Chapter 1

Structural priming: An introduction

1.1 Introduction

Priming is the well-attested phenomenon in which people tend to more favourably process a stimulus if they have just previously experienced a similar stimulus. The psycholinguistic literature recognises several types of priming including: phonological, semantic, morphological, lexical and structural priming[1]. This thesis focuses on structural priming, which is the tendency for people to repeat the structure of previously experienced sentences in subsequently produced sentences, without regard for those sentences' lexical, semantic, pragmatic or phonological content. To illustrate the phenomenon, if a speaker hears, reads or produces an English prepositional dative sentence such as *the student gave an apple to his teacher* (rather than the double object alternative form *the student gave his teacher an* apple), he/she is more likely to subsequently produce a prepositional dative form again (in preference to a double object dative form) in a context requiring a dative, even when the new context bears no semantic relationship to the context of the initial utterance (e.g., *the flight attendant offered a drink to the passenger*) (e.g., See Bock, [1986b] for a typical study illustrating this effect). Structural priming has become a well-established phenomenon in a range of contexts, including experimental and naturalistic settings, and has been frequently demonstrated in studies of adults using their first language (L1) (e.g., Bock, 1986b) and children (e.g., Brooks & Tomasello, 1999; Huttenlocher, Vasilyeva, & Shimpi, 2004), and increasingly in studies of second language (L2) learners (Biria, Ameri-Golestan, & Antón-Méndez, 2010; Y. Kim & McDonough, 2008; McDonough, 2006; McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008; Shin & Christianson, 2012). For reviews of structural priming see Branigan (2007), Pickering & Ferreira (2008) and Ferreira and Bock (2006). Aside from being of interest in itself, the phenomenon of structural priming is also an important experimental tool for investigating the internal linguistic representations of speaker's L1s (Branigan, Pickering, Liversedge, Stewart, &

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[1] In this thesis I use the term 'structural priming' although the two terms – 'syntactic priming' and 'structural priming' are used in the literature to refer to the same phenomenon.

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Urbach, 1995) and the language production process in speakers when they use their L1 (e.g., Branigan, Pickering, Stewart, & McLean, 2006; Cleland & Pickering, 2003). Structural priming has also been used as a tool for investigating whether or not syntactic representations are shared or separate in bilingual speakers (e.g., Hartsuiker, Pickering, & Veltkamp, 2004; Loebell & Bock, 2003; Meijer & Fox Tree, 2003). However, the focus of this thesis is on structural priming in L2 speakers in general and L2 learners in particular.

Structural priming possesses several key defining characteristics. I will briefly summarise these characteristics and then move on to more detailed discussion in section 1.5 of this chapter. First, among these characteristics is that speakers who are successfully primed are not consciously aware of their repetitive behaviour, and their behavior is not strategic in any sense. Therefore priming is regarded as an implicit process, below the level of conscious awareness. Second, as noted above, structural priming occurs even when the prime and target sentences do not share any semantic, lexical, pragmatic, phonological or metrical similarity (e.g., Bock & Loebell, 1990), and so is thought to depend on purely syntactic information and processing. A third, and more controversial characteristic, is that structural priming is thought by some researchers to represent a process of implicit learning of syntactic structure (Bock, Dell, Chang, & Onishi, 2007; Bock & Griffin, 2000; Chang, Dell, Bock, & Griffin, 2000). Reports of long-term structural priming in L1 contexts have led some L1 structural priming researchers to speculate that it might be a mechanism of language acquisition, not only in L1 contexts (Bock, et al., 2007), but also possibly in L2 contexts (Bock & Griffin, 2000) in which people's previous linguistic experiences can result in stable changes in their subsequent linguistic performance. A small number of structural priming studies with L2 speakers have more recently indicated that it might also be a form of L2 learning, leading to relatively stable changes in L2 performance (Ameri-Golestan & Nezakat-Alhossaini, 2012; Biria, et al., 2010; McDonough, 2006; McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough & Trofimovich, 2009; Shin & Christianson, 2012). This third characteristic of structural priming is of crucial significance for this thesis and I will return to this issue in sections 1.6.2 and 1.7.3 of this chapter, as well as elsewhere in the thesis.

1.2 Research questions

The primary focus of this thesis then is on L2 structural priming and whether it can contribute to L2 learning[2]. It is important to point out at this stage that for the purposes of this thesis I define learning as a change in linguistic behaviour towards either increased production of a target language structure or reduced production of an interlanguage (i.e., non-target) structure, or both. The temporal durability of this change (or learning) is an important but separate issue which I will ultimately discuss later in the thesis. Also, I refer the reader to section 1.8 in this chapter where I describe how I have defined learning for the purposes of this research. Overall, the following research questions guided the project:

1. Is structural priming possible in L2 contexts?
2. Can structural priming lead to second language learning?
3. If structural priming leads to second language learning, under what conditions does it occur and how long does the learning last?
4. What are some linguistic and/or behavioural constraints on L2 structural priming?
5. How can knowledge about structural priming subsequently inform L2 learning and teaching practices?

The thesis will also explore how structural priming effects[3], if they indeed turn out to be associated with second language learning, might or might not be accommodated by various theories of second language acquisition (SLA). First, I will present an overview of structural priming research to set the scene for the research to follow.

1.3 Introduction to structural priming

Much of what we know about structural priming comes from L1 structural priming research. One of the first studies to demonstrate structural priming effects was carried out by Levelt and Kelter

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[2] Although distinctions are often made in the SLA literature between the terms "learning" and "acquisition" (e.g., along the lines first proposed by Krashen, 1985), in this thesis I use these terms interchangeably. This means that for present purposes I define learning in its ordinary psychological sense as it applies to language "learners" (i.e., *not* language "acquirers"). See section 1.8.1 for a discussion.

[3] The term 'structural priming' has been used in the literature to refer to both the experimental protocol that has been set up to investigate a priming effect as well as the effect itself. I also have used the term in this way. However, where there is likely to be ambiguity I have used the term 'priming effect(s)' to specifically refer to the observable effects of a priming intervention.

(1982) who demonstrated that L1 speakers of Dutch in question/answer situations, whether in a laboratory or in natural discourse, coordinated the syntax of their answers with the syntax of the questions of their interlocutors. In a picture description task (experiment 1 in that study), speakers were presented with pictures and asked questions such as (1) and (2) about those pictures; they were expected to provide answers such as (3) and (4). Each question either included or excluded an optional preposition. Participants could answer in one of two ways: either with the optional preposition (as in sentence 3), or without a preposition (as in 4). Levelt and Kelter reported that participants tended to match the syntax of their answers with the syntax of the questions such that if the question contained a preposition, so did their answer.

    (1) *Aan wie laat Paul zijn viool zien?*

       (To whom lets Paul his violin see?)

    (2) *Wie laat Paul zijn viool zien?*

       (Whom lets Paul his violin see?)

    (3) *Aan Toos.*

       (To Toos.)

    (4) *Toos.*

       (Taos.)

Through a series of manipulations, Levelt and Kelter (1982) ruled out conversational strategies such as politeness, and attentiveness to one's interlocutor as a source of the structural repetition. They also ruled out short term explicit memory as the source of the repetition. In order to investigate whether these effects extended to outside the laboratory setting of the first experiment, Levelt and Kelter then set up a real-life conversational task (experiment 3 in their study). In that task, shopkeepers were telephoned and asked questions (in Dutch) of two alternative forms: *What time does your shop close?* or *At what time does your shop close?*. In their answers, the shopkeepers tended to reply with the same structure as the question: if the question contained a fronted preposition, their answer also contained a preposition (e.g., *at 5 o'clock*); if the question did not contain a preposition, their answer also did not contain a preposition (e.g., *5 o'clock*). Rather than explicitly invoking a priming mechanism, Levelt and Kelter termed this inter-speaker alignment "correspondence", and found similar effects in two laboratory experiments involving a range of prepositions and question types. Importantly, the repetition effect in the laboratory was no stronger when the preposition was the same across

question/answer pairs as when it was different, thus ruling out lexical and pragmatic factors. In conclusion, Levelt and Kelter ruled out episodic memory effects and argued that the repetition of the prepositions across questions and answers was an automatic and unconscious response, unmediated by explicit memory for the words themselves or the structures. The repetitive effect was also reasonably durable because the repetition of the preposition in pairs of questions and answers which were separated by extraneous distracting material (other discourse and sentences) was still as strong as between uninterrupted pairs.

After the study by Levelt and Kelter (1982), several corpus studies specifically invoked the structural priming phenomenon. Perhaps the first of such studies was carried out by Estival (1985) who investigated priming of English passives in spoken dialogue. She found that priming effects between speakers could last for up to five intervening clauses. That is, speakers tended to repeat the structural form of their interlocutor's utterances even when speaker turns were separated by up to five intervening clauses. Gries (2005) also reported structural priming effects in naturalistic contexts after examining spoken and written data from the ICE-GB corpus (the British component of the International Corpus of English). In that study, Gries found evidence for structural priming for datives and phrasal verbs. He found patterns in dialogue in which syntactic structure was repeated both across turns both between different speakers and between turns produced by the same speaker. In another corpus study examining spoken and written corpora, Dubey, Sturt, and Keller (2005) also found structural priming for noun phrase structure in dialogue across speakers, but not within speakers. These disparate findings of Dubey, et al. (2005) might suggest that structural priming effects can be modulated by the syntactic structure itself, at least in L1 contexts.

Corpus investigations into structural priming make up only a small portion of the research in the area. Structural priming has been more typically demonstrated in laboratory experiments in which speakers hear and repeat a prime sentence and shortly afterwards describe a semantically unrelated target picture, a method which was first employed in a seminal study carried out by Bock (1986b). This is called production priming. In several structural priming experiments, Bock investigated the tendency for L1 English speakers to produce either double object (DO) dative sentences (e.g., *The governess made the princess a pot of tea*) or prepositional object (PO) dative sentences (e.g., *The governess made a pot of tea for the princess*) depending on whether they had just previously experienced a semantically unrelated DO dative or PO dative prime sentence (see section 1.1 above). In the same study, Bock also investigated the tendency for L1 English

speakers to produce either a passive (e.g., *The building manager was mugged by a gang of teenagers*) or active sentence (e.g., *A gang of teenagers mugged the building manager*) depending on whether participants had just previously experienced a semantically unrelated passive or active prime sentence. Participants listened to and repeated prime sentences containing one of the four structures, and then immediately afterwards saw and described a picture which could be described using either the target prime structure or the alternative structure (i.e., either a DO dative or PO dative after dative primes, or a passive or active after transitive primes). Importantly, since part of the motivation of the study was to rule out possible pragmatic, rhetorical and other communication strategies as a cause of the sort of repetition observed in previous studies (e.g., Levelt & Kelter, 1982), participants in Bock's study were led to believe they were engaging in memory task. This was achieved by asking participants to try to recall whether or not they had seen a sentence or picture previously in the experiment. Under the pretext of improving their performance in the memory task Bock asked participants to repeat each sentence. This repetition was designed to foster a possible priming effect. The results revealed that for the passive/active alternation, after participants had heard and repeated a passive prime, they were 8% more likely to describe a picture using a passive sentence than if they had just heard and repeated an active prime. Also, they were 8% more likely to describe a picture using an active sentence after experiencing an active prime than if they had just experienced a passive prime. Similarly, for the dative alternation participants were 22% more likely to describe the target picture with a sentence containing the same structure as the prime (i.e., either DO or PO). Importantly, the two structures in each alternation were considered semantically equivalent, and so in the absence of the priming intervention participants would not have been biased to produce either structure. Therefore, any tendency to produce more of one structure than the other could be attributed to structural priming.

1.4 Experimental contexts of structural priming

The majority of structural priming research has been carried out with L1 speakers, and the findings of this research form the basis for most of what we currently know about structural priming. On the other hand, most of the L2 studies have been more narrowly focussed: on the possibility of structural priming as a means of second language learning. This section, which discusses the contexts in which structural priming has been observed and the methodological techniques used in its investigation, necessarily focusses mainly on the much more extensive L1

literature. This approach will set the scene for a subsequent closer look at the L2 research and its claims about learning (see section 1.5 this chapter), which have a more direct bearing on the thesis.

Structural priming effects have been observed in a wide range of linguistic contexts and research paradigms: in adults, children, L1 and L2 speakers and bilinguals; in spoken and written language; in language production and comprehension; in experimental and naturalistic research contexts; and in different languages. Specifically in language production, structural priming effects have been observed in monologic studies in which a speaker interacts alone with stimulus materials, and dialogic studies in which a speaker interacts with another speaker (see below). Some studies have also demonstrated structural priming effects across modalities, such as between written production and oral production where primes are presented in the written modality and target production is in the spoken modality.

1.4.1 Production priming

Broadly speaking, the literature reports two types of production priming experiments: dialogic and monologic. In dialogic priming experiments participants interact with an interlocutor who is typically a covert confederate of the researcher in L1 studies (e.g., Bernolet & Hartsuiker, 2010; Branigan, Pickering, & Cleland, 2000; Branigan, Pickering, McLean, & Cleland, 2007; Cai, Pickering, & Branigan, 2010; Schoonbaert, Hartsuiker, & Pickering, 2007), but also in some L2 studies (e.g., McDonough & Mackey, 2008). Sometimes however, the interlocutor can be the researcher him/herself (e.g., Levelt & Kelter, 1982), especially in L2 studies (Biria, et al., 2010; Y. Kim & McDonough, 2008) or another participant (Boston, 2010), and even a simulated interlocutor generated by a computer program (e.g., Cleland & Pickering, 2003; Hartsuiker, Bernolet, Schoonbaert, Speybroeck, & Vanderelst, 2008). Branigan and colleagues were the first to use the so-called confederate scripting technique. In one study exemplifying this technique Branigan et al. (2000) set up a dialogue game in which conversational partners described pictures to each other. Unbeknownst to the research participant, the other speaker was the experimenters' confederate whose task was to prime the participant to produce sentences containing a specific structure when describing the pictures. In doing this, the confederate read from a script containing prime sentences while the participant was required to spontaneously produce their own sentences to describe their own pictures. Both participant and confederate were unaware of the real purpose of the experiment, and were led to believe that the purpose of the experiment

was to investigate how people communicate when they cannot see each other. First, the confederate produced a prime sentence to describe a picture from their set of pictures and the participant chose the matching picture from his/her set of cards. The participant then produced a sentence (the target sentence) to described one of his/her pictures. Branigan et al. (2000) reported a dramatic tendency for participants to reproduce the syntactic form of their partner's (the confederate's) utterances: DO datives were produced if their partner produced a DO dative, and PO datives were produced if their partner produced a PO dative. Schoonbaert et al. (2007) also used this technique to investigate cross-linguistic structural priming between German/English and Dutch/English bilinguals and reported significant priming effects. In these sorts of dialogic experiments speakers can be primed to produce structures just by comprehending their conversational partner's prime utterances (Branigan, Pickering, & Cleland, 2000). It is perhaps unsurprising that speakers should coordinate their utterances in dialogue, and these effects in experimental settings mirror the effects reported in naturalistic corpus studies (Levelt & Kelter, 1982, Experiment 3).

In monologic production priming studies participants typically respond to stimuli presented on a computer. In these experiments participants interact with a computer (rather than another person) and are exposed to a series of linguistic stimuli (sentences) each followed by a target stimulus (usually a picture), which they must describe (Bock, 1986b, 1989; Bock, et al., 2007; Bock & Griffin, 2000; Bock & Loebell, 1990; Bock, Loebell, & Morey, 1992). In monologic picture description priming experiments, if participants tend to use the linguistic features of the prime stimulus in their description of the picture, production priming is said to have occurred. Typically, participants also are required to reproduce each prime sentence before producing a target utterance (e.g., Bock, 1986b). In this way monologic experiments typically differ from dialogic ones in which participants usually do not repeat the prime sentences provided by their interlocutor. However both types of priming has been investigated; priming effects have been observed when the speaker repeats the prime (e.g., Bock, 1986b; Branigan, Pickering, Stewart, & McLean, 2000), and when the speaker simply hears or reads the prime (e.g., Bock, et al., 2007; Branigan, et al., 2000; Francis, Matthews, Wong, & Kwan, 2011; Pickering, Branigan, Cleland, & Stewart, 2000).

Some studies of production priming employ a sentence completion technique, which may or may not be combined with picture description. In two studies by Branigan and Pickering and colleagues (Branigan, Pickering, & Cleland, 1999; Pickering & Branigan, 1998) that illustrate

the technique participants completed (in writing) sentence fragments which served as primes. Immediately afterwards they then completed another fragment which served as the target. Branigan, et al. (1999) found that after participants had completed the fragment with one form of dative (DO or PO) they were more likely to complete the target fragment also with the same form of dative. Corley and Sheepers (2002) also employed a written sentence completion technique to investigate dative priming, but this time carried out the study on the Internet with participants completing the experiment by typing their responses. This sort of priming technique can be particularly useful for investigating structures which are otherwise difficult to represent in a picture description method.

Typically, production priming studies have taken production frequencies as the index of priming (e.g., the proportion of targets produced relative to the total number items). However, occasionally a small number of studies have chosen to use other indexes such as production latencies (Corley & Sheepers, 2002; Smith & Wheeldon, 2001). Smith and Wheeldon (2001) investigated the priming of structure of coordinated noun phrases (e.g., *the spoon and the car move up*) compared to an alternative structure (*the spoon moves up and the car moves down*) and found a facilitative priming effect such that speakers initiated oral sentences containing the target noun phrase structure more quickly after they had experienced a prime containing the same structure. Along similar lines, Corley and Sheepers (2002) took as their dependent variable the onset latency of participants' written completion of sentence target fragments and also reported significant priming effects. These findings suggest that structural priming might work to foster speaker fluency and automaticity (V. S. Ferreira & Bock, 2006), a point also taken up by McDonough and Trofimovich (2009, p. 12) in relation to L2 priming.

What are the relative differences between dialogic and monologic techniques? Hartsuiker et al. (2008) compared the results of their study with the results of other similar priming studies and concluded that structural priming effects are larger in communicative contexts (e.g., dialogic contexts) than in non-communicative contexts (e.g., monologic contexts) for both written and spoken language production. Interestingly, this stronger effect was found even though Hartsuiker et al. used a computer-based method of simulation of dialogue in which participants thought they were interacting with a real person but in fact were interacting with a computer program. This observation of stronger priming in interactive contexts might be one reason why up until now most of the L2 structural priming studies have employed dialogic methods. One possible problem which arises with dialogic studies however, is the potential for speakers to behave

strategically, especially in L2 contexts. Speakers might adopt a strategy to repeat aspects of their interlocutor's language for a range of reasons. This potential problem does not seem to have been acknowledged in the literature however. I return to these issues in relation to L2 structural priming in section 1.7, this chapter and in 2.4, Chapter 2.

Some production priming studies have employed sentence recall (e.g., Chang, Bock, & Goldberg, 2003; V. S. Ferreira, 2003; Francis, et al., 2011; Griffin & Weinstein-Tull, 2003; Konopka & Bock, 2009; Potter & Lombardi, 1998), a frequently used technique in language production research (see Bock, 1996). Recall techniques rely on the fact that people generally are better at remembering the propositional or semantic content of previously experienced sentences but have difficulty recalling those sentences' exact syntactic structure. In primed recall experiments participants must recall a sentence after experiencing a prime sentence: a target sentence would first be presented followed by a prime, and then participants must try to recall the target sentence. Participants' tendency to modify the structure of the first (target) sentence by repeating the structure of the prime is taken to be a measure of priming. Sometimes participants can be required to repeat the prime (e.g., Ferreira, 2003), but this repetition is not always necessary for priming to occur, with Potter and Lombardi (1998) finding similar priming effects when participants read a prime sentence aloud (experiment 1) as when they silently read the prime (experiment 2). Recall techniques are suitable for eliciting structures which are otherwise difficult to elicit with, for example, picture description methods (Bock, 1996; Griffin & Weinstein-Tull, 2003).

Finally, the question of the effect of modality on priming is an open one. It is a little unclear at this stage whether structural priming effects in spoken and written modalities are similar or different. On the one hand, Branigan, et al. (1999) reported rapid decay in written priming using a sentence completion technique. They found that when the prime and target were separated by one intervening sentence priming effects were reduced, and when four sentences intervened that priming effects disappeared. Findings of rapid decay in written priming but long term stability in oral priming perhaps reflects differences between spoken and written language production, such that written production is more subject to conscious reflection and monitoring whereas oral production is more spontaneous. On the other hand, Hartsuiker and Kolk (1998) found that the magnitude of priming effects was similar in written and spoken production. Hartsuiker et al. (2008) also found similar effects in the two modalities. One L2 structural priming study did find

that priming effects can transfer between modalities (Biria, et al., 2010). The issue of modality effects however, is of little concern for the current investigation.

1.4.2 Comprehension priming

Not only have priming effects been demonstrated in terms of the increased production of a target structure, but effects have also been demonstrated in terms of the increased ease of comprehension of a structure (Arai, van Gompel, & Scheepers, 2007; Branigan, Pickering, & Maclean, 2005; Tooley, Traxler, & Swaab, 2009; Traxler & Tooley, 2008). That is, sentences can be more easily comprehended if a speaker has previously experienced a sentence with the same structure. Several experiments by Tooley and Traxler and colleagues have also explored structural priming using structurally ambiguous target sentences (e.g., Tooley, et al., 2009; Traxler & Tooley, 2008). In these studies, speakers' tendency to interpret the targets along the lines of the structure of the primes was taken as a measure of priming. Previous studies have operationalised comprehension in several way and indexes of comprehension ease have included: ERP (event-related potentials[4]) data, eye tracking data, reading time data. Some studies have found evidence that structural priming is stronger in production-to-production priming than in comprehension-to-production priming (Gries, 2005; Hsu, 2008). That is, it is stronger when prime sentences are not only heard or read, but also produced by speakers. However, at least one study has found comparable effects in the two conditions (Bock, et al., 2007; McDonough, 2006). This issue therefore appears to be unresolved and is complicated somewhat by methodological differences between some comprehension-to-production and production-to-production studies. For example, the former typically employ a dialogic paradigm while the latter typically employ a monologic paradigm. Given the difficulty in interpreting the meaning of measures of comprehension such as ERPs, response latencies, and eye tracking data, as well as the need for a high degree of ecological validity of the present study with its applied focus, comprehension priming was deemed less suitable than production priming here. Therefore, I will not discuss comprehension priming in detail. (See Chapter 2 for more on the methodological choices in this thesis.)

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[4] ERPs are electroencephalographic measures of brain activity (voltage changes) in response to a stimulus and are very sensitive to the time-course of processing. They are typically used for measuring linguistic processing.

1.4.3 Structures investigated in priming studies

L1 structural priming studies typically focus on syntactic alternations each consisting of a pair of structures, either of which can be used equally appropriately to represent a single proposition or event. Following Bock's (1986) initial pioneering study, most of the early investigations into structural priming tended to focus on the English *be* passive/active alternation with a particular focus on the passive (e.g., Bock, 1986b, 1989; Bock & Griffin, 2000; Bock, et al., 1992; Estival, 1985), and the English double object/prepositional object dative alternation (e.g., Bock, 1986b, 1989; Bock & Griffin, 2000; Bock & Loebell, 1990; Branigan, et al., 2000; Branigan, et al., 2006; Pickering & Branigan, 1998; Potter & Lombardi, 1998). Many child studies have also used the passive/active alternation (e.g., Bencini & Valian, 2008; Brooks & Tomasello, 1999; Huttenlocher, et al., 2004; Savage, Lieven, Theakston, & Tomasello, 2006). This tradition has continued with datives and dative-like constructions in other languages also now becoming a common target for investigation (e.g., Cai, et al., 2010; Hartsuiker, et al., 2008; Hartsuiker & Kolk, 1998; Hsu, 2008), as well as passives in Dutch (Hartsuiker & Westenberg, 2000). The selection of these two syntactic alternations has probably been for reasons of methodological convenience; the alternations involve pairs of structures in which word order varies but, especially in the dative structure, the semantic content of the sentence varies little if at all. This means that, other things being equal, and in the absence of any priming intervention, speakers are relatively free to choose to use either structure in the alternation. Thus, in priming studies any tendency to use one or the other structure in the alternation (especially compared to a baseline condition) can be attributed to the priming intervention.

In English, the range of structures investigated has more recently extended to include alternations in noun phrase structure as in phrases such as *the green square* vs. *the square that's green* (Cleland & Pickering, 2003), sentences like *the spoon and the car move up* vs. *the spoon moves up and the car moves down* (Smith & Wheeldon, 2001), and alternation between an "*s*" genitive noun phrase structure, as in *the policeman's daughter*, and an "*of*" genitive as in *the daughter of the policeman* (Skarabela & Serratrice, 2008); particle placement in literal phrasal verbs as in *John picked up the book* vs. *John picked the book up* (Gries, 2005), and idiomatic phrasal verbs as in *the burglars broke the door down* vs. *the burglars broke down the door* (Konopka & Bock, 2009); the *spray-load* alternation as in *the farmer heaped straw onto the wagon* vs. *the farmer heaped the wagon with straw* (Chang, Dell, & Bock, 2006).

It should be noted that the range of structures used in structural priming studies is relatively small. This situation probably reflects the motivation of most L1 priming studies, which is usually either to investigate the priming phenomenon itself or to make generalisations about the nature of syntactic representations. In these contexts, the selection of the structure is important only for achieving the goals of the study rather for any inherent interest in the structure and itself. The selection of the structure becomes a significant issue however, in studies which investigate the possible learning function of structural priming – i.e., studies investigating structural priming in children, L2 learners and other groups of speakers with unstable language systems. Clearly, structures which have not yet been learnt or present difficulties in acquisition are of primary interest in these contexts. I will return to this issue of structure selection in more detail in the next sections 1.4.3, 1.6.2, and 1.7, this chapter and elsewhere in the thesis.

A few comprehension priming studies have opted for a slightly different approach to structure choice. Rather than investigate speakers' priming-induced production preferences among pairs of grammatical alternations, these studies have looked at comprehension preferences of ambiguous sentences. One such study investigated comprehension priming using ambiguous prepositional phrase attachment in sentences like *the waitress prodding the clown with the umbrella* (Branigan, et al., 2005). Other studies have investigated structural priming effects in comprehension using temporary ambiguities contained in sentences with reduced relative clauses (e.g., *the child watched by the parent was playing quietly*) (Tooley, et al., 2009).

After a period focusing on English passives and datives, more recently the range of structures has begun to expand to also include structures in languages other than English. Several L1 priming studies have for example, looked at alternations in the order of auxiliary and participle in Dutch (e.g., Hartsuiker & Westenberg, 2000) as in the two alternative structures evident in sentences (6) - (9) below (see section 1.5 this chapter) which are both optionally acceptable in Dutch.

Very few studies have investigated structural priming in speakers of non-European languages. However, one recent study investigated L1 speakers of Chinese. In that study Francis, et al. (2011) investigated the priming of optional verb-doubling in Cantonese. Verb-doubling involves the duplication of the verb after the object, such as in sentence (5), taken from Francis et al., (p. 3).

(5) *Ngo5 tai2 din6si6 tai2zo2 loeng5 go3 zung1*

(I watch television watch two hour)

(I watched television for 2 hours)

This structure is frequent in Mandarin Chinese, usually follows an indefinite object noun phrase, and is typically found in sentences containing a frequency or adjunct phrase marking duration. However, verb-doubling in Cantonese is relatively optional and unconstrained. Moreover, according to Francis, et al. (2011, p. 24) "verb-doubling is grammatically optional and has no obvious semantic or pragmatic function in Cantonese". Thus, in this study, the alternation was between verb-doubling or no verb-doubling. In experiment 2 of that study Cantonese speakers listened to sentences like 9 and were asked to recall and articulate the message in the sentence by answering a question about the prime sentence. Speakers who listened to a prime sentence containing a duplicated verb were more likely to subsequently produce a sentence containing a duplicated verb. Also, in experiment 1, speakers who listened to a sentence containing a single unduplicated verb were more likely to subsequently produce a sentence containing a single verb. At least two studies have also investigated the Chinese *ba* construction, which is similar semantically to a dative (Cai, et al., 2010; Hsu, 2008). These studies have shown that Chinese speakers are susceptible to priming in a similar way to speakers of English are in respect of the dative alternation.

Overall then, the range of structures investigated in structural priming studies remains relatively small, first because of the historical focus on native English speakers and second because aside from English only a small number of European languages have been targeted. Third, only recently have studies emerged that focus on languages from other regions. One outcome of this relatively narrow focus is that it is not known to what extent structural priming effects are universal: are they language specific, or does the mechanism of priming vary as a function of a speaker's L1 (see section 1.6.2). In particular, there have been very few structural priming studies on populations of speakers from non-European backgrounds. It is not known for example, whether structural priming effects are specific to certain communication styles which might be culturally specific. To resolve these questions more research is needed on a range of populations of speakers from a range of languages backgrounds. Research into L2 structural priming is one relatively new context which might shed more light on the nature of structural priming. L2 priming research also opens up the possibility of investigating priming of different structures. (See section 1.7, this chapter.)

1.5 Characteristics of structural priming

As noted above, structural priming possesses several key characteristics. It is largely independent from the effects of semantic, lexical and phonological information and is fundamentally syntactic (Bock, 1986b; Bock, et al., 2007; Bock & Griffin, 2000; Bock & Loebell, 1990; V. Ferreira, S & Bock, 2006; V. S. Ferreira, Bock, Wilson, & Cohen, 2008; Hartsuiker, et al., 2008). It is also thought to depend on the activation of abstract syntactic information during language production (e.g., Branigan, 2007), although a lexical component has been suggested (Adjemian, 1976; Branigan, et al., 2000; V.S. Ferreira & Bock, 2006; Pickering & Branigan, 1998). In one of the first attempts to investigate how priming taps into abstract syntactic processes, Bock and Loebell (1990) demonstrated that prime sentences which share phrase structure, but not conceptual structure with target sentences (i.e., the event roles of the arguments differed in the prime and target sentences) were equally good at priming the target structure as prime sentences which shared both phrase structure and conceptual structure with the targets. This means that prepositional locative sentences such as *the wealthy widow drove her Mercedes to the church* were statistically equally as good at priming prepositional dative sentences such as *the girl gave a paintbrush to the boy* as prepositional datives themselves (e.g., *the wealthy widow gave her Mercedes to the church*). Similarly, Bock and Loebell also found that intransitive locatives such as *the 747 was landing by the control tower* were equally as good at priming full passives such as *the construction worker was hit by the bulldozer* as passives themselves (e.g., *the 747 was landed by the control tower*). From these findings, Bock and Loebell argued that structural priming tapped the process of building abstract phrase structure in language production and that this process is relatively "indifferent to the ideas being expressed" (Bock & Loebell, 1990, p.29). Potter and Lombardi (1998) also examined whether prepositional locatives such as *Leonore drove her new convertible to the beach early this afternoon* could prime prepositional datives such as *the prompt secretary wrote a message to her boss every week* in a primed recall experiment, and reported similar findings to Bock and Loebell but with one caveat: locatives were only partially effective at priming prepositional object datives than prepositional datives themselves. Potter and Lombardi found that the priming effect of the locatives lay midway between that of the prepositional object and that of the control primes. It is possible that the different findings from these two studies reflected the effect of different experimental tasks: primed recall and spontaneous picture description, suggesting that conceptual/semantic effects

might be more important in sentence recall priming than in picture description production priming.

According to some accounts, structural priming has been shown to operate at the level of the surface word and phrase order of sentences (Hartsuiker & Kolk, 1998; Hartsuiker, Kolk, & Huiskamp, 1999; Hartsuiker & Westenberg, 2000; Loebell & Bock, 2003; Pickering & Ferreira, 2008; Potter & Lombardi, 1998). For example, Hartsuiker and Westenberg (2000) found that the order of the auxiliary and participle in Dutch subordinate clauses could be primed. Therefore, prime sentences such as (6) prime sentences such as (7), and sentences such as (8) prime sentences such as (9). In Dutch subordinate clauses the order of auxiliary and participle is flexible, with both orders being acceptable.

(6) *Ik kon er niet door omdat de weg geblokkeerd was*
    (I couldn't pass through because the road blocked was)

(7) *De skier lag in het ziekenhuis omdat hij zijn been gebroken was*
    (The skier lay in the hospital because he his leg broken was)

(8) *Ik kon er niet door omdat de weg was geblokkeerd*
    (I couldn't pass through because the road was blocked)

(9) *De skier lag in het ziekenhuis omdat hij zijn been was gebroken*
    (The skier lay in the hospital because he his leg was broken)

Evidence for the critical importance of surface word order also comes from several cross-linguistic studies that have shown that between-language priming does *not* occur where prime and target sentences share conceptual or deep structure but not surface word order. For example, in a study of advanced L1 German speakers of L2 English, Loebell and Bock (2003) found that German passive primes did not prime English passives and vice-versa, and concluded that the lack of an effect was related to the different word orders for passives in German and English. In contrast, in the same study cross-linguistic priming was found for datives (double object and prepositional object forms), which share word orders in German and English. Thus, the authors concluded more generally that priming is critically dependent on surface word order; only sentences with the same surface word orders prime each other. Similarly, in a study of phrasal

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order priming in Dutch, Hartsuiker, et al (1999) presented prime sentences containing a locative prepositional phrase which was either fronted (e.g., *Op de plank ligt een boek* [*On the shelf lies a book*] or placed later in the sentence (e.g., *Een boek ligt op de plank* [*A book lies on the shelf*]). They found that after experiencing a prime sentence, participants tended to subsequently describe a target picture using the same phrasal order contained in the prime. From these findings, and a comparison of other findings of priming studies, Hartsuiker, et al. also argued that linear phrasal and word order is a structural feature which is especially susceptible to priming. However, the evidence for this claim is not clear cut.

On the other hand, there is some evidence from cross-linguistic priming studies that underlying syntactic relations can be primed. On that note, a study of German-English bilinguals (Weber & Indefrey, 2009) demonstrated that passives could be primed cross-linguistically, even when the surface word order varies between the two languages. Similarly, in a cross-linguistic priming study involving Korean-English bilinguals, Shin and Christianson (2009) also reported argument order-independent priming effects. Desmet and Declercq (2006) also found priming of hierarchical relations in relative clause structures across languages. In that study, after bilingual Dutch/English speakers experienced primes with high attachment relative clauses in Dutch, they tended to produce more high attachment relative clauses in English targets. Similarly, when they experienced primes with low attachment relative clauses in Dutch, they tended to produce more low attachment relative clauses in the English targets. Desmet and Declercq argued that these findings were evidence of shared bilingual syntactic representations.

While several studies point to the syntactic nature of priming in language production, a few studies have provided evidence that thematic role information is important in priming (e.g., Cai, et al., 2010; Chang, et al., 2003; Gámez, Shimpi, Waterfall, & Huttenlocher, 2009; Goldwater, Tomlinson, Echols, & Love, 2010; Shin & Christianson, 2009; Vasilyeva & Waterfall, 2012; Yamashita, Chang, & Hirose, 2003). Chang et al. (2003) primed sentences containing the English *spray-load* alternation, such as *the man sprayed wax on the car* vs. *the man sprayed the car with wax*. In both sentences the *man* is the agent, *wax* is the theme and the *car* the location, and in purely structural terms the formal structure of each sentence is exactly the same, namely - NP [V NP [P NP]$_{PP}$]$_{VP}$. However, the order of the functional roles in each version is different: in the former it is AGENT - THEME - LOCATION, whereas in the latter it is AGENT - LOCATION - THEME. Chang, et al. found that speakers produced proportionately more AGENT - THEME - LOCATION sentences after a prime of that type and more AGENT -

LOCATION - THEME sentences after a prime of that type. They argued that this structural persistence was a result of priming of functional role information at the level of mapping functional role to structure. Along similar lines, Goldwater, Tomlinson, Echols & Love (2010) found that young children aged 4 and 5 years could also be primed by functional role information but that only 5 year-olds were sensitive to the full structural priming effect: the 4 year-olds only displayed priming effects for functional role information. Priming effects at the functional processing stage have also been demonstrated in a study of passive priming of L1 Spanish speaking children (Gámez, et al., 2009). Spanish allows for several structural alternatives (other than a full passive) for foregrounding a patient. Gámez et al., (2009) found that child speakers were not primed for passives per se, but were merely induced to place patients in subject positions. They attributed this outcome to a general tendency for the prime sentences' conceptual structure (i.e., patient in subject position) to be repeated in the target sentences.

One thing that does appear clear is that structural priming does not depend on metrical and phonological similarities between prime and target (Bock & Loebell, 1990; Cleland & Pickering, 2003; V. S. Ferreira, 2003). For example, Bock and Loebell (1990) found that the metrical similarity (stress, rhythm and syllable length) between prime and target sentences had no effect on priming. For example, they found that prime sentences containing *to* infinitives, such as *Susan brought a book to study*, did not prime prepositional datives containing the preposition *to*, such as *Susan brought a book to Stella*. That is, speakers were less likely to produce a prepositional dative target sentence after experiencing a *to* infinitive prime sentence than after experiencing a prepositional *to* dative prime sentence, even if the prime and target sentences were phonologically matched for stress, rhythm and syllable length. Instead, participants' priming behaviour in this study was influenced only by the underlying constituent structure of the prime sentences.

The repetition of closed-class words has also been found to be immaterial to priming. In particular, there is a reasonable amount of evidence that priming effects are not modulated by the repetition of a preposition between the prime and target (Bock, 1986b, 1989; Traxler, 2008). Bock (1989) compared the production of English *to* prepositional object (PO) datives after either a semantically unrelated *to* PO dative prime sentence (e.g., *a secretary was taking a cake to her boss*) or *for* PO dative prime sentence (e.g., *a secretary was baking a cake for her boss*) and found no significant boost in priming effects following primes containing the same preposition

(*to*). In fact, in experiment 1, she reported a slight trend (albeit not statistically significant) for speakers to produce more *to* PO datives after *for* PO dative primes than after *to* PO dative primes. In a comprehension priming study, Traxler (2008) manipulated the identity and functional role of prepositions (*by* vs. *with*) in sentences containing agentive and instrumental prepositional phrases and found a facilitative priming effect in the comprehension of target sentences regardless of the preposition and its functional role. In this case prime sentences containing instrument prepositional phrases (headed by *with*) primed sentences containing agentive prepositional phrases (headed by *by*), although prime sentences containing agent prepositional phrases did not prime targets with instrument prepositional phrases. Along similar lines, Ferriera (2003) found that an optional complementiser *that* could be primed in a sentence complement structure (e.g., *The mechanic mentioned (that) the car could use a tune up*), but only by primes containing a lexically and syntactically similar *that*. That is, primes containing a determiner *that* (e.g., *The company insured that farm…*) and noun complement with *that* (e.g., *The theory that penguins built the igloos was completely false*) did not prime the sentence complement *that* structure. Ferreira argued that this was evidence for the independence of syntactic and non-syntactic processing, and that structural priming appears to be a function of processing at an abstract syntactic level.

Structural priming also appears to be unaffected by information about tense, aspect and number. In a written sentence completion task, Pickering and Branigan (1998) demonstrated no significant difference in priming when the tense (experiment 3), aspect (experiment 4) and number (experiment 5) was varied between prime and target (while the verb stem remained constant). Thus, prime fragments such as *the racing driver was showing the torn overall …* which were completed as PO datives, were equally good at priming PO datives beginning with *the patient showed …* as prime fragments containing the verb in the same aspect (e.g., *the racing driver showed the torn overall …*). Similarly, priming was not affected by differences in tense between the verbs in the prime and target (*shows* vs. *showed*), or whether prime and target differed with respect to a singular or plural noun subject and subsequent third person *s* on the verb (i.e., *show* vs. *shows*). These findings can be accounted for and explained by Roelofs' (1992) and Levelt's (1989) models of speech production and Pickering and Branigan's (1998) account of structural priming. According to Pickering and Branigan (1998), and Roelofs (1992), sentence production takes place through several stages. One of those stages is a level in which abstract information about the syntactic properties of words and their argument relations is encoded. This is called the "lemma stratum". In this level, abstract entities that encode the

syntactic and semantic properties of the words that are still to be produced are retrieved: these entities are called lemmas. Lemmas are essentially word-like entities that contain information about the syntactic and semantic properties of a word but do not include the phonological information about the word. In Roelofs' and Pickering and Branigan's models of language production and priming respectively however, morphological features such as tense and aspect marking are encoded in a separate and later level in the language production process associated with articulation. According to Pickering and Branigan, structural priming operates at this earlier lemma level in which abstract information about the syntactic properties such as argument relations and phrasal order of words is encoded. Therefore, tense and aspectual features are not subject to structural priming effects (see section 1.6, this chapter for more on the mechanism of structural priming). It therefore follows that L2 structural priming tasks which attempt to prime tense and aspectual features are unlikely to succeed (see section 6.4.7, Chapter 6 for more discussion).

Although structural priming is generally believed to operate independently of non-syntactic factors, and even some morpho-syntactic features (e.g., tense and aspect marking), lexical overlap of open-class words between a prime and target can increase the magnitude of priming. Early investigations of production priming of written (Pickering & Branigan, 1998) and spoken English (Branigan, et al., 2000) detected a lexical contribution to structural priming in the form of a "lexical boost" effect for L1 speakers when the verb was repeated between prime and target. In a production priming study of dialogue, Branigan et al. (2000) specifically manipulated the repetition of verbs between prime and target sentences and found stronger priming when the verb was repeated across utterances. A lexical boost has also been reported in many studies of comprehension priming (e.g., Branigan, et al., 2005; Tooley, et al., 2009; Traxler & Tooley, 2008). In a study of priming effects in comprehension, Branigan, et al. (2005) also reported a lexical boost associated with the verb. Schoonbaert, et al. (2007) examined structural priming in Dutch speakers of L2 English and also found a lexical boost associated with the verb within speakers' L2 (English), and between speakers' L1 (Dutch) and their L2, but only in one direction: when the prime was in their L1 and the target was in their L2. The magnitude of priming effects has also been reported to increase in oral production priming when a noun is repeated across a prime and target (Cleland & Pickering, 2003). Gries (2005) also argued that the strength of (or tendency for) priming was critically mediated by the verb lemma in prime and target. (See Bernolet & Hartsuiker, 2010, for an alternative view.)

The lexical boost is also generally accepted as more significant in comprehension priming than production priming, and lexical (verb) overlap might even be a necessary condition for comprehension priming (Arai, et al., 2007; Branigan, et al., 2005; Tooley & Traxler, 2010), but not for production priming. The repetition of lexical material, especially a verb, between prime and target sentences is known to be more critical in comprehension priming than in production priming. For example, Tooley, et al. (2009) found in a structural priming study in which ERPs were taken as an index of comprehension preferences that priming effects were only observed when the verb was repeated across prime and target; when there was no verb repetition, priming disappeared. In that study temporarily ambiguous reduced relative clauses (e.g., *The child watched by the parent was playing quietly*) were processed more efficiently after a prime with the same verb (*watched*) but not with a different verb. Experimental studies of comprehension to production priming, in which speakers hear a prime sentence but do not repeat it, have also shown that priming effects were stronger when the verb was repeated between prime and target (Branigan, et al., 2000; Branigan, et al., 2005). In a corpus analysis of priming effects Gries (2005) also found that priming was stronger when the verb (either the exact verb form or the lemma) was repeated across prime and target. On the other hand, some researchers have argued that while lexical effects contribute to structural priming, they are not fundamentally a part of structural priming in production. According to this view, the repetition of open class words (especially verbs) between prime and target has been found to enhance structural priming in production but not be essential for it to occur (Hartsuiker, et al., 2008). One problem however, with forming conclusions about the relative importance of lexical overlap in comprehension and production priming respectively has been the difficulty in comparing comprehension and production studies (Tooley & Traxler, 2010). Each type of study typically employs different methods, with picture description methods being more common in production priming studies, and measures such as reading times, eye gaze, and ERPs more typical in comprehension studies. Clearly, such significant methodological differences cause difficulties in comparability, such as when comparing statistical measures of effect sizes.

The increased priming effects attributed to the lexical boost are known to be relatively short-lived and appear to decay in a matter of seconds, suggesting that observed syntactic and lexical effects in structural priming might be the result of separate mechanisms (V. Ferreira, S & Bock, 2006). Hartsuiker, et al. (2008) found that the lexical boost effect due to the repetition of the verb decays more rapidly than purely structural priming effects, and that repetition of the verb between prime and target sentence was most effective in boosting structural priming effects

when the target immediately followed the prime sentence, but was much less effective after a short lag of two intervening sentences between the prime and target, and was ineffective after a lag of six intervening sentences. On the other hand, Hartsuiker, et al. (2008) and Bock and Griffin (2000) have both found that purely structural priming effects are much longer-lived. In sum, the literature points to separate lexical and structural priming effects. Along these lines, some researchers have argued for a dual mechanism account involving lexical and syntactic components (Hartsuiker, et al., 2008; Tooley & Traxler, 2010). Hartsuiker, et al. put forward an account of structural priming in which lexical and syntactic processes can contribute independently to the overall priming of sentences. According to their account, lexical and syntactic processes are distinguished by separate time courses and degree of temporal durability/stability (Pickering & Ferreira, 2008).

One of the key defining features of structural priming is its implicit nature; people are not consciously aware of the effect. This lack of conscious awareness has been demonstrated in numerous monologic and dialogic priming studies. Typically, in order to claim a lack of awareness, nearly all structural priming studies have included measures to ensure that participants are not aware of the priming manipulation either by actively distracting participants with a cover task, or not revealing the purpose of the experiment, or both (Bock, 1986b, 1989; Bock & Griffin, 2000). In this regard, Bock (1986b) pioneered the use of a running-recognition memory task in which, concurrent with a covert priming intervention, participants are instructed to judge whether or not they have previously experienced a prime sentence (or picture). The unconscious non-strategic nature of structural priming has also been demonstrated in comprehension priming. Traxler and Tooley (2008) had participants read prime sentences and target sentences both containing temporarily ambiguous reduced relative clauses (e.g., *The defendant examined by the lawyer was unreliable*) and measured reading times using eye tracking in a self-paced reading paradigm. In two experiments which gave participants strategic cues to predict the occurrence of a reduced relative target sentence after a reduced relative prime, priming did not occur. However, highlighting the implicit nature of priming effects, in another experiment in which no cues were available, participants were primed. This finding underscores the implicit and automatic nature of structural priming and the irrelevance that conscious strategies play in the phenomenon.

The implicit nature of structural priming has been most strikingly demonstrated however in a study of amnesics. Ferreira, et al. (2008) demonstrated that anterograde amnesics, who have

severely impaired explicit memory, were subject to structural priming effects to the same extent as a group of healthy (control) speakers. In that study, when the four amnesic participants were tested for their recognition memory for the prime stimuli, they reported little or no recognition for the prime stimuli. From this finding Ferreira et al. (2008) argued for a procedural memory account of structural priming. These findings, together with findings of structural priming in other groups of cognitively impaired speakers (Hartsuiker & Kolk, 1998; Saffran & Martin, 1997; Thompson, Choy, Holland, & Cole, 2010), form a core part of the evidence for priming as implicit learning (see sections 1.6.2 and 1.7.3, this chapter). In particular, the evidence from these studies also supports the notion that priming might also lead to *second language* acquisition based on the assumption that L2 learners and certain groups of cognitively impaired speakers share some functional similarities. First, both groups manifest unstable linguistic systems. Second, L2 learners can manifest impaired cognitive function in terms of memory due to the heavy cognitive loads under which they typically operate in the L2 (see section 1.7, this chapter for a further discussion).

1.6 Mechanism and function of structural priming

As discussed, structural priming effects have been observed in a range of experimental and naturalistic contexts and the phenomenon is quite well-established. However, what could be the purpose of structural priming? This question seems to be somewhat unresolved at present. On the surface, and in an everyday sense, structural priming simply appears to be one of the factors which determines what people say since it can influence the structures they choose to produce (Branigan, 2007). Along these lines, several researchers have suggested that the purpose of priming is to facilitate conversation through speaker alignment (Branigan, et al., 2000; Gries, 2005; McDonough & Mackey, 2008; Pickering & Garrod, 2004). Specifically, Pickering and Garrod argue that "priming is the central mechanism in the process of alignment and mutual understanding" (2004, p. 177). Another interactionally-based explanation is that the purpose of priming is to increase speakers' fluency (V. S. Ferreira & Bock, 2006). More generally however, Priming might serve several functions. In a review of structural priming Ferreira and Bock (2006) also concluded that, based on the available evidence, priming most likely has multiple functions – both internal and external to the speaker. More relevant to this thesis is the proposal that structural priming serves a learning purpose and this will be discussed in more detail subsequently (see section 1.6.2 and 1.7.3, this chapter and throughout the thesis). As for the

mechanism of structural priming, two main proposals have been put forward, and these will be dealt with in turn.

1.6.1 Structural priming as temporary activation

One proposal for the mechanism of structural priming, first put forward by Branigan and Pickering and colleagues, is that it occurs through the temporary activation of linguistic information in the mind (e.g., Pickering & Branigan, 1998; Pickering & Branigan, 1999). That is, exposure to a prime sentence causes the activation of linguistic knowledge or processes and the residual activation is subsequently, and temporarily, available to facilitate the production of structurally similar sentences. This account is predicated on a specific model of language production based on Levelt's (1989) model in which syntactic information is located within a lexical connectionist framework. In this model syntactic information is associated with abstract lexical entities (word lemmas). Combinatorial nodes are linked to these word lemmas and specify information about the potential argument structures and syntactic relations associated with each lemma. When a word is comprehended or produced, a lemma node is also activated, including the node encoding the structure in which it was just used. Importantly, nodes are connected to each other in a complex network, and this means that activation of one node can activate other nodes. Activation levels of lexical information can therefore spread through a neural network encoding grammatical information. When a structure is primed a node/nodes is/are activated in the network and this activation spreads through the system and is available to facilitate the subsequent production of syntactic structures similar to that of the original prime sentence. In this account of priming Pickering and Branigan (1998) propose that effects are temporary and transient; that is, the activation decays over time. Some researchers who have looked at structural priming in naturalistic settings have also invoked this model to explain the mechanism and function of priming in dialogue (e.g., Gries, 2005).

1.6.2 Priming as implicit learning

An alternative account of structural priming, proposed by Bock and Chang and colleagues, and which has recently received considerable support, views it as a form of implicit learning (Bock, et al., 2007; Bock & Griffin, 2000; Chang, et al., 2000; V. S. Ferreira & Bock, 2006; Hartsuiker, et al., 2008; Pickering & Ferreira, 2008; Savage, et al., 2006). At the heart of claims that structural priming is a form of language learning is evidence that priming is relatively long-

lasting. Structural priming effects are typically strongest over short time periods (e.g. less than a few seconds), but priming is also known to be surprisingly long-lived. Several experiments have reported durations of several minutes (Bock, et al., 2007; Bock & Griffin, 2000), up to 20 minutes (Boyland & Anderson, 2008), 1 week for aphasic patients (Saffran & Martin, 1997), and up to one month in children (Savage, et al., 2006). Several experimental studies have also demonstrated cumulative priming effects over multiple priming trials (Bock, 1989; Hartsuiker, et al., 1999). In one of the earlier insights into the temporal durability of priming effects, Bock (1989) found an apparent carry-over of priming effects between priming trials. She argued that this carry-over meant that, for example, DO dative priming was contaminating participants' production of PO datives in subsequent priming trials (experiment 1 in that study). When the separation between DO dative and PO dative priming trials was increased (through the inclusion of more filler trials) priming effects increased (experiment 2 in that study). Bock inferred that therefore priming effects can linger and contaminate subsequent trials which attempt to prime alternative structures. This report was one of the first to suggest that priming could be long-lasting. Hartsuiker, et al. (1999) interpreted their findings of phrasal word order priming in terms of both short term priming and long term priming, but that the long-term priming was partly a result of participants repeatedly being exposed to primes leading to a cumulative priming effect. In one of the first studies to specifically investigate the durability of priming effects, Bock and Griffin (2000) found that priming occurred in the presence of up to 10 intervening unrelated sentences between the prime sentence and target picture stimulus, thus arguing against a temporary activation account. In a corpus analysis of priming in natural dialogue, Gries (2005) also found evidence for long-lasting priming in the form of a logarithmic decline as the distance between the prime and target increased. Gries measured the number of "parse units" (typically clauses or sentences) between prime and target and found no significant decline in the strength of priming at short intervals and when distance was correlated with priming strength a significant logarithmic correlation was found.

Support for an implicit learning account of structural priming is supported by the findings from priming studies of children (Brooks & Tomasello, 1999; Gámez, et al., 2009; Hsu, 2008; Huttenlocher, et al., 2004; Messenger, Branigan, McLean, & Sorace, 2012; Savage, et al., 2006; Shimpi, Gámez, Huttenlocher, & Vasilyeva, 2007). The observation that young children display structural priming effects suggests that it could be related to language development. Several studies have demonstrated for example that young children can be primed to produce passives,

even though young children do not usually otherwise spontaneously produce many passives[5] (Brooks & Tomasello, 1999; Huttenlocher, et al., 2004; Messenger, et al., 2012; Savage, et al., 2006; Shimpi, et al., 2007), and that often this priming effect can be long-lasting (e.g., up to one month). It has been argued that this is evidence for learning of syntax. Brooks and Tomasello (1999) found that 3 year old children produced passives when primed with passives and that this effect was independent from lexical effects. Furthermore, this change in behaviour was found to be rather rapid, occurring after only one hour of experimental participation. Children have also been primed for noun phrase structure. Skarabella and Serratrice (2008) reported that although children (and adults) prefer an *s* genitive noun phrase structure, (as in *the policeman's daughter*), both groups could be primed for the dispreferred *of* genitive structure (as in *the daughter of the policeman*). Importantly, the children in that study showed structural priming effects in an immediate post-test, indicating that the priming effect, compared to a baseline performance, was temporally durable. Thus it is possible that priming could be a mechanism of language development by extending the range of productive structures in young (or developing) speakers' linguistic repertoire.

In sum, Bock & Griffin (2000, p. 189) suggested that priming was involved in "learning to talk", while Chang and colleagues (Chang, et al., 2006; Bock, et al., 2007; Yamashita, et al., 2003) also position structural priming as means of learning expressed in the following way:

> The implicit learning account illuminates structural persistence as a basic and fairly primitive mechanism of language use that supports language learning and language change, as well as providing a scaffolding upon which the short-lived dynamics of language performance can build. (Bock, et al., 2007, p.440)

Other evidence which supports an account of implicit learning comes from findings of structural priming in speakers with disrupted language and memory systems (V. Ferreira, S, et al., 2008; Hartsuiker & Kolk, 1998; Rossi, in press; Saffran & Martin, 1997; Thompson, et al., 2010). As noted previously, Ferreira, et al.'s (2008) study of amnesics pointed to the implicit nature of priming. This one finding is significant in light of the status of data from studies of amnesics as the "gold standard" in implicit learning research (Carr & Curran, 1994, p. 216). Also, several

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[5] Since many child priming studies, including Brooks and Tomasello (1999) have not included measures of baseline production (e.g., pre-tests), production levels of the target structure prior to the priming intervention are difficult to determine.

studies have demonstrated structural priming in agrammatic aphasics, pointing to the possibility that priming can activate or "tune" the linguistic systems of speakers with unstable language systems. In this respect Hartsuiker and Kolk (1998) assessed the ability of 12 Broca's aphasics to be primed relative to 12 normal control participants under three priming conditions and found that the aphasics were primed more strongly than the controls for the production of passives and datives. In a pre- and post-test design structural priming experiment, Saffran and Martin (1997) also reported that aphasic speakers with agrammatic speech could be primed to produce datives and that this effect was evident in increased production of datives in the post-test relative to the pre-test. Similarly, Rossi (in press) also found that agrammatic L1 Italian speakers were primed to the same extent as healthy control speakers to produce clitic pronouns and that the priming effect was sensitive to the location of the clitic in the sentence. These findings are intriguing because they suggest more generally that priming could be a way of facilitating syntactic competence in speakers with impaired, disrupted or unstable linguistic systems. Structural priming techniques are also used in the treatment of agrammatic patients and children with specific language impairment (SLI) (Leonard, 2011; Thompson, et al., 2010). Thompson, et al. (2010) describe an effective computer mediated treatment in which agrammatic patients are primed to produce object relative clauses and object cleft sentences, which they would otherwise not produce.

Leonard (2011) also describes how structural priming is inherent in much speech therapy given to children with SLI. He argues that structural priming should be seen as an important tool for clinicians to achieve implicit language learning in these children. Similarly, on the basis of findings of structural priming in agrammatic speakers of Italian, Rossi (in press, p. 41) also suggested that structural priming might be used as a clinical treatment technique for agrammatic speakers. These acknowledgements of priming as a method of teaching grammar to L1 speakers with disrupted or impaired language systems is an important pointer to the possibility that priming might also be an important method of teaching L2 grammatical structure to second language learners. While second language learners might not be considered to have *disrupted* language systems, they might be considered as having an incomplete, partially-formed, or even impaired L2 language system – or interlanguage – especially if compared to target language norms. In this sense, just as it is the job of a speech clinician to ensure that children with specific language impairment (SLI) or other groups of agrammatic speakers develop a native-like competence in their L1, so is it the job of a second and foreign language teacher to ensure that their learners develop native-like competence in their L2. While aphasics and children with SLI

are not the same as second language learners, all groups share one thing: a disrupted linguistic competence. It is thus reasonable to question whether the language systems of second language learners might be able to be tuned in much the same way as the language systems of aphasics can be tuned.

Another important characteristic of structural priming which lends support for the implicit learning account of priming is the so called "inverse-preference effect" (V. Ferreira, S & Bock, 2006; Sheepers, 2003). In general, structural priming effects are strongest for less frequent structures (e.g., Bernolet & Hartsuiker, 2010; Bock & Griffin, 2000; Ferreira, 2003; Ferreira & Bock, 2006; Hartsuiker, et al. 1999; Hartsuiker & Westenberg, 2000; Loebell & Bock, 2003). In studies that have investigated participants' choices between preferred and non-preferred syntactic structures, structural priming effects have been strongest for the non-preferred structures (e.g., Hartsuiker & Westenberg, 2000). Hartsuiker and Westenberg (2000) primed participle-final and auxiliary-final structures in L1 Dutch speakers. In a baseline pre-test, participle-final word order was found to be the preferred structure. Priming effects were found for the auxiliary-final structure, but not for the preferred participle-final structure. Similarly, Hartsuiker, et al. (1999) investigated word order priming in Dutch and found stronger priming for less a preferred structure. In an oral picture description priming task, they primed the production of sentences containing locative prepositional phrases - either locative state sentences such as *Een boek ligt op de plank* [*A book lies on the shelf*] or what they called frontal locative sentences such as *Op de plank ligt een boek* [*On the shelf lies a book*]. They found stronger priming for the less preferred frontal locative sentences. Several studies have also shown that DO datives are primed more strongly that PO datives. In a priming study of Dutch L1 speakers Bernolet and Hartsuiker (2010) found that DO datives are primed more strongly than PO datives. Furthermore, this study demonstrated that priming strength in DO datives was inversely proportional to the argument bias of the verb: DO sentence primes containing verbs which preferred PO dative structure primed DO datives more strongly than prime sentences containing verbs which preferred DO datives. Interestingly, target verbs which preferred PO dative structure were not more effective at priming DO datives than target verbs which preferred DO dative structure. Bernolet and Hartsuiker also found that at baseline PO datives were more frequent than DO datives but that under priming conditions DO dative production increased more than PO dative production. This finding confirmed the findings of others (Bock, 1986; Bock & Griffin, 2000) that less frequent structures are primed more strongly than more frequent structures. Once again, these findings of stronger priming for structures that are produced less frequently by

speakers suggest that structural priming is associated with language learning and lend support to the implicit learning model proposed by Chang and Bock and colleagues (Bock & Griffin, 2000; Chang, et al., 2000).

While the exact mechanism and function of structural priming remains uncertain, some researchers have begun to acknowledge that priming effects might reflect both residual activation of existing linguistic knowledge and implicit learning (Branigan, 2007; V. Ferreira, S & Bock, 2006; Hartsuiker, et al., 2008; Tooley & Traxler, 2010). Branigan (2007) and Ferreira and Bock (2006) suggest that structural priming effects might be explained by both accounts - temporary activation and implicit learning. Branigan (2007, p. 11) also noted that the observation of stronger and more durable priming in children, the occurrence of priming in aphasics, and reported priming in second language speakers (e.g., McDonough & Mackey, 2008) and suggests that priming could play an important role of language learning in people with unstable or incomplete language systems. Overall then, converging findings of stronger priming for less frequent and less preferred structures in normal and impaired L1 speakers, priming in children, and general reports of long-term priming effects in L1 speakers open the door for exploring structural priming in second language speakers.

Finally, some evidence appears to exist that the mechanism of structural priming in Japanese and Chinese L1 speakers might be different to priming in speakers of L1 English and other European languages. Yamashita, et al. (2003) found that in contrast to Bock and Loebell (1990) that L1 Japanese speakers were not primed to produce prepositional datives by locatives. That is, in a priming context, Japanese speakers were not as sensitive to abstract word order as English speakers supposedly are, but tended to be more influenced by information about the conceptual role of sentence constituents. Evidence exists that speakers of other languages also behave differently in structural priming contexts. Chinese speakers and Korean speakers have both been observed to be influenced by conceptual information (e.g., thematic role information) in structural priming (Cai, et al., 2010; Shin & Christianson, 2009). These findings suggest that speakers of different L1s might also behave differently in L2 structural priming studies, or even employ different sentence production processes. This conclusion has implications for whether or not an L2 speaker's L1 influences their propensity to be primed, or the exact mechanism of priming. In terms of the mechanism, does a speaker's L1 influence the extent to which priming results in L2 learning?

1.7 L2 structural priming

Despite claims in the literature about the possibility that structural priming represents a form of language learning, it appears that so far only a few studies have investigated this possibility with L2 speakers, and only a handful with L2 learners. In fact, not including cross-linguistic studies, the L2 structural priming literature is much smaller than the corresponding L1 literature and these L2 studies are described below. Since L2 structural priming is a relatively new field of enquiry and because of the lack of previous studies, the choice of methodology in most of the L2 structural priming studies to date has been guided by the L1 literature. This in itself is cause for some concern since the two contexts are likely to require different methods of investigation. (See section 6.6, Chapter 6 for a discussion.) The paucity of data on the performance of L2 learners in structural priming conditions points to an obvious opportunity for research. Acknowledging the bias in the research into structural priming, Branigan (2007, p. 14) suggested that in the future "perhaps the most interesting research will arise out of studies that focus on children and other special populations". This thesis attempts to realise this claim by investigating structural priming in a hitherto under-researched context, namely L2 learners.

McDonough (2006) appears to have carried out one of the first experimental studies of structural priming in L2 learners. She employed a confederate scripting technique (see section 1.4.1 this chapter) borrowed from previous L1 priming studies (see Branigan, Pickering, & Cleland, 2000) within a pre- and post-test design in order to investigate the priming of English datives and subsequent learning effects. The focus on datives also represented a continuation of the choice of this structure from previous L1 studies. In experiment 1 of that study, which manipulated prime type (both PO and DO datives were primed), a group of mixed L1 background learners interacted with a confederate of the researcher in a dialogue in which the confederate and each participant described pictures to each other. The pictures were designed to elicit datives (e.g., a picture of a girl bringing a glass of water to a boy for the target: *A girl is bringing a glass of water to her brother*). Priming effects emerged only for PO datives (not for DO datives) and persisted into a post-test. In a second experiment which only attempted to prime DO datives, priming effects emerged during the priming phase but no long-term effects were evident in the post-test. These findings suggest that, for L2 speakers, long-term structural priming effects are possible but can be modulated by the target structure itself. Curiously perhaps, this effect of structure on priming strength even applies at a relatively fine-grained level of structure whereby

even very similar structures display different priming effects (i.e., PO datives were primed but DO datives were not).

In a series of subsequent studies, McDonough and colleagues continued to investigate possible learning through L2 structural priming, often by utilising post-tests to assess long-term priming effects (McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008). In many of these studies she approached the investigation in terms of the effects of interaction on L2 development and therefore, as in her first study, employed a dialogic methodology. Specifically, in several studies it was hypothesised that priming might underlie the process in which L2 speakers develop their competence through interaction with more developmentally advanced speakers (either native speakers/instructors or more advanced L2 speakers). She hypothesised that these interlocutors would "prime" learners to produce the more advanced forms. That is, through a structural priming mechanism, L2 speakers might tend to repeat the more developmentally advanced structures of their interlocutors and in so doing acquire those structures.

In one of these studies, and also using a confederate scripting methodology, McDonough and Mackey (2008) investigated the impact of structural priming on English as a second language (ESL) question development. Speakers engaged in dialogue with a confederate who asked questions containing developmentally advanced syntax. Participants, who were all Thai L1 learners of ESL, were expected to also ask the confederate questions. Learning was defined as progression through the levels in Pienemann and Johnston's (1987) and Pienemann's (2005) developmental sequence of ESL question formation. According to Pienemann (2007, p. 138) ESL questions are acquired along a hierarchy of four stages as illustrated below.

Stage 1	SVO question	He live here?
Stage 2	wh- + SVO	Where he is?
Stage 3	Copula inversion	Where is he?
Stage 4	Aux-second	Where has he been?

Participants in McDonough and Mackey's (2008) study were progressing through stages 3 and 4 of this hierarchy and so were expected to be primed to produce more questions at stage 3 and 4 than they did in the absence of the priming intervention. Prime sentences then, were of the form: *What did you do at one pm?*. In response to experiencing the primes, speakers were expected to

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produce their own questions containing the same advanced structure as in the following target sentence produced by one participant: *uh in in the midnight what were you doing?*. In this study, participants who were reliably primed in the experimental phase performed better on two post-tests (one week, and five weeks post priming) compared to their pre-test performance. Those who were not primed showed no significant improvement on the developmentally advanced questions. Also, the more advanced speakers in the study displaying stronger priming effects than the lower proficiency speakers. McDonough and Mackey (p. 43) also found evidence that lexical repetition between prime and target was actually detrimental to the priming effect, noting that "high priming participants whose questions contained different question words and main verbs developed, whereas the participants who reused the lexical items provided in the scripted interlocutors' questions did not develop". This finding appears to be consistent with L1 findings of rapid decay of a lexical boost (Hartsuiker, et al., 2008).

Another study of L2 English speakers (ESL learners at a Korean university) appeared to show detectable levels of priming of passives (Y. Kim & McDonough, 2008). In that study, instead of a confederate providing prime sentences, Y. Kim and McDonough (2008) had speakers interact with a researcher in a picture description task by alternately listening to the researcher's descriptions of pictures and then giving their own descriptions of pictures. In this way, the task appeared to resemble a typical pedagogical task in a language classroom. The target structure was *be* passive, and the priming stimulus set consisted of 20 passive and 20 filler (active) primes sentences. The low proficiency speakers in that study displayed only relatively weak priming effects, producing only three target passive sentences in response to 20 passive prime sentences. However, the more advanced speakers showed much stronger levels of priming of between 10 and 17 targets per 20 primes for each of the two high proficiency groups respectively. No baseline or post-test data was collected in this study, making conclusions about learning effects difficult to make. The study also apparently made little attempt to control for (or report) participants' possible conscious awareness of the prime structure and strategic behaviour to actively and consciously imitate the researcher. Also, since only the more advanced speakers produced large numbers of passive targets, it was possible that speakers relied on their existing competence with passives and modified their language production to adjust to their interlocutor's speech, rather than "learnt" to produce passives. Therefore, priming effects in this study were not particularly strong, and were insignificant for low proficiency learners. Nevertheless, this study was another important step in demonstrating the possibility of priming effects in L2 speakers. Along similar lines, Ameri-Golestan and Nezakat-Alhossaini (2012) reported a study of passive

priming in L1 Persian-speaking learners of English as a foreign language (EFL). They reported very large priming effects which were also correlated with proficiency, and importantly, did take measures to minimise the development of conscious awareness of the participants. In this respect Ameri-Golestan and Nezakat-Alhossaini concealed from the participants the real purpose of the experiment by telling them that the focus of was on "the type of sentences that people would use to describe a variety of situations" (p. 861). With the exception of relatively few studies however, most other L2 structural priming studies appear to have been less than rigorous in taking account of participants' potential conscious awareness of the priming manipulation than analogous L1 studies.

L2 structural priming however, does not always work. In another study looking at priming from an interactivist perspective, Boston (2010) also attempted to prime ESL learners from Japanese L1 backgrounds to produce English passives in a dialogic priming-type task, but without success. This time learners interacted with each other in the classroom. They did this by engaging in an oral picture description task in such a way that they were expected to prime each other's utterances. However, the treatment group performed similarly to a control group, which received no priming, and very few passives were produced by either group.

Overall, these two findings of relatively weak or no L2 priming for passives (Boston, 2010; Y. Kim & McDonough, 2008), and no L2 priming for DO datives (McDonough, 2006) suggest that the choice of target structure might be critical in priming studies, even structures which appear to have semantically closely related alternative structures such as in the passive/active and dative alternations. The findings of Boston (2010) and Kim and McDonough (2008) suggest that proficiency is also a critical factor in L2 priming whereby priming effects increase as proficiency increases. Along these lines, Ruf (2009) also found that low proficiency L2 German speakers did not display long-lasting priming effects for word order, but high proficiency speakers and L1 speakers did. These findings suggest that priming might not be evidence of language learning, but rather merely the result of the temporary activation of existing syntactic knowledge. Further research is required in order to clarify.

In another dialogic priming study that employed post-tests and delayed post-tests, McDonough and Chaikitmongkol (2010) examined priming of ESL questions. Instead of interacting with a confederate (e.g., McDonough & Mackey, 2008) or a native speaker researcher (e.g., McDonough & Kim, 2009), in this study ESL learners in a language class interacted with each

other in much the same way as in Boston (2010). In McDonough and Chaikitmongkol's study however, many more opportunities for priming were given, with each learner alternately producing prime sentences for the other in several priming tasks spaced over several weeks. Massive priming effects were reported in the priming phase of the study, with also very large delayed effects emerging both in the immediate post-test and delayed post-test. One possible objection to this study however, concerns possible explicit and metacognitive learning effects. This is a major concern because the absence of conscious awareness is one of the defining characteristics of structural priming, yet there is high probability that participants were aware. Since both participants in each priming task apparently alternated reading and producing sentences (given to them by their instructor who was also one of the researchers) for the other participant, it is likely that they were all to some extent aware of the significance of the priming structure. In fact, McDonough and Chaikitmongkol reported that the learners in the study, who came from an existing EFL class, were being taught as part of their course a range of learning strategies including metacognitive strategies such as task analysis, peer review self-evaluation, and reflection. It is therefore possible that the learners might have applied some of these strategies during their priming activities, and that the activities designed to induce priming merely served to raise the attention levels of learners for the prime structure. Given that participants might have developed some conscious awareness of the significance of the priming structure (*wh*-questions) or engaged in strategic behaviour, it is unusual that there was no apparent attempt in the study to control for such a possibility, such as for example, by debriefing participants after they took part. On balance, it is very difficult to assign the effects reported in this study to structural priming.

What was noteworthy about McDonough and Chaikitmongkol's (2010) study was that it appears to have been one of the first L2 priming studies to have specifically investigated the production of an interlanguage/target structure alternation. This alternation consisted of the omission or inclusion an auxiliary verb in *wh*-questions (e.g., *Why people count sheep?* vs. *Why do people count sheep?*). This innovation appears to be an important step in L2 structural priming research and begins to open up a new avenue for L2 structural priming research.

Biria et al. (2010) also carried out an L2 structural priming study, this time investigating the production of a hitherto unexplored structure and speaker population in L2 priming research - English indirect questions and requests (e.g., *He is asking how the cell-phone works*) by Persian-speaking EFL learners. Biria et al. reported very large priming effects which also transferred

across modalities from speaking to writing in an immediate post-test, and they interpreted the priming effects as evidence of implicit learning of L2 grammar. However, once again the issue of the possible development of explicit awareness emerged from the choice of methodology. Participants interacted with their instructor in the structural priming activity and this methodological choice raises the possibility that participants might have behaved strategically to imitate their instructor, or that they might have focussed their attention on the syntactic form of their instructor's linguistic input (i.e., the primes). If either or both of these possibilities were true, it presents problems for interpreting the findings as structural priming, which by definition must be implicit. Unfortunately, Biria, et al. did not appear to control for this possibility and did not discuss the possibility. One important feature of the Biria et al. study though was the inclusion of a control group. This group engaged in the same picture description task with the researcher but did not receive any prime sentences. This was another important innovation in L2 priming research. Control groups have been rarely used in L1 and L2 structural priming research, even though they are very common in most other pedagogical research. This situation is somewhat puzzling because without a control group it is difficult to account for the possibility of various spurious factors (non-priming) contributing to changes in linguistic performance during an experimental intervention.

Following this series of dialogic-type priming studies, Shin and Christianson (2012) more recently appear to have been the first to carry out an experimental monologic-type L2 structural priming study. They also employed a pre- and post-test design and examined structural priming effects in L1 Korean learners of L2 English for two English structural alternations: separated vs. non-separated phrasal verb constructions (e.g., *The man is putting the fire out* vs. *The man is putting out the fire*) and double object vs. prepositional object datives (e.g., *The boy is handing the singer a guitar* vs. *The boy is handing a guitar to the singer*). Importantly, to address the issue of acquisition, that study also employed a delayed post-test one day after the priming session to assess the temporal durability of any priming effect. Shin and Christianson reported significant effects of learning: the learning effects found in the delayed post-test were in the order of those in the immediate post-test. The priming effects were also relatively large and were specifically attributed to implicit learning of L2 structure.

Unlike many previous L2 studies, Shin and Christianson also made systematic attempts to control for speakers' conscious awareness of the target structure and possible strategic behaviour. In one sense this was partially achieved by disconnecting the priming treatment with

interaction. Using a between-subjects design, Shin and Christianson (2012) also compared structural persistence under relatively more explicit and relatively more implicit (i.e., "aware" and "unaware") conditions. In the most implicit condition the repetition of the target structure and the priming manipulation were concealed from participants by inserting several filler prime sentences between the test prime sentence and target picture in each trial. In the second least implicit condition of the three conditions in that study the target immediately followed the prime sentence and Shin and Christianson argued that this condition represented a relatively "explicit" form of priming. The study therefore relied on large numbers of fillers, strategically placed, to divert attention away from the priming manipulation.

1.7.1 Lexical overlap

Similar to the L1 literature, the question of the contribution of lexical repetition to L2 structural priming effects is an open one. Some studies have found that lexical overlap between the prime and target is necessary for strong L2 structural priming to occur (e.g., Y. Kim & McDonough, 2008; Ruf, 2009). Drawing on the L1 findings on lexical repetition, Shin and Christianson (2012) in fact specifically incorporated verb repetition in order to strengthen any priming effects. It seems reasonable to assume, however, that lower proficiency L2 learners might be more dependent on a lexical boost because they are known to rely more on lexical processing, while more advanced learners might tend to rely more on syntactic processing (Clahsen & Felser, 2006). Several L1 and L2 priming studies on the other hand, have found that no lexical repetition is required for priming to occur (e.g., S. Kim, Mauner, & Koenig, 2009; McDonough & Mackey, 2008; Nitschke, Kidd, & Serratrice, in press). Thus, it is uncertain whether a lexical boost is actually required in L2 structural priming. It has also been found that the lexical boost decays quite rapidly for L1 speakers (Hartsuiker, et al., 2008) and so it is likely also to decay rapidly for L2 speakers, and thus contribute little to long-term learning effects.

VanPatten (2002) has argued that L2 learners should be encouraged to process the L2 in native-like ways, and this approach is elaborated in his Processing Instruction (PI) model of second language teaching. According to this approach therefore, to ensure the best chance of acquisition it would seem reasonable to encourage low level learners to rely less on a lexical boost during a priming intervention (see Chapter 2 for a description of the methodology employed in this thesis).

1.7.2 Strength of priming

Although many L1 studies have demonstrated structural priming effects, a note of caution is necessary when interpreting their findings. Despite many of these studies involving large groups of speakers (e.g., more than 100 in some studies) leading to adequate statistical power, often only relatively weak priming effects emerge. Tooley and Traxler (2010) reviewed the literature and noted that effect sizes in L1 structural priming studies are universally weak. Frequently, effects are observed on item analyses but not participant analyses or vice-versa (e.g., Bock, et al., 2007). One possible reason is the degree of inter-participant variability. Language production tasks used in some structural priming studies, such as picture description, give speakers a relatively large amount of freedom to produce a large range of structures. Therefore, the shear range of speakers' responses in these tasks could swamp any priming effects.

If anything, most L2 speakers should display even greater variability than L1 speakers in language performance. Therefore, priming strength could be statistically weak in L2 settings. On the other hand, the so-called inverse-preference effect (Ameri-Golestan & Nezakat-Alhossaini, 2012; Ferreira & Bock, 2006; Sheepers, 2003) might ensure large priming effects in L2 settings. Child priming studies also report relatively strong priming effects (e.g., Bencini & Valian, 2008), suggesting that priming is associated with language acquisition. At the moment however, due to the small number of L2 studies, the question of priming strength in L2 speakers and learners remains relatively unresolved. The issue of priming strength is discussed in this thesis in more detail in Chapter 3 in relation to the findings of Experiment 2 which explores L2 priming of passives.

1.7.3 Implicit second language learning

Referring to second language learning, DeKeyser (2008, p. 321) claims that "a thorough reading of the literature on implicit learning [...] must leave one very skeptical about the possibility of implicit learning of abstract structure, at least by adults". The evidence from L1 structural priming studies in adults and children, suggests that implicit learning of structure seems possible, at least if learning is defined as increased production of a target structure over baseline production levels. More importantly, as discussed earlier, a small number of L2 studies have demonstrated that implicit L2 learning is indeed possible through structural priming. One study in particular (Shin & Christianson, 2012) demonstrated reliable long-term L2 priming effects,

although this study did not consider the relative difficulty of the target structure, but merely measured differences in target structure production over baseline levels. Conclusions about implicit learning are possible because priming is, by definition, known to operate below the level of conscious awareness. Given this established implicit nature of structural priming, structural priming research could also inform the debate about the relative importance of explicit and implicit second language learning by adults. Learning through priming would be evidence of implicit second language leaning.

1.8 Definitions of key constructs

The research in this thesis requires a careful definition of several key terms and constructs – "learning", "awareness", and "implicit learning" – for these terms recur throughout the thesis. One reason to clarify what is meant with these terms is because of the interdisciplinary nature of the research, crossing areas of psychology and applied linguistics, and the nature of the research questions. Typically, researchers in these two disciplinary areas define these terms in different ways and this can lead to confusion.

1.8.1 Learning

The core definition of learning is usually accepted as being the process by which a lasting change in behaviour develops. For example, the online Oxford Dictionary of Psychology (Colman, 2009) defines it as "any lasting change in behaviour resulting from experience". According to Reber and Reber's (2001) Penguin Dictionary of Psychology, the definition of learning as the "process of acquiring knowledge" (p. 390) is also relatively uncontroversial and is accepted in both technical (e.g., cognitive psychology, educational psychology and similar fields) and non-technical domains. Reber and Reber point out though that several elements are inherent in the technical definition, including: the notion that learning should "be relatively permanent"; have a "response potentiality" (that is, learning effects might be delayed); and that practice and repeated occurrences will improve learning. Overall though, Reber and Reber claim that the overall tendency is to "allow the socially accepted meaning to prevail" (p. 391).

One potentially problematic element of all definitions of learning however is the question of how long-lasting a behavioural change should be for it to be considered a form of learning. On the

one hand, lay persons, many educationalists and perhaps many second language researchers might expect such changes to endure indefinitely and be relatively stable, or at least to last for very long periods – perhaps lasting several weeks or even years. Cognitive psychologists on the other hand, who are more interested in the internal cognitive processes of learning and behavioural change might argue that the change need only last for several minutes, hours or at most several days to be considered a form of learning. Although many learning definitions require a relatively permanent or long-lasting component, even Reber (1967) himself in his seminal paper on implicit learning of an artificial grammar claimed to have observed learning in respect of a change in behaviour measured only a matter of minutes after the learning phase of the treatment (learning) phase of the experiment. Along these lines most L1 structural priming researchers have also considered changes in language production or processing that last only as little as several minutes as forms of learning (e.g., Bock & Griffin, 2000). Priming studies looking at children have also categorised observed priming effects lasting as little as several minutes (as well as those lasting up to several hours or days) as evidence of language learning. In L2 priming, Shin and Christianson (2012) also attributed changes in the language production of participants that were observed in an immediate post-test administered several minutes after a priming treatment to a learning process.

Following from the above accepted definitions of learning I also chose to attribute short-term structural priming effects that were observed up to several minutes after a priming treatment as evidence of a learning process. I do not claim however, that priming *is* learning. Rather, I hypothesise that structural priming might represent a component of learning, perhaps only an initial stage in the process of learning. I discuss this issue in more detail in sections 6.3.6 and 6.4, Chapter 6.

1.8.2 Implicit learning

The notion of implicit learning is particularly difficult to pin down in an agreed definition, and researchers in psychology and second language acquisition have developed several definitions. According to Reber and Reber (2001) implicit learning is "learning that takes place largely independent of awareness of both the process of acquisition and the content of the knowledge so acquired" (p. 392). Colman (2009) defines it as the "acquisition of information occurring largely without conscious effort or explicit knowledge of what is learned" but, pointing out the methodological difficulties in measuring the phenomenon also acknowledges that "the second

part of [this] definition is controversial because of the difficulty of proving that participants lack knowledge of what they have learned". In some cases, differences in definition have also led to significant debate between SLA researchers from the two fields [e.g., see Paradis's criticism of the work of N. Ellis in relation to implicit and explicit learning in Paradis (2004)]. Even researchers within applied linguistics have defined terms such as implicit and explicit learning in different ways, causing confusion and debate and often clouding the findings of research. There is also contention about the best way to experimentally measure these constructs as experimental variables.

First, the notion of implicit learning, which is relatively central to the thesis, hinges on a range of other concepts – awareness, consciousness, attention and noticing. In structural priming studies, implicit learning is usually meant to denote learning without a speaker being aware that they have learnt anything and without having any intention to learn. The definition attention and noticing however is much more controversial. Within the fields of psychology and second language acquisition the definition of these terms has been hotly debated, with almost as many definitions as there are researchers. To illustrate the difficulty in grappling with such constructs, Schmidt (1990) from an SLA perspective for example, argued for a distinction between consciousness and noticing. Schmidt (2001) later argued that attention is also not a unitary phenomenon, but rather, a term used to cover several psychological phenomena. In particular, he claims that attention, as it is used in SLA, is closely connected to awareness, and that the two constructs are "two sides of the one coin" (Schmidt, 2001, p. 5). He also argues that attention can include "awareness with detection" and "awareness without detection" (or "preconscious registration"). According to Schmidt (2001), a second language learner might also attend to, and detect, critical linguistic stimuli unconsciously (i.e., without awareness) and proceed to acquire the critical features in question. Schmidt has elaborated on this possibility in SLA in his Noticing Hypothesis (see Schmidt, 1995) by claiming that, while no learning can occur without learners noticing the relevant feature, such noticing might not enter the consciousness of the learner. Complicating matters of terminology and possibly misinterpreting Schmidt's claims, Tomlin and Villa (1994) interpret a situation in which a learner notices an L2 feature without awareness, or experiences "preconscious registration", as one in which the learner is classed as "unaware". Clearly, the issue of consciousness, awareness and noticing in SLA is complex, subject to at times intense debate, and a full discussion of the literature in this area is beyond the scope of this thesis (see Hulstijn, 2005; Schmidt, 1990, 1995).

Rather than enter this theoretical debate, I will approach the topic of implicit learning and conscious awareness of learners from a purely practical standpoint and interpret my findings in terms second language teaching practice (see section 6.4, Chapter 6). I will argue that whether or not a learner is truly consciously aware (whatever that means) of an L2 feature is relatively unimportant for pedagogical applications. This approach is also consistent with the approach of the vast majority of L1 and L2 priming studies (e.g., Shin & Christianson, 2012) which classify implicit learning in the ordinary sense that a learner simply cannot or does not report noticing the target feature. First then, in the thesis learning was operationalised in a purely practical sense as an observed increase in production of a target structure (and where relevant a decrease in production of an ungrammatical form) relative to a baseline condition. Implicit learning was then defined in terms of what matters most: that learners were not *consciously aware* of the feature they were learning. That is, through priming, learners might detect and attend to the critical stimuli, but be unaware they have done so, and be unable to report having done so, in the sense defined by Tomlin and Villa (1994). (See Chapter 6 for more discussion).

1.9 Importance of the research

The outcomes of the research could inform models of SLA and L2 teaching techniques on a number of dimensions. These include:

- Implicit learning in SLA
- Learning of L2 syntax
- The role and nature of repetitive practice in L2 learning
- Instructional practices in second language learning

From a theoretical perspective, the possibility of learning language through priming could also be evaluated with respect to several theories of SLA. Despite many decades of research, it is still unclear whether acquisition of second languages in general, and acquisition of second language syntax in particular, is largely lexically-driven, syntactically-driven, or some combination. It is also unclear to what extent SLA depends on implicit processes (c.f., Krashen, 1985), or predominantly explicit knowledge and explicit teaching (e.g., DeKeyser, 2008; VanPatten, 2007). An investigation into structural priming might shed light on the issues of implicit versus explicit language learning.

1.9.1 Learning through repetition

In general, learning through repetition is neither unusual nor new. It is well known that second language *vocabulary* learning critically depends on repeated experiences with a word, particularly phonological experiences (hearing and repeating) (Nation, 2001). Much second language classroom practice depends on such a belief. Presumably this belief could be justified on several grounds, not least based on findings about lexical priming. Yet it appears that more recently little attention has been paid to the likelihood that learning of L2 syntax might also be subject to a similar process of repeated experiences (seeing, hearing, repeating etc.).

Rote repetition in second language teaching has been out of favour for several decades. The last time significant attention was given to this sort of teaching practice was in the 1960s and 1970s when the Audiolingual Method was the predominant teaching method of foreign and second languages (e.g., Belyayev, 1963; Billows, 1961; Girard, 1972). In fact, the mechanical and decontextualised drilling of syntactic structures, as advocated in the audiolingual approach through at least two decades of second language teaching, has been the subject of much derision since the late 1970s onwards (e.g., see Lamendella, 1979 for a criticism of audiolingualism). The key elements of audiolingual teaching techniques were "listen and repeat" drills, grammatical substitution drills, and pattern practice, all of which fostered the development of students' grammatical automaticity. Advocates of the Audiolingual Method claimed that these sorts of drills and exercises should result in improved automaticity, but frequently described expected learning outcomes in more metaphorical terms or in terms of the accepted dogma of the day. Typically, this meant they emphasised the development of "habits" and "instincts", or alternatively, "an unconscious feeling for correct usage" (Billows, 1961, p. 154) leading to subsequent fluency. Structural priming is a similar process, in that it is essentially a modification of linguistic behavior based on repetition and practice, achieved through implicit means, and in a relatively decontextualised manner. Thus, the outcomes of structural priming experiments, which did not exist when the Audiolingual Method was both developed and rejected, might allow a new evaluation of this teaching method.

1.9.2 Computer-assisted language learning

Finally, a further possible pedagogical outcome of the research could be in relation to computer-assisted language learning. Priming lends itself to computerised language learning and teaching techniques, and most or all of the experiments in this research will be conducted with computers. If priming can be shown to reflect stable language learning, similar priming techniques could be potentially employed in computerised language learning environments. This possibility was not formulated explicitly as one of the research questions because it was not central to the investigation, but it is subsumed in Research Question 5 and therefore discussed in section 6.4.6, Chapter 6 in relation to applications of structural priming activities in second language teaching.

1.10 Organisation of the thesis

The thesis explores L2 structural priming in L2 learners of English, and describes and reports on three structural priming experiments. First, Chapter 2 presents an overview of the methodology employed in these experiments, with reference to previous L1 and L2 studies. Chapter 3 describes the first of these experiments: one which investigates priming of English *get* passives. Chapter 4 describes the second experiment which investigates priming of English stranded prepositions. Chapter 5 describes the third experiment, which also investigates priming of stranded prepositions, but in a different sentential context from that of Experiment 2. This chapter also interprets and discusses the findings of Experiments 2 and 3, especially in terms of the differential sentential contexts of the target structure in each experiment. Finally, Chapter 6 discusses the overall findings of the three experiments and how structural priming effects, if they can be associated with second language learning, might or might not be accommodated by various SLA theories, and what the implications might be for pedagogical techniques in L2 teaching. This chapter also discusses several specific methodological issues associated with L2 structural priming, especially compared to L1 priming, acknowledges several limitations of the present research, and points to future possible directions for L2 structural priming research.

Chapter 2

Methodology

2.1 Introduction

This chapter gives an overview of the experimental methodology used in three structural priming experiments in this thesis. The overview presents only the common methodological features of the experiments, and further details about the precise methods in each experiment can be found in each respective chapter.

2.2 Overview

Each priming experiment contained three phases: a pre-test, a treatment phase and a post-test. Additionally, Experiment 2 included a fourth phase: a delayed post-test. Details are described below and in each respective chapter.

2.3 Participants

Participants in all three experiments in this thesis were L2 speakers of English. The vast majority of them were learners at the English language centre at the University of New England in Australia where they were studying a course in English for academic purposes and preparing to enter the university at either undergraduate or graduate level. A small number of participants were not at the language centre but were already enrolled in an undergraduate or postgraduate degree. They were all determined to be between an intermediate and advanced level of proficiency, based on their IELTS (International English Language Testing System) or TOEIC (published by the Educational Testing Service) test scores, or the language centre's own in-house placement test. The participants in each experiment did not take part in any of the other two experiments. More precise details on each participant group can be found in Chapters 3, 4 and 5.

The focus of this thesis is on L2 learners. The L2 structural priming literature however, has not always clearly distinguished between L2 speakers and L2 learners. However, for this thesis, distinguishing between the two groups had important consequences for choices in methodology and the interpretation of the findings. These consequences are discussed below in sections 2.4, 2.12 and 2.13.

2.4 Choice of priming methodology - Oral production priming

Several forms of production priming and comprehension priming were described in Chapter 1. It appears that all but one previous L2 priming study (Shin & Christianson, 2012) have employed dialogic production priming tasks. The reason for this choice of method in the past appears to have been related to the motivations of these studies, which in several cases has been to investigate the possible role of structural priming in learning in L2 interaction (e.g., McDonough, 2006). Dialogic L2 priming paradigms could also be considered closer to real-life communicative and L2 classroom learning contexts than monologic priming paradigms thus lending the findings of dialogic studies more ecological validity[6] in terms of language use, language learning and interaction. This means that findings of priming can more directly inform language teaching and learning practices and L2 acquisition through speaker interaction.

It is well-known however, that increasing the ecological validity (external validity) of a study can sometimes impact negatively on its internal validity. In other words, there is a trade-off between each type of validity. In one sense then, certain dialogic methods might be considered problematic for L2 priming investigations because of the potential impact on the internal validity of the investigation. Such problems can arise because of the likelihood that L2 learners might behave strategically in dialogic priming experiments. For this reason, as outlined in section 1.5 in Chapter 1, almost all L1 structural priming studies have employed measures such as including cover tasks and filler items to ensure that conscious strategic behaviour does not occur (see also section 2.13.1, this chapter), and to ensure that primarily implicit processes guide participants' production of the target structure. In priming investigations involving L2 learners there is a particular danger that participants will begin to behave strategically, particularly in dialogic contexts, but even more so in dialogic contexts in which an instructor, rather than a (covert)

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[6] According to Schmuckler (2001, p. 420) Ecological validity "refers to the relation between real-world phenomena and the investigation of these phenomena in experimental contexts" (see also Bracht & Glass, 1968).

confederate, engages in dialogue with participants (e.g., Biria, et al., 2010). When L2 speaking participants (especially L2 learners) engage in dialogue with native speakers of the target language, especially with those who are the participants' language instructors, they might take strategic decisions to repeat the lexical and/or syntactic form of their interlocutor's utterances. This type of behaviour is likely because, for example, L2 speakers, and L2 learners in particular, are used to situations in which they ought to repeat or mimic aspects of the utterances of others such as their teachers and other L1 speakers. Learners in particular would conceivably spend much of their time attempting to mimic the morphosyntax, lexical items and pronunciation of the native speakers around them. If L2 learners did behave in this way, claims about implicit priming effects from studies of L2 learners might be questionable. One might also argue that language learners are also more metalinguistically aware than the L1 speakers (especially monolingual L1 speakers) who have taken part in L1 structural priming studies. Therefore, this potential confound between strategic behaviour and implicit priming behaviour is unlikely to occur in L1 priming scenarios because L1 participants would presumably be less inclined to apply a conscious strategy to repeat what others say. In order to control for these possible spurious effects in L2 priming contexts, studies by McDonough (2006) and McDonough and Mackey (2008) have used a confederate scripting technique in which participants engaged in dialogue with another L2 speaker or learner. In such circumstances, it is unlikely that participants would be inclined to mimic the speech of their interlocutor on the assumption that they believe their partner to be no more competent than themselves. If my assumptions are at least partially true, L2 structural priming studies might need to more carefully scrutinise the suitability of techniques employed by L1 studies.

In light of the possible and potential confounds associated with some dialogic priming tasks in L2 settings, I chose a monologic production priming methodology. Monologic priming studies have frequently used oral picture description tasks which were also chosen for this thesis. Overall, oral picture description was considered the most appropriate technique for this thesis for the following reasons. First, other production methods such as sentence recall, although widely used in L1 priming studies, were considered unsuitable. This is largely because of the likelihood that recall methods would lead to the production of large numbers of errors and unusable data. In L1 language production research, sentence recall methods are known to induce significant numbers of inaccurate repetitions of primes or non-target repetitions, which must be excluded from analyses (e.g., Ferreira, 2003). This is largely the result of the difficulty that even L1 participants have in remembering the sentences that they need to recall. Using this method in research with

less-proficient L2 speakers would presumably result in even higher proportions of errors and unusable data than for L1 speakers; it is likely that L2 speakers would have even greater difficulty accurately recalling and repeating the prime and target sentences in a recall paradigm. Thus, the resulting L2 data would be significantly compromised. Second, priming effects are also arguably stronger in spoken than in written production (Branigan, Pickering, Stewart, et al., 2000), and so written production was also considered unsuitable here. Third, there is the issue of methodological ease and the transparency of the data. Language production is more concrete and easily measured than language comprehension which is more abstract and speaker-internal. Although several objective measures or indexes of comprehension, such as reading times, grammaticality judgments, eye movements, and electrophysiological measurements are available and commonly used in psycholinguistic research, data from these measurements are more difficult to collect and interpret than language production data. In addition, the thesis has an essentially applied linguistic motivation in which the findings will be ultimately discussed in terms of language pedagogy. In this sense, language production data aligns more closely with the typical purposes and outcomes of language teaching: to get L2 learners to perform actively and productively in the L2.

The extemporaneous oral description of carefully designed pictures can be considered a good means of measuring speakers' sentence production abilities and structural preferences in sentence production (e.g., Bock, 1986a, Bock, 1986b; 1996). To illustrate, studies of priming of passives (e.g., Bock, 1986b) have typically employed picture description tasks in which speakers might have a choice of describing a picture of, for example, a bee stinging a man with either a sentence like (1) or (2).

(1) A bee is stinging the man.
(2) The man is being stung by a bee.

Similarly, priming studies which have investigated priming of datives have also employed oral picture description. For example, a speaker might be expected to describe a picture of a man giving a child a present by producing either 3 or 4.

(3) The man is giving the child a present.
(4) The man is giving a present to the child.

Shin and Christianson (2012) also successfully used an oral picture description task to investigate priming of optionally separable phrasal verb constructions. Speakers were expected to describe for example, a picture of a girl turning a heater down in one of two possible ways – (5) or (6).

(5) The girl is turning the heater down.
(6) The girl is turning down the heater.

An oral picture description task paradigm is then perhaps one of the more ecologically valid ways to investigate whether structural priming is a form of L2 learning since these types of task are typically used in second language classrooms (Lado, 1964) and second language tests (e.g., TOEIC). Therefore, if priming effects emerge, they can be more directly related to classroom teaching and learning practices. The relationship between structural priming and second language teaching and learning will be discussed in section 6.4, Chapter 6.

2.5 Treatment phase

Although the structural priming procedures in each experiment in this thesis varied in some ways, they were also quite similar in several respects. First, participants in all three experiments heard, saw and repeated a prime sentence shortly before describing a target picture with a single sentence. Second, stimuli (e.g., prime and target) presentation times were kept suitably short in all experiments to ensure participants' responses were relatively automatic, but not so short as to cause excessive difficulty in sentence processing, planning and articulation. It was thought that if presentation times of the primes or target pictures were excessively long, participants might have engaged in excessive reflection and possibly even became consciously aware of the target structure. Longer presentation times of stimuli in the treatment phase or of the pre- and post-test target pictures might have also allowed participants time to actively reflect on their production, perhaps even modifying their production using the pedagogical grammar rules they had once learned, [i.e., learned in the sense that Krashen (1985) theorised, rather than acquired]. Such reflective behaviour would not have been ideal in a priming context because priming is thought to be relatively automatic and to engage relatively procedural and implicit memory processes (see Chapter 1). If L2 speakers are allowed time to reflect on their language production they might engage processes relying on their explicit knowledge *about* the L2. Such reflective behaviour is known to lead to quite different linguistic output than when speakers rely on their more automatic

language performance abilities (Tarone, 1979, 1985). This distinction between automatic and non-automatic language production has become generally accepted and largely reflects the distinction between explicit and implicit processes in L2 acquisition initially made by Krashen (1985) and reflected in his Monitor Hypothesis, and more recently elaborated on by N. Ellis (1995a) and many other SLA researchers. N. Ellis for example, argues for independent explicit and implicit memory systems but for interaction between the two systems. In order to maintain the focus on implicit processes in the priming research in this thesis, this interaction between these systems ideally should be minimised. This is because under more reflective (or monitored) conditions speakers might produce what they *think* is acceptable, regardless of whether it actually is acceptable by target-language norms. On the other hand, under the more automatic (or unmonitored) priming conditions, participants would be expected to produce what was induced by the priming treatment alone, regardless of whether it was consistent with speakers' conscious language knowledge or not. Precise presentation times were principally determined through piloting each experiment and were based on the performance of several trial participants. In general, they were in the order of about 5 to 10 seconds for targets and about 8 to 17 seconds for primes, which allowed enough time for repetition of the prime.

2.6 Lexical contributions

In Chapter 1 (sections 1.5 and 1.7.1) I noted that a lexical boost can occur in structural priming associated with overlap of open class words between prime and target. However, it has been shown that an overlap of the verb between a prime and target is not necessary for long-term priming (i.e., greater than a few seconds) to occur. On balance then, since the focus of the thesis is on learning (or long-term priming), I decided not to make use of a lexical boost effect and in all three experiments in this thesis there was no lexical overlap between prime and target.

2.7 Overall design

Each experiment reported in this thesis involved a mixed factorial design in which speaker group (experimental and control) was considered a between-subjects variable and test (pre-test, treatment phase, post-test, and delayed post-test in Experiment 2) were considered a within-subjects variable. In each experiment, the experimental group received a structural priming treatment involving prime sentences and target items, while the control group received the same

set of target items without the test prime sentences. The dependent variable in each experiment was the proportion (reported as a %) of target structure utterances produced as a function of the total number of target items. In Experiments 2 and 3 (Chapters 4 and 5), an additional dependent variable relating to an L2 interlanguage variant of the target structure was also included.

2.8 Control / experimental groups design

The experiments in this thesis each also incorporated a control group which did not receive the priming treatment. This element of the methodology appears to have been used only in a few previous L2 priming studies (Biria, et al., 2010; Boston, 2010; McDonough & Mackey, 2008). A control group is important for accounting for possible artifacts of the methodology. For example, exposure to non-priming aspects of the treatment materials themselves might affect speakers' language production. These effects might then be conflated with or interfere with the hypothesised priming effects.

2.9 Pre-test / Post-test design

The structural priming experiments described in this thesis also involved a pre- and post-test design. This design potentially sheds light on the possibility that priming can lead to language acquisition. It was hypothesised that, after a priming session, speakers would produce more target utterances in a post-test than in a pre-test just before the priming session, and that this increase would be attributable to structural priming (by comparison with the control group's performance in the pre- and post-tests). Since the post-test would take place several minutes (between 3 and 5 minutes) after the priming session, any increase in target production at that point would be taken as evidence of a restructuring of speakers' linguistic systems (e.g., Bock & Griffin, 2000), and that this restructuring would be evidence of L2 acquisition.

The actual design was as follows: Immediately prior to, and shortly after each priming session, both participant groups were given the same pre-and post-test to measure their baseline and post-priming levels of target production respectively. Note that in each experiment the control group did not receive any primes but completed a modified version of the priming session. Just as for the treatment phase, the pre- and post-tests were oral sentence production tasks involving picture descriptions. In each experiment, participants were presented with between 10 and 16 pictures in

the pre-test or post-tests and asked to produce a sentence to describe each picture. The actual number of pictures varied in each experiment but the number of pictures in the pre- and post-tests in each experiment was the same. As far as possible in each experiment, the pre- and post-test pictures were also matched for verbs (Experiments 1 and 2) and/or certain closed-class words associated with the target structure (Experiments 2 and 3). In this way, a comparison of participants' sentence production in the pre- and post-tests was straightforward and enabled a relatively reliable interpretation of learning outcomes. However, to ensure that participants could not simply re-use the same sentences in both pre- and post-test, or rely on their explicit memory for the pictures in the pre-test when describing the pictures in the post-test and adjust their sentence production accordingly, certain aspects of the pictures varied between tests within each experiment. These variations are described in detail in Chapters 3-5.

Also, to ensure that any effects in the pre- and post-tests were not caused by the features of specific pictures or the order of their presentation, the pre-test and post-test pictures were counterbalanced in the following way. Half of the participants in each experiment saw one half of the pictures in the pre-test, while the other half of participants saw the same half of the pictures in the post-test. The presentation order of the pre-test pictures was reversed with respect to the matching post-test pictures.

One experiment (Experiment 2: Chapter 4) also contained a delayed post-test, which took place one week after the priming session. According to R. Ellis (2008), delayed post-tests are important for measuring acquisition in research into form-focussed instruction involving an instructional intervention. First, a delayed post-test of linguistic performance can determine whether the effects of the priming intervention are durable or short-lived. Second, under certain circumstances, the effects of instruction or teaching interventions might not emerge immediately; but rather, only sometime after treatment. Some previous L2 structural priming studies have used delayed post-tests (McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012), but not all. One difficulty with delayed post-tests, is a practical one: some research participants might not be available to take part in a delayed post-test. This in fact turned out to be the case in Experiment 2. For this reason, a delayed post-test was not included in the other two experiments, even though ideally it would have been better to have included one. This methodological issue will be briefly discussed in section 6.5.3, Chapter 6.

2.10 Spacer task

Long-term priming effects (i.e., those associated with apparent learning) are more validly demonstrated when potential effects due to speakers' episodic memory can be ruled out. This is because structural priming is defined as structural persistence (or facilitation) that occurs when speakers have no explicit memory of the priming stimuli. For this reason, a short distracter spacer task was built into Experiments 2 and 3. The spacer task was designed to minimise participants' explicit episodic memory for the priming structure by requiring them to focus on doing an unrelated memory task just after the priming session and before the post-test. Just after the treatment phase both participant groups (control and experimental) were presented with 12 pictures of objects, some of which were fillers in the treatment phase and some of which were previously unseen pictures. None of the pictures were test items. Participants had to report whether or not they had seen each picture in the treatment phase by saying "yes" or "no". The spacer task took participants between 1.5 and 3 minutes to complete in each experiment. A spacer task was deemed not necessary in Experiment 1 because that experiment contained an overt cover task, which was thought to sufficiently distract participants' attention to minimise the activation of their episodic memory.

2.11 Presentation of stimuli

All stimuli in each experiment were constructed using Microsoft PowerPoint and presented to participants on a computer. Participants in Experiments 1 and 2 were run individually in a quiet room. In order to speed up data collection in Experiment 3, participants were run in small batches of four in individual sound-attenuated booths using headphones for the presentation of auditory stimuli. This technique also had the added advantage of allowing the collection of all the pre-test data to precede the collection of the treatment phase and post-test data. In the treatment phase, the items were presented in the same order to all participants.

2.12 Coding of responses

Most L1 syntactic priming studies have employed strict criteria for coding participants' utterances. For example, L1 studies investigating production priming of passive sentences have required that participants' passive sentences be relatively well-formed (e.g., Bock & Loebell,

1990). However, L2 language production research is quite different: L2 speakers are inherently more prone to grammatical and other errors due to their obviously more unstable L2 systems. From a theoretical point of view, L2 speakers' language systems are thought to be represented in interlanguage systems (Adjemian, 1976; Selinker, 1972) which are inherently unstable and variable within and between speakers with respect to the target language (R. Ellis, 1985, 1999). It should also be remembered that the L2 participants in the present study were by necessity on the edge of their competence. Thus, for reasons of speaker variability, the strict criteria used for coding the primed utterances of L1 participants could not be used for coding the primed utterances of L2 participants. First, criteria which emphasised strict well-formedness would be impractical and probably result in very little useable data from participants on the edge of their competence. Second, ill-formed utterances which reflect the interlanguage of participants might of themselves be insightful about the priming process and participants' language representations. More importantly, the purpose of the priming experiments was to investigate whether a priming treatment might lead to the acquisition of a structure which participants had difficulty with. Therefore, errors in production were *expected*, and if these had been excluded from the data analyses, the purpose of the experiments would have been radically compromised. Most previous L2 priming studies have employed quite strict coding regimes, along the lines of those used in similar L1 studies. More recently however, researchers appear to have recognised that this might not be desirable for the reasons just described. For example, in a study of ESL questions priming, McDonough and Chaikitmongkol (2010) disregarded morphological errors of tense, aspect and agreement, as well as errors unrelated to the question target structures (e.g., articles) when coding responses. This decision left open the possibility of investigating learners' *developing* question production abilities as a function of the priming treatment. More precise descriptions of coding regimes in each experiment are provided in the relevant chapters.

2.13 Participant Awareness

2.13.1 Minimising speakers' conscious awareness: distraction and cover tasks

As discussed in Chapter 1, priming is fundamentally an unconscious process. In production priming experiments, if participants become consciously aware of the prime stimuli and/or the purposes of the experiment, they might employ conscious strategies to repeat the target structure from the primes in their target utterances. By accepted definition, this type of strategic behaviour

would not be associated with priming, and any subsequent structural persistence effects would not necessarily be attributable to priming.

Almost all of the L2 speakers in the experiments described in this thesis (134 from a total 144) were second language learners in the midst of an intensive formal English language learning experience. This context presented some challenges with regard to their levels of linguistic awareness and the possibility that they might behave strategically and choose to *actively* and *consciously* repeat the syntactic structures they were exposed to. The reasons for this possibility are twofold. First, formal language learning almost invariably involves some sort modelling and repetition where learners are expected to repeat models of target language use in their own linguistic output. It was probable that speakers in this project were therefore accustomed to such learning/teaching activities and had a greater tendency to repeat than either L1 speakers, or stable L2 speakers (i.e., non-learners). Many learners also view the teacher/learner relationship as one in which the learner should strive to "please" the teacher by producing the L2 output most desired by the teacher. According to this view, teachers would model (either overtly or more subtly) the sort of language to be produced and the learners would be expected to reproduce the models. It would be unusual for example, for a learner to completely disregard input from the teacher and produce any language they wanted. Second, most formal language learning also involves a degree of metalinguistic analysis on the part of learners and arguably increased sensitivity to the linguistic input they receive. Overall then, it is therefore reasonable to assume that the L2 learners in this project might have: (a) viewed the tasks in each experiment as a form of modelling and an opportunity for repetitive practice and accurate target language production; (b) been relatively more sensitive to the linguistic input in the primes and their own output than L1 speakers or non-language learners in similar experiments. In the absence of any sort of distraction from the priming task then, both of these tendencies might have fostered a form of strategic repetitive behaviour in the experimental tasks whereby speakers conceived the tasks as activities in which they were expected to look for similarities or patterns in the input, analyse it, and repeat whatever they had noticed in the input in their subsequent output. This behaviour may or may not have impacted on the priming effects, and repetition and analysis are not necessarily detrimental to priming; there is nothing inherently damaging about active repetition. That is, speakers might have identified features *other than the target structure* and decided to repeat that feature. However, there was a danger that learners might also have become consciously aware of the target structure itself and actively striven to repeat it. What was important here was that speakers should not consciously notice the significance of the target structure for the experiment or that the

goal of the experiment was to induce the repetition of this structure. Consequently, for the experiments described in this thesis it was especially important to minimise this possibility.

For the reasons outlined above, and described in Chapter 1, many structural priming studies – mainly L1 structural priming studies (e.g., Bock, 1986a; Bock, 1986b, 1989; Bock & Loebell, 1990) – have deployed cover tasks to minimise such behaviour and effects. Cover tasks have typically been memory tasks or running recognition tasks in which speakers are told to pay conscious attention to certain peripheral features of the stimuli. For example, in several experiments in Bock's (1986b) seminal study, participants were led to believe that the purpose of the priming task was to remember and recognise the sentences and pictures they saw in the experiment. As a measure of recognition, participants had to report "yes" or "no" for each item. Another typical way that previous studies have minimised speakers' conscious awareness and therefore potential strategic behaviour is by including large numbers of structurally unrelated filler items. In this way, the salience of the target structure is minimised. This method has been used in L1 studies. Typically, in L2 structural priming studies the ratio of fillers to test items has ranged from between about 1:1 and 2:1. For example, the ration of fillers to test items was 25:20 in Biria, et al. (2010), 26:12 in McDonough (2006), and 60:40 in Shin and Christianson (2012). These ratios have served to minimise the development of participants' conscious awareness for the target structures and purpose of the experiments.

For the reasons described above, three principal measures were taken. First, participants were not informed about the purpose of the experiments. Second, fillers were included in the experimental items. The ratio of fillers to test items ranged from: 26:21 in Experiment 1, 16:24 in Experiment 2, and 15:20 in Experiment 3. Third, also following from previous L1 structural priming studies, a cover task was included in one of the experiments (Experiment 1) and this task is described in detail in Chapter 3. One problem with cover tasks however, is that they can potentially place an additional cognitive burden on speakers as they simultaneously carry out both an explicit (cover) task and a more implicit (priming) task. These sorts of spurious effects of a cover task on participants' language production in Experiment 1 are discussed in Chapter 3. For reasons of cognitive overload then, overt cover tasks were not included in Experiments 2 (Chapter 4) and 3 (Chapter 5). Instead of a cover task, in these experiments speakers were simply encouraged to believe that the purposes of the tasks were unrelated to the priming manipulation. Exactly how this was achieved is discussed in the relevant chapters.

2.13.2 Assessing participants' levels of conscious awareness of the prime stimuli

As structural priming is thought to occur below the level of conscious awareness of the critical features of the prime stimuli, any explicit memory in participants for the priming structure would be problematic for a priming interpretation in these experiments. If participants notice the recurrence of the priming structure, they might apply a conscious strategy to reproduce the structure in a subsequent post-test. This behaviour would not be attributable to priming per se. To check for conscious awareness, post-experimental recognition tests for the target structure have been used in previous L1 structural priming research, allowing those studies to argue for a lack of conscious awareness during the priming phase (e.g., Bock, et al., 1992). Therefore, a sentence recognition task was built into two of the three experiments in this thesis also to assess the degree of participants' conscious awareness for the target structure (see Chapters 4 and 5). These tests were designed to measure participants' episodic memory for the target structure in the primes and were administered right after the immediate post-test. Note that because of the inclusion of a cover task in Experiment 1 (Chapter 3) no sentence recognition task was included in this experiment (see Chapter 3 for details on the design); it was thought that this cover task would be sufficient to distract participants' conscious attention away from the structural features of target items[7]. In the sentence recognition tests, prime sentences were presented along with carefully modified prime sentences in which the target structure was modified but the semantic content was not. Participants had to report whether or not they had experienced each sentence. It was expected that participants would primarily pay attention to the semantic and lexical content of these probe sentences. If participants had *not* been aware of the target structure during the priming phase, it was expected that there would be no significant difference between their reported recognition of the prime sentences compared to their reported recognition of the modified prime sentences. Further details of the sentence recognition tests are described in the relevant chapters.

One important point needs to be made regarding the terms I use in this thesis to discuss awareness and subsequent claims about implicit learning of syntax. When I refer to "conscious awareness" I mean "noticing" in the conscious sense defined by Tomlin and Villa (1994, p. 185) who interpreted the two constructs conscious awareness and noticing as interchangeable. As for awareness, I define it as Tomlin and Villa (1994, p. 193) did when they summarised some of the literature from cognitive science and SLA and concluded that awareness is "a particular state of

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[7] An additional sentence recognition task in Experiment 1 would also have also extended the length of the experiment to beyond a reasonable timeframe for these participants.

mind in which an individual has undergone a specific subjective experience of some cognitive content or external experience" and is "able to report they were aware of the experience". Furthermore, following Tomlin and Villa, who argued that "attention is not awareness" (p. 194), I assume that attention does not require awareness as defined above and that detection of a stimulus is possible without a person being aware that they have detected it. This view broadly aligns with the view of Carr and Curran (1994) who argued that consciousness is separate from attention. That is, it is possible to attend to L2 features and process them unconsciously. Therefore, when I present evidence in the set of experiments in this thesis for a lack of awareness in speakers, I do not imply or mean that those speakers did not attend to the critical stimuli. The issue of awareness, attention and noticing is discussed further in section 6.3.2 and 6.5.4 in Chapter 6.

2.13.3 Post-task questions for participants

A further measure that was taken in all experiments in the thesis was to examine whether participants had become aware of the target structure and/or the purpose of the experiments. To do this they were asked a few questions immediately after finishing each experiment. These questions probed their subjective experiences during the experiment. Importantly, during this phase of the experiments, participants were not informed about the real purposes of the experiments in relation to priming, and nor was their attention drawn to the target structures. In addition, in a refinement of this technique, a sub-group of participants in Experiment 3 (Chapter 5) also gave written responses to specific questions one week after the main experiment. Details of the form of questioning are described in each chapter and in the Appendices. Note that it was not possible, nor desirable to directly ask participants about their experiences of the target structure. To have done so would have raised their level of conscious awareness for the target structure and possibly also their beliefs about the purpose of the experiments. Some of them might have then communicated this awareness to other participants who were subsequently to take part in each experiment (many of the participants were studying in the same class). These other participants who were yet to take part might have then altered their usual linguistic behaviour or acted strategically in the experiment. Obviously, in the context of a priming study this outcome would have been extremely undesirable. Therefore, the post-task questions were so designed as to be suitably subtle and not to raise participants' level of awareness for these factors.

Chapter 3

Experiment 1: A study to find out if L2 English learners get primed

3.1 Introduction

Chapter 3 describes an investigation in which L2 English speakers took part in a structural priming experiment designed to induce them to produce English *get* passive (herafter GP) sentences.

As already described in Chapter 1, the English passive has been a common target of investigation in L1 structural priming research. In particular, the English *be* passive has been frequently targeted in that research (Bock, 1986b, 1989; Bock & Griffin, 2000; Bock, et al., 1992; Estival, 1985; Hartsuiker & Kolk, 1998). Priming studies involving young children have also demonstrated that a range of passive types are primeable (Bencini & Valian, 2008; Brooks & Tomasello, 1999; Huttenlocher, et al., 2004; Messenger, et al., 2012; Savage, et al., 2006; Shimpi, et al., 2007). While *be* passives have been a popular target of L1 adult structural priming studies, curiously, GP has been a popular target so far only in L1 child studies (Brooks & Tomasello, 1999; Savage, et al., 2006), although many child studies have investigated priming of both *be* passives and GP (Bencini & Valian, 2008; Huttenlocher, et al., 2004; Kidd, 2012; Messenger, at al., 2012). To my knowledge, although there have been many adult passive priming studies, no adult studies have either specifically focussed on, or even considered GP. It is unclear why there should be such a marked difference in approaches to priming studies in the two populations. One possibility for the focus on GP in child studies is the claim that children as old as 11 years, including speakers of American English, produce many more GP than *be* passives in situations where passives are required and acquire *get* passives earlier than *be* passives (Harris & Flora, 1982; Marchman, Bates, Burkardt, & Good, 1991). Adults on the other hand, produce more *be* passives than *get* passives (Marchman, et al., 1991). Several studies have investigated L2

structural priming of passives (Boston, 2010; Kim & McDonough, 2008), but similar to the adult L1 studies, no L2 studies appear to have investigated GP, either incidentally or specifically. The relative paucity of L2 priming studies in general, and the apparent absence of any specific priming studies on GP in particular, is in marked contrast to the much larger number of L1 structural priming studies (see Chapter 1), and the existence of several L1 English child studies investigating GP priming in particular. This experiment then, extends the range of L2 structural priming studies to include a hitherto un-investigated structure, namely GP.

The choice of passives as a target for priming research involving L2 English speakers has an important practical justification. This is because English passives are reported to present problems for ESL learners (Boston, 2010; Hinkel, 2002; Watabe, Brown, & Ueta, 1991; Williams & Evans, 2007; Zhou, 1992). Watabe, et al. (1991) found that ESL writers from Japanese L1 backgrounds tended to inappropriately transfer their L1 discourse styles when producing English *be* passives, and to inappropriately passivise specific verbs, resulting in non-native-like passive production. However, form errors were not as frequent as stylistic and verb sub-categorisation errors, often involving passivisation of unaccusative verbs. Watabe, et al. found that although form errors were rather rare, when they did occur they mainly involved errors with the formation of the past participle. Williams and Evans (2007) also found that for a group of mixed-L1 English learners, *be* passives were resistant to both explicit and implicit (input flooding) instruction, and in a dictagloss task (i.e., a form of recall production task) these learners produced very few passives. In fact two groups of instructed learners in that study were hardly different from a control group in that "virtually no passives were used by any of the subjects" (Williams & Evans (2007, p. 150). This poor performance on the passive was in stark contrast with the other form targeted in the instruction – namely participial adjectives – on which the instructed groups clearly outperformed the control group. Williams and Evans concluded that the English passive was more difficult in general for their ESL learner participants. Based on this apparent difficulty, the inverse-preference principle (see sections 1.6.2 and 1.7.2, Chapter 1) would suggest that priming of passives should be in fact stronger for L2 speakers than for L1 speakers. Therefore, although it is possible that priming effects for passives might be weak in L2 English speakers, just as they are for L1 speakers, the construction is worth investigating, not only because of the dearth of L2 structural priming research, but also because of the difficulty which L2 English learners face with respect to acquisition and use of passives. In addition, knowledge about the L2 acquisition or L2 priming behaviour in relation to *get* passives appears to be non-existent.

English GP has been advocated as a target for L2 teaching (Endley, 2010). GP differs from the *be* passive in several ways. One important difference is that GP is known to be more frequent in spoken and informal English than in written English (Conrad, 2005; Rühlemann, 2007), while *be* passive is known to be more frequent in written and formal discourse than spoken discourse. The experiment described in this chapter employed a spontaneous oral picture description task as part of the structural priming protocol, and so this difference means that GP is a more natural choice of structure. GP is also possibly a more useful structure than *be* passive for ESL learners given that, in an immersion environment in a target-language country, they arguably spend more time speaking than writing in English (or at least *ought* to do so). Following this logic, the choice of GP for a study investigating structural priming as learning partially addresses Endley's (2010) call for GP to be the target of teaching. That is, one of the aims of the experiment was to explore whether GP can be learnt (and taught) through structural priming.

English GP is also a communicatively useful passive for speakers because it minimises ambiguity between stative and dynamic interpretations which can sometimes arise in *be* passives. For example, sentence (1) is ambiguous between a description of the state in which the window ended up in a broken state due to some prior event versus a description of the event itself. In contrast, sentence (2) unambiguously describes the event in which the window was broken. Note that a by phrase is not necessary to force this dynamic verbal interpretation in GP constructions. It appears that *get* alone forces a dynamic reading.

 (1) The window was broken
 (2) The window got broken

Therefore, GP was chosen as the target of investigation for several reasons: it represents a difficult or underused structure for L2 speakers, it is communicatively useful, it fits best with a spontaneous oral production task, and allows comparisons with other structural priming studies (mostly L1 studies) which have so far only demonstrated weak priming effects for passives.

3.2 Strength of priming effects for passives

As noted earlier in this thesis, many L1 priming studies have demonstrated structural priming of passives. However, a more thorough reading of this L1 priming literature reveals that priming effects for passives appear to be weaker than priming effects for other structures[8]. This raises an important issue which needs to be first discussed in relation to the current experiment.

Most studies have found statistically weak priming effects for passives (e.g., Bock, 1986b; Bock & Griffin, 2000; Bock and Loebell, 1990; Bock, et al., 2007: Loebell & Bock, 2003; Saffran & Martin, 1997), and the literature shows that passives are nearly always less strongly primed than datives for example. This observation can be readily made because many structural priming studies, especially earlier ones, examined priming of passives and datives in the same experiments, thus allowing direct comparisons of priming strength. Returning to the issue of weak priming effects for passives, Bock (1986b) for example found (in experiment 3 of that study) only a marginal priming effect for passives: 21% of passives were produced after passive primes but also 17% were produced after active primes (the passive priming effect only reached statistical significance on a subjects analysis – but not on an item analysis). Overall, (in experiments 2 and 3) Bock (1986b) also found a strong overriding effect of agency in the priming and that while passives were produced after passive primes containing non-human agents, very few passives were produced after passive primes containing human agents. Moreover, she found in Experiment 1 that after passive primes, 65% of utterances were still actives and only 20% passives; after active primes, 73% were actives and 12% were passives. Clearly, priming effects were small and clouded by other factors affecting sentence production which in her experiments drove speakers to produce passives. In contrast to the relatively weak priming effects for passives, Bock (1986b) found that, for the dative alternation (double object [DO] vs. prepositional object [PO]), priming effects were much stronger: after DO dative primes, 53% of utterances were DO datives (compared to 25% PO datives), and after PO dative primes, 48% were PO datives (compared to 31% DO datives). In another study, Bock and Loebell (2003) also found stronger priming effects for datives and weaker effects for passives in two experiments.

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[8] See Tooley and Traxler (2010) for a review and comparison of effect sizes reported in L1 structural priming studies.

In a cross-modal comprehension-to-production priming study, Bock, et al. (2007) also found weak priming effects for passives. In experiment 1 of that study passives and datives were the subject of priming attempts and when both structures were pooled in the analysis a priming effect emerged. However, when the structures were examined separately it appears that only datives were primed: the target dative structure (prepositional dative) was produced on 46% of dative priming trials and on 36% of trials which primed the alternative double object dative structure (a priming effect of 10%). However, for passives, the target passive was produced on 61% of passive priming trials and on 59% of trials which primed the alternative active structure (a very small priming effect of only 2%). Thus, it seems that passives were not significantly primed at all in that study; and it was only when datives and passives were pooled in the analysis that a priming effect emerged from the data. Similarly, in experiment 2 of that study a priming effect of only 3% emerged for passives (compared with 11% for datives). Bock and Griffin (2000) also found similar small priming effects for passives: 56% of passives were produced on passive priming trials vs. 52% on alternative (active) priming trials in experiment 1, and 64% and 59% respectively in experiment 2. In experiment 1 the priming effect for passives disappeared completely when there was a delay between the prime and target. On the other hand, Bock and Griffin found significant effects for dative priming which were roughly double the effects of passive priming in both experiments. Bock and Griffin acknowledged these low priming effects for passives but offered little explanation.

Weak priming effects for passives are not just confined to studies of English. In a study of L1 Dutch speakers Hartsuiker and Kolk (1998) found significant levels of dative priming but non-significant transitive priming. In that study, speakers tended to produce more passives after passive primes compared to baseline levels of passive production, but equally produced more passive sentences compared to baseline after active primes. When active and passive production was compared after passive primes, there were no significant differences: actives and passives were produced at roughly equal rates regardless of the type of prime.

In a cross-linguistic (English-Spanish) priming study Hartsuiker, et al. (2004) also reported only moderate priming effects (low to moderate *F* values), even after "cleaning" the data by excluding 6 of their 32 (19%) prime/target stimuli for reasons of ineffectiveness. Passives were produced on 56% of passive prime trials but also on 46% of OVS (non-passive sentences in Spanish with the word order object-verb-subject) prime trials, 39% of intransitive prime trials, and 37% of active

prime trials. Furthermore, production in all conditions exhibited quite high variability with standard deviations ranging between 30% and 35%. In a study of cross-language priming between German and English involving fluent bilingual German-English speakers, Loebell and Bock (2003) found that while speakers were primed to produce datives (in particular double object datives) across languages (in both directions) and within language (only German-German priming was investigated in this case), no effect was found for transitives (including passives) no matter whether the priming was within or between languages. The authors put this pattern of results down to word order differences for passives between German and English and word order similarities for datives in both languages. However, given the findings from L1 priming studies, Loebell and Bock's explanation might only be part of the story, and other factors which limit the extent to which passives can be primed in either language, including English, and in particular among L2 and bilingual speakers, might exist.

What makes these relatively weak priming effects for passives even more notable is that in almost all previous studies passive priming effects have been reported in comparison to active priming. That is, speakers' production of passive sentences after experiencing passive primes has been compared with their production of active sentences after experiencing active primes. This manipulation would seem to increase the chances of finding a priming effect in either direction, relative to examining priming effects compared simply to a neutral baseline condition in which speakers are left to their own devices for sentence production. Thus, the effects reported so far in the literature might even be considered relatively inflated and one might reasonably call into question claims about the reliability of passive priming effects.

Some experimental designs however have revealed larger priming effects in children (see Huttenlocher, et al., 2004; Shimpi et al., 2007 for between-subjects designs involving children). Interestingly, child priming studies appear to reliably report larger priming effects than the adult studies, suggesting, that priming might be associated with language learning. In one child study, Huttenlocher, et al. (2004) for example, reported an effect of 14% (Experiment 1) and 23% (Experiment 2) relative to the active priming condition. In a study of passive priming in L1 Spanish-speaking children, Gámez, et al. (2009) also reported a relatively strong and statistically significant effect for passives (11% for one form of passive). In one of the few studies to compare passive priming to baseline (control group) conditions, Bencini and Valian (2008) reported passive production after priming of 11% and 16% (depending on whether a strict or lax scoring

regime was adopted respectively), but zero passives produced in the baseline condition. Thus, it seems that priming effects for passives might be a little stronger for children than for adults.

On balance however, it seems that, compared to other syntactic structures (e.g., datives), passives might not be as amenable to priming in L1 speakers, particularly adults speakers, but might be primeable in children. There are several possible explanations for the differences observed for different structures. For one thing, the active/passive alternation is more strongly associated with discourse structure, information focus and factors which affect the assignment of the semantic roles of arguments than other structures are (e.g., datives). The low level of passive priming reported in the literature also begs the question why this structure continues to be chosen as a target priming structure at all. One reason, as I noted in Chapter 1, is probably that the passive/active represents a convenient English word order alternation which on the surface should seem primeable.

Of course L2 passive priming might well be entirely different to L1 priming. The indication that passive priming is stronger in children than adults suggests that L2 passive priming might be stronger than L1 passive priming. However, the small number of L2 priming studies makes resolving this this issue difficult. The study by Kim & McDonough (2008) appeared to show detectable levels of passive priming. On the other hand, Boston (2010) also attempted to prime ESL learners to produce English passives in a dialogic priming-type task, but without success. Due to the inconclusive findings, further investigation of passive priming in an L2 context appears to be warranted. Therefore, the following research questions were developed and guided Experiment 1:

1. Can L2 speakers be primed to produce GPs?
2. If speakers can be primed to produce GPs, will this priming effect last?

3.3 Method

An oral picture description task was chosen to investigate GP priming along the lines used in Bock (1986) and Bock and Griffin (2000) and many other studies to investigate English *be* passive priming in L1 speakers.

3.3.1 Participants

All participants were students at the University of New England, Australia. The experimental group consisted of 34 and the control group 29 speakers. Five participants in the experimental group and three in the control group were studying towards an undergraduate degree, and one control group participant was studying towards a postgraduate degree. All other participants were studying English for academic purposes at the university's English language training centre prior to subsequent enrolment in a degree at the university. The data from three experimental group participants (all Chinese L1s) were excluded because they made excessive errors or did not do the task properly: one participant made responses to only five of the targets in the treatment phase; one participant achieved very low scores on the vocabulary pre and post-tests (2 and 1 respectively out of a total of 9 items in each test), which were by far the lowest scores among all participants (overall means [Std. Dev.] of 4.16 [1.39] and 4.84 [2.22]) and indicated a very low overall language proficiency; and one participant who was only able to correctly articulate five of the prime sentences (and five filler prime sentences) and who could only produce grammatical sentences for ten target test pictures. The errors and low scores for this last participant also indicated a low level of proficiency and/or possible nervousness, both of which suggest that this participant was unable to properly complete the task. Note that the behaviour of these and many other participants stands in stark contrast to most L1 priming studies in which participants generally are able to accurately repeat prime sentences (e.g., 99% accuracy in Bock & Griffin, [2000, p. 185]) and complete the task. However, the exclusion of data from participants who are unable to accurately repeat primes in the current experiment is wholly consistent with the data analysis procedures in most L1 studies. Due to a recording failure, the data from a further three experimental group participants were also excluded. The data from four control group participants (all Chinese L1s) were excluded from the analysis either because they did not do the task properly (i.e., one participant did not repeat the primes), or due to a recording failure. The data from the remaining 27 experimental group and 25 control group participants were subjected to analysis. Both groups had similar L1 background profiles which were:

The L1s of experimental group participants were (N=27):

- 18 Chinese (10 Mandarin, 8 Cantonese)
- 3 Arabic
- 2 Japanese

- 1 Vietnamese
- 1 Indonesian
- 1 Thai
- 1 Spanish

The L1s of control group participants were (N=25):
- 16 Chinese (11 Mandarin, 5 Cantonese)
- 5 Arabic
- 3 Japanese
- 1 Spanish

Participants' English language proficiency was assessed as between intermediate and upper-intermediate in several ways. First, 18 control group participants and 19 experimental group participants had an IELTS test score (or equivalent TOEIC score) obtained in the past year. The mean IELTS test scores for each group were 5.33 (SD = 0.56) and 5.40 (SD = 0.80) respectively. The remaining participants had otherwise satisfied the English language requirement of the university's entry requirement for an English for academic purposes course (equivalent to IELTS 5.0) or entry to undergraduate or postgraduate courses (equivalent to IELTS 6.0). The experimental group contained 18 females and 9 males (mean age: 22.8 years, SD = 3.0) and the control group contained 14 females and 11 males (mean age: 22.9 years, SD = 3.5).

3.3.2 Materials

3.3.2.1 Treatment phase

The experimental group's priming stimulus set contained 21 test triplets, each consisting of: a GP prime sentence, followed by a noun, followed by a picture. Figure 3.1 presents an example triplet. The full set of test sentences are listed in Appendix 3.1. Each picture depicted one or more people, animal or object that had experienced, or was experiencing an unfortunate event. Examples included a tower being struck by lightning, a soccer player being kicked in the head by another soccer player, and a window which had been broken. All pictures could be described with either an active or passive sentence containing a transitive verb. The noun in each triplet was the patient noun naming the object, person or animal (e.g., a tower, a soccer player, or a window) which underwent the (mostly) unfortunate event. The noun was presented to participants to ease

their sentence planning based on the assumption that L1 sentence production is incremental (e.g., F. Ferreira & Swets, 2002; V. S. Ferreira, 1996), and that (at least for L1) speakers initially retrieve the first word of a sentence in sentence planning (Harley, 2007). Much less is known about L2 speech planning, but it was assumed that L2 sentence planning would operate in essentially the same way as L1 sentence planning. Providing participants with the patient noun would help them to plan a passive sentence since passive sentences canonically begin with the patient noun phrase. Also, studies employing extemporaneous language production tasks have found that L1 speakers tend to produce large numbers of sentences which are not of experimental interest: 22% in the priming study of Bock, et al., (2007) and 23% in Bock and Griffin (2000), an occurrence also noted by Bock (1986a). L2 speakers would be expected to exhibit even more variability and produce even higher numbers of irrelevant sentences. Thus, provision of some direction was necessary for these L2 participants in order to ensure sufficient numbers of relevant sentences (i.e. targets) for subsequent statistical analysis. This support was in the form of the patient noun. Provision of the target verb was not considered necessary because L1 speakers do not generally retrieve verbs before speaking; that is, speakers only retrieve the verb *after* they have started speaking – it is not part of advance planning (e.g., Schriefers, Teruel, & Meinshausen, 1998). Thus, providing the verb would not have helped utterance initiation or planning, and in fact, might have even complicated sentence production by providing an additional cognitive load for these L2 participants.

In addition to the 21 test triplets, there were 26 filler triplets which helped to conceal the purpose of the task from participants. Figure 3.2 presents an example filler triplet. The filler triplets consisted of a prime sentence; a noun, adjective or adverb representing a salient feature of the picture; and the picture. Twenty two triplets contained a noun; four contained an adjective; while one contained an adverb. The filler prime sentences were all intransitive, and the nouns, adjectives and adverbs could all be used to describe the target pictures. In both the test and filler triplets the prime sentences were semantically unrelated to the target pictures. All prime sentences and nouns were presented visually and aurally. Test and filler prime sentences were presented for between 15 and 17 seconds, depending on the number of syllables in the sentence, the word was presented for 2 seconds, and the picture for 8 seconds. The test and filler triplets were pseudo-randomly ordered, such that no more than two test triplets were ordered consecutively, and presented in the same order to all participants.
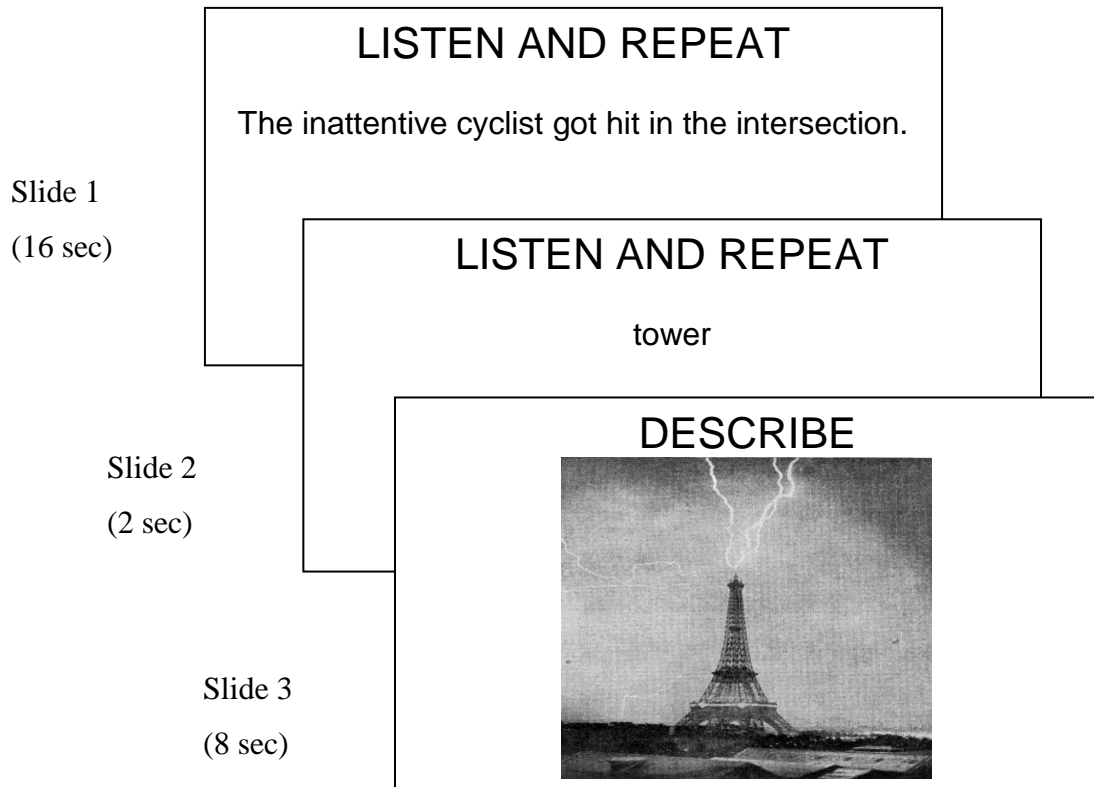
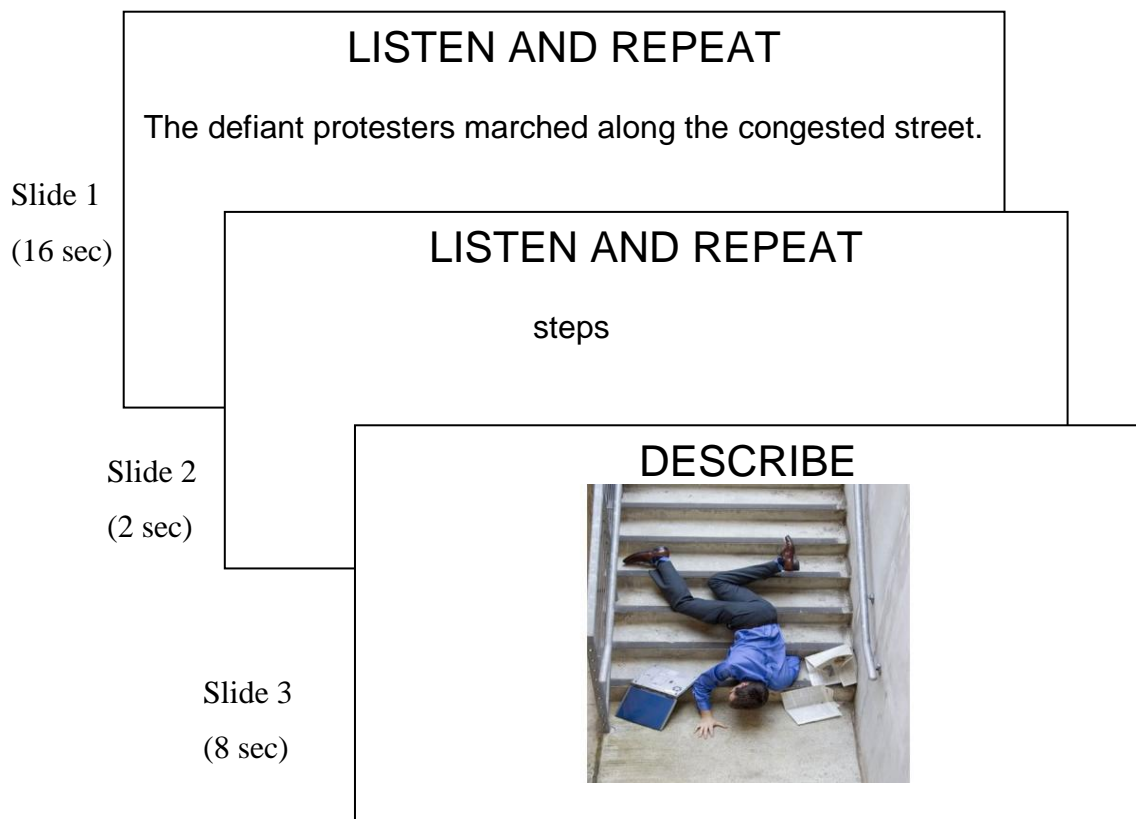*Figure 3.1. Example test triplet*

Figure 3.2. Example filler triplet

The control group stimuli were similar to the experimental group stimuli in all respects except for one important variation: no prime sentences were included. The control group was presented with 47 test and filler *pairs* rather than *triplets*, and they experienced only the patient noun just prior to each target picture. Likewise, filler pairs contained the same noun, adjective or adverb prior to the target picture as in the experimental group stimuli.

3.3.2.2 Pre- and post-tests

In this experiment the pre- and post-tests each consisted of 16 pictures. Example pictures are shown in Figure 3.3. Each picture depicted people or objects that had experienced, or were experiencing an unfortunate event. Examples included a car which had been crushed by a tree, a woman being arrested, and a man being punched. All pictures could be described with either an active or passive sentence containing a transitive verb. In order to ensure that the target responses in the post-test could be compared to those in the pre-test, the 16 pre- and post-test pictures were matched (i.e., paired) so that the same verb used to describe a pre-test picture could also be used to describe the events in the matching (paired) post-test picture. However, to ensure that participants could not simply use the same sentences in both tests, or rely on explicit memory for the pictures, other aspects of the pictures in each pair were different. For example, in one pair, the pre-test picture showed a *man* being arrested, while the matching post-test picture showed a *woman* being arrested. In this way, pre- and post-test picture pairs were suitably similar to elicit the same verb in the target GP structure, but other aspects of each picture differed, so that participants were describing different pictures in the pre-test than in the post-test. The use of the same verb also avoided potential spurious effects associated with individual verbs' subcategorisation preferences. According to connectionist approaches to sentence production, during sentence planning thematic role array configurations are activated along with the retrieval of the verb (Pickering & Branigan, 1998). If different verbs had been used across pre- and post-tests, different thematic role configurations might have been preferred, resulting in subsequent differences in passive production. L1 child acquisition of passives is also influenced by the verb such that the passive appears to emerge first with more prototypically transitive verbs and only later appears with less prototypically transitive verbs (Maratsos, Fox, Becker, & Chalkley, 1985; Marchman, et al., 1991). Thus, from both a language production and language acquisition perspective the verb seems to exert a crucial influence on passive interpretation, production and

acquisition. Each pre- and post-test picture was presented for 8 seconds which gave participants enough time to respond.

Example pre-test picture

Target response: *The man got arrested*

Example post-test picture

Target response: *The woman got arrested*

Figure 3.3. Example pre- and post-test pictures

3.3.2.3 Cover task

In the present experiment, participants' attention was diverted away from the real purpose of the task to minimise the possibility that they would become consciously aware of the recurrence of the target GP structure. This was achieved in two ways: first by including 26 filler triplets which served to conceal the test prime sentences, and second by including a cover task. This cover task was essentially a test of participants' vocabulary knowledge: immediately before doing the main task they were shown nine words on a piece of paper and, for each word asked to choose the best of four possible synonyms. The words are listed in Appendix 3.2. If they did not know a word, they were told to guess the best synonym. These words were adjectives used in the test and filler triplets (e.g., *weary*, *inattentive*) and were probably novel for participants based on their assumed English proficiency (i.e., IELTS scores). After participants had completed this task, they were told that they would see these words again in the main experimental task from which they might

be able to infer (or work out) their meaning. They were also told that after completing the main task they would have another chance to select the most appropriate synonym to see if they could improve their score. In this way, participants were encouraged to conclude that the purpose of the main (priming) task was to learn the meanings of nine novel words. The assumption was that this belief would cause them to divert their conscious attention away from the target structure and the structural priming elements of the task. Since the control group was not expected to be primed, and to save time in the administration of the experiment, it did not receive the cover task.

3.3.3 Procedure

3.3.3.1 The main task

Participants were run individually in a quiet room. Participants first read the relevant participant information sheet (see Appendices 3.3 and 3.4[9]) and then did the vocabulary cover task. Immediately after they had completed the cover task, they began the main task, which consisted of three phases: a pre-test, treatment phase and post-test. All stimuli in the main task were presented on a laptop computer using Microsoft PowerPoint. In each phase, participants were first given instructions and shown what to do, and had time to practice in the presence of the researcher, after which they completed that phase of the task in the experimental room by themselves. Participants progressed through the slides by pressing the 'enter' key on the keyboard. On each prime sentence slide the words "LISTEN AND REPEAT" and on each target picture slide and pre- and post-test picture slide the word "DESCRIBE" appeared in upper case (e.g., see Bock, et al., 2007). Along the lines of previous studies (e.g., Bock, et al.), participants were told to produce only one sentence to describe the target and pre- and post-test pictures.

In the pre-test, participants practised using one practice picture (which they could repeat), the researcher left the room and then the participant completed the pre-test on their own. After participants had finished the pre-test, which took 3 to 5 minutes, they reported to the researcher who then started them on the treatment phase. Participants were told to read, listen to, and repeat each prime sentence twice and each noun once, and then to describe each subsequent target picture by saying the first appropriate sentence that came to mind (c.f. Hartsuiker & Westenberg,

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[9] Note that experimental group participants were informed via the information sheet that they might be asked to return to take part in a delayed post-test. However, this was not actually done.

2000). Instructing participants to repeat each prime sentence twice was done for two reasons. First, it was hypothesised that repeating the prime sentence twice, instead of once which is usual in structural priming experiments, would strengthen any priming effects. The second reason was related to the cover task; by repeating the prime sentence participants would be better able to remember the relatively rare and difficult vocabulary words that were embedded in the prime sentences, thus perform more confidently in the cover task, and strengthening its face validity in the eyes of the participants. Participants first practised using four practice pictures and the researcher then again left the room. After they had finished the treatment phase, which took between 15 and 20 minutes for the experimental group participants and 12 and 15 minutes for the control group participants to complete, they reported to the researcher who started them on the third phase – the post-test. Participants' sentence descriptions were recorded and transcribed for subsequent analysis.

After the experimental group participants had finished the post-test, they completed the same vocabulary cover task that they had attempted earlier in the session. Immediately afterwards, they were given feedback on their performance in this task (i.e., their actual scores). The whole session took between 45 and 55 minutes for experimental group participants and between 25 and 35 minutes for the control group participants.

3.3.3.2 Post-task questions for participants

In order to determine whether participants had become aware of the target structure and/or the purpose of the experiment, they were asked several questions immediately after completing the task including: Did you notice anything about the sentences? Did you notice anything about the pictures? Which sentences can you remember? What was your favourite picture? What did you learn? / Did you learn anything? (see Appendix 3.5).

3.4 Results

3.4.1 Coding of responses

Very few GPs were produced by either group, but a wide variety of other passives, both well-formed and ill-formed, were produced. In order to help describe the sorts of passive sentences

participants produced, and to explain the coding scheme, the range of possible passives in English is briefly outlined below.

Generally speaking, passives can be categorised along two dimensions: length (long or short), and event status (verbal or adjectival). Long passives include a *by* phrase, while short passives exclude a *by* phrase; verbal passives describe an event, while adjectival passives (adjP here) describe a state (e.g., sentence 1). Huddleston and Pullum (2002) further identify three types of verbal passives: be passives, GPs and bare passives (beP, GP and bareP respectively here). AdjPs by definition do not contain an agent and therefore also cannot contain a *by* phrase. They can also be ambiguous with respect to their verbal/stative meaning and often can only be disambiguated by the surrounding discourse context, by tense or aspect marking of the auxiliary verb *be*. In the presence of a *by* phrase containing an agent, they should be interpreted as verbal passives. For example, the preferred interpretation of sentence (1) is a state in which the window is broken, rather than an event in which someone is breaking or has broken the window. On the other hand, sentence (2) is relatively ambiguous in the absence of surrounding discourse context because it can either describe the state in the past in which the window was broken, or an event in the past in which someone broke the window. Sentence (3) is less ambiguous because it implies an event in which the window was broken by an agent. The inclusion of the agent in the *by* phrases (as in 4 and 5) disambiguates the interpretation of sentences (4) and (5) respectively to mark a verbal passive rather than an adjectival stative passive.

    (1) The window is broken.
    (2) The window was broken.
    (3) The window has been broken.
    (4) The window has been broken by someone.
    (5) The window was broken by someone.

Where there is no *by* phrase to disambiguate verbal from adjectival passives (as in 1 - 3), Huddleston and Pullum (2002) propose three tests for adjectival status: modification by *very*, replacement of auxiliary *be* with other verbs taking a predicative complement (e.g., *seem*), and prefixation of the verb/adjective with *un*. In Experiment 1, the picture context provided a pseudo-discourse context and this helped to disambiguate ambiguous sentences.

Participants in Experiment 1 produced both long passives (containing a *by* phrase) and short passives (without a *by* phrase), and verbal and adjectival passives, and all types were included in the analysis. The inclusion of short passives was consistent with previous L2 priming studies (e.g., Kim & McDonough, 2008) and L1 child priming studies (e.g., Messenger, et al., 2012). The inclusion of adjectival passives along with verbal ones was also consistent with the approach of Estival (1985, p. 10) who, in a corpus study of L1 passive priming, argued that "to exclude lexical [adjectival] passives from our study or to collapse them with either transformational [verbal] passives or with actives would have given a distorted picture of the choices available to English Speakers". In sum, using Huddleston and Pullum's tests and taking into account the picture context, three types of adjectival passives were identified in participants' production. These involved the verbs *hurt* and *broken*. In the absence of a *by* phrase all instances of *be + hurt* were coded as adjectival passives because they easily passed Huddleston and Pullum's tests for adjectival passive status. In the absence of a *by* phrase, instances of *be + broken* did not pass the tests as easily and for this reason, as well as the disambiguating effect of picture context, past tense utterances containing *broken* were coded as attempts at verbal passives and present tense utterances as attempts at adjectival passives. Passives containing *stuck* which were produced by some participants (e.g., 6) were considered verbal only when accompanied by a locative prepositional phrase (i.e., *in the net*, *in the fence*) because the noun in the locative phrase could be considered an agent-like entity acting upon a patient (i.e., *the net captured the bird* or caused the bird to become stuck). All other *stuck* passives were coded as adjectival.

(6) the bird was stucked in a net

For present purposes, in all cases of attempts at passives the presence of a past tense verb was considered to mark a verbal passive. This assumption was justified on the basis of the disambiguating effect of picture context, which in most cases contained either an implied or explicit agent thus favouring the production of a verbal passive. The presence of a *by* phrase containing an agent was also taken to mark a verbal passive, regardless of the tense of the verb and animacy of the agent. Similarly, the presence of the agent in a prepositional phrase other than a *by* phrase, as in (6), (7) and (8), was taken to mark a verbal passive.

(7) The rider is dropped off <u>from the horse</u>
(8) In the picture there are two ducks which is trappted <u>in the net</u>

An additional type of passive was observed in the data: the bare passive (e.g., 9).

(9) man arrested by a policeman

Second language English users who are on the limit of their proficiency in a time-constrained language production task would be expected to produce a range of both well-formed and ill-formed sentences in spontaneous sentence production. In particular, in this experiment it was expected that the participants would produce a range of ill-formed sentences including ill-formed passives. This is exactly what happened. Thus, the criteria for allowable passives in this experiment were necessarily more lenient compared to comparable L1 passive priming studies in which only minor grammatical infractions were allowed in assessing the experimental acceptability of participants' sentences (e.g., Bock & Griffin, 2000; Bock, et al., 2007). In the vast majority of L1 structural priming studies anything other than a grammatically correct utterance was not considered for analysis. However, this approach would be entirely inappropriate for research with second language speakers. Some justification for a more relaxed approach to coding can be found in other priming studies of populations of language-impaired speakers. In one priming study of aphasics (Saffran and Martin, 1997), ill-formed passives accounted for 49 of 74 passive responses and were counted in the analysis. Along these lines, I therefore considered that populations of learners of English as a second language could be considered similar in their language production abilities to aphasics. In the current experiment, ill-formed passives of several types were included in the data. These ill-formed passives were categorised as follows:

- Errors in the formation of the past participle as in (10) – (20)

(10)   a boy was <u>bite</u> by the bee
(11)   two soldiers were <u>arrest</u>
(12)   a man protestor <u>catch</u> by the police
(13)   the rider is <u>throw</u> in the fall
(14)   a car was <u>rained</u> by the tree
(15)   a bird is <u>catched</u> by line
(16)   the soccer-player was <u>hitting</u> by another soccer-player

(17)   the bird was the bird was <u>stucked</u> in a net

(18)   the man was <u>hitted</u> by a fearless person

(19)   the thief is <u>attacking</u> by a dog

(20)   the window of the car was <u>broke</u>

- Omission of, or ill-formed *be* (e.g., 21 – 24)

(21)   he <u>attacked</u> by bee

(22)   a criminal <u>were</u> arrest by police

(23)   there's a soccer-player <u>be</u> hurt

(24)   a girl with a flower was <u>running after</u> by a lot of bee

       (c.f. *a girl with flowers <u>was being run after</u> by a lot of bees*)

Omission of, or ill-formed *get* (e.g., 25)

(25)   the football player <u>get</u> hurt and on the ground

- Ambiguous utterances because of a lexical error (e.g., 26 – 28)

(26)   the horse rider was dropped down on the floor (produced by a speaker who   also said: a tree was dropped down onto the car)

(27)   the rider is dropped off from the horse (the agent *horse* is present)

(28)   a man was dived down onto the sea

- Some semantically incongruous but well-formed utterances were coded as well-formed passives (e.g., 29 – 32). This decision was taken on the basis that the critical phenomenon of interest was the priming of syntactic structure.

(29)   the man is hit by the golf

(30)   three people are <u>locked</u>

(31)   a tree broke a a car is <u>broken</u> by a tree

(32)   a car was rained by the tree

- Utterances in which the verb could have been interpreted as an active verb (e.g., 33).

(33)   the soccer-player hurt

Overall, and as expected for their level of competence in the L2, participants produced quite a diverse range of passives when describing the pictures. Their utterances included both grammatical and ungrammatical, and present and past tense versions of the range of passive types identified by Huddleston & Pullum (2002). The range included:

- Present tense GP
- Past tense GP
- Ill-formed GP (present and past)
- Present tense be passives (beP)
- Past tense beP
- Ill-formed beP (present and past)
- Bare passives (bareP)
- Ill-formed bareP
- Adjectival passives (adjP)
- Ill-formed adjP

Production data for well-formed and ill-formed passives were aggregated in the analyses. This approach was consistent with the approach of McDonough and Chaikitmongkol (2010) who, in a structural priming study of L2 English learners, included in their data analysis utterances containing morphological errors involving number, tense and aspect agreement. This more flexible approach reflects the inherent variability in the competence of developing L2 learners and so was considered appropriate in the current study into L2 acquisition processes. See Figure 3.4 for a graphical breakdown of the main types of passives produced by each group in the experiment. Because relatively few bare passives and adjectival passives were produced across all phases of the experiment, these two types were not analysed independently, but rather, were aggregated into the variable allP (see section 3.4.5 below). Because tense is not a recognised as a primeable feature (e.g., Pickering & Branigan, 1998), utterances containing different tenses were collapsed into the one category for each passive type. Table 3.1 summarises each group's passive production in the experiment for the three categories which were later statistically analysed. All

results are reported as proportions, represented as percentages, of test target pictures described with each type of passive.
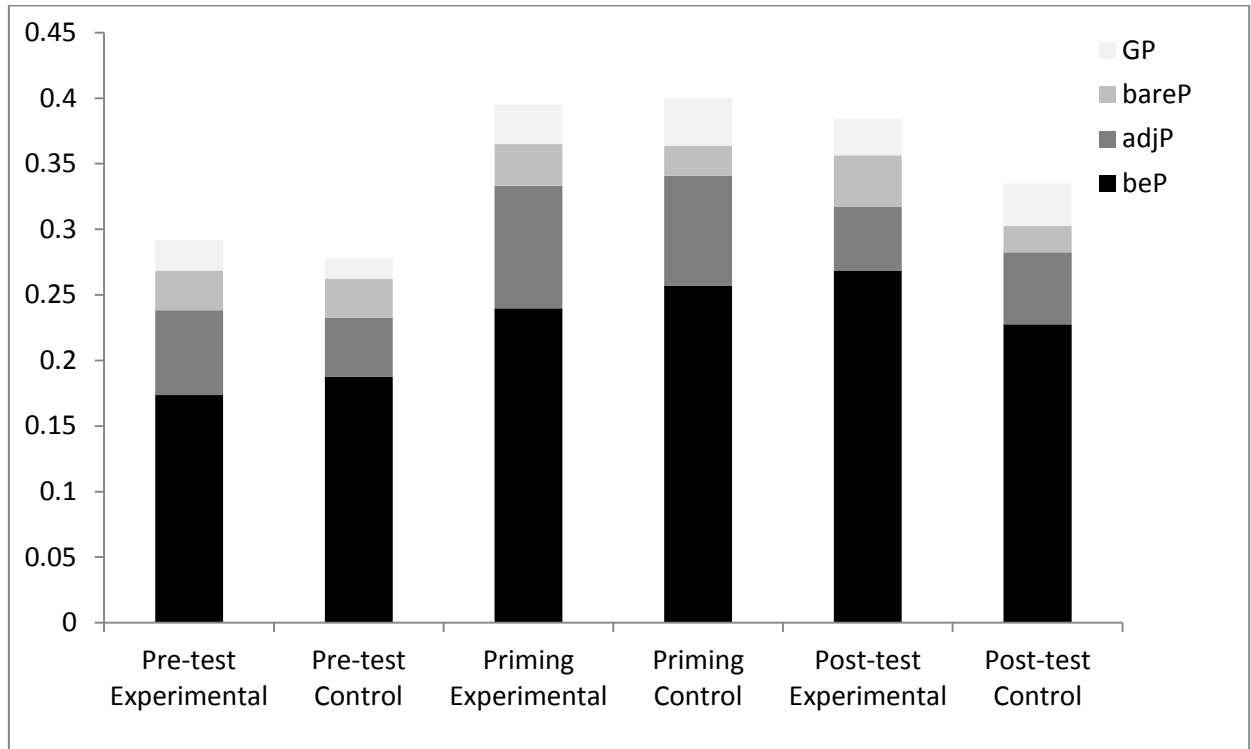

Figure 3.4. Breakdown of passive production by experimental and control groups as a function of test (mean proportion of target pictures). * Key: GP = *get* passives; bareP = bare passives; adjP = adjectival passives; beP = *be* passives

Table 3.1. Proportion (as percentages) of target descriptions as a function of passive type (SDs in brackets). * Percentages do not sum to 100% because participants also produced non-passive utterances in the experiment.

	Pre-test		Priming		Post-test	
	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.
GP	2.31 (3)	1.50 (4)	3.00 (3)	3.62 (5)	2.78 (5)	3.25 (6)
beP	17.13 (12)	18.75 (21)	22.39 (18)	26.09 (20)	26.85 (16)	22.50 (19)
allP	28.94 (16)	27.75 (22)	38.4 3 (18)	40.38 (21)	38.43 (15)	33.50 (20)

Statistical analyses involved principally analyses of variance (ANOVA) with F_1 values for subjects considered as the random factor, and with F_2 values for items as the random factor. Where appropriate, each group's performance on the pre- and post-tests was compared independently.

3.4.2 Awareness of participants

Both control and experimental group participants were asked several questions after they took part (see Appendix 3.5) to see if they had noticed any critical feature of the experiment. Their responses revealed that no experimental group participants noticed the recurrence or significance of the target GP structure in the primes. None of these participants reported noticing passive sentences, nor that they had produced passive sentences. Nor did any participant report any insight into the purpose of the experiment. For example, when probed about what they had learned from the experiment, many participants (more from the experimental group than the control group) reported that they had noticed the repeated occurrence of unfamiliar words and were able to infer the meanings of several of these words. Participants did not report remembering structurally similar or related sentences (i.e., the primes), although most of them reported that they could remember seeing several similar pictures. Several participants reported that they noticed a pattern of adverse events befalling people and objects.

3.4.3 Production of GP

Very low rates of GP production were observed for both groups throughout the experiment. In the treatment phase only eight experimental group participants each produced a single well-formed GP, another four each produced a single ill-formed GP, and a further one produced two ill-formed GPs. The proportion of GPs produced by the experimental group in the pre-test was 2.40%, increasing to 2.93% in the treatment phase and 2.88% in the post-test. Mean suppliance for the control group in the pre-test was 1.50%, increasing to 3.62% in the treatment phase and 3.25% in the post-test. There was no significant difference between the groups' GP production in the treatment phase ($t[50] = 0.547$, $p = 0.587$). When the two groups' performances in the pre- and post-tests were compared there were no main effect of test ($F_1[1,49] = 2.332$, $p = 0.133$), or group ($F_1[1,49] = 0.024$, $p = 0.877$), or interaction between test and group ($F_1[1,49] = 0.789$, $p = 0.379$). Because of the small number of observed GPs and the lack of a clear difference between

the groups in a subjects analysis (reported as F_1), F_2 values are not reported for GP data and no further GP analyses were carried out. In the absence of significant numbers of GPs and because of the possibility that the GP primes had induced participants to produce other types of passives, analyses of production of other passives were conducted and are reported below.

3.4.4 Production of *be* passives (beP)

Although participants produced few GPs they did produce many other types of passives. Of these passives, bePs were the single most frequent type (See Figure 3.5). Production rates of bePs increased in the treatment phase relative to the pre-test for both groups. On average, the experimental group produced bePs in response to 17.13% of the pre-test target pictures rising to 22.39% in the treatment phase and increasing further to 26.85% in the post-test. The control group had a slightly higher rate of production in the pre-test, producing bePs in response to 18.75% of pre-test target pictures, rising to 26.10% in the treatment phase but decreasing somewhat to 22.50% in the post-test. This small difference between the groups in the pre-test was non-significant ($t[50] = 0.352$, $p = 0.726$).
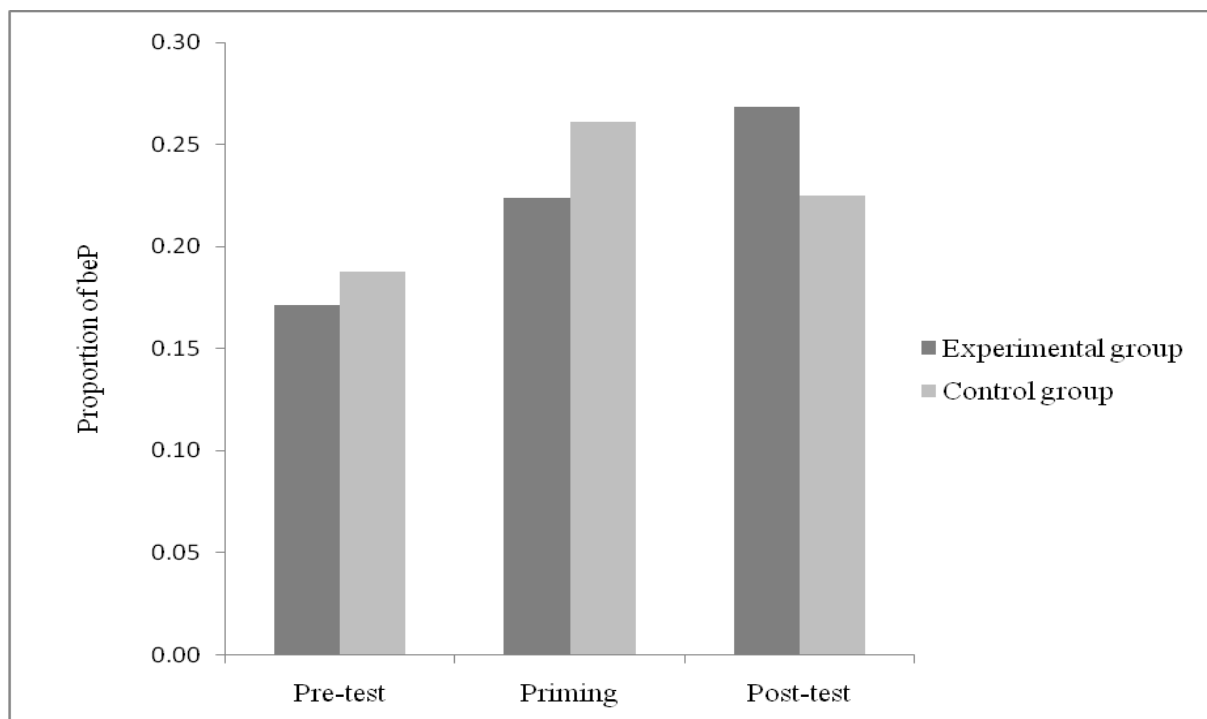

Figure 3.5. Production of beP by experimental and control groups as a function of test (mean proportion of target pictures)

The main area of interest was each group's performance on the pre- and post-tests and inspection of the raw results indicated that the groups appeared to behave slightly differently in these tests. The rate of production of bePs increased from pre- to post-test for both groups, but the experimental group experienced a greater increase than the control group. To examine this difference between the groups statistically, the pre- and post-test scores of both groups were compared in a 2 X 2 ANOVA: an analysis by subjects in which test was considered a within-subjects variable (two levels: pre- and post-test) and group a between-subjects variable (two levels: control and experimental); and an ANOVA by items in which both test and group were considered within-subjects variables. A significant main effect of test emerged ($F_1[1,50] = 16.88$, $p < 0.001$, $\eta^2 = 0.252$; $F_2[1,15] = 17.72$, $p < 0.001$, $\eta^2 = 0.347$), a non-significant main effect of group ($F_1[1,50] = .10$, $p = 0.760$; $F_2[1,15] = 0.27$, $p = 0.612$), a marginal interaction between group and test on a subjects analysis and a non-significant interaction on an items analysis ($F_1[1,50] = 3.32$, $p = 0.075$, $\eta^2 = 0.062$; $F_2[1,15] = 1.94$, $p < 0.185$). The marginal interaction on the subjects analysis, together with the descriptive data, suggest that the groups might have behaved somewhat differently. To further statistically explore this apparent difference, each group's performance on the pre- and post-tests was also compared separately in paired t-tests. For the experimental group the difference in beP production between the pre- and post-tests was highly significant ($t[26] = 4.337$, $p < 0.001$, $d = 0.84$), but for the control group was non-significant ($t[24] = 1.55$, $p = 0.134$). Thus, the two groups indeed appeared to behave differently, and in the expected way, suggesting that structural priming had occurred.

3.4.5 Production of all passives (allP)

To further explore priming effects, the production of all types of passives (allP) was combined in an analysis. This measure - allP - included: beP, adjP, GP and bareP production. When allP production was considered, the performance of the groups was similar to their beP production. See Figure 3.6 for a summary of allP production for both groups. The experimental group produced allPs in response to 28.94% of pre-test target pictures, rising to 38.43% of priming target pictures and remaining at 38.43% of post-test target pictures. The control group produced allPs in response 27.75% of pre-test target pictures, rising to 40.38% of priming target pictures but falling to 33.50% of post-test target pictures. Thus, while both groups started out with similar baseline production rates of all types of passives, and were primed to similar extents in the treatment phase, the priming in the experimental group appeared to be more temporally durable

than in the control group, as measured in the post-test. To statistically examine this possibility, participants' production of allP was compared in a 2x2 ANOVA comparing each group's pre and post-test performance. On this analysis there was a significant main effect of test ($F_1[1,50] = 15.16$, $p < 0.001$; $F_2[1,15] = 5.58$, $p = 0.032$), a non-significant main effect of group ($F_1[1,50] = 0.43$, $p = 0.514$; $F_2[1,15] = 0.35$, $p = 0.563$), and also a non-significant interaction between test and group ($F_1[1,50] = 0.91$, $p = 0.344$; $F_2[1,15] = 0.35$, $p = 0.563$).
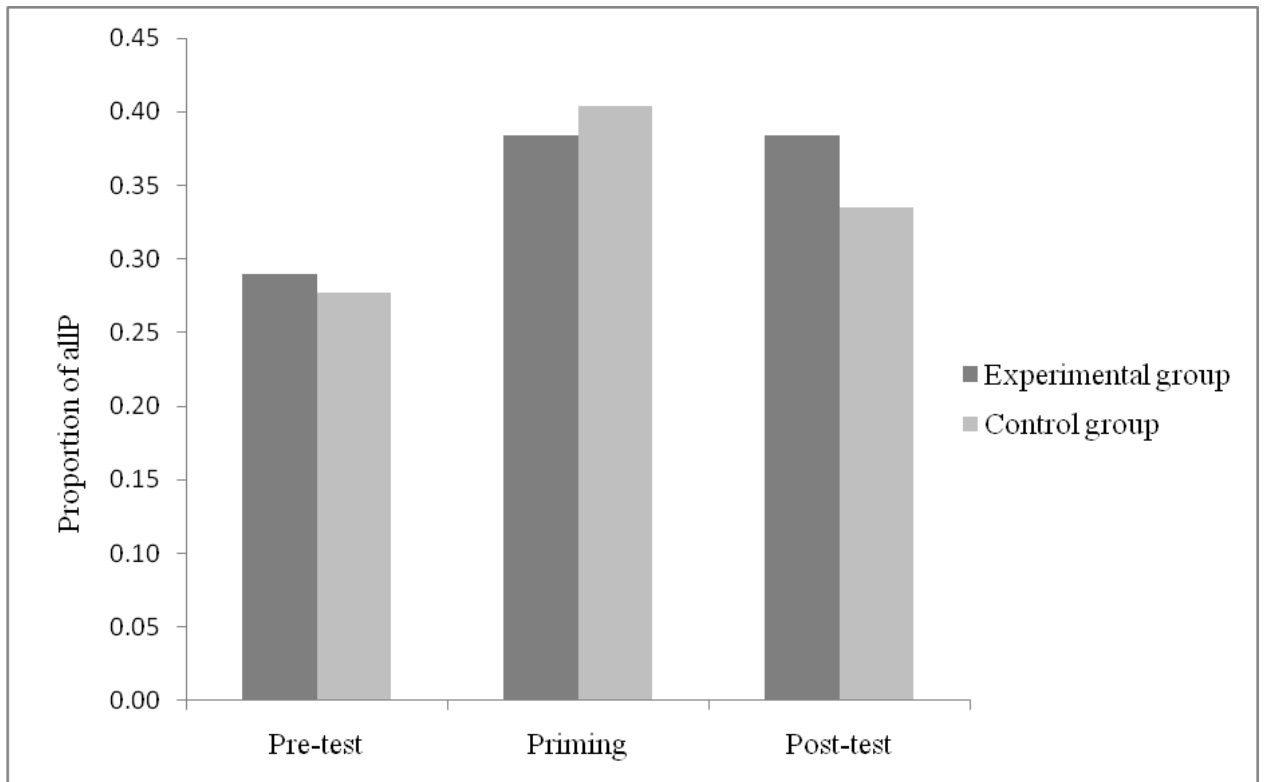

Figure 3.6. Production of allP by experimental and control groups as a function of test (mean proportion of target pictures)

The absence of a significant main effect of group and the non-significant interaction between group and test for allP was somewhat surprising given the appearance of a small *descriptive* difference between the groups. Just as for the measure beP, to further investigate a possible difference between the groups in the pre- and post-tests separate paired *t*-tests were carried out. For the experimental group, there was a significant difference between its pre- and post-test production of allP ($t[26] = 3.49$, $p < 0.002$, $d = 0.61$). For the control group, the difference between pre- and post-test allP production was marginally significant ($t[24] = 2.04$ p, $= 0.052$, $d = 0.28$). Thus, the two groups did not differ significantly on this measure.

3.4.6 Production of other passives

The main types of passives produced in this experiment were beP, and only small numbers of the other types were produced (see Figure 3.4). This made statistical comparisons of other passives impractical. When the descriptive data was inspected, no obvious pattern of differences between the groups emerged for any other forms of passive production.

Finally, since the control and experimental groups appeared to behave similarly in all phases of the experiment, combined groups analyses were carried out in which both group's passive production was pooled and each phase of the experiment compared. First, with regard to all participants' production of beP, there was a clear difference between participant's performance on the pre- and post-tests ($F_1[1,51] = 15.73$, $p < 0.001$; $F_2[1,15] = 7.96$, $p < 0.013$). With regard to all participants' production of allP, a significant difference also emerged between participant's pre- and post-test performance ($F_1[1,51] = 15.50$, $p < 0.001$; $F_2[1,15] = 5.09$, $p < 0.039$). The significance of these findings and the apparent similarity of the groups' performances are discussed below.

3.5 Discussion

The main finding from this experiment was the absence of a noticeable priming effect for GP. However, structural persistence effects for other types of passives did emerge on analysis of the data: both the experimental and control groups produced higher proportions of passives in the treatment phase relative to the pre-test; and both groups combined produced significantly more passives in the post-test than in the pre-test. These two findings were true for the measures beP and allP, and indicated that both groups' behaviour in relation to passive production was modified by the stimuli they received. Certain other structural persistence effects were also observed. Notwithstanding the overall similarity between the groups' performances, subtle differences between the two groups emerged on close inspection of the data: there were indications that the experimental group was structurally primed. This apparent priming of the experimental group and other structural persistence effects, particularly on the control group are discussed below.

First, the findings of weak passive priming reported in this experiment are consistent with those reported in previous L1 and L2 structural priming studies (e.g., Bock, et al., 2007; Bock & Loebell, 1990; Boston, 2010; Hartsuiker & Kolk, 1998; Y. Kim & McDonough, 2008). After priming, the experimental group produced more bePs in the post-test than in the pre-test, a difference which was statistically significant in a t-test. The control group also produced more bePs in the post-test than in the pre-test, but the difference was non-significant in an analysis by subjects, and only marginally significant on a *t*-test by items. This small apparent difference between the two groups was also evident in a marginally significant interaction between group and test on an ANOVA by subjects on the pre- and post-test data. The present finding thus extends the reported weak effects from L1 to L2 speakers and could suggest that structural priming effects are critically modulated by the choice of target structure: some structures are primed more strongly while others more weakly (see also section 6.2, Chapter 6).

Second, the control group behaved very much like the experimental group in terms of overall increased production of passives in the treatment phase and post-test relative to the pre-test. This behaviour suggests that the control group also displayed a form of structural persistence, the explanation for which probably hinges on one feature of the experimental protocol. Immediately before each target picture both groups saw, heard and repeated the noun corresponding to the patient in that picture. Moreover, the entity corresponding to the functional role of patient was also highly salient in most of the target pictures. Thus, visual salience of the patient, and the appearance of the patient noun and its articulation just prior to the target picture most likely induced both groups of participants to spontaneously place the patient in subject position and produce passives. This behaviour can be readily explained in terms of research on the effects of saliency and lexical and semantic accessibility on sentence production. Bock and Warren (1985, p. 50) defined conceptual accessibility as "the ease with which the mental representation of some potential referent can be activated in or retrieved from memory" and can have semantic and lexical components (Bock, 1982). Salience and lexical accessibility are known to be important factors in determining how speakers assign conceptual roles and subsequent serial sentence positions of competing entities when producing sentences (Bock, 1986b; Bock & Warren, 1985). Phonological accessibility is also a factor that can affect the formulation of sentence structure (Bock, 1987). In a picture description task in a semantic priming study, Bock (1986b) found that English speakers are more likely to place more accessible words earlier in sentences than less accessible words. In that study, participants were presented with a prime word which was

semantically similar to one of two target words associated with a subsequent picture depicting a transitive action. After being primed with this word, the proportion of participants' passive and active sentences to describe the pictures was measured. If the prime word was semantically similar to the patient in the subsequent target picture, speakers tended to place the patient in subject position and produce a passive. If the prime word was an agent, then they subsequently tended to place the agent in subject position and produce an active sentence to describe the picture. Bock (1987) found that speakers tended to place phonologically accessible words earlier in a sentence (e.g., in subject position). Visual salience is also an important factor in sentence production. Many studies have demonstrated that, in sentence production, speakers tend to place the most salient or accessible entity in sentence locations which represent higher syntactic functions, or in other words, in left-most sentence positions. Typically, this position is the subject in English, but need not be, especially in other languages with less fixed word orders. For example, Vogels, Kramer & Maes (in press) found that speakers are more likely to place the referents of visually salient entities in subject position in sentences. Importantly, findings of the importance of salience and lexical/semantic accessibility in determining sentence structure have been replicated in numerous studies in a diverse range of languages including: Spanish (Prat-Sala & Branigan, 2000); Japanese (V. S. Ferreira, & Yoshita, 2003); Odawa (Christianson & Ferreira, 2005); and English (Bock & Warren, 1985), suggesting that it might be a universal phenomenon.

In the current experiment, the presentation of the patient noun just prior to each target picture would have meant that for the participants the most salient entity (or argument) in the context of the target pictures (and subsequent sentence conceptualisations) would have been the patient. Participants also repeated the patient noun, thus increasing its phonological accessibility in short-term memory for later use in sentence production. Assuming that sentence production occurs in a multi-stage process (e.g., Bock & Levelt, 1994), once participants saw and uttered the patient noun, they would have then begun to construct a sentence by placing the salient patient noun in sentence initial subject position. Along these lines, one might assume that, after experiencing the patient, participants preferentially retrieved the lemma associated with the patient in the initial encoding stage. Once the process of activation and retrieval had begun, and assuming that sentence production at the positional level is incremental, a passive sentence would have been inevitable, especially since English provides few other structural alternatives to a passive at this stage of sentence planning (other than perhaps left dislocation or clefts, both of which would have

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been more difficult for these L2 participants). Therefore, the production of passive sentences was actually favoured in this experiment.

The idea that participants preferentially placed the patient noun in the subject position, thus initiating a passive, is compatible with several models of L1 sentence production (Bock & Levelt, 1994; Dell, Chang, & Griffin, 1999; Kempen & Hoenkamp, 1987; Levelt, 1989). In specifying the process of building syntactic structure within his comprehensive model, Levelt (1989, p. 239) argues that "fragments of a message are expressed as much as possible in the order in which they became available". This assignment of lexical items takes place in an incremental left-to-right process with information feeding forward from conceptualisation, to building syntactic structure, and finally to articulation. Dell, Chang and Griffin (199, p. 530) argue similarly that:

> Grammatical encoding is highly opportunistic; the most prominent message elements are the first to be lexicalized and the earliest lexicalized concepts are assigned to the earliest occurring grammatical roles, such as sentential subject.

Using a concrete example from the current study, in one trial participants saw, heard and repeated the noun *rabbit*, which would have made 'available' the concept and lemma for RABBIT. Immediately afterwards they saw a picture of a fox with a rabbit in its mouth. The higher accessibility of the lemma RABBIT would have then led to the placement of a patient NP *the rabbit* or *a rabbit* into the subject position and led eventually to the construction and articulation of a passive such as *a rabbit was caught by a fox*. Thus, the structural persistence effects observed here might have been a function of argument salience rather than, or perhaps in addition to, any structural priming process.

One alternative but related explanation for the structural persistence observed in the experimental group is that the serial arrangement of functional roles (patient-agent) was primed in this experiment which in turn affected speakers' decisions about word order and subsequent sentence production choices. This effect might also have been at least partially associated with self-priming in the control group (see section 3.5.1 below for a discussion on this). Conceptual priming of the functional role arrays could have occurred as participants repeatedly saw and heard the patient noun across the whole priming session, which lasted about 20 minutes. This interpretation of a separate priming component at the functional processing stage follows from

Bock and Levelt's (1994) model of sentence production in which the assignment of conceptual roles takes place in an independent functional processing stage [in much the same way as elucidated by M. F. Garrett (1975, 1976)]. In Bock and Levelt's model, functional processing takes place before positional processing where serial sentence positions are assigned. According to this interpretation the increased production of passives by both groups might have been partially or entirely due to an effect at the functional level of sentence planning rather than a structural priming effect at the positional planning stage. This explanation is also plausible in light of previous findings of structural priming at the functional level in adults (Chang, et al., 2003; Vasilyeva & Waterfall, 2012) and children (Gámez, et al., 2009; Goldwater, et al., 2010; Vasilyeva & Waterfall, 2012). These studies have found that the order of the constituents in thematic role arrays can be primed (see section 1.5, Chapter 1). One could argue for a similar effect in the current experiment in which very few GPs were produced following GP primes, but at the same time a tendency for both groups to place the patient in the subject position using a variety of adjectival and *be* passives. Given the fact that there was no systematic manipulation of functional role priming in the current experiment, it was not possible to disentangle effects at the functional level of processing from effects at the positional level here. On balance however, it seems plausible that in Experiment 1 priming could have taken place at the functional level such that speakers tended to place patients in subject positions after experiencing primes containing patient roles in subject positions. In addition, this explanation could account for the structural persistence observed in both groups of participants in terms of self-priming.

3.5.1 Self-priming

On the assumption that the control group's sentence production was influenced by the presentation of the patient noun, control group speakers might have also primed *themselves* as they repeatedly produced passive target sentences in the treatment phase. This effect could have arisen even though control speakers did not see or hear any prime sentences. This account could then explain why they not only produced more passive sentences in the treatment phase than in the pre-test, but also why they produced more passives in post-test that in the pre-test, just like the experimental group. This interpretation is relatively uncontroversial because previous studies have demonstrated that structural priming need not stem from exposure to primes produced by an external source (either an interlocutor or a computer program for example). Many L1 structural priming studies, such as those employing sentence recall techniques (e.g., Konopka & Bock,

2009) have specifically employed a sort of self-priming methodology. For example, Smith and Wheeldon (2001) found a priming effect such that a speakers' prior utterance of a target structure facilitated the subsequent processing of that structure. A self-priming account is also consistent with previous explanations of priming of passives in young children (Savage, et al., 2006) and adults (Pickering, Branigan, & Maclean, 2003). Savage et al. (2006) explained long-term priming in four year-old children partially in terms of a self-priming effect in which only the children who received an opportunity to re-produce the passive targets one week after the main priming session displayed priming one month after the main priming session, while those children who did not have this opportunity to re-produce the targets did not display long-term priming. Several studies of dialogic priming and studies which have compared comprehension and production priming have also described self-priming effects (e.g., Gries, 2005). Pickering et al. (2003) also found that self-priming effects stemming from participants *producing* a prime structure were stronger than priming effects stemming from participants only *comprehending* the prime structure. According to this account, it is also possible, and perhaps likely, that the experimental group also primed itself. However, self-priming effects and priming effects related to the prime stimuli might not necessarily be additive. I will return to a discussion of self-priming effects in Chapter 6.

Overall, the data suggests that the experimental group did appear to have been structurally primed to some extent. However, this priming effect could have been concealed (or even overwhelmed) by stronger salience and lexical accessibility effects. A logical modification to Experiment 1 would be to remove the patient noun from the experimental protocol so that the experimental group would only receive the passive prime sentences and target pictures, while the control group receives only the target pictures. In this way the priming effect of the patient noun could be factored out of the experiment and the priming effect of the prime sentences *alone* could be investigated. Presumably, one would expect in this case that the control group would remain unprimed while the experimental group would be structurally primed to some extent.

3.5.2 Effect of the cover task

The relatively weak structural priming effects observed here could have also been partially due to the vocabulary cover task, which only the experimental group engaged in. Their additional task was to pay explicit attention to, and memorise nine words from the test materials. The control group did not have to do this, and so the experimental group was therefore under a heavier overall

cognitive load than the control group. This task might have diverted cognitive resources from the primary (covert) priming task and resulted in lower levels of priming for the experimental group than would have otherwise been expected. Priming experiments are inherently long and sometimes complicated. Previous studies have reported that attempts by participants to memorise test items in running recognition memory cover tasks might weaken priming effects (Bock, et al., 2007), although whether this is due to a general increase in cognitive load or specific cognitive effects is not certain. It is well accepted however, that human language processing is a limited-capacity system and that in multi-task situations cognitive resources can become depleted leading to impaired performance. Evidence for this in an SLA context was reviewed by Carr and Curran (1994, p. 219). They speculated that language learners "will be hindered by dividing attention between syntactic processing and other activities, even if what is being learned about syntax remains implicit or unconscious", and that "if [a] task is performed under dual task conditions in which attention is distracted from sequence processing by the need to perform another, unrelated task, then structural learning is attenuated or eliminated". The current design highlights the potential difficulty of adapting priming methodologies from L1 studies to L2 studies. Most L1 speakers would presumably have little problem dealing with multiple cognitive demands within such priming experiments. However L2 speakers, particularly those on the "edge of their linguistic competence" [or as Krashen (1985) would describe at i + 1 stage of acquisition] might experience cognitive overload resulting in unexpected outcomes or degraded linguistic performance. The issue of adapting L1 priming methods to L2 contexts is further discussed in section 6.6, Chapter 6. A logical modification to the methodology in future research would be to eliminate or modify the cover task such that each group had an equally and relatively minor additional load.

3.5.3 Individual differences in structural priming effects

The priming effects found in Experiment 1 were in the expected direction but were relatively small in size and only marginally statistically significant when the control and experimental groups were statistically compared. L1 structural priming studies have mostly treated participants as homogeneous groups of individuals in terms of priming behaviour. Recently however, researchers have begun to pay attention to the possibility of variation between individuals in their potential to be structurally primed (Kidd, 2012). In addition, some evidence for individual differences can be inferred from two earlier L1 priming studies: Bock et al. (2007) reported that

in experiment 1 of their study, almost a quarter (22%) of their participants produced neither the target primed structures nor the alternative structures (for both transitive or dative alternations), while Bock and Griffin (2000), in their experiments 1 and 2, reported similar levels of non-target production (23%). Although these authors did not discuss these findings in detail, one possible conclusion is that certain cognitive factors or other personal factors might mean that some individuals are more resistant, or less prone than others to repeat a structure and/or be primed.

If individual differences were large enough in Experiment 1 in this thesis, statistical power could have been reduced enough to mask latent structural priming effects within certain speakers. Statistical power depends on factors such as sample size and effect size: as sample size and/or effect size increase so does power. This relationship is due at least in part to a reduction in the variance as sample size grows[10], such that a more homogenous population would require a smaller sample size for a given expected effect size than a less homogenous population. Therefore, using a simple calculation of power, an estimate can be made of the required group size (N) necessary to repeat the current experiment. In the current experiment the observed power for the interaction of group and test (pre- and post-test) was only 0.43. That is, in experiments with the current number of participants and the observed mean passive suppliance by both groups on each test, only 43% of the time will a significant interaction be found. This level of power is rather low and a more adequate level of power would be around 0.80. As outlined in Howell (2008), a calculation can be performed to estimate the number of participants required to reach this increased level of power in a new experiment, while maintaining the same differences between groups. This calculation reveals that a minimum N = 64 participants would be required in each group. Unfortunately, carrying out such an experiment with individual sessions (as in the current methodology) would be lengthy and difficult. If such a future passive priming experiment was planned with larger group sizes, one would probably need to conduct the priming sessions in groups to facilitate efficient data collection and speed the research process. I will discuss this issue, in particular in relation to L2 structural priming studies, in more detail in section 6.6.3, Chapter 6.

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[10] The variance is defined as the sum of the squares of the differences between each data point and the mean divided by the total number of points in the data set. Therefore, as the number of participants in the data set increases, so does the denominator and therefore the variance decreases.

3.5.4 Effect of participants' L1

The L1s of some of the participants might have influenced their production of passives in this experiment. Hinkel (2002) argues that speakers with Chinese and Japanese L1s can inappropriately transfer factors from their L1s that affect the formulation of sentence structure. These factors include the relative importance speakers give to the agentivity, animacy and sentience of nouns, and the patienthood of entities. The result of inappropriately applying such factors to sentence processing can be non-target-like English passive production and comprehension. More than half of the participants in Experiment 1 had Chinese or Japanese L1 backgrounds (18 and 2 respectively from 26 in the experimental group and 16 and 4 from 25 in the control group). Specifically, Chinese passives do not normally allow animate entities to be logical objects (patients) and therefore to appear in subject position in passives, but reserve inanimates for subjects in passives (LaPolla, 1988; Li & Thompson, 1981). In the treatment phase, just over half (13) of the 21 target patient nouns were animate, and in the pre- and post-tests more than half (11) of the 16 target pictures contained an animate patient noun. This design could have therefore inhibited priming and the subsequent production of passives by L1 Chinese speaking participants because their L1 preferences might have inhibited them from placing these animate entities in subject positions. That is, priming might have been inhibited by L1 influence and this might explain why the control and experimental groups' performances were similar.

Conversely, another L1 factor might have worked to *encourage* the production of passives produced by many of the participants, namely typologically derived topicalisation preferences of participants. Chinese and Japanese are known to be topic-prominent languages (Li & Thompson, 1976). Likewise, Thai (Iwasaki & Ingkaphirom, 2005) and Vietnamese (Iwasaki & Ingkaphirom, 2005) are also regarded as topic-prominent languages. Together, participants with these L1s accounted for 87% of the total participant group (93% of the experimental group and 80% of the control group). English on the other hand, is regarded as a subject-prominent language. This is why, according to Yip (1995, p. 90) Chinese speakers[11] of L2 English, especially at low to intermediate levels of proficiency, typically misinterpret subjects as topics. Along these lines, such speakers might mistakenly misparse the subject *Mary* in sentence (34) as a topic rather than a subject.

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[11] Yip studied mainly Mandarin Chinese speakers (mainly of Taiwanese origin).

(34)   [$_{TOP}$ Mary$_i$] [$_s$ Ø$_i$ loves bread]

According to Yip (1995) this tendency to topicalise subjects, and interpret subjects as topics, means that Chinese speakers of L2 English also tend to produce pseudo-passives and frequently produce what outwardly appear to be real passives but are, in fact, topic-comment structures in their interlanguages where are placed into the sentence-initial topic position in English. Typically, these pseudo-passives also omit certain morphological features as in sentence 35 given as a typical example from a Chinese speaker by Yip (1995, p. 97).

(35)   New cars must keep inside

From a developmental perspective, this tendency also results in Chinese speakers going through a phase in which they overgeneralise and over-produce passives. Thus, for at least half, and perhaps up to 87% of the participants in this experiment, pseudo-passives and passives could have been the preferred and default structure to produce even in the absence of any priming treatment. Additionally, Chinese requires that topics are definite (Li & Thompson, 1976; Yip, 1995), and the presentation of the subject (patient) noun and the pictorial representation of its referent might have therefore enhanced the definiteness of the patient. Therefore, also for reasons of L1 transfer, most Chinese participants might have tended to topicalise this NP, placing it in sentence-initial position and producing a passive or pseudo-passive. This analysis might explain why both the control and experimental groups produced passives in the pre-test and why the experimental group differed only slightly from the control group in the treatment phase and post-test. This tendency to topicalise is not only a possible result of L1 influence, but might also be a more universal tendency in L2 learners. According to Pienemann's (2007) Topic Hypothesis, initially all learners go through a phase in which they do not distinguish between topic and subject functions. It is only later, as learners progress, that they begin to differentiate between subject and topic. From this developmental perspective, it was possible then that participants were at a stage in which they did not differentiate between subject and topic.

The tendency for some participants to transfer topicalisation preferences from their L1 might also have been the source of some of the bare passives produced by these participants. Chinese allows for topics to be introduced via an existential verb (i.e., *you* in Mandarin) glossed in English as *there be* (Yip, 1995). The nearest English equivalent is the existential dummy subject phrase

there is/are. Accordingly, several Chinese L1 speaking participants produced existential constructions followed by what appears to be a bare passive, as in (36).

(36)   There is a criminal controlled by a policeman

A further L1 transfer-related factor is the tendency in Chinese, Japanese, Vietnamese and Thai to reserve passives for adversative events only (Li & Thompson, 1981; Yip, 1995). Therefore, English passive sentences such as "she is liked by many people" is for example, incongruous in Chinese (Yip, p. 80). Also, Chinese tends to use topicalisation in linguistic situations in which English employs passives and Yip (p. 80) claims that "topicalization in Chinese often corresponds functionally to passivization in English". While Yip claims that learners undergenerate passives in early stages of acquisition, she argues that learners overgenerate passives in latter stages of acquisition, giving rise to sentences such as "the instrument is easy to be performed." (p. 80). As noted earlier, almost all participants were from these L1 backgrounds, while almost all of the target pictures and primes depicted adverse events. This combination could have led participants to produce relatively more passives than would have been expected for speakers from other L1 backgrounds and to produce more passives for the experimental stimuli than for other more neutral (or non-adversative) stimuli. Thus, yet another possibility for L1 transfer effects raised its head in Experiment 1.

In sum, many participants in this experiment had a pre-determined tendency, even in the absence of a priming treatment, to produce passives and pseudo-passives due to L1 topicalisation preferences, and due to the specific way the stimuli were presented resulting in highly salient patients. Since only relatively weak passive priming effects have been observed and reported in the literature, the overall effect of these L1 and methodological effects was probably that a certain "ceiling effect" of passive production was reached which "swamped" such weak priming effects. Whether or not future structural priming studies involving speakers from similar backgrounds and investigating passives can control for these factors is an open question. More generally, this analysis reveals that careful selection of structure is required in L2 structural priming studies and that structures used in L1 structural priming studies might not necessarily be relevant or useful for L2 priming studies. This point does not appear to have been widely acknowledged in L2 structural priming studies to date since many L2 priming studies have employed the very same structures used in L1 studies (e.g., passives, and datives).

3.6 Conclusion

What could explain the extremely low rates of GP production in Experiment 1? At the moment this question is difficult to resolve. Very few studies have investigated the L2 acquisition of English GP. One interesting finding from the current study however does stand out: although the experimental group received only GP primes, a marginally significant priming effect emerged for other types of passives. If this finding can be born out in more robust future priming studies, it would suggest that underlying syntactic structure can be primed.

Chapter 4

Experiment 2: A preposition is something you can end a sentence with

4.1 Introduction

Experiment 1 involving *get* passives (Chapter 3) yielded relatively weak and inconclusive priming results. In one sense this was somewhat unexpected given the focus on passives in many previous L1 and L2 structural priming studies. However, in another sense, the relatively weak effects were consistent with the findings of many of those previous studies. A different target structure was needed to explore L2 structural priming, and therefore the English stranded preposition was chosen for Experiment 2.

In contrast to many previous L2 structural priming studies, and the focus of Experiment 1 in this thesis, Experiment 2 took a somewhat different approach. This experiment investigated priming of a structure which does not have a straightforward and semantically related grammatical alternative in the target language. Instead, I examined speakers' tendency to produce either of two possible structures in the target language, one of which was grammatical and one which was an L2 interlanguage variant. This approach is based on the widely accepted assumption that the interlanguages of L2 speakers are cognitively real linguistic representations independent from speakers' L1 representations and the L2 target language (Adjemian, 1977; Selinker, 1972; White, 1989). Along these lines, it was assumed that interlanguage structures are equally valid language production choices for L2 speakers as grammatical choices are for L1 speakers. In this way, the present study extends the scope of L1 and L2 priming research from an investigation of speakers' production of equally acceptable structural forms (e.g., passives vs. actives) to L2 learners' production of a target form compared with an interlanguage variant, and answers the call by McDonough (2006, p. 199) for researchers to investigate structural priming "in contexts in which an interlanguage

system provides a L2 speaker with a choice between structures that are not equally acceptable". This approach places the study squarely in the realms of language learning.

This approach is not entirely unique, in that a similar approach was recently taken by McDonough and colleagues in several studies. In one of those studies, McDonough and Chaikitmongkol (2010) investigated L2 English learners' production of 'wh' questions during and after priming. Specifically, they examined and compared learners' production of the target form containing an auxiliary verb (e.g., *Why do people count sheep?*) and an ungrammatical interlanguage variant which omitted the auxiliary (e.g., *Why people count sheep?*). They compared a group of learners which engaged in a collaborative priming task with a control group which received no priming and found that the priming group produced significantly more target forms than the control group while the control group produced significantly more interlanguage forms than the primed group. McDonough and Mackey (2008) also investigated ESL question development. That study attempted to prime learners to produce questions defined as "developmentally advanced" according to Pienemann's (2007) developmental sequence and reported moderate priming effects.

The targeted interlanguage feature of this experiment was the so-called "null prep" in L2 English (Bardovi-Harlig, 1987). Its grammatical (target) analogue is the stranded preposition structure evident in sentences (1-7 below). The stranding of a preposition at the end of certain clauses is a rather distinctive structural feature of English. Preposition stranding occurs in English in association with *wh*-movement in questions, as in sentences 1 and 2; in relative clauses, as in 3 and 4; infinitive complements, as in (5) and (6); and passives, as in (7).

(1) *Who were you talking to?*
(2) *Which chair would you like to sit on?*
(3) *That's the man she was talking to.*
(4) *A camera is something (that) you can take photos with.*
(5) *She used a knife to cut the potatoes with.*
(6) *The water was too cold to swim in.*
(7) *Their house was broken into.*

The stranded preposition construction appears to be difficult for learners of L2 English. Many L2 English speakers, particularly for those whose L1s do not allow stranding, frequently omit stranded prepositions in passives, *wh*-questions and relative clauses (Bardovi-Harlig, 1987; Hokari & Wakabayashi, 2009; Kao, 2001; Klein, 1995, 2001; Sadighi, Parhizgar, & Saadat, 2004), resulting in null prep. In a production study, Bardovi-Harlig (1987) compared the L2 acquisition of stranded prepositions with preposition pied-piping in dative *wh*-questions, such as 8 and 9, and relative clauses, such as 10 and 11, by L2 English learners from a range of proficiency levels and L1 backgrounds studying at an American university. She found that learners go through an initial interlanguage stage of null prep (e.g., 12 and 13) before they acquire stranded prepositions (e.g., 8), and eventually acquire pied piping (e.g., 9).

(8)   *Who did peter throw a football to?*
(9)   *To whom did Peter throw a football?*
(10)   *The woman who Bob sent a postcard to was his aunt.*
(11)   *The woman to whom Bob sent a postcard was his aunt.*
(12)   *Who did Mary give the book?*
(13)   *The man Mary baked a cake was Joe.*

Other more recent studies have targeted specific populations of L2 English speakers – those from a Japanese L1 background (Hokari & Wakabayashi, 2009; Kao, 2001) and Iranian L1 background (Rezai, 2006; Sadighi, et al., 2004). These more recent studies have focussed on comprehension, employing grammaticality judgement tasks, and reported that L2 speakers frequently accept null prep sentences as grammatical. Sadighi, et al. reported that Iranian L2 English learners at both low and high proficiency levels accepted null prep sentences as grammatical (see Table 4.1 for a summary of the results). All of Sadighi et al.'s participants had also previously received classroom instruction in English stranded prepositions. Thus, it appears that the acquisition of stranded prepositions might also be relatively resistant to instruction. Also employing a grammaticality judgement task, Hokari and Wakabayashi (2009) reported that Japanese learners of L2 English at a range of levels also frequently accepted null preps in passives and *wh*-questions (see Table 4.1). Several studies have also demonstrated that null prep acceptance and production is not a function of a lack of knowledge about verbs' subcategorisation preferences: null prep occurs even when speakers can identify

and use the correct preposition with verbs in non-stranding contexts (i.e., declaratives) (e.g., Hokari & Wakabayashi, 2009; Kao, 2001), suggesting that the null prep phenomenon is primarily syntactic in origin.

The available evidence thus indicates that null prep is a well-documented L2 English interlanguage feature. The failure of L2 speakers from a range of L1 backgrounds and proficiency levels to supply stranded prepositions in contexts which require them and those speakers' acceptance of null prep constructions reflects the difficulty faced by some L2 English learners in acquiring the stranded preposition construction. For this study, stranded preposition production was examined in the context of relative clauses (e.g., sentence 3).

Table 4.1. Mean percentages of null prep acceptance in questions, relative clauses and passives reported in previous studies of L2 English learners (* *wh*-questions only)

Study	Sadighi, et al., (2004)			Hokari & Wakabayashi, (2009)		
L1	Persian			Japanese		
Proficiency level	low	mid	high	low	mid	high
Questions	67	54	37	54*	26*	20*
Relative clauses	76	62	46	---	---	---
Passives	---	---	---	92	53	46

4.2 Hypotheses and research questions

Overall, I set out to investigate whether giving L2 English learners a priming treatment would result in those learners producing more stranded prepositions than would otherwise be the case. Specifically, given the clear indication that L2 English speakers

struggle with acquiring and using stranded prepositions, together with evidence from L1 structural priming studies that the word order features of sentences are primeable (Hartsuiker, et al., 1999; Loebell & Bock, 2003; Pickering & Ferreira, 2008; Potter & Lombardi, 1998), the following hypotheses were formulated:

1. In a preliminary test prior to a priming treatment speakers will frequently omit the obligatory stranded preposition in English relative clauses and produce null prep sentences.
2. During a priming treatment, speakers will be primed to correctly produce stranded prepositions in relative clauses.
3. Immediately after the priming treatment, speakers will produce more stranded prepositions than before priming.
4. Immediately after the priming treatment, speakers will produce fewer null preps than before priming.
5. Speakers will produce more stranded prepositions (and fewer null preps) one week after the priming treatment than before priming, as measured in a delayed post-test.

In addition to the main hypotheses, I formulated a further research question. This question concerned the effect of repetition of the preposition between the stranded preposition priming sentence and the stranded preposition target sentence. In the L1 priming literature, the repetition of closed-class words has been found to be immaterial to structural priming. In particular, priming effects are not modulated by the repetition of a preposition between the prime and target (Bock, 1986b, 1989; Traxler, 2008). Bock (1989) compared the production of English *to* prepositional object (PO) datives after either a semantically unrelated *to* PO dative prime sentence (e.g., *a secretary was taking a cake to her boss*) or *for* PO dative prime sentence (e.g., *a secretary was baking a cake for her boss*) and found no significant boost in priming following primes containing the same preposition (*to*). In a comprehension priming study, Traxler (2008) manipulated the identity and functional role of prepositions (*by* vs. *with*) in sentences containing agentive and instrumental prepositional phrases and found a facilitative priming effect in the comprehension of target sentences regardless of the preposition and its functional role. In this case prime sentences containing instrument prepositional phrases (headed by *with*) primed sentences containing agentive prepositional phrases (headed by *by*),

although prime sentences containing agent prepositional phrases did not prime targets with instrument prepositional phrases.

Little is known however, about the effect of closed-class repetition on structural priming in L2 speakers. Thus, two questions remain: would L2 structural priming also be unmodulated by preposition overlap between prime and target; and would the L1 findings so far for a limited range of structures generalise to other English structures in an L2 context? According to Clahsen and Felser (2006), L2 speakers rely more strongly on lexical information than syntactic information in online sentence processing, which would suggest that, along the lines of the 'priming as learning' hypothesis, they might be more strongly primed when there is lexical overlap than when there is none. In order to investigate these questions, a specific research question was formulated and the identity of the prepositions in prime/target pairs in the current study was manipulated: What will be the effect on priming of repetition of the preposition between prime and target?

4.3 Method

4.3.1 Design

The study consisted of two parts: a main priming task and a delayed post-test. The main task consisted of three sections: a pre-test to measure baseline production of stranded prepositions and null-preps, a treatment phase, and a post-test. The delayed post-test took place one week after the main task. The investigation of priming within a pre- and post-test design sheds light on the possibility that stranded prepositions might be able to be learnt (and taught) through priming and so addresses previous reports in the literature which suggest that stranded prepositions might be resistant to instruction (Bardovi-Harlig, 1987; Sadighi, et al., 2004). The inclusion of a delayed post-test is meant to address concerns that, under certain circumstances, the effects of instruction or teaching interventions might not emerge immediately, but rather only sometime after treatment (R. Ellis, 2008), as well as to check the durability of any effect found.

4.3.2 Participants

Participants were all L2 English speakers. They were randomly assigned to one of two participant groups: an experimental and a control group. The experimental group consisted of 26 speakers and the control group 22 speakers. One participant from the experimental group was undertaking an undergraduate degree. Twelve participants (7 experimental and 5 controls) were undergraduate education students from a Hong Kong university on a six week visit to the Australian university for English language and other study purposes. All other participants in the two groups were studying English for academic purposes at the university's English language training centre prior to subsequent enrolment in a degree at the university. The data from six experimental group participants, and three control group participants were excluded from the analyses either because they did not do the task properly (e.g., they did not repeat the primes), or otherwise did not follow the instructions. The data from one additional control group participant was excluded due to a recording error. The remaining participants had the following L1 backgrounds:

Experimental group (N = 20)
- 15 Chinese (8 Mandarin, 7 Cantonese)
- 2 Arabic
- 2 Vietnamese
- 1 Thai

Control group (N = 18)
- 13 Chinese (9 Mandarin, 4 Cantonese)
- 3 Arabic
- 1 Vietnamese
- 1 Thai

Participants' English language proficiency was assessed in several ways as intermediate to upper-intermediate. Eleven participants from each group had an average IELTS test score (or equivalent TOEIC score) obtained in the past year of: 5.45 (SD = 0.43) for the control group and 5.41 (SD = 0.61) for the experimental group. The remaining

participants had otherwise satisfied the university's English language requirement for entry to an English for academic purposes course (equivalent to IELTS 5.0) or to an undergraduate or postgraduate course (equivalent to IELTS 6.0). The experimental group contained 13 females and 7 males (mean age: 22.7 years, SD = 2.8) and the control group contained 10 females and 8 males (mean age: 22.7 years, SD = 2.5).

4.3.3 Materials

All materials were constructed in Microsoft PowerPoint. Stimulus pictures were freely available pictures sourced from the Internet using a Google image search. See the Appendix 4.1 for the full set of experimental items.

4.3.3.1 Pre- and post-tests

The pre- and post-tests each consisted of 12 pictures of tools or instruments (e.g., a spoon, a pencil, a fishing rod) or locations (e.g., a mattress, a tent) with each picture accompanied by a sentence starter (e.g., *A pencil is something you …*). Example pre- and post-test pictures are shown in Figure 4.1. Participants were required to complete each sentence starter. Each picture could be described by completing the sentence starter with a sentence containing a stranded preposition (e.g., 14 and 15).

(14)   *A pencil is something you write with.*
(15)   *A mattress is something you sleep on.*

The sentence starter was incorporated into the task to reduce the variability in participants' responses: early piloting of the task demonstrated that without the sentence starter participants produced a random selection of sentences, many of which were unrelated to the target structure or null prep alternative, thus impacting on the usefulness of much of the data. Therefore, the sentence starter was designed to induce participants to produce either the target stranded preposition sentences or null prep sentences, as well as to ease the sentence production burden for the participants. McDonough and Trofimovich (2009, p. 133) also suggested the use of sentence completion tasks in L2 structural priming studies.

The pre- and post-test target sentences contained three different prepositions (*with*, *on*, *in*), which were roughly balanced across tests. Six target description sentences contained an intervening noun phrase between the verb and preposition (e.g., *a hook is something you hang your clothes on*), while six did not (e.g., *a tent is something you sleep in*). The items in the pre- and post-tests were ordered so that no more than two consecutive items contained the same preposition, and all items were presented in the same order to all participants.

In order that the pre- and post-test responses could be compared in a straightforward manner, items were matched in the following way. Eleven of the pictures were matched across tests so that the same verb could be used to describe pictures in both tests. However, to ensure that participants could not simply use the same sentences for both pictures in a pre- and post-test picture pair, the matched objects differed. For example, a picture of a chair in the pre-test, was matched with a picture was of a bench in the post-test, and each picture was designed to elicit a sentence containing *sit on*. Only one pre- and post-test picture pair contained a non-matching verb. To control for possible order effects, the presentation order of the picture pairs was reversed between the pre and post-tests for each participant. Three additional practice pictures were included at the beginning of the pre-test.

Although 11 of the 12 pre- and post-test items were matched for verbs, in order to further control for possible item effects, all pre- and post-test items were also counterbalanced across participants in the following way. Each participant saw each picture either in the pre-test or the post-test, but not in both. One caveat to this manipulation was that the control group contained uneven numbers of usable participants (19) and so precise balancing in this group was not possible.

Pre-test picture   Post-test picture

Target response: *A mattress is something*   Target response: *A sleeping bag is*
you sleep on   *something you sleep in*

Figure 4.1. Example pre- and post-test pictures

4.3.3.2 Treatment phase

The experimental group's priming stimulus set contained 24 test pairs, each consisting of a stranded preposition prime sentence and matching picture, followed by a target picture and a matching sentence starter of the same form as for the pre- and post-tests. An example test pair is shown in Figure 4.2. As in the pre- and post-tests, all test prime and target pictures depicted objects that could be used as tools or instruments (e.g., a saw, a shopping trolley) or locations (e.g., a nest, a pool) and all prime sentences began with the words: '*An X is something you*' in which *X* represents the pictured object. All target pictures could be described by completing the sentence starter with a sentence containing a stranded preposition. None of the prime or target pictures in the treatment phase also appeared in the pre- or post-test. In thirteen pairs the same preposition was repeated across prime and target, and in eleven pairs the preposition varied between prime and target. Nine pairs contained an intervening NP between the verb and preposition in both prime and target (e.g., *a hammer is something you hit nails with / a trolley is something you put your shopping in*), while in fifteen pairs the preposition directly followed the verb (e.g., *a ladder is something you climb up / a glass is*

something you drink from). Verbs alternated across prime and target in 22 test pairs. Only in 2 pairs did the same verb (*put*) appear in both prime and target.

A saw is something you cut wood with.

Prime

A camera is something you …

Target
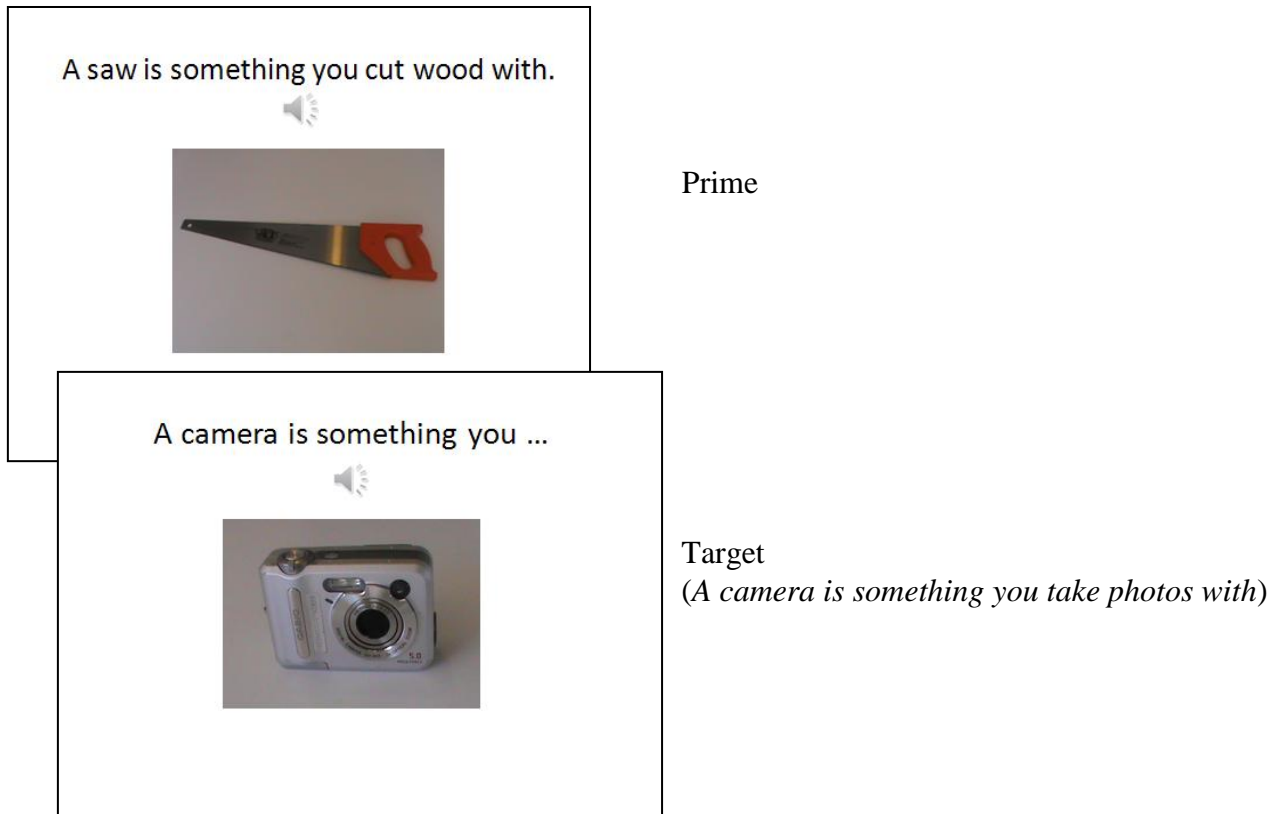(*A camera is something you take photos with*)

Figure 4.2. Example test prime-target pair.

In addition to the 24 test pairs, 16 filler pairs helped to conceal the purpose of the task and target structure from participants. None of the filler prime sentences contained a stranded preposition, and none of the filler target pictures could be well-described by completing the sentence starter with a sentence containing a stranded preposition. The filler prime sentences and filler target sentence starters all began in the same way structurally as the test items (i.e., *An X is something you …*). In no filler pairs was the verb repeated. Test and filler pairs were pseudo-randomly ordered subject to the criterion that no more than two consecutive prime-target test pairs were allowed. All participants saw the items in the same order. Additionally, items were ordered so that the occurrence of prepositions was suitably distributed: only two consecutive prime-target test pairs contained primes with the same preposition, and only one consecutive pair contained targets with the same preposition.

For the control group, each of the 24 stranded preposition prime sentences/pictures was replaced by one of the filler prime sentences/pictures or filler target pictures from the experimental group's stimulus set. None of the control prime sentences contained a stranded preposition. Where an experimental filler *target* picture was used as a control *prime* picture, an appropriate non-stranded preposition prime sentence was added. Four filler prime-target pairs were also included. Both the experimental and control groups practised on three prime/target pairs prior to starting the treatment phase.

4.3.3.3 Intervening spacer task

In order to foster the investigation of the temporal durability of the priming effect, and to control to some extent for possible explicit memory effects, an intervening spacer task was included after the treatment phase and before the post-test. This was a memory task in which participants were shown 12 objects, some of which were fillers in the treatment phase. They were asked to report whether or not they had seen each object in the treatment phase. The spacer task took participants between 1.5 and 3 minutes to complete.

4.3.3.4 Delayed post-test

The delayed post-test consisted of three parts. Part 1 was essentially similar to the pre- and post-tests in the main task: participants saw twelve pictures of instruments and locations, accompanied by a sentence starter, all of which could be described using a sentence containing a stranded preposition. Half of these pictures were new and half were the same ones that each participant saw in the pre-test. Additionally, part 1 contained ten filler pictures and three practice pictures, none of which could best be described using a stranded preposition. Part 2 contained 12 sentence fragments (without pictures) which could all be completed using a stranded preposition. The structure of the part 2 target sentences differed from those in the main task: instead of a relative clause, the sentences contained an infinitive complement clause containing a stranded preposition (as in sentence 6). Six of the target sentences contained objects (nouns) from the pre- or post-test (e.g., *the pencil was too blunt to write with*), and six contained new objects (nouns) (e.g., *the road was too narrow to drive on*). Thus, part 2 of the delayed post-test was designed to assess the extent to which priming effects would

transfer to a slightly different sentential context than that used in the treatment phase. Additionally, there were eleven filler sentence fragments involving the same infinitive complement structure but not requiring a stranded preposition. Only the experimental group did the delayed post-test on the basis that the control group did not receive the priming treatment.

4.3.3.5 Sentence recognition test

Participants were presented with five test prime sentences from the main experiment, and five *modified* test prime sentences from the main experiment that did not include a stranded preposition (e.g., 16). The accompanying pictures were not presented so that participants were encouraged to make *linguistic* judgments rather than rely *solely* on visual and semantic memory. Participants were also presented with two *original* filler prime sentences and two *modified* filler sentences from the main experiment, and two *new* filler sentences. Thus, in all, there were 16 sentences, which were pseudo-randomly ordered such that only once did two same sentence type appear consecutively in the list. Two counterbalanced lists were created so that half the participants saw the modified version of a prime sentence (without the stranded preposition) (e.g., 16), and the other half saw the original version of a prime sentence (e.g., 17). Sentences were presented in the same order to all participants. Also, to somewhat control for the possibility that participants might have been gradually reminded of the significance of the target structure (either consciously or unconsciously) as they progressed through part 3, slightly more fillers, and fewer primes and modified primes, were presented earlier in the list than later: four primes and modified primes were presented in the first ten items, and six were presented in the last ten items.

16. *A seesaw is something children ride.*
17. *A seesaw is something children play on.*

4.3.4 Procedure

Participants were run individually in a quiet room. They were seated in front of a laptop computer and progressed through the PowerPoint slides by pressing the 'enter' key on the keyboard. Their target production and prime sentence repetitions were digitally recorded on a separate device. See Appendices 4.2 and 4.3 for participant instructions.

In the pre-test, participants were first given instructions and shown what to do, and had time to practice in the presence of the researcher, after which they completed the pre-test by themselves. After participants had completed the pre-test, which took 3 to 5 minutes, they reported to the researcher who then started them on the treatment phase. In the treatment phase, all prime sentences were presented visually and aurally, the target sentence starters were presented only visually, while the name (noun) for each target picture object was also presented aurally. On each treatment phase trial, participants listened to and read each prime sentence and then immediately repeated it out loud. They described the target pictures by completing the sentence starter using the first appropriate sentence that came to mind (c.f. Hartsuiker & Westenberg, 2000). Participants first practised in the presence of the researcher who then left the room for the remainder of the session. After participants had finished the treatment phase, they received further instructions on the computer and continued through the third and fourth phases – the spacer task and post-test – on their own. Immediately after completing the main task, participants were asked a few questions to probe their subjective experiences during the tasks (see Appendix 3.5 [Chapter 3] for the sorts of questions they were asked). The whole session took between 14 and 24 minutes for the experimental group participants to complete and 14 and 21 minutes for the control group participants. The delayed post-test and sentence recognition test, which was administered one week later, took 10 to 12 minutes for participants to complete.

4.3.5 Scoring

Participants' stage of acquisition of English meant that, while many of their responses were well-formed and/or communicatively and semantically appropriate, some of their responses were lexically or grammatically inappropriate. In principle, responses which

included a stranded preposition were coded as such and included in the analysis regardless of whether the preposition was correct or semantically appropriate or not (e.g., 18) or the presence of other semantic or grammatical errors (e.g., 19 and 20) elsewhere in the utterance. Sentences with stranded prepositions which were followed by a full clause (e.g., 21 to 23) were also included. Four participants in the experimental group and five in the control group ended several utterances with *inside* in contexts which could be construed as requiring a preposition (e.g., 24). Depending on context, *inside* can be considered a preposition, noun, adjective or adverb. Given this uncertainty about its word category, utterances ending with *inside* were not counted as stranded prepositions and therefore not included in the analysis.

18. A bag is something you take with

19. Axe is something for cut some wood use with

20. A nest is something the bird live in

21. A tent is something you can live in when you are outside

22. A pillow is something in the bed that you want to sleep in you must use it

23. Bench is something you sit on often in park

24. A rubbish bin is something you throw rubbish inside

A response was coded as a null prep if an obligatory preposition was omitted (e.g., 25)

25. Chair is something you have a good rest

All other responses were coded as 'other' in the analysis. 'Other' responses included: zero responses (timeouts); incomplete utterances; utterances containing the verb *use* and sentences which did not strictly incorporate the sentence starter for the target and therefore which obviated the need for a preposition; sentences containing an object pronoun following the preposition; resumptive object pronouns, as well as a range of other grammatical and ungrammatical sentences not requiring a stranded preposition (e.g., see 26-33).

26. Mug is something I use to drink

27. Paintbrush is something you use for painting

28. A spoon is something I use it to eat

29. A pillow is something you sleep on it

30. Rubbish bin is something to take the rubbish

31. A drill is something you build into the wall

32. Nest is some is the place where the birds stay

33. A fishing rod is something you bring with you when you go fishing

4.4 Results

The primary data consisted of the proportion of stranded preposition and null prep sentences produced by participants in the pre-test, post-test and treatment phase. The main statistical analyses treated 'test' (pre-test, priming, post-test, and where applicable delayed post-test) as a within-subjects variable on both subjects (reported as F_1) and item analyses (reported as F_2), and 'group' (experimental and control) as a between-subjects variable on subjects analyses and a within-subjects variable on item analyses. Participants' responses to the post-task questions revealed that none of them detected the purpose of the main experiment. Instead, when asked what they thought of the experiment and what they had learned while taking part, most participants said things like they had "learned how to describe objects", or they had "learned the English names of particular objects", which some participants had reported were characteristically "Australian" (e.g., a boomerang [filler]). No experimental group participants reported noticing the stranded prepositions in the prime sentences. The results are summarised in Table 4.2.

*Table 4.2. Data summary for % suppliance (standard deviations in brackets) of stranded prepositions, null preps and other responses for experimental (Exp.) and control (Contr.) groups in all phases of the experiment (The control group did not take part in the delayed post-test.) * total suppliance does not add to 100 due to rounding error.*

Test	Pre-test		Priming		Post-test		Delayed post-test	
Group	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.	Exp.	
							Part 1	Part 2
Stranded prepositions	9 (11)	9 (12)	40 (27)	6 (10)	33 (29)	7 (15)	24 (20)	11 (18)
Null prep.	24 (24)	41 (27)	26 (22)	41 (24)	19 (23)	44 (32)	26 (20)	46 (30)
Other	67 (29)	49 (23)	34 (22)	51 (21)	48 (31)	47 (31)	50 (32)	40 (17)

4.4.1 Production of stranded prepositions

As expected, the experimental and control groups both produced similarly low baseline amounts of stranded prepositions in the pre-test: on 9% of items for both groups (F value < 1 in a one-way ANOVA). Overall however, when each group's production of stranded prepositions was compared across the pre-test, treatment phase and post-test, the two groups performed very differently (see Figure 4.3). Hypotheses 2 and 3 were therefore supported: the experimental group produced many more stranded prepositions in the treatment phase (40%) and post-test (33%) than in the pre-test. In contrast, the control group's stranded preposition production remained at baseline levels in the treatment phase (6%) and post-test (7%). When the groups' performances in the treatment phase were statistically compared, a clear and significant difference emerged ($F_1[1,36] = 24.11$, $p < 0.001$; $F_2[1,23] = 154.06$, $p < 0.001$, Cohen's d = 1.63) reflecting the fact that the experimental group received the priming treatment while the control

group did not. When the groups' performances on the pre- and post-tests were statistically compared, there was a significant main effect of test ($F_1[1,36] = 12.85$, $p < 0.001$, $\eta^2 = 0.26$; $F_2[1,11] = 29.82$, $p < 0.001$, $\eta^2 = 0.73$) and group ($F_1[1,36] = 6.23$, $p = 0.017$ $\eta^2 = 0.15$; $F_2[1,11] = 27.61$, $p < 0.001$, $\eta^2 = 0.71$), and importantly, a significant interaction between group and test ($F_1[1,36] = 16.18$, $p < 0.001$, $\eta^2 = 0.31$; $F_2[1,11] = 47.99$, $p < 0.001$, $\eta^2 = 0.81$), indicating that the experimental group increased its production of stranded prepositions in the post-test but the control group did not.
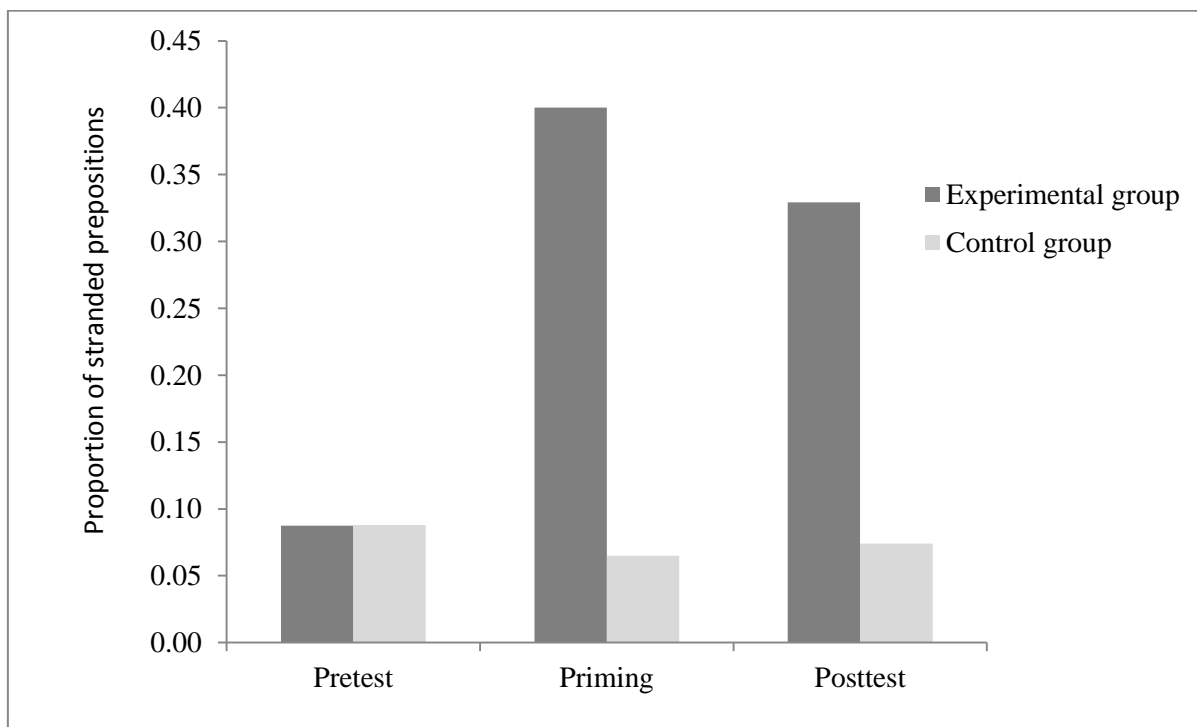

Figure 4.3. Production of stranded prepositions by experimental and control groups as a function of test (proportion of target pictures)

4.4.2 Production of null preps

Hypothesis 1 stated that participants would produce null preps before the priming session and this was supported, although there was a significant difference between the two groups at baseline ($t[36] = 2.06$, $p = 0.046$, Cohen's d $= 0.67$). Hypothesis 4 stated that experimental group would produce fewer null preps after priming than before. At first glance this hypothesis also appears to have been supported: the control group actually produced slightly *more* null preps in the post-test than in the pre-test, and the

experimental group produced *fewer* null preps (see Figure 4.4). In order to investigate this apparent difference, the groups were compared statistically across pre- and post-tests. There was a non-significant interaction between group and test on an analysis by subjects ($F_1[1,36] = 1.28$, $p = 0.26$) , and only a marginally significant interaction on an analysis by items ($F_2[1,11] = 4.56$, $p = 0.056$, $\eta^2 = 0.29$). A comparison of experimental group's pre- and post-test null prep production revealed no statistically significant difference ($t[19] = 1.11$, $p = 0.28$), in contrast to group differences in stranded preposition production as a function of the priming treatment.
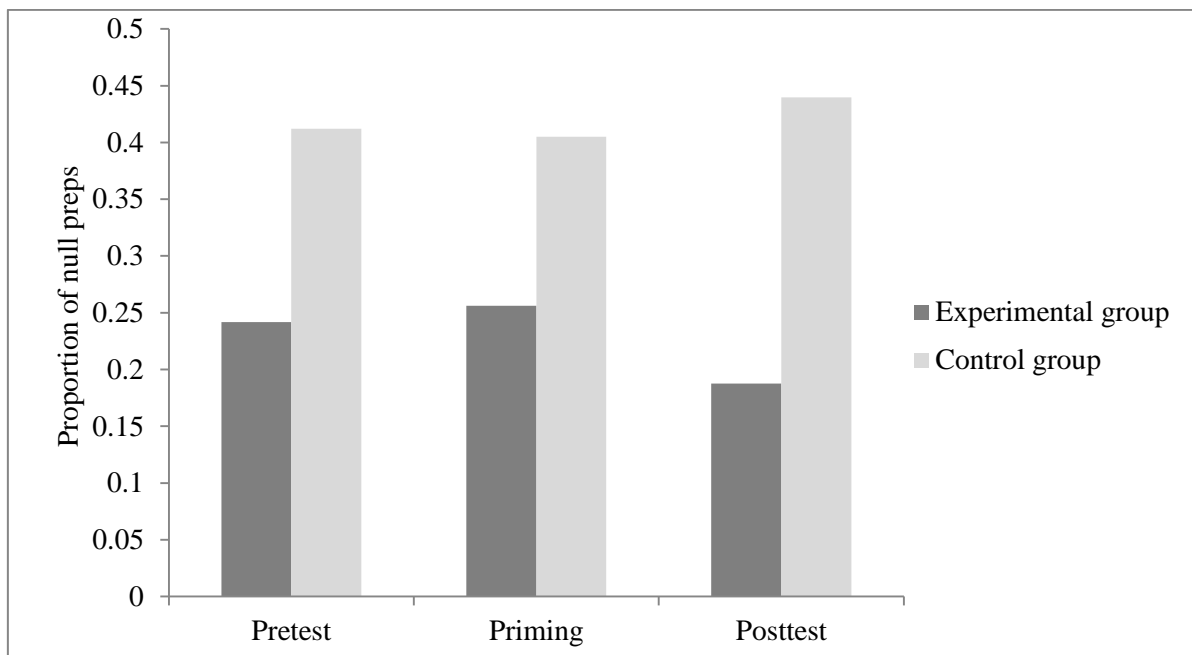

Figure 4.4. Production of null preps by experimental and control groups as a function of test (proportion of target pictures)

4.4.3 Effect of preposition overlap on priming

Earlier I posed the question of what influence preposition overlap between prime and target would have on priming. In order to investigate this influence, I made a comparison between the behaviour of the experimental group when the prime and target shared the same preposition and when they contained different prepositions. In this analysis, participants' *actual* target responses clouded the issue somewhat because participants did not always produce the expected target preposition (and target sentence) when describing the target picture, even when producing a well-formed sentence

containing a stranded preposition. For example, after the prime sentence *soap is something you wash yourself with*, one participant produced a sentence containing a different stranded preposition (*axe is something you hit on*) rather than repeating the expected preposition *with* in the target sentence (*an axe is something you cut wood with*). Given this behaviour, participants' actual sentence production, rather than their expected target production, was used in measuring their tendency to repeat or not repeat prime prepositions. The analysis revealed that during the treatment phase, the experimental group produced sentences containing the same preposition as in the prime sentence on 23% of trials, and sentences containing a different preposition than in the prime sentence on 17% of trials. In a paired samples t-test (one-tailed) this difference was found to be statistically non-significant (t[19] = 1.59, p = 0.258) indicating that preposition overlap did not significantly affect priming.

This experiment focussed on investigating learning through priming, as evidenced in temporally durable priming effects emerging in a post-test. Therefore, it was also important to determine whether preposition overlap in the treatment phase influenced the durability of priming effects. One way to measure the temporal durability of priming effects over the short-term was to examine the difference in stranded preposition production between the pre- and post-tests by subtracting pre-test scores from post-test scores and arriving at a derived variable, which I named "priming strength", reflecting strength of the learning effect associated with the priming in the treatment phase. Priming strength was then correlated with two other measures: the proportion of targets produced in the treatment phase containing the *same* preposition as in the prime, and the proportion of targets produced containing a *different* preposition than in the prime. Figure 4.5 displays both correlations. I assumed that preposition overlap would either enhance long-term priming effects slightly, or have no effect, and so I conducted a one-tailed correlation. Since it was not known a priori whether the relationships in each case would be linear or not and since I had to contend with the occurrence of several tied scores, a one-tailed Kendal tau-b rank order correlation was performed. Significant correlations emerged between same-preposition production and priming strength (*tau-b* = 0.410, N = 20, p = 0.008) and different-preposition production and priming strength (*tau-b* = 0.438, N = 20, p = 0.006). Thus, overlap of prepositions between primes and targets did not influence priming strength or the short-term temporal durability of the priming effect.
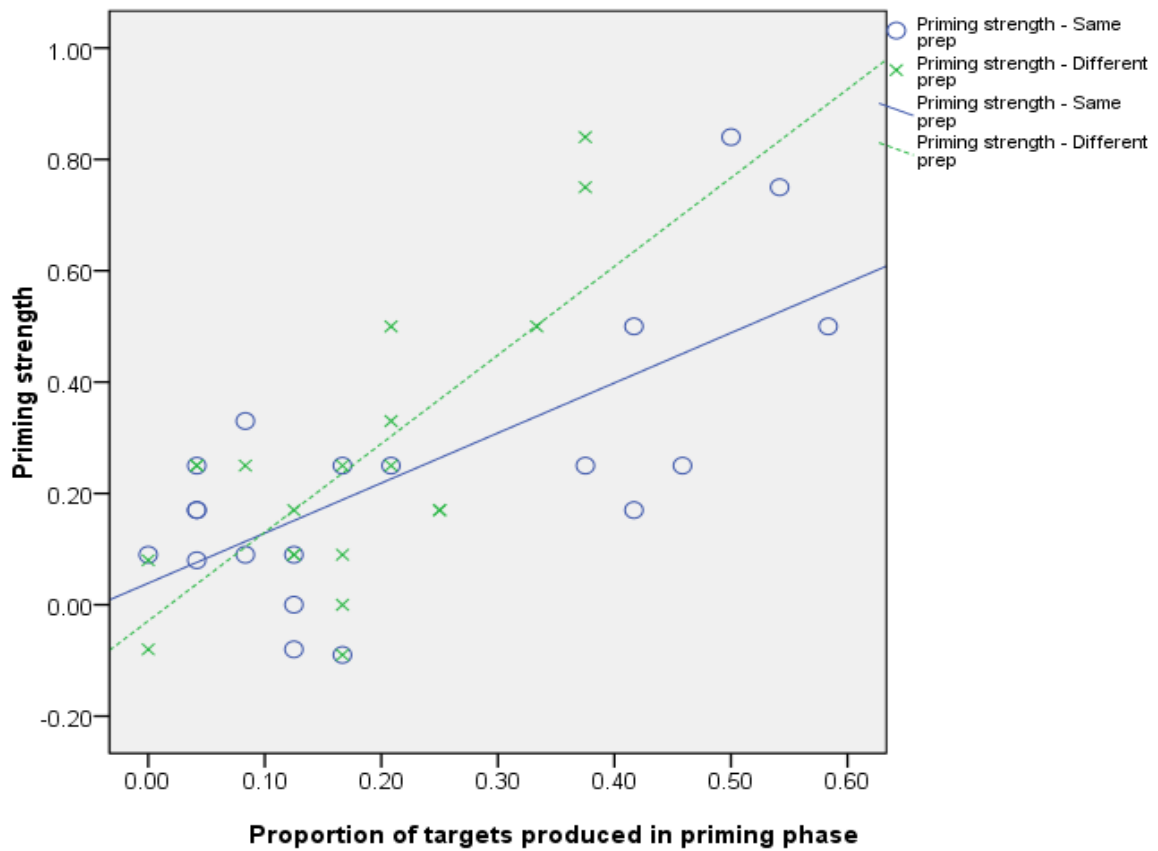
Figure 4.5. Correlation of priming strength with production of targets with same and different prepositions

4.4.4 Delayed post-test

4.4.4.1 Production of stranded prepositions

One week after completing the main task, twelve experimental group participants were invited to take part in the delayed post-test and seven accepted this invitation. The decision to invite only a sub-group of experimental group participants was made out of difficulty in scheduling these extra sessions and having to rely on participants' availability. The data from one participant in part 1 of the delayed post-test was missing due to a technical error in recording. The seven participants who took part were comparable to those experimental group participants who did *not* take part (N = 13): mean stranded preposition production rates for participants and non-participants on the

pre-test (7% and 10% respectively), treatment phase (40% and 41% respectively) and immediate post-test (40% and 31% respectively) were comparable (all F values < 1). These seven participants still produced stranded prepositions in response to 24% of the pictures in part 1 and used stranded prepositions when orally completing 11% of the sentences in part 2.

The relatively small number of participants who took part in the delayed post-test meant that a full statistical analysis of this data was impractical. Nevertheless, the data affords a tentative insight into possible long-term priming effects. Figure 4.6 shows the proportions of stranded prepositions produced by the seven participants in the delayed post-tests (part 1 and 2) and for comparison, the production of stranded prepositions by the entire experimental group in the pre-test, treatment phase, and post-test.

4.4.4.2 Production of null preps

Figure 4.7 shows the proportions of null preps produced by the seven participants in the delayed post-tests and for comparison, the production of null preps by the entire experimental group in the pre-test, treatment phase, and post-test. Once again, full statistical analyses were impractical, but a trend towards increased production relative to the main task was observed. Participants produced null preps in part 1 of the delayed post-test (26%) at virtually the same rate as all experimental group participants did in the pre-test (24%). In part 2 their production rate was even higher than in the pre-test (46% vs. 24%).

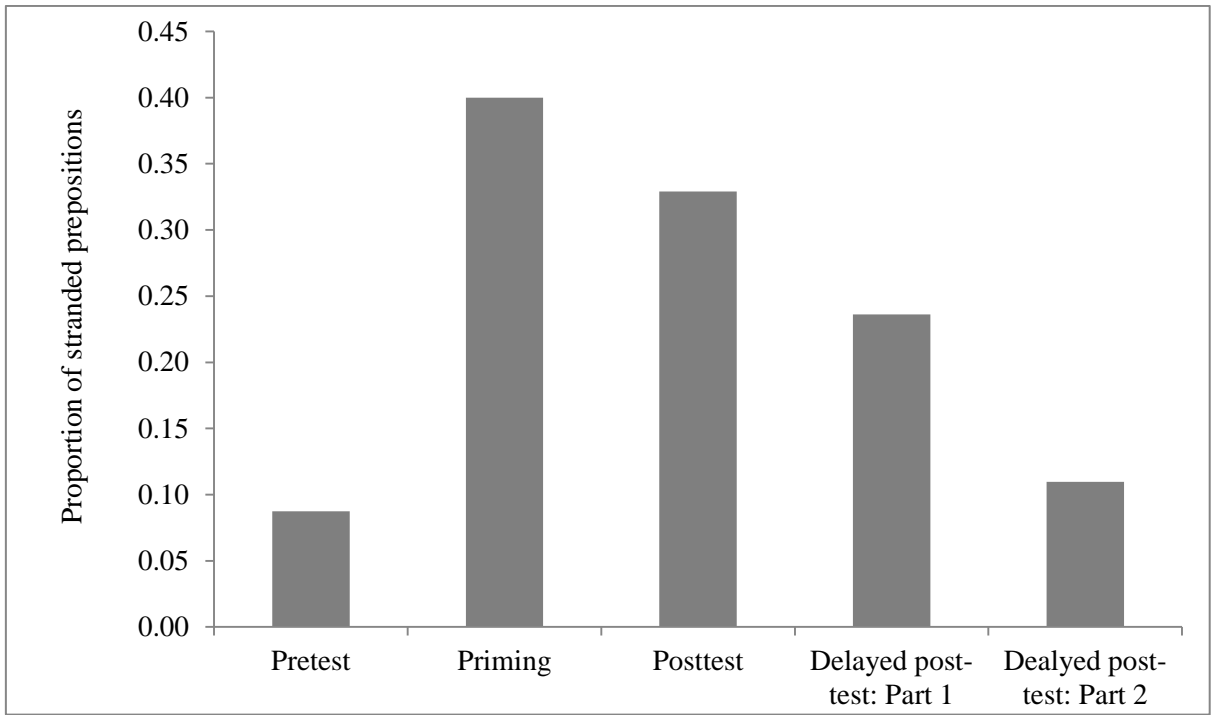*Figure 4.6. Production of stranded prepositions by experimental group as a function of test (proportion of target pictures)*
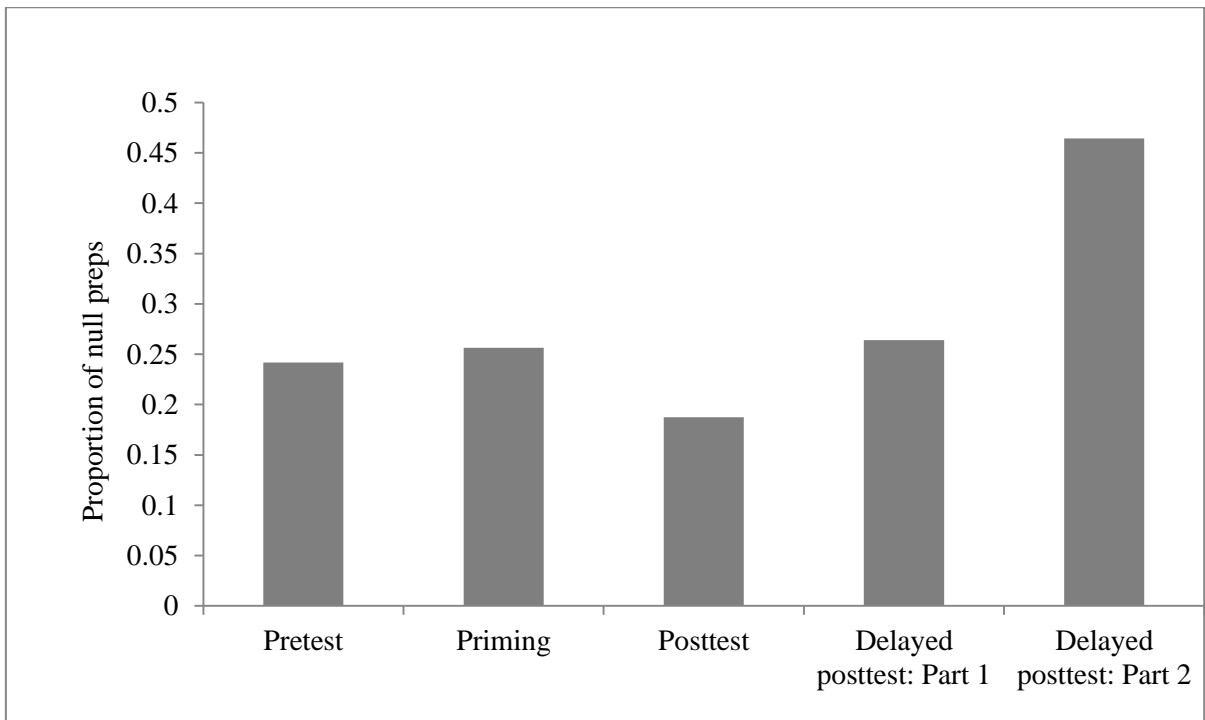

Figure 4.7. Production of null preps by experimental group as a function of test (proportion of target pictures)

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Finally, an analysis of the data from the sentence recognition test in the delayed post-test revealed that participants appeared not to have retained conscious awareness of the stranded preposition structure from the main task. Prior to analysis, the data from one participant was excluded because she appeared to not properly engage with the task choosing 'no' for 14 of the 16 items, including for the last seven items and behaving as if she was not making a considered judgment. None of the six other participants correctly rejected all of the five modified primes on a recognition test (mean rejection 1.67 out of 5). Put another way, participants incorrectly reported earlier experiencing the modified primes, none of which contained a stranded preposition but all retained the original semantic information. On the other hand, when it came to *accepting* the original (unmodified) prime sentences, participants performed quite well: two participants correctly accepted all five items; one accepted four; one accepted three; and two accepted two. The mean acceptance for unmodified primes was 3.5. By comparison, their mean correct acceptance or rejection of the six filler items, some of which were new items, was 2.33. In sum, participants scored well on the primes, poorly on the modified primes and just slightly worse than chance on the fillers indicating a general reliance on memory of the content rather than the form of the sentences in the experiment and supporting the conclusion that participants had not noticed the purpose of the task.

4.5 Discussion

To summarise, Hypothesis 1 was supported: all participants produced significant numbers of null preps before the priming intervention. This finding confirms the findings of previous studies of null prep and stranded preposition production by L2 speakers (Bardovi-Harlig, 1987; Hokari & Wakabayashi, 2009; Kao, 2001; Klein, 1995, 2001; Sadighi, et al., 2004). As demonstrated in these earlier studies, the speakers in the current experiment also clearly considered null prep constructions to be grammatical within their own interlanguages. Hypotheses 2 and 3 were also supported: during the treatment phase the experimental group produced more stranded prepositions than the control group; and the experimental group produced more stranded prepositions in the post-test compared to the pre-test while the control group's production remained at

baseline levels. Hypothesis 4 was not supported: the experimental group did not produce significantly fewer null preps in the post-test compared to the pre-test. I interpret this finding below.

Overall, the findings indicate that priming can result in implicit learning of L2 syntax. This conclusion is true in the short-term with a large and significant priming effect in the treatment phase, and a large and significant improvement in stranded preposition production between the pre- and post-tests for the experimental group compared to the control group. The conclusion is possibly also true in the long-term with a continued, albeit smaller improvement in the delayed post-test over the pre-test. Although only seven experimental group participants took part in the delayed post-test, one week after priming they still produced stranded prepositions in relative clauses at almost three times their production rate in the pre-test, and in infinitive complement clauses at a rate 31% higher than their production in relative clauses in the pre-test. Therefore, Hypothesis 5 appeared to be partially supported. These findings are consistent with the findings of Shin and Christianson (2012) of syntax learning by L2 English speakers one day after a 40 minute priming task. In the most similar condition in that study (the "no lag" condition), speakers started at low baseline levels of production of the two target structures - datives and phrasal verbs (3% and 12% respectively) and improved in the post-test to produce 56% and 80% of the two target structures respectively. The findings here are also comparable to previous findings of long-term structural priming in young L1 English-speaking children on two counts: first, that priming effects can occur for a structure which speakers do not normally produce; and second, that implicit learning effects tend to fade in the absence of reinforcement (Savage et. al., 2006). Future L2 research might also investigate the effect of reinforcement on implicit learning after an initial structural priming treatment. Overall, the findings of relatively large and persistent structural priming effects for a structure which L2 learners do not normally produce thus support the implicit learning account of structural priming, and are consistent with claims in the L1 literature that priming effects are stronger for less frequent structures (Bock & Griffin, 2000; Ferreira & Bock, 2006; Hartsuiker & Kolk, 1998; Hartsuiker & Westenberg, 2000) and in speakers with developing language systems (see Branigan, 2007).

Structural priming effects are known to be independent of semantic, pragmatic and phonological information in the stimuli. In the present study, this assumption was reflected in the apparent learning of L2 structure in a repetitive task in the face of significant lexical/semantic dissimilarities between the primes and targets in the treatment phase, and between the pre- and post-test items. In addition, findings from several L1 structural priming studies have demonstrated that the repetition of closed-class words (e.g., prepositions) between primes and targets is not necessary for priming to occur (Bock, 1986, 1989; Traxler, 2008). Consistent with this finding, Experiment 2 also demonstrated that preposition overlap between the primes and targets in the treatment phase had no effect on the overall strength of priming. It did not matter whether participants tended to repeat the preposition contained in a prime sentence in their target utterance, or whether they used a different preposition in their target utterance: participants who did either produced equally high numbers of stranded prepositions in the post-test relative to the pre-test here. One pedagogical implication of this observation is that repetitive learning activities such structural priming tasks need not rely on lexical repetition to ensure the acquisition of L2 syntax. Such an approach to repetitive learning tasks is reminiscent of grammatical substitution drills, in which learners acquire or practice a grammatical structure by substituting different lexical items into a single grammatical frame in an iterative fashion. Could structural priming be the underlying basis for learning in such drills? Future pedagogically-focussed research might investigate this question, perhaps by carefully controlling for learners' conscious awareness in substitution drills. I return to this issue in section 6.4, Chapter 6.

Another outcome of the present study was the lack of an effect of the priming treatment on the production of null preps. This finding attests to the resilience of null prep as a stable and reliable interlanguage feature. Even after speakers' interlanguages had been readjusted through priming to induce their production of stranded prepositions, a proportionate drop in null prep production did not occur in either the immediate post-test or the delayed post-test. The experimental group's continued production of null preps in the treatment phase at virtually the same rate as in the pre-test also suggests that the null prep interlanguage feature is relatively resistant to change, even as speakers begin to produce the target construction. This pattern of results is consistent with the findings of Bardovi-Harlig (1987) who reported that even groups of advanced learners who had begun to produce target stranded prepositions continued to produce null preps.

Gradual adjustments to speakers' interlanguages is also consistent with Carroll's (2007) view of L2 development. According to this view mental representations associated with structural features will usually change incrementally and gradually rather than suddenly and all at once.

The combined results for null prep and stranded preposition production suggest that even as learners acquire a target language feature (and representation) they can still retain an associated interlanguage representation, using both in parallel in L2 production. Thus, it seems that under certain conditions L2 learners are slow to discard their interlanguage grammatical representations even after they have implicitly acquired the complementary target language feature. First, the findings here appear to be consistent with some reports of variable L1 acquisition of syntax whereby children retain two competing syntactic representations, one target-like and one non-target-like, for extended periods (Anderson, 2005). Second, the above interpretation is consistent with Sharwood-Smith and Truscott's (2005) and Truscott & Sharwood-Smith's (2004) view of L2 acquisition in which they posit that learners can simultaneously maintain and use competing grammatical representations in their developing interlanguage. Specifically, they claim that:

> Learners seem, sometimes for long periods, to entertain alternative structural solutions while trying to make sense of the language to which they are exposed: a new solution does not force the extinction of an old one in a straightforward manner (Sharwood-Smith & Truscott, 2005, p. 221).

Sharwood-Smith and Truscott argue that, at this point in acquisition, learner interlanguage is characterised as having some "optionality" in that they are free to choose from one or more representations and that "learners appear to simultaneously maintain two competing sets of grammatical characteristics, as if they were in two different stages at the same time" (Sharwood-Smith & Truscott, 2005, p. 225), and that "there will be extended periods when alternative systems exist side by side" (Sharwood-Smith & Truscott, 2005, p. 237). Chapter 6 (section 6.3.4) contains a further discussion of Sharwood-Smith and Truscott's framework.

This interpretation of variation in interlanguage also appears to be broadly consistent with some earlier views about interlanguage development (e.g., R. Ellis, 1985, 1989, 1999). R. Ellis argued that in the course of SLA "new devices are not integrated into the learner's interlanguage system but instead are simply attached, loosely and additively, to an existing form-function mapping" (R. Ellis, 1999, p.469). R. Ellis described this behaviour in terms of "free variation", which is the variation in target language performance within a speaker at a particular point in time, and can be thought of as "variability that could not be attributed to any known linguistic, situational, or psychological factor" (Verspoor, Lowie & Van Dijk, 2008, p. 216). According to Selinker (1972) interlanguage has several key characteristics. It is: permeable; dynamic and constantly changing; and systematic and rule-based. I suggest that while interlanguage is rule-based and systematic, it might not always be permeable or dynamic. Rather, interlanguage, or certain aspects of it, might be relatively impermeable and static, at least in implicit learning contexts. Instead, what might occur is that learners acquire a target language form and simultaneously hold on to their interlanguage form at the same time. Therefore, competing interlanguage and target language representations in the mind of a speaker and subsequent performance can *co-exist*, not just at the moment of acquisition of a rule, but possibly for extended periods after such acquisition.

What might cause free variation or optionality in interlanguage? I propose that the free variation I observed in relation to null prep and stranded preposition production might be a function of different memory processes in SLA. According to Tarone (1979, 1985), interlanguage variability within individual speakers is partially determined by their level of attention to form. Tarone (1985) found that learners' accuracy was lower when they paid attention to form than when they did not. This conception of variability would not be incompatible with my findings. This view hinges on the implicitness of priming. According to this view speakers produced stranded prepositions through an implicit mechanism activating procedural memory systems and with little (or any) conscious awareness, active reflection and control of their production. At the same time however, speakers continued to produce null preps, possibly with some controlled monitoring of their production, reflecting on the well-formedness of their utterances using their existing interlanguage rule. Some evidence for this position comes from the observation that, during the treatment phase, both groups continued to produce null preps at roughly

baseline levels and it was only *after* priming, in the post-test, that the experimental group reduced its production of null preps somewhat. I attribute this small reduction to a partial conscious restructuring of their production. This position would also be consistent with Krashen's (1981) Monitor Model in which speakers draw not only on their "acquired" knowledge located in procedural memory, but also actively monitor and adjust their language production using explicit knowledge about the language.

A somewhat radical corollary of the interpretation of my findings is that structural priming engages a completely separate memory system in the learner than that responsible for the storage of his/her interlanguage rules. Selinker (1972), in his seminal paper introducing the concept of interlanguage, acknowledged that most (95%) of second language learners are relatively unsuccessful and argued that the notion of interlanguage is only relevant to these unsuccessful learners: the remaining 5% of learners go through a different process of acquisition. This observation raises the possibility that learners *need not* go through the usual interlanguage processes to acquire a target language and that these usual processes can be circumvented through the activation of a separate system. I suggest that one of these alternative pathways to acquisition might be via a priming mechanism. Indeed, this view of separate systems is reminiscent of Krashen's (1981) distinction between implicit acquisition and explicit learning. While my account is purely speculative at this stage, it would also be consistent with a dissociation between explicit and implicit learning processes and the role of declarative and procedural memory in SLA (Ullman, 2005; Paradis, 2009). According to Paradis (2009) declarative and procedural components of memory are distinct and do not interact in second language acquisition. Schmidt (1995) also reviewed the literature on attention and awareness in SLA and concluded that there is general consensus for the existence of two distinct forms of SLA: explicit and implicit. It is possible then that the free variation (or dissociation) between null prep and stranded preposition production which was observed in this experiment reflect these different systems: one representation stored in a relatively more procedural component of memory and one in a relatively more declarative component. Future research in L2 structural priming might shed light on these possibilities.

4.6 Conclusion

Experiment showed that stranded prepositions can be primed in L2 learners and that this priming appears to have contributed to a learning effect. However, while stranded preposition production increased, null prep production did not decrease significantly either during the priming treatment session or shortly afterwards. These findings point to the stability of L2 interlanguage representations.

Chapter 5

Experiment 3: These prepositions were too strange to end a sentence with

5.1 Introduction

A strong, reliable and relatively durable priming effect for the stranded preposition structure was demonstrated in Experiment 2 (Chapter 4). That finding suggests that L2 speakers can acquire and learn to produce this structure through structural priming. However, while speakers in that experiment were primed to produce more stranded prepositions in relative clauses in the priming phase, immediate post-test and delayed post-test compared to a pre-test, these effects did not appear to fully generalise to a different sentential context. In the delayed post-test in that experiment speakers produced fewer stranded prepositions in a different sentential context – infinitive complement clauses – than in relative clauses. Although no *baseline* data was collected in Experiment 2 for speakers' stranded preposition production in infinitive complement clauses, and relatively few speakers took part in the delayed post-test in Experiment 2, this tentative finding of different priming effects for different sentence contexts suggests that priming effects for a structure might be modulated by the global sentential context.

In order to confirm that structural priming can indeed lead to stranded preposition acquisition, and to further investigate this apparent effect of sentential context on structural priming, a second priming experiment was conducted. While in Experiment 2 stranded prepositions were primed in the context of a relative clause (e.g., 1), in Experiment 3 the structural context was an infinitive complement clause (e.g., 2). Thus, as well as both containing a stranded preposition, the target sentences in Experiment 3 and Experiment 2 were also very similar lexically, and to some extent also semantically. These similarities would make comparisons between the outcomes of Experiments 2 and 3 relatively straightforward.

(1) A bed is something you sleep on

(2) The bed was too uncomfortable to sleep on

5.1.1 English tough movement

In addition to involving an infinitive complement clause, the stranded preposition structure in Experiment 3 also included a syntactic feature known in English as tough movement (TM). This movement feature involves object-to-subject raising (e.g., 2 and 4) and typically occurs with tough adjectives such as *difficult* or *easy*. They can be compared to sentences involving subject-to-subject raising such as (3), which are superficially similar but quite different at a deeper structural level.

(3) John is eager to please

(4) John is easy to please

The choice of a TM structure containing an infinitive complement clause for the priming structure in Experiment 3 also allows for the investigation of a known phenomenon in L2 English interlanguage development: the difficulty for Chinese L1 speaking learners of English in acquiring TM constructions (Yip, 1995). Faced with the presence of TM in English, Yip argues that Chinese L2 English speakers frequently resort to an erroneous passivisation strategy instead of producing the target TM and tend to produce sentences such as (5) (taken from Yip, 1995, p. 159).

(5) The instrument is easy to be performed (Chinese speaker interlanguage utterance)

(6) The instrument is easy to perform [on] (target form)

Yip (1995) attributes this strategy to a transfer of procedures from speakers' L1. Yip claims that Chinese learners of English have difficulty with English TM in both comprehension and production, and consistently misapply TM to subjects but not objects in complement clauses, resulting in sentences like *I am very easy to forget* (target: *I forget very easily*). For objects in complement clauses, Chinese speakers are apparently reluctant to use a TM structure, but instead, as Yip claims, prefer to use a pseudo-passive as in (5) instead of the target structure (6).

TM is not only difficult for Chinese speakers but is acknowledged as difficult for other ESL learners, even those whose L1 has an equivalent TM to English (e.g., French) (Yip, 1995). These claims about Chinese learners of English are particularly relevant here: recall that 28 of 38 participants in Experiment 2 had Chinese L1s. In the experiment described in this chapter, 31 of 33 participants also had Chinese L1s (see section 5.3.2 below).

Yip (1995) presented data from a grammaticality judgement task to show that Chinese speakers either do not accept TM sentences (e.g., *the evidence is not easy to find*) as grammatical, or wrongly interpret TM sentences as involving subject raising. According to Yip, this means that a Chinese speaker would typically interpret (7) as meaning *he has difficulty seeing* rather than the correct interpretation *it is difficult to see him*.

> (7) He is difficult to see

Yip argues that this is evidence that Chinese L1 speakers of English, even at advanced levels of proficiency, have generally not acquired TM as part of their interlanguage development. Pointing to the possibility that L1 influence is not the only factor, Yip (1995) argues that subject raising is universally preferred over object raising, such that English sentences like (3) are preferred, or easier to understand and produce, over sentences like (4). This applies to L2 speakers as well as L1 speakers. It would thus be unsurprising if L2 speakers from other L1 backgrounds also had difficulty with TM.

English TM is also difficult for German L1 learners of ESL, and has been found in corpus analysis to be under-represented in learner language. According to Legenhausen and Rohdenburg (1995, p. 138, cited in Callies, 2008, p. 36) English TM is relatively complex, cognitively demanding and therefore difficult for ESL learners to acquire:

> When compared with their bi-clausal variants, *tough*-movement constructions exhibit a larger distance between form and function, since the grammatical subject is not the logical or semantic subject of these sentences. Consequently, *tough*-movement sentences are functionally and semantically more complex, less transparent and less explicit, cause more cognitive cost and require more

processing time for the recipient in terms of the analysability and decoding of
the form-function relation.

More generally, Callies (2008) argued that English raising structures, both subject-to-subject raising as in (3) and object-to-subject raising (TM) as in (4), are problematic for L2 learners to acquire. Callies argued for this position from two overlapping perspectives. First, English raised structures are typologically marked and therefore, according to Eckman's (1977) (1977) Markedness Differential Hypothesis more difficult for L2 learners to acquire. Second, in so far as in TM the thematic object of the complement clause is raised to subject position in the matrix clause, TM is relatively semantically opaque with a 'loose-fit' between form and function. These two factors contribute to the overall difficulty of acquisition of raising structures, and in particular difficulty in the acquisition (and comprehension) of TM.

TM is also widely acknowledged as presenting difficulty in L1 acquisition (e.g., Anderson, 2005; Byrne, 1981; Chomsky, 1969). For example, Chomsky (1969) found that children often initially incorrectly think that, in a sentence such as 3, *John* is the one who does the pleasing (i.e., the subject of the complement verb *please*), when in fact *John* is the object of *please*. It is only later, as children develop, that they start to interpret TM sentences correctly.

Other researchers however, have argued that TM is not especially difficult for learners, even those from Chinese L1 backgrounds. Ren (2009) found that TM sentences are no more difficult for Chinese L2 speakers of English to interpret than other similarly structurally complex English sentences. Bongaerts (1983) also reported that Dutch ESL learners had little difficulty with TM. On balance however, the comprehensive evidence presented by Yip (1995) together with the more limited evidence presented by Callies (2008) in relation to L2 speakers, plus the well-documented difficulty of TM for English-speaking children in L1 acquisition (e.g., Anderson, 2005; Byrne, 1981; Chomsky, 1969), suggests that TM should be dificult for L2 learners.

In sum, L2 speakers, and Chinese speakers in particular, should experience difficulty with infinitive complement clauses involving a stranded preposition such as in 4, not only with the stranded preposition feature, but also with the TM involved in the sentence. In Experiment 2, a difficulty with preposition stranding (as evidenced for example in a production preference for null prep) was investigated in the context of movement within a relative clause structure. Here it

is within the context of TM. Thus, a comparison of the findings of Experiments 2 and 3 can shed light on the effect of sentential context on structural priming in particular, and of interlanguage processes in general. These two experiments also potentially shed light on the importance of underlying structural relationships on priming, for while sentences such as 1 and 2 share some surface similarity, they differ in the underlying syntactic relations. However, given the robust priming effects found for relative clauses in Experiment 2, similar effects should be expected in Experiment 3 for infinitive complement clauses.

In Experiment 2, preposition overlap between prime and target was manipulated. It was found that the repetition of the same preposition between prime and target had no significant effect on the strength of the priming effect, backing up the findings of previous L1 structural priming studies of English datives (Bock, 1986b, 1989; Traxler, 2008). Since repetition of the preposition was found to have no material effect on structural priming, prepositions differed between all prime/target pairs in Experiment 3.

5.2 Hypotheses and research questions

Structural priming effects are thought to operate by some psycholinguists at the level of surface word order (e.g., Hartsuiker, et al., 1999; Loebell & Bock, 2003). If this is true, the fact that target structure for Experiment 3 (e.g., sentence 2 above) is similar in terms of surface structure to the structure used in Experiment 2 (e.g., sentence 1 above), should ensure that the robust priming effects observed for stranded prepositions in Experiment 2 are replicated in Experiment 3; the hypotheses here were similar to those of Experiment 2. However, there is some evidence from cross-linguistic structural priming studies that hierarchical structure is subject to priming. In this regard, Desmet and Declercq (2006) found that the hierarchical relations in relative clauses could be primed across languages in bilingual Dutch/English speakers. This finding suggests that the locus of priming might also lie in the underlying syntactic structure of sentences.

Based on the findings of Experiment 2 regarding null prep production, an additional hypothesis was formulated for speakers' behaviour in the priming treatment (3) , and a new hypothesis was formulated for their behaviour immediately after priming (5). The hypotheses were:

1. In a preliminary test prior to a priming treatment speakers will omit the obligatory stranded preposition in English infinitive complement clauses and produce null prep sentences.

2. During a priming treatment, speakers will be primed to correctly produce stranded prepositions in infinitive complement clauses.

3. During the priming treatment, speakers will continue to produce null preps at the same rate as before priming.

4. Immediately after the priming treatment, speakers will produce more stranded prepositions in infinitive complement clauses than before priming.

5. Immediately after the priming treatment, speakers will continue to produce null preps in infinitive complement clauses at the same rate as before priming.

A delayed post-test was not possible in Experiment 3 due to the unavailability of participants and so the long-term effects of priming could not be investigated (see footnote 1).

5.3 Method

5.3.1 Design

Except for the omission of a delayed post-test, the overall design for Experiment 3 was the same as for Experiment 2, consisting of a pre-test, priming session and post-test.

5.3.2 Participants

As for Experiment 2, all participants were students at the University of New England in Australia. All of them were studying English for academic purposes at the university's English language training centre. Volunteers from three equivalent level English classes were randomly assigned to one of two groups: an experimental (22 speakers) and a control group (18 speakers). Nineteen participants (11 experimental and 8 controls) were taking an English course prior to enrolment in a degree at the university, and twenty one other participants (11 experimental and 10 controls) were undergraduate education students from a Hong Kong university on a six week visit to the Australian university for English language and other study purposes. The data from four experimental group participants, and two control group participants was excluded because they completed the pre-test but not the priming session and post-test. The data from one

additional experimental group participant who completed the entire experiment was excluded from the analysis because she commented that she had noticed the repetition of the stranded preposition, thus compromising the priming treatment.

The remaining participants had the following L1 backgrounds:

Experimental group (N = 17)

- 16 Chinese (5 Mandarin, 11 Cantonese)
- 1 Arabic

Control group (N = 16)

- 15 Chinese (5 Mandarin, 10 Cantonese)
- 1 Arabic

Participants' English language proficiency was assessed as intermediate to advanced level of proficiency: five participants from each group had a recent IELTS score (experimental group mean: 5.5; control group mean: 5.3). All participants from the Hong Kong university had previously studied English throughout their schooling (generally from age 5). All participants had also satisfied the English language training centre's entry requirements for their class level (which was considered equivalent to an IELTS score of 5.5). The experimental group contained 12 females and 5 males (mean age: 22.0 years, SD = 1.9) and the control group contained 12 females and 4 males (mean age: 21.0 years, SD = 1.9).

5.3.3 Materials

See Appendix 5.1 for the experimental test items and Appendix 5.2[12] for participant instructions.

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[12] Note that, as in Experiment 1 (Chapter 3), the experimental group participants in Experiment 3 were also informed via the participant information sheet (see Appendix) that they might be asked to return to take part in a delayed post-test. However, this was not actually done due to the non-availability of participants.

5.3.3.1 Pre- and post-tests

The pre- and post-tests consisted of 12 test pictures, each displaying an object or location, and in some pictures also people (e.g., a wet notepad, a dirty sofa, very cold water, children playing on a frozen pond). Each picture was also accompanied by a sentence starter containing reference to the object or location and a qualifying adjective (e.g., *The notepad was too wet to …*, *The ice wasn't thick enough for the children to …*). Example pre- and post-test pictures are shown in Figure 5.1. Each picture could be described by completing the sentence starter with a sentence containing a stranded preposition (e.g., as in 8, 9 and 10). Each pre-test picture was presented for between six and seven seconds.

(8) The notepad was too wet to write on.

(9) The water was too cold to swim in.

(10) The ice wasn't thick enough for the children to play on.

The pre- and post-test target sentences contained six different prepositions (*on, in, to, through, up, with, along*). One target sentence contained an intervening object noun phrase between the verb and preposition (e.g., *The rubbish bin was too full to put any more rubbish in*), while eleven targets did not. One target sentence contained an intervening adverbial phrase between the adjective and infinitive complement clause (e.g., *The alleyway was too dangerous at night to walk along*), and one target sentence contained an intervening *for* phrase between the adjective and infinitive complement clause (i.e., *The ice was too thin for the children to walk on/play on*).

The items in the pre- and post-tests were ordered so that no more than two consecutive items contained the same preposition, and all items were presented in the same order to all participants. In order that participants' pre- and post-test responses could be compared in a straightforward manner, the pre- and post-test items were matched in several ways. First, all of the target sentences were matched across tests for verbs. However, so that participants did not simply view the post-test as a repetition of the pre-test, and to ensure that participants could therefore not simply repeat their pre-test responses in their post-test responses, nine of the pre- and post-test pairs varied in other ways. Within three pairs the noun (and object) varied (e.g., pre-test item: *The <u>mattress</u> was too uncomfortable to sleep on* vs. post-test item: *The <u>bed</u> was too uncomfortable to sleep on*); within two pairs the adjective (and picture) varied (e.g., pre-test

item: *The water was too <u>cold</u> to swim in* vs. post-test item: *The water was too <u>dirty</u> to swim in*); and within four pairs the adjective and polarity of the target sentence (but not the picture) varied (e.g., pre-test item: *The sofa <u>was too dirty</u> to sit on* vs. post-test item: *The sofa <u>wasn't clean enough</u> to sit on*). Three pre-/post-test pairs were identical. To control for possible order effects, the presentation order of the picture pairs was reversed between the pre and post-tests for each participant. Three additional practice pictures were included at the beginning of the pre-test.

In order to further control for possible item effects, all pre- and post-test items were counterbalanced across participants in the same way as in Experiment 2, such that each participant saw each item in either the pre-test or post-test, but not in both tests. One caveat to this manipulation was that due to the exclusion of the data from several participants the numbers of participants in each order and list condition were uneven and so precise balancing was not possible.
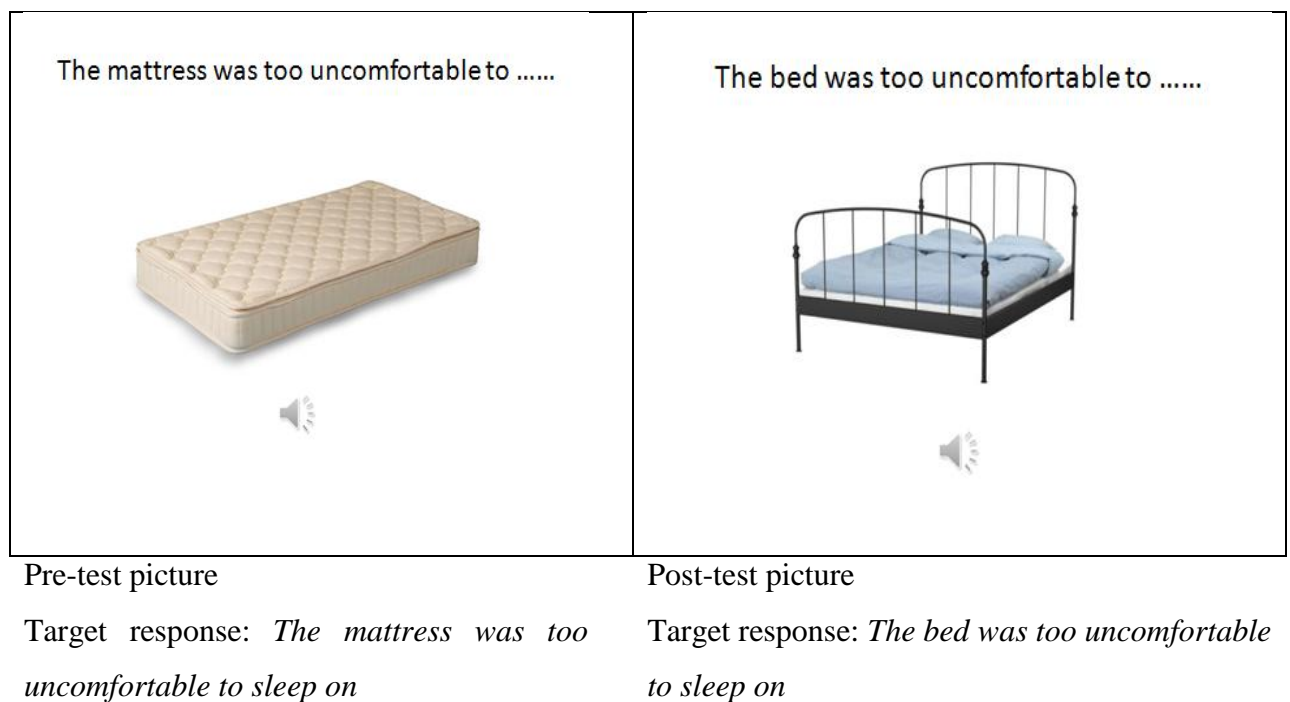

Pre-test picture

Target response: *The mattress was too uncomfortable to sleep on*

Post-test picture

Target response: *The bed was too uncomfortable to sleep on*

Figure 5.1. Example pre- and post-test pictures.

5.3.3.2 Treatment phase

The experimental group's priming stimulus set contained 20 test pairs, each consisting of a stranded preposition prime sentence and matching picture, followed by a target picture and a matching sentence starter of the same form as in the pre- and post-tests. An example test pair is shown in Figure 5.2. As in the pre- and post-tests, all test prime and target pictures depicted objects or people (e.g., a flat tyre, an angry man) or locations (e.g., a smoggy city, a skier on a steep ski slope) and all prime sentences began with the words: *The X was too ADJ to ...* or *The X wasn't ADJ enough to ...* in which *X* represents the pictured object, location or person. Each prime picture/sentence was displayed for between 8 and 13 seconds, depending on the length of the sentence, and each target picture for between 5 and 7 seconds. Presentation times were kept relatively short in order to foster an automatic response from participants and minimise opportunities for excessive reflection during sentence production.

All target pictures could be described by completing the sentence starter with a sentence containing a stranded preposition. None of the prime or target pictures in the treatment phase also appeared in the pre- or post-test. In all pairs the preposition alternated between prime and target. Three pairs contained an intervening *for* phrase between the adjective and infinitive complement clause (e.g., *The bridge wasn't high enough for the truck to pass under / The trampoline wasn't safe enough for the children to play on*), and four pairs contained an intervening NP between the verb and preposition in both prime and target (e.g., *The clothes rack wasn't big enough to hang all the clothes on / The knife wasn't sharp enough to cut the tomato with*). In all but one pair the verbs differed between prime and target.

The tyre was too flat to drive on.

Prime

The sleeping bag was too cold to ......

Target
(The sleeping bag was too cold to sleep in)

Figure 5.2. Example experimental group test prime-target pair.

In addition to the 20 test pairs, 15 filler pairs helped to conceal the purpose of the task and target structure from participants. None of the filler prime sentences contained a stranded preposition, and none of the filler target pictures could be well-described by completing the sentence starter with a sentence containing a stranded preposition. The filler prime sentences and filler target sentence starters all began in the same way structurally as the test items (i.e., *The X was too ADJ to …* or *The X wasn't ADJ enough to …*). In no filler pairs was the verb repeated. Test and filler pairs were pseudo-randomly ordered subject to the criterion that no more than three consecutive prime-target test pairs were allowed. All participants saw the items in the same order. For the control group, and just as in Experiment 2 (Chapter 4), each of the test prime sentences/pictures was replaced by one of the filler prime sentences/pictures or filler target pictures from the experimental group's stimulus set. None of the control prime sentences contained a stranded preposition. Where an experimental filler *target* picture was used as a control *prime* picture, an appropriate non-stranded preposition prime sentence was added. Three filler prime-target pairs were also included. Figure 5.3 shows an example control group item pair. Both the experimental

and control groups practised on three prime/target pairs prior to starting the treatment phase. As in Experiment 2, for both control and experimental groups the same type of memory spacer task followed the priming session and preceded the post-test.
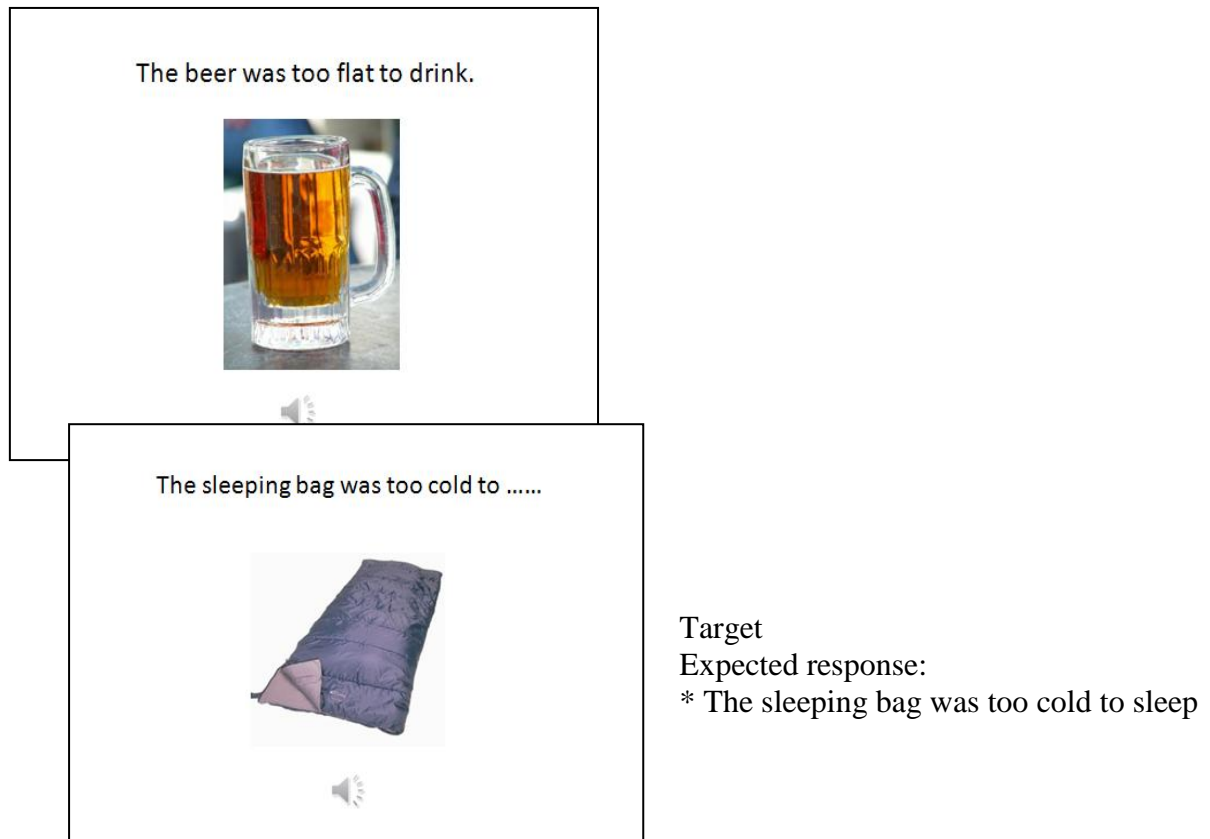

The beer was too flat to drink.

The sleeping bag was too cold to ......

Target
Expected response:
* The sleeping bag was too cold to sleep

Figure 5.3. Example control group test pair.

5.3.3.3 Controlling for conscious awareness

As in Experiment 2 (Chapter 4), several measures were also taken in Experiment 3 to minimise the development of conscious awareness in the participants. These measures included the following: not informing participants about the actual purpose of the experiment; and including 15 filler prime-target pairs in the treatment phase. In addition, two post-experimental measures were taken to control for any awareness of the prime structure or purpose of the experiment that might have developed during the experiment. One of these measures was the elicitation of information from participants through two simple questions just after the main experiment (after the post-test) (See Appendix 5.3). In addition, in order to gain a fuller insight into the thinking of a substantial portion of participants, all 21 of the Hong Kong participants (11 experimentals and

10 controls) also responded individually in *writing* to two questions one week after the completion of the experiment. It was thought that their written responses might have been more thoughtful and reflective than the oral responses given earlier at the time of the experiment. The principle reason why only this sub-group of participants was targeted in this way was because they made up a pre-existing class group and were therefore easy to test in this way as a group after the main experiment. On the other hand, the other participants came from several ESL classes and were more difficult to access in a timely manner. The questions for the Hong Kong subgroup were:

What do you think was the purpose of the research?
Did you learn anything from the tasks? If yes, what did you learn?

The other measure of awareness was a sentence recognition test, along the lines of the test used in Experiment 2, containing five prime sentences (e.g., *The beach was too dangerous to swim at*) and five modified test prime sentences from the main experiment that did not include a stranded preposition (e.g., *The chair was too damaged to sit*).

5.3.4 Procedure

The procedure was the same as in Experiment 2 except in one key respect. In Experiments 1 and 2, participants completed the experimental tasks individually at different times over a period of several weeks. In this situation there is always the danger that as some participants completed the tasks they might subsequently discuss their experiences and intuitions about the nature of the task with other participants who are yet to do the tasks. This might result in those future participants altering their normal behaviour in unexpected ways, thus impacting on the integrity of the experiment. The critical danger was, of course, that if one participant recognised the importance of the target structure or priming intervention, he/she might have communicated this knowledge to future participants, potentially raising their awareness of the target structure and purpose of the experiment and influencing their subsequent behaviour in the experiment.

Therefore, in a further refinement of the methodology, in order to minimise the possibility that some participants might influence other participants' subsequent experimental behaviour, the pre-test component and the priming session/post-test component of the task in Experiment 3

were separated and run on two different days. That is, participants first completed the pre-test and then came back between one and three weeks later to do the priming session and post-test. In addition, all participants from each English class completed the pre-test separately before any participant in that same class took part in the priming session. Additionally, in each class, participants who were assigned to the experimental group (*priming* treatment) did not complete the priming treatment phase and post-test before all those who were assigned to the control group had first done so.

The pre-test took between 3 and 5 minutes, and the combined priming session (or control session) and post-test took between 13 and 19 minutes for the experimental group and between 8 and 12 minutes for the control group. Participants received instructions before they began each section of the task, and could practice before they began the pre-test and priming sessions. Immediately after completing the main task, participants were asked a few questions to probe their subjective experiences during the experiment.

5.3.5 Scoring

As in the other experiments in this thesis, participants' stage of acquisition of English meant that, while most of their responses were well-formed and/or communicatively and semantically appropriate, some of their responses contained errors. In principle therefore, similar coding and scoring judgements were made here as in the other experiments. This meant that, for example, responses which included a stranded preposition were coded as such and included in the analysis regardless of whether or not the preposition was correct or the sentence was semantically appropriate for the stimulus picture. Examples of stranded preposition responses containing semantically inappropriate prepositions and verbs are 11 - 13.

    (11) The garage was too small to go through

        (Target: The garage was too small to park the car in)

    (12) The snow was too deep to pass by

    (13) The rubbish bin wasn't big enough to put thing down

Examples of *accurate* production of null preps and stranded prepositions are 14 and 15 respectively.

(14) The queue was too long to wait

(15) The window wasn't clear enough to see through

All responses which contained neither a stranded preposition nor null prep, whether accurately produced or not, were coded as 'other' in the analysis. 'Other' responses included: zero responses (timeouts); incomplete utterances; utterances containing the verb *use* and therefore obviating the need for a preposition; sentences containing a resumptive object pronoun following the preposition; as well as a range of other grammatical and ungrammatical sentences not requiring a stranded preposition (e.g., see 16-19).

(16) The razor wasn't sharp enough to use

(17) The pillow was too firm to sleep on it

(18) The rubbish bin was too full to carry rubbish

(19) The doorway was too small for the big man to enters

5.4 Results

Just as in Experiment 2, the primary data in Experiment 3 consisted of the proportion of stranded preposition and null prep sentences produced by participants in response to the test stimuli in the pre-test, post-test and treatment phase. The main statistical analyses treated "test" (pre-test, priming, post-test) as a within-subjects variable on both subjects (reported as F_1) and item analyses (reported as F_2), and "group" (experimental and control) as a between-subjects variable on subjects analyses and a within-subjects variable on item analyses. A summary of the results are presented in Table 5.1.

Table 5.1. Proportion (as a %) of stranded preposition and null prep sentences produced by participants in response to the test stimuli in the pre-test, post-test and treatment phase (standard deviations in brackets).

Test	Pre-test		Priming		Post-test	
Group	Exp.	Contr.	Exp.	Contr.	Exp.	Contr.
Stranded prepositions	6	3	24	13	17	9
	(9)	(7)	(19)	(14)	(19)	(14)
Null prep.	71	60	53	60	61	67
	(10)	(21)	(16)	(12)	(21)	(15)
Other	23	36	23	25	21	22
	(9)	(19)	(9)	(7)	(11)	(11)

Participants' responses to the probe questions after the pre-test, and after the treatment phase and post-test, revealed that no participants detected the purpose of the experiment. Nor did any participant report noticing the recurrence of the priming structure. In addition, the more detailed written responses from the Hong Kong participants, which are summarised in Figure 5.4, also revealed that this group also did not notice the purpose of the experiment. This data provided a rich insight into participants' thoughts on the experiment, and presumably was representative of the participant group as a whole. These participants' typically thought the purpose of the experiment was about learning and teaching vocabulary (8 Experimentals, 3 Controls [52% of total responses]), determining participants' English level (5 Experimentals, 4 Controls [43%]), and investigating second language development (2 Experimentals, 7 Controls [43%]). Note that participants were free to write more than one purpose or learning outcome, and several did so. Only one participant, who was from the Experimental group, thought the task had anything to do with sentence structure. This participant wrote "different structure of the sentences" in response to the first question. It was unlikely however, that this participant was specifically referring to the stranded preposition structure because she produced only two stranded prepositions when responding to the target pictures in the treatment phase (10% of her responses), which was much less than the experimental group's mean response rate of 24%, and none at all in the pre- and post-tests. None of the other Hong Kong participants indicated they had noticed any structural component of the experiment or stimuli. Thus, it is reasonable to assume that one week after the experiment this subgroup had little or no conscious awareness of the structural priming manipulation and the repetition of the stranded prepositions in the primes.
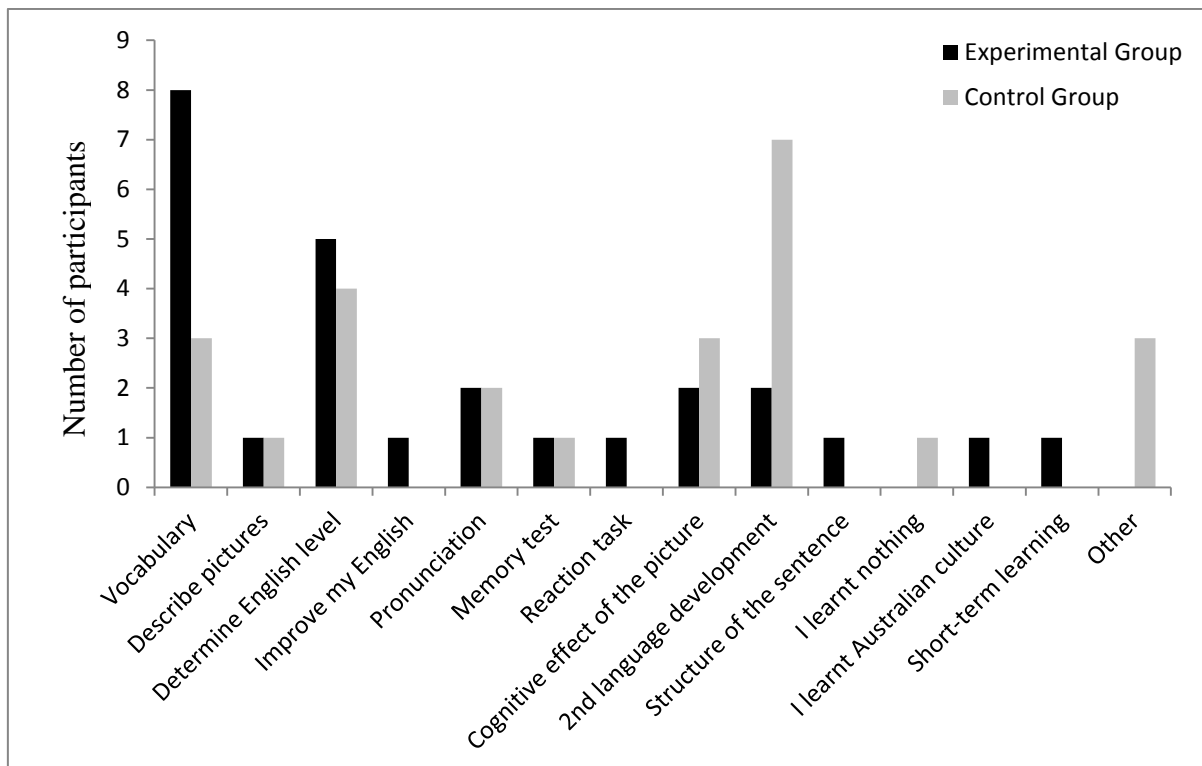
Figure 5.4.Combined summary of Hong Kong participants' opinions about the purpose of the experiment and what they had learnt by taking part.

5.4.1 Production of stranded prepositions

Figure 5.5 shows the production of stranded prepositions by the experimental and control groups in the pre-test, treatment phase and post-test. As expected, the experimental and control groups both produced similarly low baseline amounts of stranded prepositions in the pre-test: 6% and 3% of item responses respectively, a difference which was not statistically significant ($F_1[1,32] =$ 1.20, $p = 0.281$). In order to investigate the effect of the priming treatment, the two groups' stranded preposition production in the treatment phase was directly compared in an ANOVA, in which a marginally significant difference emerged between the groups on a subjects analysis ($F_1[1,32] = 3.05$, $p = .090$), and a clearly significant difference on an item analysis ($F_2[1,19] =$ 29.95, $p < 0.001$, $\eta^2 = 0.61$). Since there was no significant difference between the groups at baseline (in the pre-test), the significant difference between the groups in the treatment phase can be attributed to the priming treatment that the experimental group received. Thus, Hypothesis 2 was supported, with a priming effect in the hypothesised direction for the experimental group. This effect was reflected in the clear increase the experimental group's production of stranded

prepositions in the treatment phase (24%) compared to the pre-test (6%), a difference which was found to be statistically significant in a one-tailed t-test (t[17] = 3.38, p = 0.002). However, the control group also increased its production of stranded prepositions in the treatment phase (13%) compared to the pre-test (3%), a difference which was statistically significant in a one-tailed t-test (t[16] = 2.81, p = 0.007). This increased production of stranded prepositions is discussed further in section 5.5.1 below.

In order to evaluate Hypothesis 4, the two groups' production of stranded prepositions in the pre- and post-tests was statistically examined. In a 2 X 2 factorial ANOVA with test at two levels and group at two levels, there was a significant main effect of test (F_1[1,31] = 10.71, $p < 0.003$, η^2 = 0.26; F_2[1,11] = 13.30, $p < 0.004$, η^2 = 0.55), a non-significant main effect of group on a subjects analysis (F_1[1,31] = 2.31, p = 0.139), a significant main effect of group on an item analysis F_2[1,11] = 9.16, $p < 0.012$, η^2 = 0.45), and a non-significant interaction between group and test (F_1[1,36] = 1.14, p = 0.293; F_2[1,11] = 2.05, $p < 0.180$, η^2 = 0.16). Even though the experimental group produced significantly more stranded prepositions in the treatment phase than the control group, indicating some priming took place, the absence of a significant interaction between group and test in an analysis of their pre- and post-test production indicates that the priming effect was not long-lasting in the experimental group and that Hypothesis 4 was not supported. In order to confirm this conclusion, separate comparisons of each group's production of stranded prepositions in the pre- and post-tests were carried out. For the experimental group, the production of stranded prepositions in the pre-test (6%) and post-test (17%) was significantly different (t[17] = 3.37, p = 0.004). For the control group however, the production of stranded prepositions in the pre-test (3%) and post-test (9%) was not significantly different (t[16] = 1.43, p = 0.173). This statistical analysis might suggest that the priming treatment did indeed result in a small long-term priming effect (i.e., learning). On balance however, the absence of a significant interaction between group and test suggests that Hypothesis 4 was probably not supported.
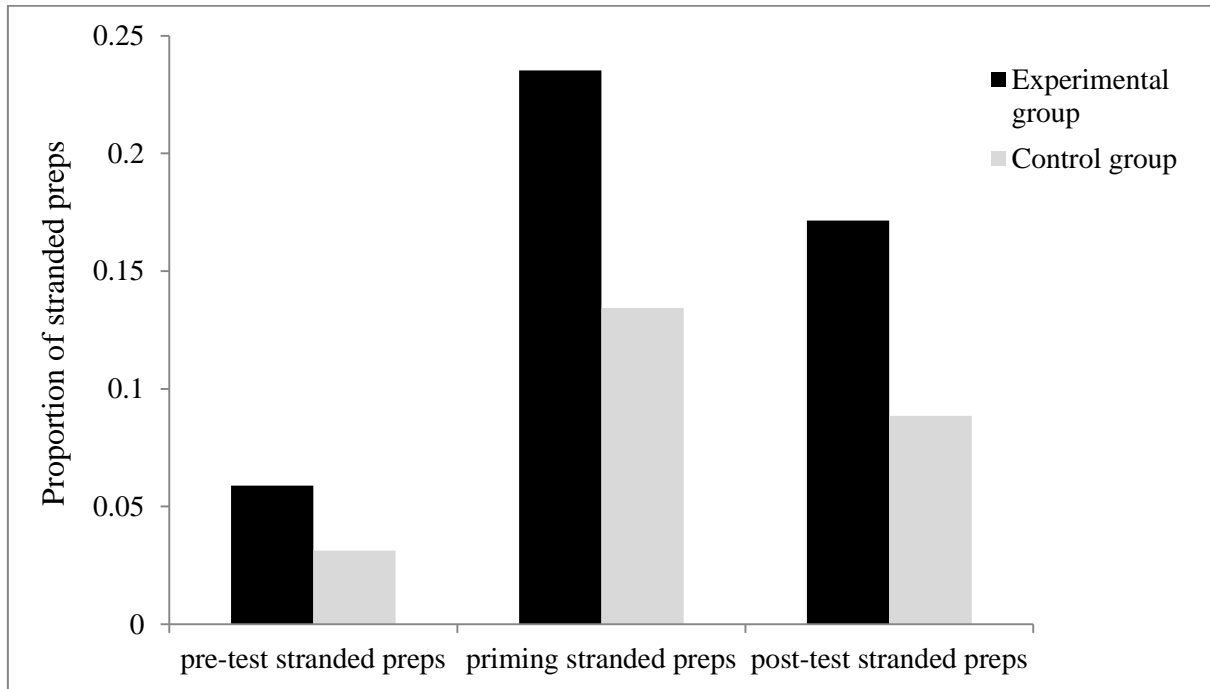
Figure 5.5. Production of stranded prepositions by experimental and control groups as a function of test (proportion of target pictures)

5.4.2 Production of null preps

Figure 5.6 shows the proportion of null preps produced by each group in the pre-test, treatment phase and post-test. As expected, both groups produced large numbers of null preps in the pre-test, with the experimental group producing slightly more null preps (71%) than the control group (60%), a difference which was marginally significant by subjects ($F_1[1,32] = 3.42$, $p = 0.074$) and significant by items ($F_2[1,11] = 9.07$, $p = 0.012$, $\eta^2 = 0.45$). Although there was this significant difference between the groups, both groups produced large numbers of null preps at baseline. Therefore, Hypothesis 1 was supported.

Hypothesis 3 predicted that participants would continue to produce null preps in the treatment phase. A statistical analysis of the two groups' null prep production in the treatment phase revealed that the experimental group produced fewer null preps than the control group, but this difference was not statistically significant ($F_1[1,32] = 2.16$, $p = 0.152$; $F_2[1,19] = 0.84$, p = 0.341). This finding established that the two groups performed similarly with respect to null prep production during the treatment phase, even though one received a priming treatment and the other did not. More importantly, Hypothesis 3 predicted that the priming treatment would have

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no significant influence on the experimental group's null prep production in the treatment phase compared to its baseline production in the pre-test. This prediction however, was not borne out in the descriptive statistics: the experimental group produced fewer null preps in the treatment phase (53%) than in the pre-test (71%), while the control group however, produced exactly the same proportion of null preps in the treatment phase (60%) as in the pre-test (60%). When the two groups' null prep production in the pre-test and treatment phase was compared in a 2 X 2 ANOVA, a statistically significant interaction between group and test emerged ($F_1[1,31] = 6.12$, $p = 0.019$, $\eta^2 = 0.165$), although the effect size was small. Thus, Hypothesis 3 does not appear to have been supported.

Hypothesis 5 stated that participants would continue to produce the same amount of null preps after the priming session than before. At first glance, this does not appear to have been supported either, with the experimental group's production falling from 71% in the pre-test to 61% in the post-test and the control group's production rising from 60% to 67%. This difference between the groups was reflected in a significant statistical interaction between group and test ($F_1[1,31] = 5.528$, $p = 0.025$, $\eta^2 = 0.151$; $F_2[1,11] = 11.803$, $p = 0.006$, $\eta^2 = 0.518$). Thus, Hypothesis 5 was also not supported and the priming treatment appeared to have influenced the experimental group's null prep production after the priming treatment.
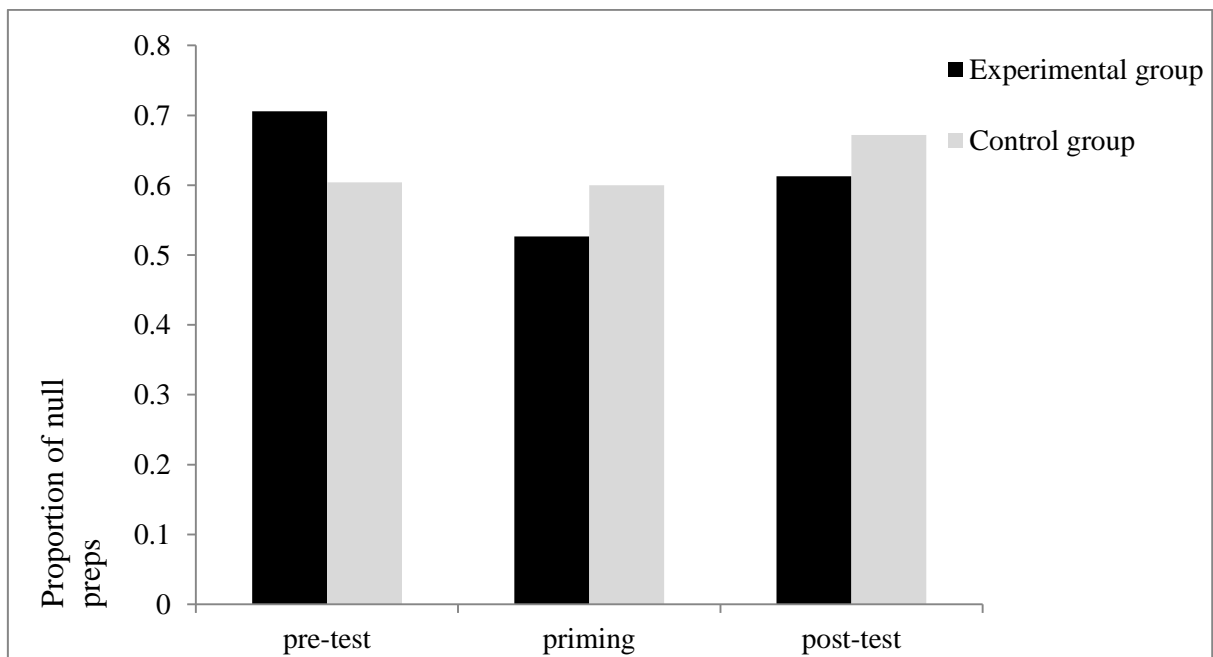

Figure 5.6. Production of null prep by experimental and control groups as a function of test (proportion of target pictures)

5.4.3 Participants' conscious awareness

An analysis of the data from the sentence recognition test immediately after the priming session and post-test would shed light on whether experimental group participants were aware of the priming structure in the stimuli. Prior to this analysis, the data from one participant was excluded because he did not properly complete the task and merely repeated the sentences rather than making a recognition judgment. The analysis revealed that participants appeared not to have had conscious awareness of the stranded preposition structure. None of the 16 participants in the analysis correctly rejected all five modified prime sentences in the recognition test. Rather, they scored quite poorly in this task, with a mean rejection score of 1.50 for the 5 test sentences. Put another way, participants *incorrectly* reported earlier experiencing the modified primes, none of which contained a stranded preposition (they were all null preps) but all retained the original lexical elements of the prime sentence. On the other hand, when it came to *accepting* the original (unmodified) stranded preposition prime sentences, participants performed quite well: five participants correctly accepted all five sentences; three accepted four; five accepted three; and three accepted two. The mean acceptance for these unmodified primes was 3.62 for the 5 test sentences. By comparison, their mean correct acceptance or rejection of the 10 filler items, some of which were new items (2), was 9.06 (from 10). In sum, participants scored reasonably well on the primes, poorly on the modified primes and extremely accurately on the fillers indicating a general reliance on memory for the content rather than the form of the sentences in the experiment and supporting the conclusion that participants had not noticed the purpose of the task and its focus on sentence structure.

5.5 Discussion

5.5.1 Summary of the findings

To summarise, Hypothesis 1 was supported: all participants produced significant numbers of null preps before the priming intervention. This finding extends the findings of Experiment 2 and earlier studies regarding null prep production in English relative clauses (Bardovi-Harlig, 1987;

Hokari & Wakabayashi, 2009; Kao, 2001; Klein, 1995, 2001; Sadighi, et al., 2004) to null prep production in infinitive complement clauses[13].

Hypothesis 2 also appears to have been supported: during the treatment phase the experimental group produced more stranded prepositions than the control group, and while both groups produced more stranded prepositions in the treatment phase than in the pre-test, in the case of the experimental group the increase in production was greater than for the control group. This pattern or results indicates that some structural priming occurred in the experimental group. One question remains however: why did the control group produce more stranded prepositions in the treatment phase than in the pre-test? One explanation is that participants already had some knowledge of stranded prepositions in the target sentence context. If this were the case, they might have spontaneously been able to produce stranded prepositions upon repeatedly seeing infinitive complement clause sentence starters. That is, the sentence starter alone might have been enough of a stimulus to induce the control group to produce some stranded prepositions.

In contrast to experiment 2, in which stranded preposition production was significantly increased by the priming treatment, stranded preposition production did not increase significantly as a result of the priming treatment in Experiment 3. Therefore, Hypothesis 4 does not appear to have been supported. The overall findings for stranded prepositions indicate that, although some priming occurred in the treatment phase, it was not very long-lasting and did not translate into any significant learning as measured in the post-test. There was one tentative indication however that a small priming effect might have occurred in that there was a descriptive difference between the groups' performances in the pre- and post-tests in the predicted direction. That is, the difference between stranded preposition production by the experimental group in the pre- and post-tests was 11% (production went from 6% to 17% in the pre- and post-test respectively), but the difference was only 6% for the control group (production went from 3% to 9%). This apparent difference between the groups' improvement scores might have been reflected in the statistically significant difference in the pre/post-test scores found for the experimental group but the failure for the difference to reach significance for the control group. On a conservative and conventional reading of the results however, one would have to remain rather skeptical of the significance of this interpretation.

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[13] The findings of Experiment 3 also appear to be one of the first empirical accounts of null prep production in English infinitive complement clauses by L2 speakers.

Hypotheses 3 and 5 stated that, during and after priming the priming treatment group would continue to produce just as many null preps as in the pre-test. These two hypotheses were not supported: speakers in that group produced not only significantly lower proportions of null preps in the priming treatment phase than in the pre-test, but also fewer null preps in the post-test compared to the pre-test, apparently as a result of the structural priming treatment. This "re-tuning" or learning effect appeared to be relatively small but durable over time because null prep production decreased slightly from the pre- to the post-test for the experimental group, but *increased* slightly for the control group. However, the size of the drop in null prep production from pre- to post-test for the experimental group was quite small (71% to 61%). Therefore, this small tuning effect underscores the claims made in Chapter 4 (e.g., see section 4.5) that interlanguage features can be relatively resistant to change. Overall though, the two groups showed different trends in null prep production and the findings do support the notion that structural priming has some effect in restructuring learners' interlanguages.

To the extent that the above effects were implicit, an evaluation of the awareness levels of participants was in order. The tests of awareness indicated that participants were unaware of the purpose of the experiment and unaware of the critical stimuli. While both tests were taken post-experiment, there is good reason to believe the results were also a reasonable indication of participants' level of awareness at the time of taking part in the main priming task and post-test. First, I will discuss the questionnaire completed by the Hong Kong group. It is conceivable that participants within this relatively cohesive group (they were all on an overseas "study tour" together and spent much time each day interacting with each other) would have discussed their experiences in the main experiment, at least briefly, thus reinforcing memories and maintaining whatever conceptions about the tasks they might have initially developed. Thus, their initial conceptions should have been at least partially evident in their responses to the questions one week after the main task. Given that no awareness for the purpose of the experiment or the significance of the target structure was found one week later in their written responses to the post-task questions, there is a good chance that they never had any awareness in the first place. It is also reasonable to assume that the Hong Kong group's responses were reasonably representative of the awareness of all the participants. The combined evidence then is that participants had no awareness about the real purpose of the experiment or of the critical stimuli. Thus, it is reasonable to assume that any priming or learning effects were, in principle, implicit.

5.5.2 Comparison of findings of Experiment 3 with Experiment 2

When the findings of Experiment 2 (Chapter 4) and Experiment 3 (Chapter 5) are compared, one puzzling outcome emerged: quite different priming effects for the same structural feature – stranded prepositions. Recall that priming effects were strong in Experiment 2 for target sentences such as (1) but weak here in Experiment 3 for target sentences such as (2). This was a surprising outcome and the following discussion will offer some explanations for these divergent findings.

1. A bed is something you sleep on
2. The bed was too uncomfortable to sleep on

One explanation might be that the arguably more syntactically complex TM target structure might have led to weaker priming effects in Experiment 3 than in Experiment 2. Some support for this position comes from child L1 study of TM processing and acquisition. Byrne (1981) presented evidence that poor child readers between the ages of 7 and 8 years had particular difficulty interpreting sentences like *John is easy to please*. In particular, Byrne found that TM sentences were even more difficult than centre-embedded relative clauses (e.g., *the horse that the girl is kicking is brown*), even though the latter might be considered by some measures more syntactically complex. This somewhat surprising finding suggests that the relative clause target structure in Experiment 2 (Chapter 4) might actually be easier for learners to process and acquire than the TM structure used in Experiment 3. This difference might at least partially account for the different priming effects observed in these two otherwise similar experiments. The additional difficulty of processing and interpreting TM prime sentences in Experiment 3, and then having to produce target sentences with this more difficult structure might have overloaded participants and inhibited a potential priming effect compared to the relative clause structure in Experiment 2. Future research might investigate structural priming of TM, and the L2 acquisition of TM, given its apparent difficulty for L2 speakers (Callies, 2008; Yip, 1995). Such priming research might conceivably compare priming of TM (or object-to-subject raising) as in sentences 2 and 3, and its structural cousin, subject-to-subject raising, as in 4. The findings might shed light on the priming differences observed here in Experiments 2 and 3.

Another possible clue to the divergent results lay in other features of the structural context of the stranded preposition in the sentences used in Experiments 2 and 3. First however, it should be noted that sentences (1) and (2) are lexically and structurally quite similar: they both contain a stranded preposition and both involve an extracted object NP resulting in a gap in sentence-final position. For both L1 and L2 speakers object extraction is known to be more difficult and burdensome to process than subject extraction (as in for example *The girl was the person who slept*). It is also widely accepted that processing any filler-gap dependency places an additional burden on the computational resources of L1 and L2 speakers when comprehending sentences (e.g., Gibson, 1998; Marinis, Roberts, Felser, & Clahsen, 2005). In order to systematically account for this difficulty, Gibson (1998) proposed the Syntactic Prediction Locality Theory (SPLT) according to which the distance between a filler and its gap plays a role in determining the complexity (and hence difficulty) of a structure for processing. At the heart of this account of complexity in sentence processing is the idea that, due to working memory limitations, the greater the distance between a gap and filler the greater the processing burden on speakers as they must hold information in working memory for longer periods of time while simultaneously processing the rest of the sentence. While Gibson linked his theory to evidence from comprehension studies, and formulated the theory in the context of L1 sentence processing, less is known about the effect of filler-gap dependencies in L2 sentence production. However, drawing on the SPLT, it would be unsurprising if L2 speakers of English also had difficulty producing and comprehending constructions involving object extraction in relative clauses (e.g., 1) and infinitive complement clauses (e.g., 2). Add to this difficulty a stranded preposition and sentences such as (1) and (2) might be even more difficult to interpret and produce for these speakers. Perhaps this account might partially explain why the L2 speakers in Experiments 2 and 3 continued to produce significant numbers of null preps even after the priming treatment.

However, although sentences (1) and (2) are quite similar structurally, the priming effects found in Experiments 2 and 3 for stranded prepositions were quite different. The question is why? One explanation might be related to the slightly different distances between the gaps in these two sentences: the gap is one word longer in (2) than in (1). This slightly longer distance requires speakers to hold the filler surface subject NP (*the bed*) for slightly longer in memory until the gap is reached in (2) than in (1). More importantly, in Experiment 2 the gaps between the surface NP and the lexical verb in the prime and target sentences in the treatment phase and in the targets in the pre- and post-tests were uniformly three words. In comparison, in Experiment 3 the gaps

in the primes and targets were generally longer and varied from 4 to 6 words, with the longest being 7 words for one item in the pre- and post-tests. When syllables are considered, the difference in distances between the fillers and gaps were even greater in Experiment 3 than in Experiment 2. For example, while in Experiment 2 syllabic length was uniformly four syllables in the pre- and post-test target sentences, in Experiment 3 it ranged from four to ten syllables in the pre- and post-test targets, with a mean length of 5.4 syllables. Thus, on two measures filler-gap distance was greater in the targets here in Experiment 3 and this greater distance might partially explain the disparate findings of Experiments 2 and 3.

Sentence like (2) also contain an additional difficulty. This difficulty arises out of the absence of an actor for the verb *sleep*; the sentence provides no information that can inform the reader about *who* sleeps. In (1) the actor for *sleep* is explicit (the generic third person pronoun *you*), but in (2) the actor (e.g., *for someone, for you, for anyone,* etc.) must be inferred or "filled-in" by the listener or reader. This missing element places an extra burden on the language user, and in the case of L2 speakers, this burden might be sufficient to cause processing difficulties which might emerge in the form of production or comprehension difficulties. Another structural difference might also help explain the different results. In the case of (1) the extraction takes place across a relative clause boundary, whereas in (2) it occurs across a main and complement clause. This structural difference, although purely speculative, might have been the source of an additional processing and/or production difficulty for sentences like (2), a difficulty which even the priming intervention was unable to ameliorate. Arguably then, this combination of structural factors makes sentence (2) more difficult to process and produce than (1) and might account for the differences in priming.

One SLA researcher to have acknowledged the effect of distance on L2 speakers is DeKeyser (2008, p. 334) who has argued that the greater the intra-sentential distance between two critical structural features to be learned (e.g., filler gap dependencies), the more important explicit memory processes become in learning. Presumably then, this means that implicit memory processes would become correspondingly less important. According to this argument, the implicit memory processes involved in structural priming might have therefore become somewhat overloaded when processing and learning the stranded preposition structure in sentences such as (2) in Experiment 3 compared to learning a similar structure in sentences such

as (1) in Experiment 2. Since there was no additional explicit instruction in either experiment, less acquisition occurred in Experiment 3 due to the slightly longer gap.

The above interpretations are consistent with evidence from a structural priming study of agrammatic speakers. Rossi (in press) carried out a production priming study of Italian clitic pronouns with two groups of speakers - healthy and agrammatic L1 speakers. Clitic pronoun placement in Italian can occur in two positions depending on context: either immediately after the finite verb or (optionally in some contexts) immediately a verbal complex consisting of a modal and lexical verb. The former is referred to as enclisis and the latter as proclisis or in "climbed" position. Critically, the climbed position in optional contexts involves syntactic movement and, according to Rossi, is more complex and difficult for speakers to acquire and process. For direct-object clitic pronouns, she found that agrammatics were primed for clitic placement in both positions. That is, when the prime contained a pre-verbal clitic speakers tended to place the clitic in preverbal position in targets, and when the prime contained a clitic in post-verbal position they tended to also place the clitic in post-verbal position in targets. The healthy controls had the same tendency, but also exhibited an inverse-preference priming effect (see section 1.6.2, Chapter 1) such that priming effects were stronger for the less preferred climbed position. The agrammatics however, did not exhibit the same inverse-preference effect. This suggests that overall syntactic complexity moderated the priming effect for the agrammatics but not for the healthy controls. Rossi therefore concluded that

> the fact that agrammatic speakers showed a larger priming effect for clitics that require a shorter movement (i.e., in the enclisis position) respect to when clitics require a longer movement (i.e. in the climbed position) suggests that the syntactic priming effect in agrammatic speakers is modulated complexity in syntactic movement" (Rossi, in press).

In experiment 3 in Rossi's (in press) study, she also primed indirect-object clitic pronouns, which are reported to be more morpho-syntactically complex than direct-object clitic pronouns. In this case, agrammatics were not primed for the climbed position, but the controls were primed. These set of findings suggest that the syntactic and morpho-syntactic complexity of a structure can moderate structural priming in speakers with impaired linguistic systems (e.g., agrammatics and L2 speakers), such that more difficult structures are subject to weaker priming. This moderating effect does not appear to apply to healthy L1 speakers however, which seems to

be reflected in the operation of the previously observed inverse-preference effect in structural priming (Ferreira & Bock, 2006; Sheepers, 2003).

Finally, the differences between the findings of Experiments 2 and 3 might have been at least partially a function of differences between the items in each experiment. In contrast to Experiment 2, in which the pictured objects (and nouns) differed in all 12 pre- and post-test pairs, the pictured objects (and nouns) were the same in 7 of the 12 the pre- and post-test pairs in Experiment 3. A further 2 picture pairs in Experiment 3 had the same noun but different objects. This similarity of the pictures pairs in Experiment 3, but not in Experiment 2, could have accounted for different observations about the long-term priming effects. Due to this similarity, and even duplication of the items, participants in Experiment 3 might have relied to some degree on their episodic memory for their descriptions of the pre-test pictures when describing the post-test pictures. According to this view, if they had *not* produced a stranded preposition to describe a pre-test picture (as they typically did because stranded preposition production in the pre-test was predictably low), they might have been inclined to also avoid a stranded preposition for the equivalent post-test picture and produce the same or similar non-target utterance as their pre-test utterance. That is, they might have tended to simply repeat their non-target production in the pre-test in the post-test. This effect would have been less likely in Experiment 2 however, because the pictures were not the same across tests. In that case, participants would have been more likely to construct new utterances to describe the post-test pictures. If item effects were real, then a new experiment could adjudicate on the possibility by re-designing the pre- and post-test item sets in Experiment 3 to ensure that the picture pairs were not the same (as they were in Experiment 2).

Lastly, and notwithstanding the issues raised in the above discussion, it is possible that in Experiment 3 a structural priming effect for stranded prepositions in the infinitive complement clause context was masked by low statistical power. This low power might have been due to a relatively small sample size (33) and relatively high variance in the sample group. Using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) to obtain an estimate of appropriate sample size for this experiment, it was revealed that a somewhat larger sample size of 44 participants would have been required to reach statistical significance for an equivalent effect size to that achieved in the experiment ($\eta^2 = 0.16$) and a desired power of 0.80. The assumption that improved power would reveal structural priming is possible is however a theoretical one; the

effects of structural context might still turn out to be real, with only some structures being "primable". Only a further experiment with a larger sample could adjudicate on the outcome.

5.6 Conclusion

Structural priming occurred through the priming treatment in Experiment 3, but long-term priming effects for stranded prepositions were weak or non-existent. These findings are somewhat clouded by two other findings. First, the control group also increased its production of stranded prepositions, though not to the same extent as for the treatment group. It was not clear why both groups should have displayed such effects. Second, during and after the priming treatment, speakers' production of the ungrammatical interlanguage variant null prep decreased slightly compared to baseline as an apparent result of the priming treatment, indicating that the interlanguages of L2 speakers can be tuned through structural priming. Also, when the findings of the previous Experiment 2 are compared with those of Experiment 3, differences emerged which might be explained by the influence of syntactic context. It is possible that L2 structural priming is modulated by processing constraints such that global syntactic complexity can moderate priming effects. I return to a discussion of this possibility in section6.2.

Chapter 6

General discussion

6.1 Introduction

This chapter discusses the overall findings of the thesis. First, I will discuss how the findings contribute to our understanding of L2 structural priming and, in particular, the theoretical relationships between L1 and L2 priming. Next, I discuss the implications of the findings of this thesis for theories of SLA. Following on from the motivation of the study, I then discuss the implications of the findings for L2 pedagogy and how structural priming might be integrated into L2 teaching and learning. Finally, I discuss several methodological issues which potentially limit the scope of the conclusions drawn in the thesis, and point to possible future research opportunities in L2 structural priming.

6.2 Implications of the findings for structural priming theories

One general finding to emerge from the three experiments in this thesis was that L2 structural priming appears to be critically modulated by both the target structure and the syntactic context of the target structure. This conclusion stems from the findings of relatively weak priming for passives in Experiment 1, and the disparate findings for stranded prepositions and null preps in Experiments 2 and 3. It appears however, that most previous structural priming studies have tended to ignore the possible impact of syntactic context on priming. Theoretically, the syntactic context should not even be relevant to priming according to some accounts. Along these lines, Pickering, et al. (2000) proposed a mechanism of structural priming involving the activation of syntactic representations (e.g., combinatorial nodes) associated with a connectionist view of syntax. They argued that these representations are essentially context-free. That is, once activated for the processing the same structure "irrespective of the syntactic context in which that structure appears" (p. 207). According to this view, the stranded preposition rule apparently activated in the priming treatment phase in Experiment 3 should have facilitated the production of stranded prepositions in the post-test, just as it did in Experiment 2. However, this was not the

case. Thus, the present L2 structural priming findings do not appear to be consistent with Pickering et al.'s proposed mechanism, and context does appear to be relevant to L2 priming.

In another sense, the findings of Experiments 2 and 3 also tell us about L2 structural priming and how it might be different to L1 priming. My findings of distinctly different effects for the same syntactic structure (stranded prepositions) when it occurs in different syntactic contexts are somewhat similar to the findings of McDonough (2006) who also found distinctly different effects in L2 speakers for two highly related structures: significant long-term priming effects for PO datives but not for DO datives. Rossi (in press) also found significant priming effects for agrammatic Italian speakers for direct-object clitic pronouns but not for indirect-object clitic pronouns. On the other hand, L1 priming studies have repeatedly shown largely similar priming effects for English DO and PO datives. One conclusion is that structural priming effects in populations of speakers with unstable or incomplete linguistic systems appear to be different to priming in L1 effects in speakers. This conclusion however, is rather speculative and future structural priming research on speakers from these other less-researched populations would be useful. In particular, a wider range of structures should be investigated in future L2 structural priming studies (see section 6.7.1 this chapter for other possible structures).

A range of methodological issues also arose through the research in this thesis and these will be discussed in sections 6.5 and 6.6.

6.3 L2 structural priming and SLA theories

One of the aims of the research in this thesis was to explore the relationship between L2 structural priming and theories of SLA. How does evidence of L2 learning via a structural priming mechanism fit with theories of SLA, and what particular theories might explain or accommodate L2 acquisition through structural priming, and in particular, the findings of this thesis?

6.3.1 Implicit learning of grammatical structure

Structural priming is thought to be associated with implicit learning of syntactic structure (e.g., Bock & Griffin, 2000). The findings of Experiment 2, and to lesser extents Experiments 1 and 3,

indicate that some implicit learning did in fact occur. Therefore, the findings here add to the findings from other L2 structural priming studies (Biria, et al., 2010; Y. Kim & McDonough, 2008; McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008; Shin & Christianson, 2012) demonstrating that implicit learning of L2 syntactic structure indeed appears possible through a priming mechanism. In particular, the findings of Experiment 2 (Chapter 4) closely mirror those of Shin and Christianson (2012) who found robust implicit learning of a syntactic structure that involves the arbitrary placement of a preposition in a sentence.

Several theories of SLA also propose that much of SLA takes place through an incidental route, pointing to the importance of implicit learning. These theories include, but are not limited to: Krashen's Monitor Hypothesis (Krashen, 1985); VanPatten's Input Processing (IP) Model (VanPatten, 2002, 2007), Carroll's Autonomous Induction Theory (Carroll, 2007), and Gass & Mackey's Interaction Hypothesis (Gass & Mackey, 2007). Incidental learning and implicit learning can be considered equivalent in the sense that the latter involves learning without intention to learn (Williams, 1999, p. 4), which in itself is generally considered to be a defining characteristic of incidental learning. At first glance, the present findings might be considered compatible with several theories of SLA which incorporate a role for implicit learning. However, the findings sit largely outside the framework of most of these theories. This is principally because most SLA theories, including some of those mentioned above, assume that at least some conscious awareness is required for the acquisition of syntax. Most theories also assume that learners are driven by a need to derive *meaning* from the L2 input, for example by favouring the acquisition of structures or grammatical morphemes which have clear and unambiguous form-meaning connections. For example, although VanPatten's IP model (2002, 2007) reserves a role for implicit learning of structure, learners are principally driven by a need to make form-meaning connections. This implies that each structure must have a relatively unique association with a particular meaning, without which learning presumably does not take place. The problem with this assumption of IP for the present findings is that each of the target structures in this thesis did not have a unique form-meaning connection. Rather, in Experiments 2 and 3 each target structure was one half of *a pair of structures* (null prep vs. stranded preposition) that could both be used interchangeably to convey virtually the same propositional meaning. Experiment 1 also involved a pair of structures (active vs. passive) which could both be used to convey arguably the same or very similar meanings; although passive and active sentences arguably differ with

respect to information focus, the choice of either structure is generally accepted to be determined by discourse and other non-syntactic factors. However, such potentially confounding factors were not relevant in Experiment 1 due to its design. To illustrate, in the picture description task in Experiment 1, speakers could have produced either a passive or an active sentence to describe each target picture; there was no discourse context which might have favoured production of either alternative structure. In this sense, speakers did not need to learn any form-meaning connection to favour one or other of the alternatives. Rather, they simply appeared to learn to produce more passives than equally valid active sentences when describing pictures. This finding provides some evidence for a dissociation between form and meaning when learning L2 structure, and is thus incompatible with one of the central assumptions of IP.

The argument that form-meaning connections are not necessarily so critical in SLA is also supported by other L2 structural priming evidence. Shin and Christianson (2012) found that, in a picture description structural priming task, L2 English learners learnt to arbitrarily separate a verb from its preposition and place the preposition in sentence final position (e.g., *the girl is turning the heater down*), rather than placing it in sentence-medial position (e.g., *the girl is turning down the heater*). In these sentences, the location of the preposition with respect to the verb is reasonably arbitrary (i.e., primarily a function of syntactic form) and is not associated with any particular meaning. Similarly, the difference between the null prep interlanguage construction and stranded preposition target construction is purely one of form, not of meaning, and learners in Experiment 2 also learnt to arbitrarily place the preposition in sentence final position (e.g., *a chair is something you sit on*), rather than omit it as in null prep (e.g., *a chair is something you sit*). Thus, L2 syntax learning seems possible without the need to derive meaning per se from a particular form. Such a claim of course does not preclude the possibility that learners are driven to find form-meaning connections in non-priming contexts. Indeed, VanPatten's (2002, p. 760) claim that "a form with no or consistently little communicative value is the least likely to get processed and, without help, may never get acquired" might explain why null prep is so prevalent in learner speech, even in learners at high levels proficiency, and why null prep production did not drop significantly after stranded preposition priming in Experiment 2 (see Chapter 4).

6.3.2 Input and awareness in second language acquisition

Clearly, some sort of input is important for language acquisition to occur. However, it is not entirely clear how input leads to acquisition. In second language acquisition contexts, VanPatten (2002) emphasises the role of input in his IP model, and particularly input enhancement in his Processing Instruction (PI) model of instructed SLA, and refers to this issue when claiming that in any theory of SLA "what is necessary is that the learning mechanisms that act upon input or interact with it be spelled out in some fashion" (p. 757). VanPatten (2002, p. 762) attempts to elaborate on this requirement by suggesting that when input is processed "internal mechanisms accommodate data into the system (often triggering some kind of restructuring"; this is the basis for his IP model. Structural priming is also characterised by the activation of speakers' internal mechanisms and representations by linguistic input (primes) and is thought to be the result of linguistic restructuring in the minds of speakers. If it were not for VanPatten's insistence on conscious and explicit focus on form and input enhancement (elaborated in his PI model of instructed SLA), his input-based view of SLA might be compatible with a structural priming account. However, this is not the case, hindering any compatibility between IP and structural priming accounts of SLA. VanPatten makes this divergence especially apparent in his PI account of instructed SLA. According to PI, in order for specific linguistic aspects of the input to be acquired they must be attended to *consciously* and *explicitly*. That is, learners must be made aware of what they are learning. Schmidt (1995) takes a similar approach and claims that no learning can take place without attention and conscious awareness. These approaches are in direct contrast with a potential priming account of instructed SLA in which the input is attended to *unconsciously* [i.e., attended to but not noticed, according to the distinction made by Schmidt (1990, 1995) between *attention* and *noticing*], and where learners are apparently *unaware* of the structure(s) they are learning. Thus, SLA theories which insist on a role for explicit and conscious awareness in the acquisition of syntax are not entirely compatible with L2 structural priming data.

6.3.3 Processability Theory

As discussed in Chapter 5, processing factors might be one explanation for the differences in performance observed in this thesis. According to Pienemann's Processability Theory (PT) of SLA (2007), *acquisition* directly reflects *processing*. PT follows Levelt's (1989) model of

sentence production and assumes that all language users (L1 and L2) rely on the same language processing architecture; second language learners must learn to build the rules of the L2 using this basic architecture. Pienemann argues that the inherent processability of various grammatical structures is a critical factor in determining the rate and order in which those structures will be acquired.

According to PT, which is based on general language processing principles, learners go through the following six stages of acquisition (see Pienemann, 2007, p. 140).

1. No procedure (e.g., producing a simple word such as *yes*)
2. Category procedure (e.g., adding a past-tense morpheme to a verb)
3. Noun phrase procedure (e.g., matching plurality as in *two kids*)
4. Verb phrase procedure (e.g., moving an adverb out of a verb phrase to the front of a sentence "I went yesterday/yesterday I went.")
5. Sentence procedure (e.g., subject-verb agreement)
6. Subordinate clause procedure (e.g., use of subjunctive in subordinate clauses triggered by information in the main clause)

Pienemann (2005, 2007) also bases PT on the assumption that language processing is automatic and modular. Structural priming is also known to be automatic and beyond conscious awareness and not subject to conscious intention to repeat, and the findings of Experiment 2, and to lesser extents Experiments 1 and 3, support this conclusion. Therefore, structural priming, in so far as it can be considered associated with language learning, appears to be broadly consistent with Pienemann's view of SLA. His model also requires that speakers do not attend to grammatical information, but only need to attend to the propositional or semantic information in messages. This assumption might also be considered consistent with structural priming given its implicit nature.

Pienemann's approach to SLA might, in broad terms, also explain the different priming results in Experiments 2 and 3 because it emphasises processing effort. PT also emphasises the notion of "readiness" to acquire, which refers to whether or not a learner has reached a stage of acquisition for a particular feature. According to Pienemann, if a learner has not yet reached a stage of readiness (e.g., the feature is too advanced for the leaner to acquire), he/she will not be able to

acquire that feature. Along these lines, speakers might have experienced greater difficulty processing the infinitive complement clauses compared to the relative clauses for the reasons explained in sections 5.5.1 and 5.5.2, Chapter 5. This greater difficulty could have led to greater cognitive load and an inability to effectively benefit from the priming intervention. That is, speakers were not yet ready to acquire the feature in the more complex tough movement (TM) context. In sum then, if we assume, as Pienemann claims, that processability factors are critical in SLA, we might then imagine that the acquisition of stranded prepositions in the context of an infinitive complement clause (e.g., TM) is qualitatively and quantitatively different from acquisition of the same feature in relative clauses.

Up until now PT appears only to have been empirically validated in relation to acquisition orders of a limited number of syntactic structures in a limited number of languages (e.g., English questions). The findings of Experiments 2 and 3 might be taken as some evidence for a potential acquisition order for stranded prepositions in two superficially similar but different syntactic structures. Specifically, the findings suggest that stranded prepositions in relative clauses are easier to acquire than stranded prepositions in infinitive complement clauses for possible reasons of processability. The findings also appear to identify a possible more fine-grained level in Pienemann's processability hierarchy. The two structural contexts investigated in Experiments 2 and 3 both involved subordinate clauses and so are located within Pienemann's sixth level in his processability hierarchy. However, the contexts differed in more subtle ways – the distance between filler and gap, and the salience of the arguments in the clause. Future research might explore this possible elaboration of PT. Overall then, PT might turn out to be one of the SLA models which could accommodate the possibility that structural priming can lead to second language acquisition.

6.3.4 Acquisition by Processing

What other model(s) of SLA might be more compatible with the findings in this thesis? One possibility is Truscott and Sharwood-Smith's (2004) Acquisition by Processing Theory (APT) and their later model MOGUL (Modular On-line Growth and Use of Language) which attempts to explain interlanguage development in terms of continua as opposed to a progression through discrete stages (Sharwood-Smith & Truscott, 2005) (see also section 4.5, Chapter 4). APT is essentially a theory of language *acquisition* through language *processing*, and so shares some

similarity with the approaches of others such as McLaughlin (1987), Pienemann (2005), and VanPatten (2007). The critical feature of Truscott and Sharwood-Smith's approaches however, is that changes in mental "activation levels" of linguistic representations result in acquisition. This particular view of acquisition is therefore quite similar to a learning-through-priming view (e.g., Chang, et al., 2000; Chang, et al., 2006). It also reflects Yamashita et al.'s (2003) view (of L1 acquisition at least) that "language learning can structure language processing", and that the particular language being learned can influence the processing mechanism and the learning mechanism. That is, language acquisition and language learning are linked. In particular, Truscott and Sharwood-Smith imply a link between priming and acquisition with reference to changes in activation levels of linguistic features. In particular, they claim that (2004, p. 6):

> If an item or feature value has its current level raised by a processor and the increased level is maintained throughout the parse, the lingering effect is a small lasting increase in its resting level, the effect of which is that it becomes more readily available for future processing.

In fact, Truscott and Sharwood-Smith (2004, p. 8) go so far as to suggest that, in their model, learning is simply a by-product of processing; there is no separate learning mechanism, "only the lingering effects of processing within an innately constructed performance system".

According to MOGUL, L2 development and changes to interlanguage are gradual and incremental rather than sudden and categorical. Sharwood-Smith and Truscott (2005) base their claim on the assumption that development occurs as the activation level of various grammatical representations increases. This framework appears to nicely explain how structural priming might contribute to L2 acquisition because structural priming is also thought by some researchers to work through changes to activation levels of grammatical representations (e.g., Hartsuiker, et al., 1999; Pickering & Branigan, 1998). That is, structural priming occurs when the prime stimuli raise the resting level of syntactic representations resulting in behavioural changes in linguistic performance (e.g., increased production of the primed target structure). This view also finds support from studies of other populations of speakers with grammatical processing difficulties. Rossi (in press) found evidence of structural priming of clitic placement in the speech of agrammatic L1 Italian speakers and argued that this effect could be explained in terms improved access to linguistic representations. That is, the priming intervention allowed agrammatic

speakers to more easily access linguistic information associated with the clitics and to appropriately place them in sentences.

The critical feature of activation level in MOGUL is also ideal in explaining the findings of Experiment 2 (Chapter 4). Along these lines the activation level of stranded prepositions in the minds of speakers in that experiment was raised through structural priming, leading to increased production of that structure. At the same time, speakers' baseline activation levels of null preps were *unchanged*, resulting in very little change in null prep production after the priming intervention. In the end after priming, speakers effectively had two competing grammatical representations activated at similar levels leading to output of both in apparent random variation. Truscott and Sharwood-Smith (2004) would refer to this variation as "optionality".

It appears that the current set of experiments constitutes one of the only empirical studies to link structural priming with Truscott and Sharwood-Smith's (2004) and Sharwood-Smith and Truscott's (2005) models of SLA and interlanguage development. Clearly however, the different priming results in the three experiments present difficulties in interpretation. Future research could further explore structural priming as means of learning through their theoretical framework.

6.3.5 The role of output in SLA

Finally, the findings of the three experiments in this thesis also speak to the role of production in language learning. According to VanPatten's (2007) IP model of SLA, and referred to in sections 6.3.1, 6.3.2 and 6.3.4, learner production is not essential to SLA and can even be detrimental to the acquisition process. On the other hand, other researchers and SLA theorists, such as Muranoi (2007), argue that output practice, (i.e., production activities) is critically important in SLA. What emerges from the findings of these experiments is that learners appear to be able to acquire a structure simply by repeatedly producing it in a range of contexts and with a range of lexical content, even without explicit instruction or even external exposure[14] to the target structure. Therefore, while acquisition might be *possible* without output, the increased production of the target by the control group in Experiments 1 and 3 clearly demonstrated that the participants'

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[14] The findings from Experiment 1 indicated that control group speakers primed *themselves* to produce the target structure, without external target structure input from external sources.

own output played a crucial role in increasing their target production rates. As the control groups produced the target structure in the treatment phase, they tended to also keep producing it in the post-test, albeit to a lesser extent than in the treatment phase but to a greater extent than in the pre-test. Recall that the control groups *did not receive any target structure input* in the experiments. The precise explanation for this effect is uncertain. Perhaps a form of self-priming might have played a role, or perhaps some existing syntactic knowledge was activated. The pedagogical implications of these findings are discussed in the next section below.

6.3.6 Structural priming as the seed of learning

One important point needs to be emphasised in relation to the findings of this thesis. That is that throughout the discussion of the findings and their potential relevance to L2 pedagogy, I do not claim that priming *is* learning (See section 1.8.1, Chapter 1), for this conclusion would be premature on the existing evidence. Clearly, a whole range of factors are important in acquiring L2 syntax. Rather, I propose that structural priming could be the seed of acquisition, the force that begins the acquisition and restructuring process, but nevertheless an important component of L2 syntax learning in certain circumstances. I elaborate on this conception of priming and its potential relevance to L2 pedagogy in section 6.4.7, in this chapter.

6.4 L2 structural priming and L2 pedagogy

One of the motivations for the research in this thesis was to investigate whether structural priming might lead to L2 learning. As a consequence, a discussion of how structural priming might be relevant to classroom practice is warranted.

6.4.1 Structural priming and repetitive practice

The findings of Experiment 2 (Chapter 4) revealed that learning of a syntactic structure through repetition can occur quite rapidly – within 20 minutes. That is, just by hearing, reading and repeating prime sentences learners can begin to acquire an L2 target structure, even in the absence of explicit instruction about the L2 structure. The findings of Experiment 1 (Chapter 3) also revealed a small amount of learning attributable to structural priming, either through exposure to prime sentences or to learner "self-priming" by repeatedly producing the target

structure, or both (see pages 21-23, Chapter 3). Learning through repetition in that experiment was also attributable to other factors (e.g., the increased salience of a noun phrase). From these findings then, it appears that implicit learning of L2 syntax is possible, and can be rather rapid, through repetitive production tasks.

These findings suggest that repetitive behaviour might be considered worthwhile in L2 classrooms. In many classrooms, L2 learners are typically encouraged to repeat a target structure in both communicative and non-communicative tasks, and in free and controlled activities. The findings from Experiment 1 in which patient saliency and speakers' topicalisation preferences induced speakers' to produce passives, suggest that language learners who engage in repetitive L2 production tasks might indeed learn to acquire (or at least produce more of) a certain structural feature even without exposure to all aspects of the target. More specifically, the findings suggest that repetitive production in the classroom without explicit instruction, in the form of a priming-type of production task, can be a legitimate and effective basis for structuring language learning activities to facilitate acquisition of syntactic structure.

Perhaps one of the most obvious applications of priming in the L2 classroom is within certain types of pairwork tasks. In this regard, several L1 and L2 structural priming studies have employed a so-called confederate scripting technique (see Chapter 1) in which speakers describe to each other pictures, either printed on sets of cards (Branigan, et al., 2000; Cai, et al., 2010; McDonough, 2006; McDonough & Mackey, 2008), on displayed on a computer (Bernolet & Hartsuiker, 2010), using a specific linguistic structure. This sort of task is very similar to an ordinary "information gap" language learning task commonly used in L2 classrooms usually with a focus on form or vocabulary but with a primary (or overt) focus on communication (understanding and producing descriptions of pictures). McDonough and colleagues have used this priming technique with learners of English in several studies and have reported significant priming effects whereby speakers tend to repeat the structure that their interlocutor (the confederate) just used. Examples include studies which have set up pairs of *learners* (i.e., another learner instead of a confederate) in a similar way and also demonstrated priming effects (McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009). Learners can be required to repeat the prime (i.e., production priming) as in McDonough (2006), or just listen to the prime (i.e., comprehension priming). The fact that priming effects were observed is evidence that

structural priming effects might in fact underlie the grammatical learning attributable to a range of common pairwork tasks in L2 classrooms.

6.4.2 Structural drills and language learning

Several decades ago, in the 1960s and 1970s, repetition of structure, in the form of repetitive and decontextualised structural drills, was emphasised in second and foreign language teaching (e.g., Belayev, 1963; Billows, 1961; Girard, 1972; Young & Nakajima-Okano, 1984). Drills and repetitive practice have often been associated with the Audiolingual Method, which emphasized the development of habits and instincts, defined as "an unconscious feeling for correct usage [of the L2]" (Billows, 1961, p. 154). Typically, these drills and related activities would focus on a single structure. They were also usually relatively decontextualised and non-communicative and designed to lead to oral fluency and automaticity for the target structure. Structural priming tasks appear to share some similarity with such an approach to L2 learning because priming and priming tasks are also designed to modify speakers' linguistic behaviour through repetition, through implicit means and in a relatively decontextualised manner. Beginning in the late 1970s however, the emphasis in language teaching shifted away from tightly controlled decontextualised drills and rote repetition to more communicative, contextualised and freer tasks with little emphasis on structural repetition. This shift was mainly because of a perceived lack of evidence for the effectiveness of drills and a rejection of behaviourist psychology (e.g., see Lamendella, 1979 for a criticism of Audiolingualism). I will propose below that structural drills and repetition can be viewed in a new light on the basis of evidence from L2 structural priming research.

Cook (2008, p. 242) defines drills as "a form of mechanical practice in which words or phrases are substituted within a frame and practiced until they become automatic". Drills, in particular structural drills, have received an enormous amount of criticism over the past few decades and have fallen so far out of favour that they are now hardly mentioned in SLA research, other than in descriptions of past methods, and then principally in a negative light. For example, in an 824 page volume on SLA, R. Ellis (1994, p. 60) includes only one reference to "drills" in the book's index, referring to the phrase "overdrilling", followed by a statement that "drills performed without consideration for meaning can also result in error". This single lonely reference suggests that in R. Ellis' view, drilling is at best largely irrelevant in second language acquisition, or at

worst has a negative or damaging impact on learners. Evidence for the wider status of drills in language teaching includes the widespread occurrence of the phrase "drill and kill" in the second language teaching literature in reference to drills. Furthermore, in a discussion of practice and focus on form(s) in SLA, DeKeyser (1998, p. 62) claimed that "drills seldom have anything to offer", even for developing automaticity in learners, and that (p. 59) "mechanical drills [are] a repetitive behaviour that is far from ideal in developing either declarative or procedural knowledge".

Many SLA researchers have assumed that there is also little or no psycholinguistic basis for drills. For example, DeKeyser (1998 p. 54) criticised the use of drills in language teaching on the apparent assumption that drills have no psycholinguistic basis:

> The behaviour actually engaged in by most students in most mechanical drills is not even a psycholinguistic behaviour in the sense of linking forms with meaning.

DeKeyser (1998) argued that drills are of no use because they apparently do not assist learners to make form-meaning connections, which according to DeKeyser are the essence of second language learning (see also VanPatten, 2002, 2007). However, DeKeyser (1998, p. 54) also acknowledged that in limited circumstances in which form-form connections are to be learnt (e.g., in DeKeyser's view: "some phonological and morphological rules") that mechanical drills might be useful. More recently however, DeKeyser (2007, p. 10) appears to have acknowledged the distorted demonisation and derision attached to drills and noted how even "talking about drilling" in SLA has fallen out of fashion, perhaps indicating a softening of his previous stance.

In further criticism, Wong and VanPatten (2003) go as far as to claim that drills are completely useless and without any empirical or theoretical basis [see Leaver, Rifkin, and Shekhtman (2004) for a rebuttal]. I argue however, that certain types of drills share similarities with typical structural priming tasks, which do lead to acquisition. Therefore, drills might also be expected to lead to acquisition.

> If, as I will later suggest, one assumes a link between structural drills and structural priming, it appears that DeKeyser's (1998) comment and Wong

> and VanPatten's (2003) claims are misguided: drills can indeed be boring
> and tedious but might in fact have some psycholinguistic basis.

This is to say that *specific* forms of repetition which involve multiple iterative lexical substitutions into a syntactic frame could be analogous to structural priming tasks like the ones carried out in this thesis. which appear to be effective for language learning. This assumption is consistent with the evidence so far from the main findings of this thesis and several other structural priming studies, and aligns closely with the type of repetitive drill most advocated by the Audiolingual Method – the substitution drill.

6.4.3 Substitution drills and structural priming

A substitution drill is arguably broadly similar to the type of activity engaged in by speakers in a structural priming task. These drills involve substitution of lexical elements into "slots" in a grammatical frame. L2 substitution drills can be conceived as reflecting a view of L1 sentence production involving "slots" and "sentence frames" along the lines suggested by M. F. Garrett (1975) and others (e.g., Bock, 1989). According to this view, sentences consist of syntactic frames (abstract sentence structures) with slots for open class words (vocabulary). Sentences are produced in a two stage process: a syntactic frame is activated and open class words are retrieved from the mental lexicon and "inserted" into the slots in this frame. In this way, syntactic and lexical processing occurs independently in sentence production.

Substitution drills (also called pattern drills) were supposed to focus on one structural feature at a time while allowing for substitution of lexical elements into the grammatical slots in the structure. This ensured that each sentence a learner heard and said was semantically different to the previous. It also helped to ensure that the learner's conscious attention was directed away from the target structure and toward the lexical or semantic content of the utterances (e.g., Lado & Fries, 1958; Rivers, 1968). In this way the method associated with substitution drills (and some other types of drills) was generally conducive to inductive learning of structure. This is reflected in the comments of Billows (1961, p. 165) who noted that the teacher "should sweep the pupil on through so many examples, so many experiences of the form, that there is no time to stop and reflect on anything but the situation", and that learners should be encouraged to allow their minds to "move rapidly in the language without reflection on the individual words or their

positions in the sentences" (p. 5). Thus, in this way, substitution drills were also intended to foster oral automaticity. During the 1950s and into the 1960s, substitution drills became regarded as one of the most effective ways for adult second language learners to acquire L2 sentence patterns. Reflecting this view, Lado (1964, p. 96) claimed that "oral substitution becomes the most useful and powerful drill available to practice the pattern". However, even early in this period of enthusiasm, some were warning of the need for careful construction and implementation of drills (e.g., Rivers, 1968, p. 103), perhaps suggestive of the danger of misuse.

Lado and Fries (1958) provided examples of substitution drills for use in classrooms. In one drill (Lado and Fries, 1958, p. 253) learners would practice English modal perfect, a structure which has long been known to be difficult for learners (e.g., Bowen & McCreary, 1977; Chou, 2000; DeCarrico, 1986; Swan & Smith, 2001). This drill, consisting of 12 repetitions of the structure, is presented below. These 12 prompts were designed to be used with the picture prompts in Figure 6.1 (taken from Lado & Fries, 1958, p. 253).

	Prompt	**Sentence response**
2.	Look at	He could have looked at the typewriter last night.
3.	Look for	He could have looked for the ink last night.
4.	Look at	
5.	Use up	
6.	Pick up	
7.	Use up	
8.	Look for	
9.	Use up	
10.	Fill up	
11.	Look for	
12.	Look for	

CHART V

(Introduced in Lesson VI)

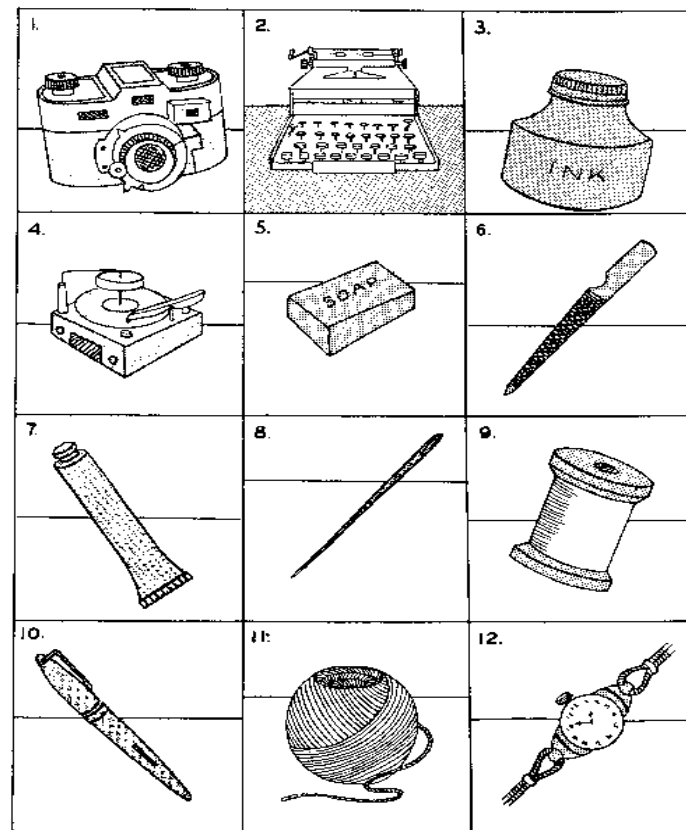| 1	2	3
camera [kǽmərə]	typewriter [táɪpraɪtər]	ink [ɪŋk]
4 record player [rɛ́kərd pleər]	5 soap [sop]	6 nail file [nel faɪl]
7 toothpaste [túθpest]	8 needle [nídəl]	9 thread [θrɛd]
10 pen [pɛn]	11 string [strɪŋ]	12 wrist watch [rɪst watʃ]

CHART V

Figure 6.1. Example of substitution drill picture prompts (taken from Lado & Fries, 1958)

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What is the relationship between substitution drills and structural priming tasks? Both types of tasks share some key characteristics, which are summarised in Table 6.1. The key similarities are: repetition, lexical substitution into a single syntactic frame, and implicitness. Rivers (1968) summarized the key characteristics of a good substitution drill; they turn out to be very similar to the target component of a structural priming task. First, reflecting one of these similarities in respect of the primacy of word order features in priming effects (see section 1.5, Chapter 1), Rivers emphasised that, when substitutions are made in a syntactic frame in a drill, no changes in word order should be made. Second, the purpose of effective drills should be to

> concentrate the attention of the student on one structural problem at a time and to provide him with a steady practice in handling this problem in various lexical contexts, without requiring him to give conscious attention to the details of the sequence (Rivers, 1968, p. 101).

Third, reflecting the irrelevance of morpho-syntactic features in structural priming (see section 1.5, Chapter 1 and section 6.4.7, this chapter), Rivers (1968, p. 101) also noted that in well-constructed and effective substitution drills that

> sometimes the insertion of a new item in one slot will involve a morphological change for an item in another slot (as with singular-plural, masculine-feminine adjustments in some languages, changes of person in relation to the verb, or adjustments devolving from a change of a preposition)

Perhaps one sticking point however in comparing the substitution drills and structural priming tasks is the dimension of implicitness. This difficulty I comparison is in spite of what Rivers (1968) argued about the lack of a need for conscious attention in effective grammatical substitution drills. In practice, most second language teachers would typically assume that drills should be explicit; learners must first be told what structure to produce to successfully complete the drill. However, this need not be the case. Indeed, the original advocates of drills (e.g., in the Audiolingual Method) emphasised an inductive approach in which learners' attention is placed elsewhere than the target structure, such as on lexical and semantic elements of utterances (e.g., Billows, 1961; Lado & Fries 1958; Rivers, 1968). According to Lado and Fries (1958, p. 105), Audiolingual drills should focus on "problem patterns with attention on something other than the

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problem itself". According to Billows (1961), explicit explanations were supposed to be given only after some level of automaticity and proceduralisation of the structure had occurred, while Lado (1964) argued that explicit explanations of grammatical rules were next to useless and result in little or no learning. This approach was supposed to engage the learner's "habit system" (Lado, 1964, p. 106). Rivers (1964) also argued that grammar teaching should be inductive. That is, learners should be acquainted with the formal details of the structures they are learning only *after* they had partially acquired them through a more implicit drilling process. Thus the teaching approach associated with these sorts of drills was highly implicit. Crucially, priming studies also rely on directing participants' conscious awareness away from the target priming structure while at the same time allowing them to repeatedly experience (and produce) the structure using different lexical items. Thus, substitution drills and priming tasks share not only the superficial characteristics of repetition and lexical substitution, but also, arguably implicitness. The relationship then between drills and structural priming tasks, although a rather subtle one perhaps when it comes to implicitness, is best viewed as one of degree rather than requiring that learning be either wholly explicit or implicit.

6.4.4 Structural priming, drills and rote repetition

Of course as their name suggests, substitution of different lexical items is the key to substitution drills. That is, these sorts of drills should not be considered an exercise in rote repetition. The importance for learning of alternating between different lexical items in substitution drills and structural priming tasks is underscored by evidence that long-term priming effects are stronger when lexical items alternate between prime and target in child L1 speakers (Savage, et al., 2006; Shimpi, et al., 2007) and L2 speakers (McDonough & Mackey, 2008). In a similar vein, McDonough and Mackey (2006) also found that immediate repetition in corrected recasts of learner errors was *not* associated with question development but structural priming was. R. Ellis and Sheen (2006) also more generally questioned the effectiveness of recasts, such as the immediate or delayed reformulation of an erroneous sentence, on the basis that present empirical evidence is inconclusive as to this method's effectiveness. Thus, there seems to be some converging evidence about the importance of maintaining some (lexical) creativity in repetitive tasks when it comes to L2 acquisition; rote repetition, whether in the form of "listen and repeat" drills or repetition of an instructor's corrected recast of a learner error, might not be an effective means of fostering L2 acquisition. Therefore, it is important not to confuse rote repetition with

the more creative repetition involved in substitution drills on the one hand and structural priming on the other.

One way of viewing the relationship then between drills and structural priming is to consider a priming effect as the seed from which acquisition subsequently develops (see sections 6.3.6 and 6.4.7 this chapter for more on this), along the lines apparently recently envisaged by McDonough and Trofimovich (2009). Such a view would be consistent with Truscott and Sharwood-Smith's (2004) and Sharwood-Smith Truscott's (2005) views of SLA in which activation levels of syntactic structures in implicit memory are raised through repetition, eventually leading to acquisition of those structures. In a similar way, substitution drills might be just an initial activity to raise cognitive activation levels of a target structure, later leading to further less constrained practice tasks with possibly even explicit instruction and eventual acquisition. Future structural priming research might explore possible similarities between these older (and now discarded) drill tasks and structural priming in language learning contexts.

Finally, one point needs to be made regarding the relative decontextualised nature of drills. Although many SLA researchers and language teaching practitioners proclaim the need for a focus on communicative contextualised tasks with a focus on meaning (e.g., VanPatten, 2002, 2007), several researchers have also acknowledged the possibility that learning of some aspects of a second language, most notably syntax, might best be suited to decontextualised classroom tasks which focus on form alone. Along these lines, Schmidt (1995, p. 15) argues that "learning some aspects of language probably requires or at least benefits from some degree of decontextualization, whereas others may not". This position appears to suggest that relatively decontextualised drills such as those referred to above indeed have a place in second language teaching.

Table 6.1. Comparison of substitution drills and structural priming tasks

Substitution drills	Structural priming production tasks
Lexical substitution into slots within a frame	Lexical substitution into slots within a frame
Little semantic connection between drill items	Structural repetition works best when lexical items alternate between prime and target
	Not dependent on lexical and semantic overlap
Implicit, fostering automaticity "an unconscious feeling for correct usage" (Billows, 1961, p. 154)	Implicit, automatic
	Unconscious behaviour
Minimal explicit instruction	Speakers receive no instruction to repeat
Designed to form "subconscious habits and reactions" (Girard, 1972, p. 68)	
Inductive learning	
NOT purely imitative (Rivers, 1968)	NOT conscious imitation
Relatively decontextualised	Priming is relatively "indifferent to the ideas being expressed" (Bock & Loebell, 1990, p.29)
Relatively non-communicative	Non-communicative
Grounded in psychological theory (Behaviourist psychology)	Grounded in psychological theory?

6.4.5 Possible pedagogical tasks incorporating structural priming

A possible pedagogical task might be the conversion into a substitution drill of the priming task in Experiment 2 involving stranded prepositions. Such a task could take the form described in Figure 6.2. In order to minimise the development of learners' conscious awareness for the target structure, and therefore ensure that the task retains a priming character, a range of measures could be undertaken. First, learners' conscious attention could be directed away from the target structure. Instead, they could be told the primary purpose of the task is to learn and practice a range of lexical items (e.g., *wallet*, *trolley*, *discuss*, *dummy*), or that the purpose of the task is to learn and practice relative clauses, or that they are simply learning to describe everyday objects. Care would need to be taken to not overload learners with difficult vocabulary however as Experiment 1 in the thesis demonstrated that dual tasks can negatively impact on priming effects. In addition, filler items which do not contain the target structure could be mixed among the target structure items to act as distracters.

Such a task could be implemented in several ways in a learning environment. One way would be for learners to complete the task in pairs with each learner alternately providing prime sentences for the other using printed cards as prompts along the lines of several L2 priming tasks previously employed by McDonough and colleagues and by Boston (2010). A brief period of teacher-led guidance would be helpful initially. Another way would be for learners to simply engage with a computerised version of the drill, as in Experiment 2. Specific vocabulary could be pre-taught.
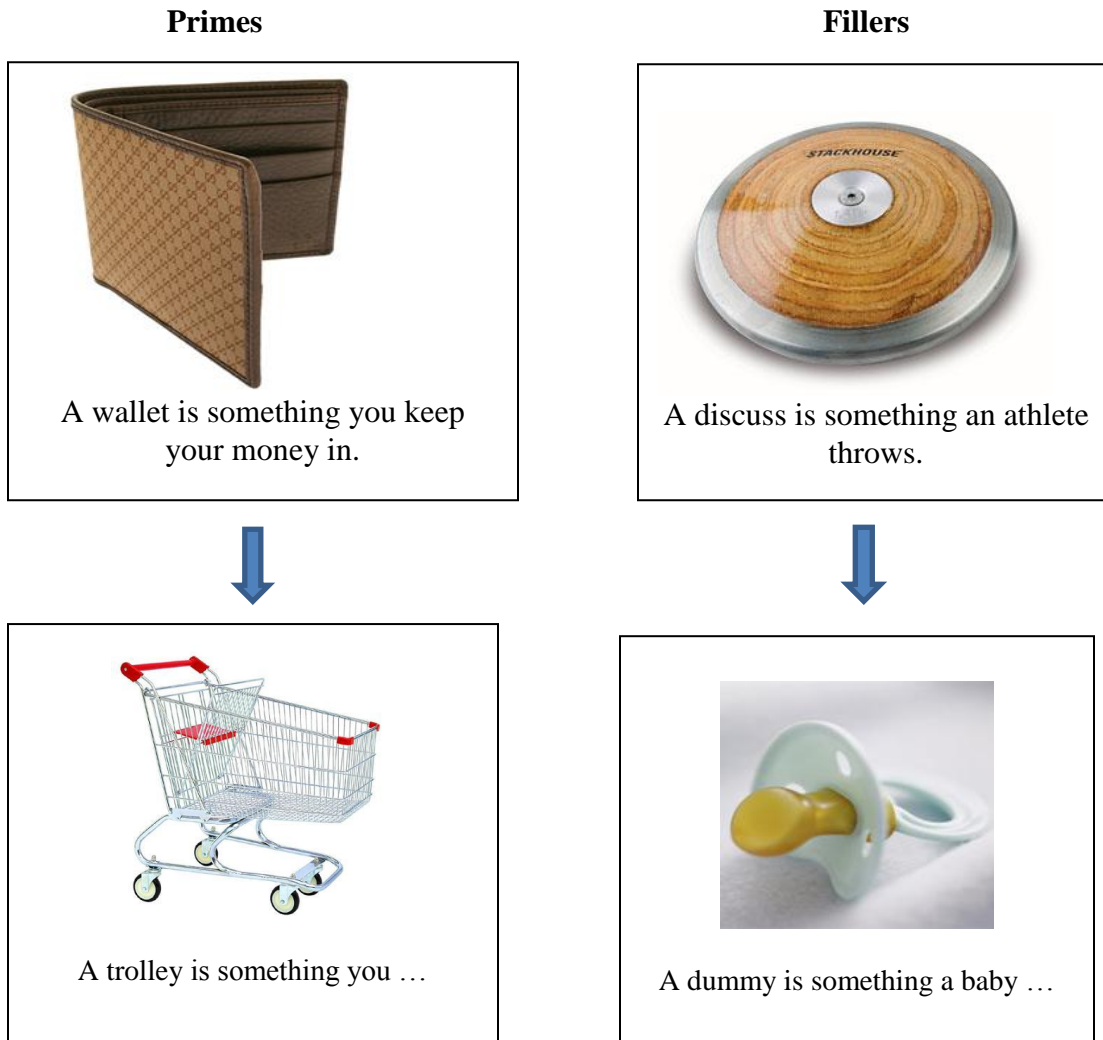
Primes

A wallet is something you keep your money in.

Fillers

A discuss is something an athlete throws.

A trolley is something you …

A dummy is something a baby …

Figure 6.2. Items for a substitution drill

Another possible classroom priming task would be to have pairs of learners alternately orally describe and match similar pictures. In this case, each learner might have a set of pictures of objects (e.g., tools and instruments) and they would alternately describe each of these objects to each other and match similar pictures as they do this. Each learner would a prime set of pictures, each with a prime sentence, and a target set without a sentence. Learner A might describe a shovel with a prime sentence such as *a saw is something you cut wood with*. Learner B would then have to search for a matching picture in their target set of pictures (e.g., *an axe*) and describe this picture with a sentence (e.g., *an axe is also something you cut wood with*). In order to make the task interactive, and to reduce the conscious focus on the target structure, the overt focus could be on an aspect of the task

other than on the target structure itself such as on the matching aspect. This sort of task might be used to overtly teach or recycle already-learnt vocabulary (nouns or verbs) but covertly teach the stranded preposition construction through a priming mechanism. The inclusion of filler prime and target pictures (e.g., *a bracelet is something you wear around your wrist / a necklace is something you wear around your neck*) would also serve to hide the target structure. An example set of pictures designed for a pairwork picture matching and description task can be found in Nation and Newton (2009, p. 102). However, these authors did not recommend using the pictures in this highly specific way.

6.4.6 Structural priming and computer-assisted language learning (CALL)

Several decades ago, going back to audiotape language learning laboratories and into the early days of using computers in second language teaching, curricula involving machine-driven language learning materials included liberal doses of repetitive drill-like tasks. However, as the emphasis in language teaching shifted away from decontextualised drills to more communicative and contextualised tasks, CALL software design also changed. These changes have resulted in CALL software typically attempting to simulate real-world communication and rarely utilising repetitive drills and decontextualised learning tasks.

While repetition and drill has generally fallen out of favour in language teaching in general including CALL, it is not entirely absent. Perhaps strangely, *vocabulary* learning has continued to rely heavily on repetition in both non-CALL and CALL contexts (e.g., Godwin-Jones, 2010), and there is quite a large literature discussing the effect of repetition and various drill-like techniques in vocabulary learning in both CALL and non-CALL contexts. N. Ellis (1995b) discussed the cognitive basis of implicit learning of vocabulary and its applications in CALL. In this context, he acknowledged that lexical priming is most likely a mechanism of L2 learning. However, N. Ellis did not mention the possibility that structural priming could also be a mechanism of L2 learning. This exploration of L2 vocabulary learning is exemplary of the recent concentration on vocabulary learning processes and the relative neglect of grammatical learning processes in the CALL literature as well. This focus on the lexicon also possibly reflects a more general focus in second language pedagogy recently on the lexicon as the driver of second language acquisition, with the question of syntax acquisition largely

thought to be either a by-product of lexically-based instruction, or brought about by explicit instruction of pedagogic "grammar rules". Around the same time, Warschauer and Healey (Warschauer & Healey, 1998, p. 59) also noted that drills were primarily important only for vocabulary learning in CALL:

> Drills do have a place in language learning, particularly in the first stages of vocabulary acquisition where giving the same information in multiple modes, such as visual plus aural plus textual, enhances recognition and recall.

A review of the current CALL literature however reveals little discussion about the value of repetition for learning L2 *syntax*. Perhaps reflecting the unpopularity and negative perceptions of repetitive drills in language teaching, and CALL in particular, Amaral and Meurers (2011) also specifically argued that grammatical substitution drills should *not* be included in CALL programs at all. In a review of past and current trends in CALL and reflecting these attitudes, N. Garrett (2009, p. 722) also commented that:

> in the past two decades, SLA theory and language pedagogy have so strongly privileged communicative teaching methods and activities that few developers have been interested in innovative drill-and-practice CALL.

However, N. Garrett (2009) argues that, on the basis that grammar instruction methods in CALL have largely remained unchanged for many years, it is time to rethink approaches to grammar instruction in CALL. Thus, it might be time to take a fresh look at repetition and drill-like tasks in CALL. This is where evidence from L2 structural priming studies might inform such a rethink. Also, in highlighting the need for psycholinguistic approaches to CALL research, N. Garrett (2009, p. 734) acknowledges that "the use of the computer to track the psycholinguistic processing of classroom SLA [is] relatively under-explored in our literature". Future L2 structural priming research with a CALL focus research might go some way to addressing this apparent gap in the literature. Unfortunately, any teaching approach remotely associated with grammatical drills often attracts the pejorative "behaviourist" label (e.g., Dettoria & Lupib, 2010; Warschauer & Healey, 1998), and as a

consequence is dismissed out of hand as somehow discredited and unworthy of any further consideration.

Evidence of rapid implicit learning through computer-based structural priming tasks in this thesis suggests that such tasks could indeed be (re)integrated into CALL design. In particular, learning appears to occur when lexical items are substituted in multiple iterations of a single syntactic frame (e.g., as in substitution drills). Computer-based language learning environments are ideal for learning through repetition and the phenomenon of structural priming provides a theoretical and empirical basis for such learning. The computer-based priming experiments described in this thesis could be adapted for use in a CALL learning environment to explore this area in a pedagogical context.

Notwithstanding their current deficiencies, chatbots (e.g., see Coniam, 2008) might be one medium through which structural priming could be implemented for language learning in CALL. Chatbots are responsive interactive avatars with which language learners can interact. They typically use pattern matching to facilitate chat, but at the moment the principal focus is only on matching lexical information. Perhaps in the future chatbots could also incorporate structural pattern matching to facilitate the repetition of syntactic structure in dialogue between the chatbot and a language learner. Along these lines a chatbot could be set up to covertly present multiple structural prime sentences to a learner in order to induce a priming effect in the learner for a particular structure. Such a conception has already been explored in an L1 structural priming study. In that study Hartsuiker, et al. (2008) used a simulated chat program in which to study L1 structural priming of Dutch dative sentences. Participants engaged in a picture description task with a computer on a sham basis: Participants were told they were interacting with an interlocutor in an online "chat". In reality however, the "interlocutor" was a computer program which generated written prime sentences and gave simulated evaluative responses to participants' written picture descriptions. The findings of this study revealed that speakers were structurally primed. This finding opens up the possibility of replicating such a structural priming task with L2 learners. Learners would engage in a simulation with a chatbot generated by a computer program. The chatbot would provide multiple iterations of the target structure in prime sentences, with the hypothesis that learners would be induced to (unconsciously) use (and learn) the target structure. The pedagogical implications of the findings of such a study might be revealing.

As an example of such a study, the priming study of Shin and Christianson, (2012) could be modified so that the primes would be presented to participants by a chatbot in a simulated chat (either written or aurally) along the lines of Hartsuiker et al.'s (2008) study. In this case separated phrasal verb primes (e.g., *The man is putting the fire out*) and double object dative primes (e.g., *The man is handing the singer a guitar*) would be presented by a chatbot controlled by a computer program. In a learning context, software might monitor learners' progression through the priming materials to determine whether or not they had been structurally primed. This last innovation is possible for written language (e.g., text chat), but is currently a challenging task for spoken language.

Structural priming might also be integrated into mobile language learning (MLL) environments. Research into MLL is a steadily growing but to date most studies appear to have focussed predominantly on vocabulary learning (e.g., Saran, Gölge, & Kürşat, 2012). It appears that very few studies have investigated MLL of grammatical structures. One way that MLL can operate is through a "push" process in which an instructor can pre-determine the frequency, quantity and spacing of input to learners, as in the study by Saran et al. (2012). Using a structural priming paradigm stimuli containing a specific structure(s) could be "pushed" through to the learner through the mobile device in a repetitive manner, either orally or in text, and learning might occur through a process of structural priming. Learners might then have the opportunity to respond orally or in text. Of course, a means of monitoring learners' output would also be required to ensure that any priming resulted in learning.

Overall, research has indicated that repetition of structure should not be overlooked as a legitimate learning method in CALL. Findings from the work in this thesis and other L1 and L2 structural priming studies have demonstrated that speakers' internal linguistic systems can be "tuned" to facilitate the understanding and production of a specific syntactic structure through repeated experiences. This view has also been alluded to by N. Ellis (1995a) who suggested an "implicit tuning" mechanism whereby repeated exposure to syntactic patterns might tune a learner's internal linguistic representations. Computer-based language learning environments might in one sense be ideal for learning through repetition, a notion that had significant currency some time ago. The

phenomenon of structural priming provides a theoretical and empirical basis for such learning and provides a concrete mechanism for previous more theoretical proposals about implicit tuning.

6.4.7 Pre-task priming and communicative language teaching

Structural priming need not be seen as a direct teaching technique however, leading to complete acquisition in and of itself. Rather, as described in the seed metaphor above, priming might be viewed as an initial first step in inducing learners to use and acquire a structure. Such a view might be termed "pre-task priming" (Boston, 2010). Although Boston found no priming effect for passives with Japanese-speaking L2 learners of English, it seems reasonable to investigate the possibility that other structures might be amenable to pre-task priming, especially given the similarly small priming effects observed for passives in Experiment 1 but large priming effects for stranded prepositions in Experiment 2 of this thesis. Learners could engage in a covert structural priming task, perhaps under the cover of a distracter task, then engage in a freer (perhaps more communicative) task, and their subsequent acquisition of the structure evaluated via a pre- and post-test design. Priming effects could be assessed and correlated with performance on the target structure. Following Truscott and Sharwood-Smith's (2004) and Sharwood-Smith and Truscott's (2005) models, in a production task the assumption would be that, if priming occurred, activation levels of the target structure representations would be raised in learners resulting in increased production of the target in the second (freer) task. Such production could then be compared to baseline production in a prior pre-test. One positive by-product of such an investigation is the relatively higher ecological validity compared to purely laboratory-based priming studies since the method more closely reflects classroom practice. McDonough and Trofimovich (2008) have previously referred to the need to increase the ecological validity of L2 priming studies.

One way to implement and investigate pre-task priming in the classroom might be to use either a standard structural priming task, as in Experiment 2, or a modified version as described in section 6.4.5. Shortly after doing the priming task, learners would then engage in a less structured freer task, such as the following, to give them opportunities to produce the target structure. In such a task, learners might be asked to perform a role play in which each person assumes an occupation (e.g., a gardener) and explains his/her special tools, clothing etc. to another learner using a set of picture

prompts for support. Target (and filler) sentences, each with an appropriate accompanying picture, might include the following:

This is the saw I cut the tree branches with (picture of saw)

This is the ladder I climb up to reach the branches (picture of ladder)

This is the lawnmower I mow the lawns with (picture of lawnmower)

These are the overalls I wear (filler) (picture of overalls)

This is the bin I put the rubbish into (picture of rubbish bin)

This is mask I wear on my face (filler) (picture of mask)

This is the truck I drive to work in (picture of truck)

This is the last customer I worked for (picture of customer)

At the same time, other learners would role play different occupations (e.g., a carpenter, mechanic, farmer, engineer, or cook) and share information with other learners. A third step might be for each learner to report back to the class about the function of various objects, thus recycling the target structure and maximising possibilities for its production. From a research perspective, this freer post-priming task could also form the basis of a post-test for investigative purposes. Learners' production of the target structure would be assessed in this freer task to see if priming had influenced their production and increased it vis-a-vis the pre-test.

Structural priming need not focus on sentence level target structures, but could be used to foster the acquisition of noun phrase structure for example. In a confederate scripting dialogic priming task employing picture description, Cleland & Pickering (2003) showed that L1 English speakers could be primed to produce either a pre- or post-modified noun phrase (e.g., either: *the red sheep*, or *the sheep that's red*) after hearing the respective phrase structure. This sort of task could also be adapted for use with L2 learners of English to tune their acquisition of both types of Noun phrase modification.

Finally, it is important to note that previous L1 structural priming research has found that priming effects are insensitive to information about tense, aspect and number (Pickering & Branigan, 1998). Moreover, this finding has been incorporated into some accounts of the mechanism of structural

priming (e.g., Cleland & Pickering, 2003; Pickering & Ferreira, 2008). This characteristic of structural priming suggests that pedagogical drills or other repetitive activities designed to exploit structural priming effects to teach tense or aspectual features of an L2 (e.g., English present perfect) are unlikely to be successful, at least in terms of a priming contribution. Rather, following Hartsuiker and Westenberg (2000), and Loebell and Bock (2003) word order and phrasal order (Hartsuiker, et al., 1999) are more likely to benefit from this sort of instruction.

6.4.8 Structural priming, cultural background and learning style

Many, even most, of the participants in this thesis came from East Asian cultural and linguistic backgrounds. Compared to westerners, learners from these backgrounds are reported to favour a relatively more didactic mode of education, in which rote repetition is valued (Dimmock & Walker, 2005, p. 110). The vast majority of participants were also students in a university English language centre, and were asked to engage in what for them was, on the surface, a computer-based language-related activity during the hours of their language courses. It would therefore have been unsurprising if participants had viewed the research activity as an extension of their other language learning activities and invoked their pre-conceived notions about education and learning and adopted a repetitive mode of behaviour. It is conceivable therefore that given this background and tendency, some of the participants might have been relatively more inclined to repeat the priming structure in the experiments, thus enhancing any priming effects. It also follows therefore that repetitive learning tasks such as the drills described above might also lead to significant levels of learning in such learners. This thesis did not set out to explore this aspect of priming or learning however, and such a conclusion is purely speculative. Future research could explore the effect of speakers' backgrounds in a systematic way to investigate possible culturally and L1-related differences in priming (see also section 6.6.3 below on individual differences).

6.5 Limitations of the present investigation and future research opportunities

A number of methodological issues were identified in the experiments in this thesis which might have impacted on the findings. Each of these is discussed in turn below and suggestions made for future research.

6.5.1 Randomisation of items

The current set of experiments did not randomise the items in either the priming phase or the pre- and post-tests. The only measure taken to control for order effects in the experiments was a counterbalanced reversal of the order of pre- and post-test items in which half the participants in each condition (control and experimental) saw the items in one order while the other half saw the items in the reverse order. However, this choice of a non-randomised presentation in the priming phase was not considered problematic for a study which investigated learning and focussed primarily on the behavioural changes as measured in the pre- and post-tests; it did not matter so much what happened within the priming phase itself. However, a randomised presentation of the items in that phase could have allowed an examination of the *time-course* of priming effects. Presumably, priming effects should build up as a session progresses and speakers are exposed to more and more prime sentences and produce more and more target sentences (possibly leading to self-priming effects) (Kaschak, Kutta, & Coyle, in press; Kidd, 2012). Kidd (2012) found for example, that structural priming in young L1 speaking children "built up" over the course of a priming session. Presumably, the same would occur for other developing speakers – namely L2 speakers. Future experiments could therefore incorporate randomisation of items to investigate this issue in L2 contexts.

6.5.2 Homogeneity of participants

The research participants in this investigation came from several L1 backgrounds. A mixed L1 group of language learners does have certain value in terms of bringing ecological validity to the study, since the group more closely reflects real-world groups of L2 learners. In fact, such a choice has been opted for in previous structural priming research (McDonough, 2006). Nevertheless, it is also true that the vast majority of participants in the experiments in this thesis came from L1 Chinese-

speaking backgrounds (Mandarin and Cantonese) and therefore were quite homogenous anyway. However, the inclusion of small numbers of speakers from other backgrounds (e.g., Thai, Arabic, and Japanese) limited the extent to which robust conclusions could be made about L2 structural priming of English in specific speaker groups, and clouded possible effects of L1 influence. It is possible for example, that individual speaker characteristics might influence the tendency to be primed (e.g., see Kidd, 2012). Future research could systematically investigate L2 structural priming of speakers from specific and homogeneous L1 backgrounds, and possibly compare priming effects in speakers from two or more L1 backgrounds.

6.5.3 Assessment of long-term learning

The experiments in this thesis did not shed sufficient light on exactly how temporally durable learning effects observed here might be, since only immediate learning effects were assessed in Experiments 1 and 3 (and only limited evidence was obtained from a delayed post-test in Experiment 2). Moderating such claims is the reality that most learning is clearly a process and typically occurs gradually rather than "all at once". Consistent with this assumption, I am not suggesting that structural priming *is* learning, rather that structural priming might be a *component* of the learning process for L2 syntax. I have attempted to expand on this claim in a more concrete way in terms of second language teaching in section 6.4.7 above.

Man researchers have argued however, that learning can only be reliably demonstrated in delayed post-tests that measure longer-term retention of learning, as opposed to immediate post-tests. Along these lines, R. Ellis (2008) argues that delayed post-tests are essential in SLA research for assessing learning in experimental interventions, a point also repeatedly taken up by McDonough and colleagues (McDonough, 2006; McDonough & Kim, 2009; McDonough & Mackey, 2008) in relation to calls for future L2 structural priming research. More recently, Shin and Christianson (2012) and McDonough and Chaikitmongkol (2010) are two studies to have answered this call and incorporated delayed post-tests to successfully demonstrate robust learning of L2 structure through priming. For mainly administrative reasons however, in this thesis only Experiment 2 included a delayed post-test. In the other experiments participants were generally unavailable for further research participation after the main task. Even in Experiment 2 the delayed post-test proved difficult

to implement: two or more weeks after the main task in that experiment, many of the research participants were unavailable to take part in the delayed post-test resulting in only 7 of the 20 experimental group participants actually taking part. Many of the other participants apparently did not see sufficient benefit in attending multiple research sessions. Among other things, this outcome highlights the difficulty in carrying out applied linguistic research with volunteer participants who are part of pre-existing language classes that are beyond the control of researchers. Appropriate institutional support which encourages L2 learners and speakers at universities and language centres to take part in research might go some way in helping implement delayed post-tests in complex multi-task research projects. Notwithstanding the difficulties, future structural priming research should attempt to include delayed post-tests where possible. The benefit for researchers is the potential to demonstrate much more robust and temporally stable structural priming treatment effects.

Notwithstanding the above limitations on claims about L2 learning, it should be noted that claims of learning based only on immediate post-test data are common in the structural priming literature, even in L2 priming studies (e.g., see Y. Kim & McDonough, 2008; McDonough, 2006). The key technical criterion for classifying priming effects as learning in a range of L1 and some L2 priming studies appears to have been changes in behaviour that have lasted for at least several minutes. This definition of learning is consistent with my definition outlined in Chapter 1. The underlying assumption is that if speakers change their language production preferences (or processing preferences) for this amount of time, they must have re-tuned their internal linguistic representations. That is, the changes cannot be a result of enhanced activation of linguistic representations alone, which are typically fleeting and last only for several seconds (Chang, et al., 2006). Therefore, on balance the findings of this thesis suggest that structural priming can play contribute to L2 learning. Nevertheless, future research could more fully explore the durability of learning through priming by including delayed post-tests.

6.5.4 Conscious awareness

To recap, several measures were taken in the experiments reported in this thesis to limit the development of participants' conscious awareness of the priming interventions and the critical prime

stimuli and to assess any possible conscious awareness that did develop. These measures included the inclusion of fillers, active distraction in the form of a cover task in one experiment (Experiment 1), withholding information from participants about the purposes of the experiments (see the appendices in chapters 3, 4 and 5 for instructions for research participants), a spacer task between the priming session and post-test, post-hoc tests of awareness for the critical features of the stimuli, and debriefing after the experimental session to detect possible awareness.

It is important to note that none of the tests of awareness detected any significant awareness in participants for the priming manipulation or that they had noticed the recurrence of the critical target structures. It is also important to note however, that these tests were administered *after* participants had completed the relevant section of the experiment and so only measured their awareness "after-the fact". This form of awareness testing has been quite severely criticised in the literature, most notably by Leow and colleagues (e.g., see Hama & Leow, 2010; Leow, 2007) who have advocated the use of concurrent tests of awareness such as think-aloud protocols in place of post-hoc tests of awareness. Schmidt (1995) has also criticised post-hoc tests for being rather useless and noted the problem of associating verbal reports and whether or not a speaker has noticed a linguistic feature (Schmidt, 1990). For these reasons Schmidt (1995) has argued that research into implicit learning (or learning without awareness) must demonstrate a lack of "awareness at the level of noticing" *at the time of learning*. Notably, Schmidt argues in his Noticing Hypothesis (Schmidt, 2001) that a learner might detect a critical feature without conscious awareness - "preconscious registration" as he puts it (Schmidt, 2001, p. 3) - and proceed to acquire that feature. The possibility of preconscious awareness would not be incompatible with a priming approach and my overall interpretation of the findings: what mattered most here was that participants, when probed, were unable to report awareness of the target structure and the priming manipulation. Therefore, one could reasonably argue that participants in the current set of experiments might have developed some temporary awareness during an experiment but, for whatever reason did not report this awareness. This interpretation of their verbal reports reflects a distinction made by some SLA researchers between awareness, perception and attention (e.g., see Schmidt, 1990, 1995), according to which people can perceive and attend to external stimuli but not be consciously aware of them.

For the purposes of this this, and in view of its pedagogical motivations, the possibility that participants were temporarily aware of the critical prime stimuli is not necessarily problematical. The fact that learners might have developed some fleeting and temporary awareness of the target structure at the time it was presented to them in the priming phase, or even during the post-test, does not reduce the pedagogical implications of the intervention and the importance of any learning which occurred (especially in Experiment 2). What the findings mean is that, regardless of any debate about the role of noticing and awareness in SLA, learners do not necessarily need to be told to pay conscious attention to or repeat a structure for them to learn it. Nor might they need to be explicitly taught the structure. What the findings of at least two of the current experiments show is that learners can simply begin a repetitive task which covertly focusses on a particular structure and, within 20 minutes have at least partially acquired the structure or altered their interlanguages. This conclusion has important consequences for language classrooms. Primarily, it suggests that teachers and learners can potentially avoid long grammatical explanations under the right learning conditions and thus save time for more productive (i.e., language production) classroom learning tasks. One of these conditions might be achieved through a structural priming activity. This, as I argued earlier (see sections 6.4.5 and 6.4.7), is perhaps one practical way to view structural priming activities: as a way of tuning learners' interlanguages through structured input and output. Alternatively, structural priming activities might be viewed as preliminary activities which alter the levels of activation of the target structure in the minds of learners prior to other types of tasks along the lines presumably envisaged by Boston (2010).

6.6 Adapting L1 structural priming methods to L2 contexts (and other methodological issues)

Adapting L1 structural priming methodologies to L2 contexts represents a challenge for studies of L2 priming. The primary reason for this challenge is differences between L1 and L2 speakers. L1 speakers are by definition stable speakers operating with minimal cognitive effort. L2 speakers in comparison, with the exception of stable bilinguals, have typically unstable language systems and operate under higher cognitive loads in their L2. These factors have implications for the design of psycholinguistic experiments for each group. In structural priming research the methodological

elements which require adaptation for each case include among other things: the number of stimuli and duration of experiments, and measures which assess and manipulate speakers' conscious awareness (e.g., cover tasks). For L2 structural priming research which investigates learning effects, control groups are also an important component. These issues will be dealt with in turn below.

6.6.1 Number of stimuli

Most L1 structural priming studies have incorporated large numbers of filler items to disguise the priming stimuli (e.g., Bock, 1986b; Bock, 1989; Bock & Griffin, 2000; Bock, et al., 2007; Ferreira et al., 2008). For example, Bock (1989) included equal numbers of fillers to primes: 128 filler sentences for 128 test primes; Bock (1986b) used more fillers than primes: 42 filler sentences for 36 test primes; while Bock and Griffin (2000) used many more non-critical sentences (fillers, foils and spacer items) than test primes: 139 to 48. Bernolet and Hartsuiker (2010) used an even higher ratio of non-critical stimuli to targets of 240 to 48 in a study of Dutch L1 speakers. These relatively high ratios of fillers to test items are typical of the stimulus sets used in L1 priming studies. L1 speakers would presumably have far less trouble progressing through such large numbers of stimuli without becoming fatigued than L2 speakers, who, particularly those who are less proficient, would have much great difficulty. Such fatigue and cognitive overload would be likely to result in changes in linguistic and cognitive performance during the experiment, possibly influencing priming effects.

Many L2 structural priming studies indeed appear to have consisted of modified L1 designs. At one extreme, speakers in one L2 priming study (McDonough & Kim, 2009) each apparently received approximately 40 primes (it varied depending on person), but did not include any fillers. Similarly, Boston (2010) also did not include any fillers among the 15 primes. Kim and McDonough (2008) however did include equal numbers (20) of active primes as fillers in a study of passive priming, while in one of the first L2 structural priming studies, McDonough (2006) included just over twice as many fillers as primes (26:12) and even included fillers within pre- and post-tests.

While it might be wise to limit filler numbers in L2 priming studies, some studies have used comparable numbers to the L1 studies. For example, in a similar L2 priming study (Shin & Christianson, 2012) to the current investigation, 72 filler sentences appear to have been used for just

48 test prime sentences (presented in pairs for each target), although interpretation of the method description in that study is difficult. This is a relatively high ratio but a somewhat smaller total number of stimuli than for comparable L1 studies. Thus, perhaps high ratios of fillers to test items are tolerable if the total number of stimuli is kept at manageable levels for L2 speakers.

6.6.2 Duration of the priming session

For L2 speakers with limited processing capacity, the length of experimental sessions would be extremely important. Yet, somewhat frustratingly, very few L1 studies appear to have reported on the length of the priming session. Some L2 priming studies also appear to neglect this issue by not reporting on the length of main priming session, but many have, perhaps because most L2 researchers are aware of the importance of managing this variable. Recent studies to have done this include: Shin and Christianson (2012) (60 minutes); Biria et al. (2010) (45-60 minutes); and (McDonough & Chaikitmongkol, 2010) (10-15 minutes); and (Y. Kim & McDonough, 2008) (60 minutes). Encouragingly, given the positive findings of these studies, it appears that both short and long priming sessions can be tolerated by L2 learners and may result in learning. Future research could strive to assess and report on the temporal limits of L2 priming sessions more rigorously

6.6.3 Individual differences in L2 priming

Many L1 structural priming researchers appear to have assumed a relative uniformity among L1 speakers in their tendency to be primed. However, one study by Kidd (2012) of young L1 English-speaking children (mean age 5.5 years) appears to be the first to have acknowledged and systematically investigated individual differences in structural priming. Assumptions about the relative uniformity of L1 speakers might be reasonably acceptable perhaps, but populations of L2 speakers and L2 learners are inherently much more diverse in terms of linguistic knowledge and proficiency, and in terms of differences in cultural and educational backgrounds and language experiences. In fact, L2 speaker populations, especially low proficiency speakers and language learners, are arguably inherently more variable than L1 populations. Therefore, one should expect to observe relatively higher individual variability in L2 language production than in L1 production. Reflecting the characteristic variability of L2 speakers, the question of individual differences in

discourse styles, linguistic performance, and learning styles are rich fields of enquiry in SLA research. Given this diversity, not all L2 speakers might display structural priming effects either. Many L2 studies have either intentionally or unintentionally minimised or attempted to control for this potential variability by examining L2 speakers from single L1 backgrounds, or stratifying participants into sub-groups based on proficiency (e.g., Y. Kim & McDonough, 2008). However, to my knowledge, no L2 structural priming studies have specifically and explicitly addressed the issue of individual differences in structural priming, and it appears that so far very little can be concluded about the issue. Further research could explore individual factors in L2 structural priming.

One implication of individual differences among participants is of methodological concern. As mentioned in Chapter 3 (section 3.5.3) and Chapter 5 (section 5.5.2), individual variability might have ensured relatively low statistical power. L2 populations are inherently less linguistically homogenous than L1 populations, particularly when sampling must occur from pre-existing groups such as from L2 classrooms. This inherent variability in L2 populations means that larger sample sizes should be required for L2 psycholinguistic research than for similar research on L1 populations. This added "complication" is even more significant for L2 psycholinguistic research involving L2 *learners*. However, in either of these L2 contexts this issue of statistical power does not seem to have been widely addressed in the literature. One way to reduce inter-participant variability and increase power might be to rigorously control for L2 proficiency through for example pre-testing. However, language testing is fraught, and language proficiency cannot always be accurately and reliably assessed even in the most objective and well-designed tests. It seems then that increasing sample size in L2 priming experiments, compared to comparable L1 experiments), is the easiest way to reach the appropriate level of statistical power, (e.g., see Howell, 2008). As explained in section 3.5.3, Chapter 3) however, 64 participants would be required in both the treatment and control groups in a replication of Experiment 1, resulting in a grand total of 128 participants (if group size was balanced). This large number of participants clearly presents additional problems of recruitment and exceeds the participant group size of most previous structural priming studies. In many L2 learner research settings it is not always straightforward to recruit and manage such large numbers of participants. For example, previous L2 studies with a single treatment group have included: McDonough and Chaikitmongkol (2010) with 42 participants; Shin and Christianson (2012) with 45 participants; and Kim and McDonough with 96 participants. For comparison, Bock and Griffin

(2000) included 72 participants and Bock and Loebell (1999) 92 participants. Clearly, structural priming studies with between groups design present challenges in this respect.

6.6.4 Need for control groups in L2 structural priming research

One rather surprising finding emerged from Experiments 1 and 3. In both experiments the control group, which did not receive any priming treatment and was not experimentally exposed to the target structure, also displayed increased production of the target structure compared to baseline levels. First, this outcome raises important questions about the need for control groups in second language research that explores pedagogical or pseudo-pedagogical treatments. When one looks at the sorts of priming trends in these studies one sees a very similar pattern to the one that would emerge if both groups had been combined in the in Experiments 1 and 3 in this thesis. That is, there is an increase in target production during the priming phase and then a slight drop again into the post-test phase. Therefore, one must ask the question whether previous studies had inadvertently captured some non-priming behaviour. Clearly, something other than a true structural priming effect might occur in speakers as they describe target pictures designed to elicit the target structure in a "priming phase" causing them start to spontaneously produce the target structure. In Experiment 1 this effect was explained in terms of the effects of saliency, animacy and topicalisation preferences of speakers. It is not clear what could explain the similar effect which also emerged in Experiment 3. Control groups might help adjudicate on these questions. It appears however, that many previous L2 structural priming studies have not included control groups in their designs. Biria, et al. (2010) appears to have been the only study to have included a control group which took part in a treatment phase but received only the target stimuli (i.e., not the primes). McDonough and Mackey (2008) included a control group but this group only completed the pre- and post-tests and did not have the opportunity to describe target pictures in the treatment phase. The "comparison" group in McDonough and Chaikitmongkol (2010) also apparently did not take part in any truly comparative activity, such as describing the same pictures that the experimental group saw, but instead engaged in completely different activities it seems. Future L2 structural priming studies would benefit from the inclusion of control groups, enabling more robust conclusions about the effect of structural priming on L2 acquisition.

6.7 Further research opportunities in L2 structural priming

6.7.1 Structural alternations for future L2 structural priming experiments

It is also evident that the range of structures so far investigated in structural priming studies is quite small. Specifically, some researchers have suggested that future L2 structural priming research which targets L2 learners should investigate priming of interlanguage/target structure alternations (e.g., McDonough, 2006; McDonough & Chaikitmongkol, 2010). For example McDonough (2006, p. 199) argued that "future studies need to investigate the occurrence of syntactic priming in contexts in which an interlanguage system provides a L2 speaker with a choice between structures that are not equally acceptable". This view of L2 priming reflects these researchers' focus on L2 learners (as opposed to L2 speakers) and also points to the need to modify methods employed in studies of L1 structural priming to suit the needs of studies of L2 learners. In Experiments 2 and 3 in this thesis I introduced such an interlanguage/target structure alternation – namely the null prep/stranded preposition alternation. However, what other alternations might be suitable for structural priming studies? One possible alternation might involve word order variation associated with non-inversion of an auxiliary in embedded English questions such as in (1) – the target form and (2) – an ungrammatical interlanguage variant.

(1) I don't know what that man is eating
(2) I don't know what is that man eating

Another possible alternation to investigate might be word order variation associated with non-inversion of the copula in imperative statements in English, as in the target form (3), compared to its ungrammatical interlanguage variants (4), (5) and (6).

(3) Look how big that tree is!
(4) Look how that tree is big!
(5) Look how big is that tree!
(6) Look how is that tree big!

The assumption would be that, depending on their stage of acquisition, many L2 English learners will incorrectly invert the copula in these contexts. Using the above target structures in a future study I plan to investigate whether learners can be primed to correctly place the copula in its correct non-inverted sentence-final position.

6.7.2 Adapting the experiments in this thesis to dialogic contexts

Following on from the rationale of McDonough and colleagues (e.g., McDonough & Chaikitmongkol, 2010) that structural priming effects might be associated with L2 interaction, it would be interesting to adapt the monologic design of the experiments in this thesis to a dialogic design. In particular, it would be interesting to investigate whether the strong priming effects observed in Experiment 2 (for stranded prepositions) in this thesis could be replicated in a dialogic design. Also, it would be worthwhile investigating whether *stronger* priming effects could be induced for the structures in Experiment 3 through a dialogic design.

6.8 Conclusion

Looking back at the research questions that drove the research in this thesis, one can tentatively conclude the following. First, structural priming is indeed possible in L2 contexts. Second, priming effects might vary depending on the target structure and syntactic context. Third, while it is still an open question whether structural priming *is* a form of language learning, or even whether it is the *basis* of L2 syntax learning, it appears indeed possible that structural priming is a component of second language learning, at least in the short term. An open question is the long-term durability of such learning effects for only relatively short-term learning effects were observed in this thesis; future research will be able to answer this question with more confidence. One point is noteworthy however. The learning effects observed in this thesis, particularly for stranded prepositions, were implicit and rapid.

Passives have been used previously in many L1 and L2 structural priming studies, priming effects for this structure are almost universally weak; the findings of weak priming effects in this thesis reinforce this conclusion. It is possible that other structures, such as stranded prepositions, might be

more suitable in L2 priming contexts. However, while stranded prepositions were subject to a priming effect in Experiment 2, the findings in Experiment 3 of weak effects for this same structure cloud this issue somewhat. Nevertheless, for L2 studies, interlanguage alternations, such as for example the null prep / stranded preposition pair, might be more suitable targets, especially for those studies which investigate possible learning effects through priming. Future studies will hopefully uncover other suitable structural features. On a theoretical note, the findings of Experiment 2 also revealed that interlanguage tuning does not occur all at once but that interlanguage and target forms can co-exist in speakers' minds.

The findings in two of the experiments (1 and 3) that control group speakers, who simply engaged in repetitive language production activity, also appeared to learn to produce the target structure suggests that direct exposure to the target input might not be necessary for learning to occur. Rather, under suitable conditions learners might be able to activate their own latent linguistic knowledge to facilitate the production of target language structures. This finding also has methodological implications for future L2 structural priming studies and points to the need for the inclusion of control groups.

Finally, the findings reveal that repetitive language production tasks, and structural priming tasks in particular, can contribute to facilitating L2 syntax acquisition. It is possible for example, that structural priming might form the basis of learning through repetitive drill-like tasks which focus on syntactic structure. Future pedagogical research might investigate this possibility.

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Appendix 3.1 Experiment 1: Test items

Target sentences in pre- and post-tests

The tree got cut down	The tree got cut down
The man got attacked by the dog	The man got attacked by the dog
The man got arrested	The woman got arrested
The man got bitten by the dog	The man got bitten by the dog
The woman got sprayed with water	The girl got sprayed with water
The (black) car got crushed by the tree	The (white) car got crushed by the tree
The boy got spanked by his father	The boy got spanked by his father
The wineglass got smashed	The wine bottle got smashed
The man got punched in the face	The man got punched in the head
The man got sunburned	The woman got sunburned on her back
The golfer got hit on the head by a ball	The baseball player got hit by the ball
The (female) soccer player got injured	The (male) soccer player got injured
The dog got thrown into the water	The man got thrown into the water
The deer got caught in the fence	The duck got caught in the net
The people got tied up	The lady got tied up
The man got chased by the dog	The boy got chased by the deer

Priming test items

Primes	Targets
The inattentive cyclist got hit in the intersection	The (Eiffel) tower got struck by lightning
The defiant child got punished by the stern teacher	The rabbit got caught by the fox
The inattentive tourist got robbed in the dark laneway	The boy got chased by a swarm of bees
The animals got burned in the dreadful bushfire	The town got flooded
The bothersome insects got killed by the campers	The protestor got dragged away by another man
The unfortunate boy got bitten by a venomous snake	The couple got married in the church
The reckless taxi-driver got fired by his boss	The soccer player got kicked in the head by another player
The notorious criminal got sent to prison	The vehicle got pulled out of the mud
The venomous snake got killed by the farmer	The boy got stung by the bee
The impertinent girl got blamed for the shameful incident	The soccer player got carried off the field on a stretcher
The reckless doctor got infected with a virus	The car window got smashed
The soldiers got attacked in the rugged mountains	The criminal got arrested by the police
The disruptive student got expelled from the exclusive school	The window got broken
The mischievous child got told to behave	The thief got bitten by the dog
The gallant soldier got shot in the stomach	The vehicle got covered in snow
The luxury vehicle got stolen from the car park	The rider got thrown off the horse
The reckless nurse got kicked out of the hospital	The black car got crushed by a tree
The prominent politician got elected by the people	The boy got given a present by Santa
The dog got run over on the congested street	The bird got caught in the net
The prominent actress got invited to the exclusive party	The soldiers got captured by some other soldiers
The prominent football player got selected for the final	The car's windscreen got smashed

Appendix 3.2 Experiment 1: Vocabulary cover task

Vocabulary list A

Circle the best synonym (a, b, c, d) for each of the following words.

	Word	a	b	c	d
1	**weary**	alert	bored	naughty	sleepy
2	**inattentive**	careful	relaxed	alert	careless
3	**stern**	intelligent	strict	sad	cheerful
4	**mischievous**	terrible	well-behaved	naughty	obedient
5	**bothersome**	pleasing	worried	personal	annoying
6	**venomous**	poisonous	harmless	offensive	very confident
7	**prominent**	notorious	well-known	unknown	secure
8	**shameful**	disgraceful	honourable	proper	respectful
9	**joyful**	glad	peaceful	hopeful	dreadful

Vocabulary list B

Circle the best synonym (a, b, c, d) for each of the following words.

	Word	a	b	c	d
1	**furious**	calm	cute	very angry	dangerous
2	**defiant**	strong	obedient	confident	disobedient
3	**congested**	regular	overcrowded	frequent	empty
4	**dreadful**	lovely	awful	very unhappy	severe
5	**shrewd**	criminal	wise	careless	immature
6	**reckless**	cautious	violent	unrestricted	irresponsible
7	**impertinent**	foolish	polite	important	disrespectful
8	**gallant**	weak	fearless	respectful	cowardly
9	**tranquil**	peaceful	noisy	motionless	asleep

Appendix 3.3 Experiment 1: Information sheet and consent form for experimental group participants

INFORMATION SHEET for PARTICIPANTS
Research Project: Learning words and sentences in a second language

You are invited to take part in a study of language learning. This research project is part of a PhD at the University of New England, under the supervision of Dr. Brett Baker (bbaker2@une.edu.au, (02) 67733220), Dr. Inés Antón-Méndez (iantonme@une.edu.au, (02) 67733765) and A/Prof Jeff Siegel (jsiegel@une.edu.au, (02) 67733202).

Aim of the Study:

In this study, I am interested in how people learn and use English vocabulary and grammar.

Time Requirements:

The study consists of two tasks – a main task and a delayed task. The main task takes about 50 minutes to complete, and the delayed task takes about 10 minutes to complete.

The Main Task:

The main task consists of three sections. You will be shown what to do, and you will have time to practice before you start each task.

1. In the first section, you will be given a list of 9 words and asked to choose a synonym for each. You will also be asked to describe 16 **pictures** displayed on a computer screen. Please try to describe what happened in each picture quickly and accurately **using a complete sentence**. Do not dwell too long on any one picture; try to use the first sentence that you can think of. You also do not need to describe each picture in great detail, so one sentence is enough. Please remember that there is no right or wrong answer and you should say any sentence that accurately describes what happened in the picture. Your oral descriptions will be recorded and later transcribed for analysis.

2. In the second section, you will see and hear **sentences, words** and **pictures** displayed on a computer screen. You should read, listen to, and repeat the sentences and words as accurately as you can, and describe the pictures. Once again, just as you did in section 1, please try to describe each picture quickly and accurately **using a complete sentence**, and try to use the first sentence that you can think of. Once again, there is no right or wrong answer and you should say any sentence that accurately describes each picture. Your oral responses to the words, sentences and pictures will be recorded and later transcribed for analysis. After the main task, you will be asked a few questions about your experiences in the task, and your responses will be recorded.

3. The third section is much the same as the first section. You will again be given a list of 9 words and asked to choose a synonym for each, and you will again be asked to describe 16 **pictures**.

The Delayed Task:

You may be asked to do a short follow-up task a few weeks after the main experiment at a time suitable for you. In this follow-up task you will again be asked to choose a synonym for 9 words, and describe some **pictures** displayed on a computer screen. Once again, just as you did in the main task, please try to describe each picture quickly and accurately **using a complete sentence**, and try to use the first sentence that you think of.

Participation is completely voluntary. You may withdraw from the research at any time and there will be no disadvantage if you decide not to participate or withdraw at any time.

The audio recordings will be kept in a locked filing cabinet at the researcher's office. The transcriptions will be kept in the same manner for five(5) years following thesis submission and then destroyed.

Research Process:

It is anticipated that this research will be completed by the end of 2012. The results may also be presented at conferences or written up in journals but no individual will be identified in any publication of the results.

This project has been approved by the Human Research Ethics Committee of the University of New England (Approval No. HE09/204, Valid to 15/12/2010)

Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at the following address:

Research Services

University of New England

Armidale, NSW 2351.

Telephone: (02) 6773 3449 Facsimile (02) 6773 3543

Email: ethics@une.edu.au

Thank you for considering this request and I look forward to further contact with you.

Regards

Mark Conroy

Consent Form for Participants

Research Project: Learning words and sentences in a second language

I, ..., have read the information contained in the Information Sheet for Participants and any questions I have asked have been answered to my satisfaction.   Yes/No

I agree to participate in this activity, realising that I may withdraw at any time. Yes/No

I agree that research data gathered for the study may be published and that my anonymity will be preserved in any published version of this project.   Yes/No

I agree to my responses being recorded and transcribed.   Yes/No

....
        Participant   Date

....
        Researcher   Date

Appendix 3.4 - Experiment 1: Information sheet and consent form for control group participants

INFORMATION SHEET for PARTICIPANTS
Research Project: Second language English speakers' language production

You are invited to take part in a study of language learning. This research project is part of a PhD at the University of New England, under the supervision of Dr. Brett Baker (bbaker2@une.edu.au, (02) 67733220), Dr. Inés Antón-Méndez (iantonme@une.edu.au, (02) 67733765) and A/Prof Jeff Siegel (jsiegel@une.edu.au, (02) 67733202).

Aim of the Study:

In this study, I am interested in how second language English speakers use English to describe pictures.

Time Requirements:

The study consists of three tasks. You will be shown what to do, and you will have time to practice before you start each task.

1. In the first section, you will also be asked to describe 16 **pictures** displayed on a computer screen. Please try to describe what happened in each picture quickly and accurately **using a complete sentence**. Do not dwell too long on any one picture; try to use the first sentence that you can think of. You also do not need to describe each picture in great detail, so one sentence is enough. Please remember that there is no right or wrong answer and you should say any sentence that accurately describes what happened in the picture. Your oral descriptions will be recorded and later transcribed for analysis.

2. In the second section, you will see **words** and **pictures** displayed on a computer screen. You should read, listen to, and repeat the words as accurately as you can, and describe the pictures. Once again, just as you did in section 1, please try to describe each picture quickly and accurately **using a complete sentence**, and try to use the first sentence that you can think of. Once again, there is no right or wrong answer and you should say any

sentence that accurately describes each picture. Your oral responses to the words, sentences and pictures will be recorded and later transcribed for analysis. After the main task, you will be asked a few questions about your experiences in the task, and your responses will be recorded.

3. The third section is the same as the first section. You will again be asked to describe 16 **pictures** displayed on a computer screen.

Participation is completely voluntary. You may withdraw from the research at any time and there will be no disadvantage if you decide not to participate or withdraw at any time.

The audio recordings will be kept in a locked filing cabinet at the researcher's office. The transcriptions will be kept in the same manner for five(5) years following thesis submission and then destroyed.

Research Process:
It is anticipated that this research will be completed by the end of 2012. The results may also be presented at conferences or written up in journals but no individual will be identified in any publication of the results.

This project has been approved by the Human Research Ethics Committee of the University of New England (Approval No. HE09/204, Valid to 15/12/2010)

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Thank you for considering this request and I look forward to further contact with you.

Regards

Mark Conroy

Appendix 3.5 Experiment 1: Post-task questions for participants

After completing Experiment, each participant was asked some of the following questions. The exact questions depended on each participant's initial responses and his/her perceived inclination to talk. (Some participants appeared reluctant to talk about their experiences). All participants were asked the questions marked with an asterisk (*).

* How did you go?

* Did you learn anything from this experiment?

If yes, what did you learn?

Did you notice anything special about the sentences or pictures?

* What pictures can you remember?

*Which picture(s) did you like the most?

What happened in those pictures?

Can you remember what you said when you saw those pictures?

What sentences can you remember?

Did you get stuck on any of the pictures or sentences? Which ones?

What words can you remember?

Did you get confused about anything in the experiment?

Did you get surprised by any of the pictures or sentences?

Do you have any questions?

Appendix 4.1 Experiment 2: Test items

Target sentences in pre- and post-tests

A mattress is something you sleep on

A bed is something you sleep on

A spoon is something you eat with

A fork is something you eat with

A fishing rod is something you catch fish with

A net is something you catch fish in

A chair is something you sit on

A bench is something you sit on

A pencil is something you write with

A pen is something you write with

A hook is something you hang things on

A coat hanger is something you hang your coat on

A cup is something you drink with

A mug is something you drink with

A mop is something you clean the floor with

A broom is something you sweep the floor with

A plate is something you put your food on

A bowl is something you put your food in

A drill is something you make holes with

A kettle is something you boil water with

A tent is something you sleep in

A sleeping bag is something you sleep in

Scissors are something you cut paper with

A knife is something you cut things with

Priming test items

Primes	Targets
A footpath is something you walk along	A sofa is something you sit on
A stool is something you sit on	A bike is something you ride on
A saw is something you cut wood with	A camera is something you take photos with
Music is something you listen to	A keyboard is something you type on
A queue is something you wait in	A pool is something you swim in
A doormat is something you wipe your feet on	A pillow is something you put your head on
A compass is something you navigate with	A bubbler is something you drink water from
A steering wheel is something you steer a car with	A vacuum cleaner is something you clean the floor with
A wallet is something you put your money in	A trolley is something you put your shopping in
A hammer is something you hit nails with	A coat rack is something you hang your coat on
A paddle is something you paddle with	A paintbrush is something you paint with
A hose reel is something you store a hose on	A picture frame is something you put pictures in
A ladder is something you climb up	A glass is something you drink from
A chainsaw is something you cut wood with	A thermometer is something you measure the temperature with
A notepad is something you write on	A stove is something you cook on
A seesaw is something children play on	A nest is something a bird lives in
A razor is something you shave with	A microphone is something you speak into
A wardrobe is something you store your clothes in	A trolley is something you carry things on
An ice-rink is something you skate on	A rocking chair is something you sit on
A needle is something you sew with	A shovel is something you dig with
Shears are something you trim plants with	A rubbish bin is something you put rubbish in

Primes

A house is something you live in

Soap is something you wash yourself with

A vase is something you put flowers in

Targets

A baby bottle is something a baby drinks from

An axe is something you cut wood with

A bag is something you put your things in

Target sentences in delayed post-test

Part 1

A hook is something you hang your clothes on

A bucket is something you put water in

A mop is something you clean the floor with

A purse is something you put your money in

A trampoline is something children jump on

A padlock is something you lock things with

A tent is something you sleep in

Scissors are something you cut things with

Scales are something you weigh things on

Chopsticks are something you eat with

A drill is something you make holes with

A pencil is something you write with

Part 2

The mattress was too smelly to sleep on

The road was too narrow to drive on

The doorway was too narrow to walk through

The chair was too wobbly to sit on

The spoon was too filthy to eat with

The light was too intense to look at

The pencil was too blunt to write with

The slope was too steep to walk down/up

The cup was too greasy to drink from

The swimming pool was too shallow to swim in

The window was too opaque to see through

The ice was too slippery to walk on

Appendix 4.2 Experiment 2: Information sheet for experimental group participants

INFORMATION SHEET for PARTICIPANTS

You are invited to take part in a study of language production. This research project is part of a PhD by Mark Conroy (mconroy@une.edu.au, (02) 67733517 at the University of New England, under the supervision of Dr. Inés Antón-Méndez (iantonme@une.edu.au, (02) 67733765) and A/Prof Jeff Siegel (jsiegel@une.edu.au, (02) 67733202).

Aim of the Study:

In this study, I am interested in how people use English to describe everyday objects.

Time Requirements:

The study consists of two tasks – a main task and a delayed task. The main task takes about 20 minutes to complete, and the delayed task takes about 10 minutes to complete.

The Main Task:

The main task consists of 4 parts.

On a computer screen, you will see pictures of familiar objects, and sentences and words which name and describe these objects. You should look at the objects, listen to the words and sentences, repeat the sentences, and describe the objects **using a complete sentence**. It's very easy, and you will have time to practice before starting the experiment so that you know exactly what to do.

The Delayed Task:

You may be asked to do a short follow-up task a few weeks after the main experiment at a time suitable for you. In this follow-up task you will again be asked to produce some sentences.

Your sentences will be recorded and later transcribed for analysis.

Participation is completely voluntary. You may withdraw from the research at any time and there will be no disadvantage if you decide not to participate or withdraw at any time.

The audio recordings will be kept in a locked filing cabinet at the researcher's office. The transcriptions will be kept in the same manner for five(5) years following thesis submission and then destroyed.

Research Process:

It is anticipated that this research will be completed by the end of 2012. The results may also be presented at conferences or written up in journals but no individual will be identified in any publication of the results.

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Regards

Mark Conroy

Appendix 4.3 Experiment 2: Information sheet for control group participants

INFORMATION SHEET for PARTICIPANTS

You are invited to take part in a study of language production. This research project is part of a PhD by Mark Conroy (mconroy@une.edu.au, (02) 67733517 at the University of New England, under the supervision of Dr. Inés Antón-Méndez (iantonme@une.edu.au, (02) 67733765) and A/Prof Jeff Siegel (jsiegel@une.edu.au, (02) 67733202).

Aim of the Study:

In this study, I am interested in how people use English to describe everyday objects.

Time Requirements:

The study consists of two tasks – a main task and a delayed task. The main task takes about 20 minutes to complete, and the delayed task takes about 10 minutes to complete.

The Main Task:

The main task consists of 3 parts.

On a computer screen, you will see pictures of familiar objects, and words which name these objects. You should look at the objects, listen to the words, and describe the objects **<u>using a complete sentence</u>**. It's very easy, and you will have time to practice before starting the experiment so that you know exactly what to do.

The Delayed Task:

You may be asked to do a short follow-up task a few weeks after the main experiment at a time suitable for you. In this follow-up task you will again be asked to produce some sentences.

Your sentences will be recorded and later transcribed for analysis.

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Email: ethics@une.edu.au

Thank you for considering this request and I look forward to further contact with you.

Regards

Mark Conroy

Appendix 5.1 Experiment 3: Test items

Target sentences in pre- and post-tests

The mattress was too uncomfortable to sleep on	The bed was too uncomfortable to sleep on
The water was too cold to swim in/dive into	The water was too dirty to swim in
The sofa was too dirty to sit on	The sofa wasn't clean enough to sit on
The music was too awful to listen to	The music was too awful to listen to
The water was too deep to drive through/in	The snow was too deep to drive in
The steps were too steep to walk up	The steps were too steep to walk up
The ice wasn't thick enough for the children to walk on/play on	The ice was too thin for the children to walk on/play on
The razor was too blunt to shave with	The razor wasn't sharp enough to shave with
The rubbish bin wasn't big enough to put any more rubbish in	The rubbish bin was too full to put any more rubbish in
The track was too dangerous to walk along	The alleyway was too dangerous at night to walk down
The road was too muddy to drive on	The road was too bumpy to drive on
The notepad was too wet to write on	The notepad was too wet to write on

Priming items

Primes	**Targets**
This airline was too dodgy to fly with	The tunnel/space was too narrow to crawl through
The beach was too dangerous to swim at	The pool was too shallow to dive into
The water was too murky to see through	The fence was too high to climb over

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Primes	Targets
The paintbrush was too stiff to paint with	The queue was too long to wait/stand in
The bridge wasn't high enough for the truck to pass under	The trampoline wasn't safe enough for the children to play on
The dog was too ugly to look at	The pencil was too blunt to write with
The flippers were too clumsy to walk in	The pillow was too firm to sleep on
The slope was too steep to ski down	The hotel was too expensive to stay at
The tyre was too flat to drive on	The sleeping bag was too cold to sleep in
The thermometer was too unreliable to measure the temperature with	The river was too rough to paddle the boat across
The city was too smoggy for some people to live in	The doorway was too small for the big man to go through
The soccer ball was too flat to play soccer with	The road was too icy to drive (a car) on
The well wasn't clean enough to drink from	The bridge wasn't safe enough to walk across
The keyboard was too small to type on	The house was too filthy to live in
The ladder wasn't stable enough for anyone to climb up	The seat wasn't big enough for the big man to sit in
The chair was too damaged to sit on	The window wasn't clear enough to see through
The man was too angry to talk to	The footpath was too slippery to walk on
The compass wasn't reliable enough to navigate with	The stove wasn't clean enough to cook on
The water was too deep to ride a bike through	The garage was too small to park the car in
The clothes rack wasn't big enough to hang all the clothes on	The knife wasn't sharp enough to cut the tomato with

Appendix 5.2 Experiment 3: Information sheet for participants

Using English as a second language

Information sheet for participants

You are invited to take part in a study of language production. This research is part of a PhD at the University of New England by Mark Conroy (mconroy@une.edu.au, 02 67733517), under the supervision of Dr. Inés Antón-Méndez (iantonme@une.edu.au, 02 67733765) and A/Prof Jeff Siegel (jsiegel@une.edu.au, 02 67733202).

Aim of the Study:

In this study I am interested in how second language speakers of English describe pictures.

Time Requirements:

There are two parts: Part 1 takes 10 minutes and Part 2 takes 35 minutes. You will do part 2 a few weeks after part 1.

What you will do:

In part 1 you will see 20 pictures on a computer. You should look at the each picture and say one sentence about the picture.

In part 2 you will again see some pictures on a computer, hear some sentences and also say some sentences to describe the pictures. Both parts are easy and you will be shown what to do. You will also have time to practice before starting each part so that you know exactly what to do.

Your sentences will be recorded for research purposes. If you wish, you will later be given feedback on your performance in this task.

Participation in this research is completely voluntary. You may withdraw from the research at any time and there will be no disadvantage if you decide not to participate or withdraw at any time. The audio recordings will be kept in a locked filing cabinet at the researcher's office. The transcriptions will be kept in the same manner for five(5) years following thesis submission and then destroyed.

Research Process:

It is anticipated that this research will be completed by the end of 2012. The results may also be presented at conferences or written up in journals but no individual will be identified in any publication of the results.

This project has been approved by the Human Research Ethics Committee of the University of New England (Approval No. HE09/204, Valid to 15/12/2012). Should you have any complaints concerning the manner in which this research is conducted, please contact the Research Ethics Officer at the following address:

Research Services

University of New England

Armidale, NSW 2351.

Telephone: (02) 6773 3449 Facsimile (02) 6773 3543

Email: ethics@une.edu.au

Thank you for considering this request and I look forward to further contact with you.

Regards

Mark Conroy

Appendix 5.3 Experiment 3: Post-task questions for participants

Questions for the Hong Kong group

Your research participation

Over the last few weeks you did two tasks involving looking at pictures and saying sentences in English. Please answer the following questions.

What do you think was the purpose of the research?

Did you learn anything from the tasks? If yes, what did you learn?

Questions for all participants

What did you think?

What did you learn?