	2 (French)	-
12	3	4	2 (Italian)	-
31	4	3	2.5 (German)	2.5 (Portuguese)
48	5	3	2 (German)	2 (French)
38	3	4	2 (French)	1 (Portuguese)
2	4	4	3 (French)	2 (?)
61	3	4	5 (French)	1 (German)
40	4	4	3 (Hebrew)	1 (French)
29	4	2	2(Norwegian)	1 (French)

Appendix D: Word familiarity ratings questionnaire

This is a test to see how well you know certain Spanish words. You will be presented with a list of 33 Spanish words. Mark each of the words according to how well you know it on a scale from 1 to 7 (a 1 indicates "never seen, heard, or used the word in my life"; a 7 indicates "often seen, heard or used the word").

muñeca

1 2 3 4 5 6 7

banana

1 2 3 4 5 6 7

cesta

1 2 3 4 5 6 7

plato

1 2 3 4 5 6 7

flecha

1 2 3 4 5 6 7

Etc.

Appendix E: Mean word familiarity ratings across bilingual groups

Target word:	Less immersed group:	More immersed group:
Swedish/Spanish non-cognates:		
Boca (mouth)	6.83	6.86
Pelota (ball)	5.26	6.14
Nube (cloud)	5.22	6.36
Pantalón (trousers)	6.65	6.86
Montaña (mountain)	6.61	6.71
Árbol (tree)	6.70	6.86
Corazón (heart)	6.70	6.93
Techo (roof)	4.78	6.0
Galleta (cookie)	4.61	6.07
Libro (book)	6.96	7.0
Reina (queen)	5.78	6.50
Muñeca (doll)	4.22	5,57
Plato (plate)	6.65	6,86
Llave (key)	6.48	6.64
Peine (comb)	5.17	5.07
Mochila (backpack)	4.22	6.29
Tenedor (fork)	5.70	6,57
Cama (bed)	6.87	6.93
Total:	**5.85**	**6.46**
Swedish/Spanish cognates:		
Balcón (balcony)	5.48	6.29
Banana (banana)	5.57	4.86
Bomba (bomb)	5.09	6.21
Tractor (tractor)	4.35	5.21
Camello (camel)	3.22	4.93
Lampara (lamp)	5.91	6.71
Pistola (gun)	5.43	6.0
Sofá (sofa)	5.83	6.5
Cebra (Zebra)	3.78	5.71
Total:	**4.96**	**5.82**

Appendix F: Picture stimuli, Experiment 1

Doll:

docka-muñeca

Trousers:

byxa-pantalón

Mountain:

berg-montaña

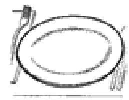


Plate:

tallrik-plato

Tree:

träd-árbol

Comb:

kam-peine

Cookie:

kaka-galleta

Roof:

tak-techo

Queen:

drottning-reina

Heart:

hjärta-corazón

Key:

nyckel-llave

Fork:

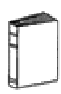
gaffel-tenedor

Mouth:

mun-boca

Ball:

boll-pelota



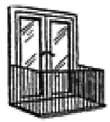
Book:

bok-libro

Cloud:

moln-nube

Appendix G: Picture stimuli, Experiment 2

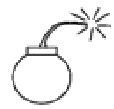


Balcony:

balkong-balcón

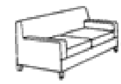
Banana:

banan-banana



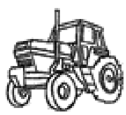
Bomb:

bomb-bomba



Sofa:

soffa-sofá

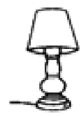


Tractor:

traktor-tractor

Camel:

kamel-camello

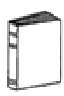


Lamp:

lampa-lampara

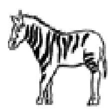
Gun:

pistol-pistola



Book:

Bok-libro



Zebra:

zebra-cebra

Fork:

gaffel-tenedor

Backpack:

ryggsäck-mochila

Doll:

docka-muñeca

Queen:

drottning-reina

Key:

nyckel-llave

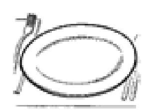
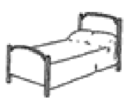


Plate:

tallrik-plato



Bed:

säng-cama

Comb:

kam-peine

Appendix H: List of interfering stimuli, Experiment 1

Picture name (target word)	IS, semantically related to the target word	IS, phonologically related to the target word	IS, phonologically related to the translation equivalent of the target word
*Àrbol (träd, tree)	Blomma (flower)	Armband (bracelet)	Träsko (clog)
Montaña (berg, mountain)	Hav (sea)	Morrhår (whisker)	Bädd (bed)
Llave (nyckel, key)	Dörr (door)	Jacka (jacket)	Nystan (ball (of wool))
*Corazón (hjärta, heart)	Blod (blood)	Kompis (friend)	Hjälte (hero)
*Pelota (boll, ball)	Mål (goal)	Persika (peach)	Borg (fort)
*Galleta (kaka, cookie)	Bröd (bread)	Gardin (curtain)	Karta (map)
*Libro (bok, book)	Tidning (newspaper)	Linne (top)	Bostad (home)
Nube (moln, cloud)	Himmel (sky)	Nos (snout)	Måltid (meal)
Techo/tejado (tak, roof)	Vägg (wall)	Täcke (cover)	Tal (number)
Tenedor (gaffel, fork)	Kniv (knife)	Tändsticka (match)	Galge (hanger)
*Muñeca (docka, doll)	Nalle (teddy bear)	Morot (carrot)	Dolk (dagger)
Pantalón (byxa, trousers)	Skjorta (shirt)	Panna (pan)	Byggnad (building)
Plato (tallrik, plate)	Glas (glas)	Planka (wooden board)	Tangent (typewriter key)
*Boca (mun, mouth)	Tunga (tongue)	Bock (he-goat)	Mussla (clam)
*Peine/peineta (kam,	Borste (brush)	Peppar (pepper)	Kant (margin)

comb)			
Reina (drottning, queen)	Slott (castle)	Regn (rain)	Droppe (drop)

* = marks Swedish/English cognate status

Appendix I: List of interfering stimuli, Experiment 2

Picture name, target word	Semantically related IS	Phonologically related IS
Non-cognates		
Llave (nyckel, key)	Dörr (door)	Jacka (jacket)
*Libro (bok, book)	Tidning (news paper)	Linne (top)
Tenedor (gaffel, fork)	Kniv (knife)	Tändsticka (match)
*Mochila (ryggsäck, backpack)	Väska (bag)	Morgon (morning)
*Muñeca (docka, doll)	Nalle (teddy bear)	Morot (carrot)
Plato (tallrik, plate)	Glas (glas)	Planka (wooden board)
*Peine/peineta (kam, comb)	Borste (brush)	Peppar (pepper)
Reina (drottning, queen)	Slott (castle)	Regn (rain)
Cama (säng, bed)	Kudde (pillow)	Kalv (calf)
Cognates		
*Balcón (balkong, balcony)	Fönster (window)	Bassäng (pool)
*Banana (banan, banana)	Åpple (apple)	Bagage (luggage)
*Bomba (bomb, bomb)	Vapen (weapon)	Borr (drill)
*Tractor (traktor, tractor)	Lastbil (truck)	Tratt (funnel)
*Camello (kamel, camel)	Öken (desert)	Kappa (coat)
*Lampara (lampa, lamp)	Ljus (candle)	Lamm: (lamb)
*Pistola (pistol, pistol)	Gevär (rifle)	Pinne (stick)

*Sofá (sofa, sofa)	Fåtölj (armchair)	Socka (sock)
*Cebra (zebra, zebra)	Häst (horse)	Segel (sail)

* = marks Swedish/English cognate status

Appendix J: Frequency rating from SUC of Swedish picture names in Experiment 2

Non-cognate picture names	**Frequency**	**Cognate picture names**	**Frequency**
Bok (book)	309	Balkong (balcony)	10
Docka (doll)	17	Banan (banana)	5
Drottning (queen)	17	Bomb (bomb)	17
Gaffel (fork)	8	Kamel (camel)	20
Kam (comb)	2	Lampa (lamp)	29
Nyckel (key)	55	Pistol (pistol)	24
Ryggsäck (backpack)	12	Soffa (sofa)	33
Säng (bed)	131	Traktor (tractor)	1
Tallrik (plate)	11	Zebra (zebra)	1
Mean:	48.26	Mean:	15.7

Appendix K: Oral instructions for Experiment 1 and 2

When the experiment starts, pictures will automatically be fed onto the screen. You will name each picture in Spanish, by using the name we just established. You should name the pictures as quickly and as accurately as possible, without stressing yourself. Simultaneously with each picture you will hear a word in Swedish in the headset. You should ignore this word. Just name the picture.

If you at any time during the experiment forget the name for a picture, do not say anything. You might fell like saying “oh I don’t remember the name”. But don’t do that. Don’t say anything. Just wait until the next picture appears. Don’t feel stressed. It does not matter if you miss some pictures.

The equipment is sensitive, so do not breathe directly into the microphone. If you feel like coughing during the experiment, do so at the side of the microphone.

ACTA UNIVERSITATIS UPSALIENSIS
Studia Linguistica Upsaliensia
Department of Linguistics
Editors: Joakim Nivre and Åke Viberg

1. *Jörg Tiedemann*, Recycling translations. Extraction of lexical data from parallel corpora and their application in natural language processing. 2003
2. *Agnes Edling*, Abstraction and authority in textbooks. The textual paths towards specialized language. 2006
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