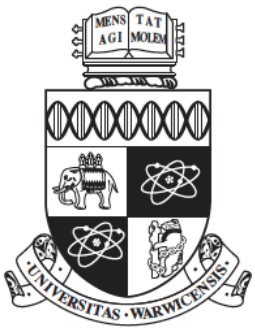

An exploration of second language learning via syntactic priming

by

Marion Coumel

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Declaration

This thesis is submitted to the University of Warwick in support of the application for the degree of Doctor of Philosophy in Psychology. It has been composed by the author and has not been submitted in any previous application for any degree. The work presented (including data collection and data analyses) was carried out by the author. Parts of this dissertation have been adapted, prepared for publication and submitted to journals by the author:

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Abstract

This dissertation investigates the psycholinguistic mechanisms supporting and the factors influencing second language (L2) learning via syntactic priming, speakers' tendency to re-use the syntactic structure of recent sentences in subsequent language production.

One set of studies explores the mechanisms that support priming as L2 learning. Chapter 2 tests the predictions of two influential psycholinguistic language learning models of syntactic priming. Although the results do not clearly favour one of the two models, they indicate that priming fosters L2 long-term learning and that explicit processes may contribute to this learning. Chapters 3-5 explore how individual differences in attention and motivation influence syntactic priming. Overall, self-reported attention and motivation do not relate to L2 priming and learning but instructing participants to pay attention to the syntax of stimuli specifically seems to increase immediate priming. Chapter 4 also reveals that priming magnitude is affected by the frequency with which the target structure is used across modalities (in written vs. spoken language), but long-term language learning can arise both from written and spoken prime sentences.

Two further studies extended these investigations to more naturalistic contexts. Chapter 6 was designed to investigate classroom-based priming and learning across teaching settings and depending on students' attention and motivation. Based on the current (incomplete) results, it remains unclear whether priming varies between teacher-to-students and student-to-student, and between comprehension-to-production and production-to-production priming conditions. Data completion is required to explore the effect of individual differences in this study. Chapter 7 examines learning via syntactic priming of multiple simultaneously-targeted structures depending on L2 speakers' conscious decisions to use or avoid them and on their prior knowledge. This study shows that in written chat-based interactions, learners do experience equivalent priming and learning for multiple structures. Prior knowledge and decisions do not affect immediate and long-term priming, but they modulate structure production. Specifically, the results suggest that participants overall produce more the structures that they are the most familiar with and that they choose to use.

This thesis demonstrates that syntactic priming supports language learning for multiple structures, across language combinations and priming contexts. As it investigated the nature of L2 learning via syntactic priming and the factors influencing this learning, it has both psycholinguistic and pedagogical implications. The studies reveal that priming, learning and overall structure production during priming tasks rely on both explicit and implicit processes. They also shed light on how to best implement priming activities to facilitate language learning. For example, priming fosters learning regardless of the modality of the interaction and this learning is larger when the priming task targets only one structure at a time.

Chapter 1

Introduction

Learning a second language (L2) seems essential, almost indispensable, nowadays. Moving abroad for education, for work, travelling for leisure, and globalization, have made more societies multilingual and, as a result, more and more people need to be able to communicate in an L2. Yet, learning an L2 is challenging. An individual who starts to learn a language during their adolescence may struggle to use the L2 syntax, even after years of practice. Learning this linguistic aspect is particularly important because it contributes to how comprehensible L2 speakers sound to native (L1) speakers (e.g., Suzuki & Kormos, 2020). It is therefore necessary to understand how people acquire syntactic knowledge in the L2.

One way through which learners may acquire syntactic knowledge in the L2 is by experiencing syntactic priming effects (e.g., McDonough & Mackey, 2008; Trofimovich & McDonough, 2011; see Jackson, 2018 for a review of syntactic priming in L2 speakers). Syntactic priming in language production is the tendency of speakers to re-use the syntactic structure of recently perceived sentences to formulate subsequent sentences (Bock, 1986). To observe and measure this effect, researchers expose participants to a series of prime sentences that contain one of the following: a specific target syntactic structure (such as a passive form, e.g., “the robber is being tickled by the surgeon”) or its syntactic alternative (in that case an active form, e.g., “the surgeon is tickling the robber”). In this specific example, participants would display syntactic priming if they were more likely to produce target sentences in the passive form after a passive prime than after an active prime. Research has shown that such effects lead L2 speakers to use the targeted form(s), which could be complex structures or structures they never use, more accurately and more frequently both during and after a syntactic priming task (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008; McDonough & De Vleeschauwer, 2012). As such, psycholinguists and applied linguists have identified syntactic priming as a possible L2 learning mechanism and L2 teaching tool.

However, the exact mechanisms through which syntactic priming supports L2 learning and which factors affect this learning remain largely unclear. The aim of this thesis is to explore these knowledge gaps in order to inform current psycholinguistic theories of syntactic priming, our understanding of L2 learning processes, and L2 pedagogical practices.

1.1 Language learning via syntactic priming: evidence and mechanisms

Syntactic priming is a ubiquitous phenomenon that researchers have observed for various structures and languages, across modalities and across groups of speakers (see Gries & Kootstra, 2017; Jackson, 2018; Mahowald et al., 2016; Pickering & Ferreira, 2008 for reviews). However, its magnitude, its duration and even the likelihood of it arising at all vary widely across these contexts. There is as a result no full consensus over the exact psycholinguistic mechanism responsible for syntactic priming effects.

In order to process and produce a given syntactic structure, a speaker needs to possess, have access to and be able to retrieve its corresponding syntactic representation. Early psycholinguistic models postulated that syntactic priming arises due to transiently facilitated retrieval of such representations. According to the Residual Activation theory (Pickering & Branigan, 1998; Pickering & Ferreira, 2008), exposure to a syntactic form increases the level of activation of a speaker's syntactic representation for that form. This enhanced activation makes the syntactic representation more available for immediate subsequent language production, thereby triggering syntactic priming effects.

However, since the early 2000s, researchers have hypothesized that syntactic priming may also support language learning. Bock and Griffin (2000) observed that L1 speakers experienced significant priming even with intervening unrelated filler sentences between prime and target sentences. This revealed that priming made target structures more available not just immediately after exposure to primes, but also for later re-use. Such long-term effects indicate that priming fosters changes in speakers' language system and syntactic representations that persist over time (see also e.g., Hartsuiker et al., 2008; Kaschak et al., 2011).

Psycholinguists have designed two types of accounts to explain language learning via syntactic priming. Error-based models (Chang et al., 2006, 2012; Dell & Chang, 2014; Jaeger & Snider, 2013) argue that, when comprehending language, speakers predict upcoming words (Chang et al., 2006, 2012) or sentences (Jaeger & Snider, 2013), based on their knowledge of and experience with the target language. These predictions are compared to the actual language input. If the predictions and the syntactic structures perceived in the language input do not match each other, speakers' language system generates an error signal. This error signal triggers modifications in the weights connecting message-level representations and syntactic representations. Specifically, the weightings of recently perceived syntactic structures are increased. These structures thus become more available for subsequent language production and speakers become more likely to re-use them to express similar messages in the future. This also reduces speakers' likeliness to experience further prediction errors. Long-term priming effects occur because these changes are long-lasting. Error-based models also predict that the magnitude of priming, since it increases with the size of the error signal, should be larger for unfamiliar structures: speakers' predictions are more likely to be erroneous with structures they are not familiar with or which they have only experienced infrequently. This explains the inverse frequency effects reported in the literature whereby, when considering a syntactic alternation, L1 speakers tend to prime more on the structure of the alternation they are the least familiar with (e.g., Hartsuiker & Westenberg, 2000; Jaeger & Snider, 2008). For example, Kaschak, Kutta and Jones (2011) tested participants whose use of dative forms was naturally biased towards producing more Double Object (DO) datives (e.g., "Meghan gave Michael the violin") than Prepositional Object (PO) datives (e.g., "Meghan gave the violin to Michael"), and found that they showed larger cumulative priming for PO than for DO datives. Because such inverse-frequency effects show that speakers' likelihood to prime depends on their state of knowledge (i.e., speakers experience the most learning with structures they have the least knowledge of), they constitute further evidence that syntactic priming supports language learning (Ferreira & Bock, 2006).

Other language learning models of syntactic priming combine features of the activation-based models (Pickering & Branigan, 1998; Pickering & Ferreira, 2008) with a learning architecture (Malhotra et al., 2008; Reitter et al., 2011). In the model of Reitter et al. (2011), the syntactic nodes associated with syntactic structures have

a certain base-level activation which is determined by speakers' familiarity with the structures. For instance, the syntactic nodes of familiar structures will have high base-level activation. Exposure to a syntactic structure triggers spreading activation from the working memory buffer to the corresponding syntactic node in long-term memory. This leads to an increase in the base-level activation of the syntactic node in long-term memory, which makes the structure more available both for immediate re-use, thereby generating immediate priming effects, and for later production, which in turn leads to long-term learning. This account explains inverse frequency effects by the fact that syntactic representations for frequent structures have higher base-level activation than those of less frequent structures. Therefore, exposure to frequent structures triggers smaller increases in activation, and hence less learning, than exposure to less frequent structures. Malhotra et al.'s hybrid model (2008) similarly accounts for priming in terms of memory traces and incremental adjustments in base-level activation of syntactic representations. Given that it does not represent syntactic structures, but rather retrieves them from a look-up table, this model seems however to only explain syntactic priming for a limited number of syntactic alternations.

Overall, psycholinguists have designed syntactic priming models to account for the lasting influence of experienced syntax in L1 speakers (e.g., Reitter et al., 2011), and for first language acquisition in children (e.g., Chang et al., 2006). Given this entails models with a learning architecture, it raises the question as to whether such effects can explain language learning in L2 learners as well.

1.2 Syntactic priming in L2 speakers

Researchers have mainly used L2 or bilingual syntactic priming tasks to investigate the nature of syntactic representations and language processing in bilinguals. A large part of this field is dedicated to understanding whether syntactic representations are shared across languages (e.g., Bernolet et al., 2013; Hartsuiker & Bernolet, 2017; Huang et al., 2019; Hwang et al., 2018; Muylle, 2020; Schoonbaert et al., 2007), or whether cross-linguistic transfer affects L2 syntactic processing (e.g., Flett et al., 2013; Hopp & Grüter, 2021; Jackson & Ruf, 2017; Kaan & Chun, 2017). Based on the assumption that syntactic priming is a language learning mechanism, another strand of research has focused on either using priming to understand the mechanisms

of language learning (e.g., Weber et al., 2019) or on studying L2 learning via syntactic priming (e.g., McDonough & Chaikitmongkol, 2010). The latter direction is the focus of this thesis.

1.2.1 Evidence for L2 learning via syntactic priming

Like L1 speakers, L2 speakers experience language learning via syntactic priming: L2 speakers exhibit long-term priming effects. For instance, Korean L1 speakers manifest significant priming for English DO datives and separated phrasal-verb constructions with a post-object particle (e.g., "The man is putting the fire out") both when prime and target sentences follow each other and when they are separated by four to five unrelated fillers (Shin & Christianson, 2012; see also Bernolet et al., 2016; McDonough & Kim, 2016). Similarly, L2 speakers' production of target structures increases between pre- and post-tests, both in post-tests performed immediately after the priming task (e.g., Grüter et al., 2021; Jackson & Hopp, 2020; Jackson & Ruf, 2018; McDonough, 2006; Ruf, 2011) and in post-tests completed up to a few weeks afterwards (e.g., Hurtado & Montrul, 2021a; Kim et al., 2019; McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012). L2 speakers also experience cumulative priming effects, whereby their magnitude of priming increases as the number of times they have encountered the target structure increases (Jackson & Ruf, 2017; Kaan & Chun, 2017). This set of findings reveals that priming activities foster long-term changes in learners' L2 syntactic representations.

L2 speakers also exhibit inverse-frequency effects. Korean L1 speakers show for example more cumulative priming for English DO datives than for PO datives (Kaan & Chun, 2017), even though previous literature indicates that they prefer the latter construction (McDonough, 2006; Shin & Christianson, 2012). Hence, although some research suggests that learners may need to have some minimal knowledge of a dispreferred structure in order to manifest immediate and long-term priming (Jackson & Ruf, 2017; McDonough, 2006), priming tasks foster practice and learning of structures L2 speakers spontaneously disprefer (Hurtado & Montrul, 2021b; Kim & McDonough, 2008; McDonough & Fulga, 2015; Shin & Christianson, 2012; but see Hurtado & Montrul, 2021a for a discussion of L2 frequency effects). In other words, priming makes L2 speakers acquire new form-meaning mappings, i.e., new syntactic ways to express a given meaning.

Finally, there is evidence that syntactic priming helps L2 speakers learn how to accurately produce a syntactic form. Upon exposure to a series of well-formed instances of a target syntactic structure (e.g., “What did you do yesterday?”), learners tend to adopt that well-formed version of the structure and to reduce their production of the non-nativelike alternative (e.g., “What you did yesterday?”) (e.g., McDonough & Chaikitmongkol, 2010). The most often studied structure in this context has been direct English Wh-questions (Kim et al., 2020; McDonough & De Vleeschauwer, 2012; McDonough & Mackey, 2008; McDonough & Kim, 2009; McDonough & Chaikitmongkol, 2010), although Kim et al. (2020) targeted indirect questions as well (e.g., “Do you know why your body needs vitamins?”) and Kim et al. (2019) stranded prepositions (e.g., “This is something (which) you take cookies from” vs. “This is something which you take cookies”). Priming therefore seems to support L2 syntactic learning in terms of inclusion of syntactic constituents, as well as ordering of thematic roles (e.g., for passives or datives). However, since priming is insensitive to variation in tense, aspect (e.g., Pickering & Branigan, 1998) or case marking for instance (e.g., Muylle, 2020), it seems unlikely that priming activities would promote the acquisition of L2 morphosyntactic knowledge (McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012; but see Michel & Stiefenhöfer, 2019 for instance).

These findings overall demonstrate that L2 priming tasks support L2 learning by fostering more frequent and more accurate use of dispreferred and unfamiliar L2 syntactic structures, both during and after a priming task. This designates priming activities as a potential L2 teaching tool.

1.2.2 Syntactic priming tasks for L2 teaching

Language instructors can incorporate syntactic priming methods into various teaching tasks to support the acquisition of L2 syntactic knowledge (see for instance McDonough & Chaikitmongkol, 2010 or Trofimovich et al., 2013). For example, teachers may integrate syntactic priming into meaning-focused activities such as information-exchange tasks (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough & de Vleeschauwer, 2012; Trofimovich et al., 2013). Doing so can help implement Communicative Language Teaching, the pedagogical approach

which the Council of Europe (Council of Europe, 2009) advocates, according to which instructors should teach languages while focusing on communication, rather than on their formal aspects. Priming methods also provide a mean to teach target grammatical forms implicitly, since learners experience priming for a given L2 structure even without grammar instruction about the target structure (e.g., McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012).

Additionally, according to the Interaction hypothesis in Second Language Acquisition (SLA) research, peer-to-peer interactive activities are particularly well-suited to foster L2 learning (Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994), but priming can improve and make such activities more efficient in this regard. First, priming tasks can foster language learning without requiring learners to give each other feedback, to produce the output with modifications or to discuss the structures (Trofimovich et al., 2013). Furthermore, teachers can use priming manipulations to ensure that, even with minimal supervision, students practice new, accurate and complex grammatical structures in such settings (McDonough, 2006; Trofimovich et al., 2013), even though they tend not to do so spontaneously during peer-to-peer tasks (Bruton, 2005; McDonough & Chaikitmongkol, 2010; Swan, 2005). To illustrate, McDonough et al. (2015) implemented priming activities to boost learners' use of relative clauses (e.g., "Unhappiness in marriage is convincing evidence that they will divorce") and adverbial clauses (e.g., "when their children are aged 8-12"), rather than of less complex prepositional phrases (e.g., "Unhappiness in marriage is convincing evidence of divorce"), or noun or prepositional phrases respectively (e.g., "for children between the ages of 8 and 12 years") in collaborative tasks.

Finally, syntactic priming tasks make learners comprehend and produce L2 structures with a variety of lexical items. This may help them acquire abstract syntactic representations that are not only linked to specific lexical items (McDonough, 2006; McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008; Trofimovich et al., 2013).

To summarise, there is ample empirical evidence that syntactic priming supports L2 learning. Priming activities seem, as a result, a valuable tool to foster learners' acquisition of L2 syntactic knowledge and to help teachers build L2 learning activities. However, which exact psycholinguistic mechanisms underlie L2 learning

via syntactic priming, as well as which task characteristics modulate such learning remains to be fully understood. I discuss these knowledge gaps specifically in the next two sections and indicate the research questions addressed in this thesis.

1.3 The nature of L2 syntactic priming and learning

1.3.1 Comparing the language learning models of syntactic priming

Though psycholinguists have designed at least two types of models to account for language learning via syntactic priming, i.e., error-based learning models (e.g., Chang et al., 2006) and hybrid models (e.g., Reitter et al., 2011), it is unclear which of these two accounts best explains current empirical findings. To my knowledge, most empirical studies focus on testing the error-based accounts of priming (see for instance Jackson & Hopp, 2020; Grüter et al., 2021), while no study has directly compared the predictions of this model against the similar, but not completely overlapping predictions of the hybrid account (Reitter et al., 2011). Examining the mechanisms behind priming is however important to understand how L2 learning occurs and how it can best be achieved through using priming as a teaching tool.

Both the error-based and the hybrid models predict that speakers should experience long-term priming effects. Moreover, when tested in the same language, individuals who are less familiar with the targeted structures, such as L2 speakers, should exhibit larger priming magnitudes than more experienced users of the language, such as L1 speakers (see for instance Jackson & Hopp, 2020; Ruf, 2011). Due to their inexperience, in Chang et al.'s (2006) model, L2 speakers should experience larger prediction error than L1 speakers and such errorful predictions drive the priming and learning process (e.g., Jackson & Hopp, 2020; Messenger, 2021). Likewise, in Reitter et al.'s (2011) model, L2 speakers' syntactic representations should be associated with low base-level activation. Exposure to a target structure should therefore generate larger increases in activation in that population than in L1 speakers.

In contrast, the models differ in the predictions they make regarding between-group variation in priming with lexical overlap (i.e., with repeated lexical

items between prime and target sentences) and regarding how priming with and without lexical overlap should vary within individuals across syntactic structures.

I first describe the expectations regarding between-group variation in priming with lexical overlap. Research has shown that the magnitude of immediate priming tends to be larger in the presence of lexical overlap than without such overlap (a phenomenon called "the lexical boost"; e.g., Branigan et al., 2000; Mahowald et al., 2016; Pickering & Branigan, 1998). Since this boost to priming seems to be short-lived (see e.g., Flett, 2006; Hartsuiker et al., 2008), the two accounts argue that the priming effects arising in the presence of lexical overlap are driven by short-lived explicit memories of the prime sentences. Concretely, repeated items across prime and target sentences cue the re-use of specific structures with specific lexical items, but this influence decays quickly.[1] Chang et al.'s (2006) model makes the prediction that the magnitude of lexically-based priming (i.e., priming with lexical overlap) and the lexical boost to priming should not vary across speaker groups, since priming in the presence of lexical overlap does not rely on the error-based mechanism, but on separate explicit, short-term memory processes. However, based on Reitter et al.'s (2011) account, priming with lexical overlap and the lexical boost should both be larger in L2 than in L1 speakers, as priming in this context still relates to the base-level activation of a target structure, even if it relies on explicit memory processes (see section 1.1).

Concerning the prediction regarding individual variation in priming across structures, Chang et al.'s (2006) account proposes that abstract (immediate and long-term) syntactic priming depends on an individual's learning rate and lexically-based priming on their short-term memory. As such, it makes the prediction that the extent to which an individual primes on one structure should relate to the degree of priming they experience with another structure, both in conditions with and without lexical overlap. On the contrary, if the magnitude of both abstract and lexically-based priming for a given structure is determined by the base-level of activation of its representation (Reitter et al., 2011), then speakers should be less likely to exhibit

[1] Note that the recent multifactorial account of Bernolet et al. (2016) proposes that such explicit memory processes contribute not only to lexically-based priming but also to abstract immediate priming (i.e., to immediate priming without lexical overlap). Based on their account, explicit memories of prime sentences can indeed boost priming in target sentences produced immediately after primes, even in the absence of lexical overlap (see Chapter 3 for further discussion of this model).

consistency in priming effects between structures across overlap conditions (see Table 1.1 for a summary of the models' predictions).

Therefore, studies that compare immediate and long-term priming across groups of speakers and syntactic alternations with and without lexical overlap are necessary to understand which of the two accounts best explains patterns of priming and learning. This comparison is the object of **Chapter 2**.

Table 1.1 Overview of the language learning models' mechanisms and predictions.

	Chang et al.'s (2006) model	**Reitter et al.'s (2011) model**
Mechanism for abstract priming	Error-based learning	(Lasting) changes in base-level activation
Mechanism for lexically-based priming	Explicit memories	Explicit memories and (short-lived) changes in base-level activation
Predictions for abstract priming	Larger immediate and long-term priming in L2 than in L1 speakers	Larger immediate and long-term priming in L2 than in L1 speakers
Predictions for lexically-based priming	1) No lexical boost to long-term priming 2) Similar immediate priming magnitudes for L2 and L1 speakers	1) No lexical boost to long-term priming 2) Larger immediate priming in L2 than in L1 speakers
Predictions for priming across syntactic alternations	Individually-consistent priming effects within speakers across structures	Variation in priming magnitudes within speakers across structures

1.3.2 The contribution of explicit processes to syntactic priming and learning

Psycholinguistic models define abstract syntactic priming (i.e., priming in the absence of lexical overlap) and the resulting learning as primarily implicit processes (e.g., Bernolet et al., 2016; Chang et al., 2006, 2012; Malhotra et al., 2008; Reitter et al., 2011). According to these frameworks, speakers show abstract priming and experience learning via this mechanism automatically and without awareness of the underlying processes (e.g., Ferreira et al., 2005). Syntactic priming that relies on explicit processes, such as explicitly remembering the structure of primes in the context of lexical overlap (e.g., Chang et al., 2006; Reitter et al., 2011), should in contrast not foster long-term priming. However, the respective contribution of

implicit and explicit processes to language learning via syntactic priming remains largely unexplored (see for instance Bernolet et al., 2016 for such an investigation in L1 speakers; see Ferreira & Bock, 2006 for a discussion of the contribution of explicit and implicit processes to priming; see Jackson, 2018; Jackson & Ruf, 2018; McDonough, 2011; Ruf, 2011 for discussions of how priming with lexical overlap relates to long-term priming).

Exploring this issue in L2 speakers is particularly relevant as Costa et al. (2008) argue that priming in that population may be less implicit and automatic than in L1 speakers. Depending on their syntactic knowledge or on the processing loads they experience during a priming task, learners may take conscious decisions to use or avoid the structure targeted in a priming task. They may, for example, consciously choose to use the target structure in order to practice their L2 skills (Ruf, 2011) or, in contrast, decide to avoid it if it is too effortful to produce (Kim et al., 2020) or if they lack confidence in their metalinguistic knowledge (Costa et al., 2008). Importantly, if language learning via syntactic priming relies on an implicit mechanism, it is unclear whether such decisions relate to priming processes.

SLA research has also shown that individual differences in attention to the linguistic input and language learning motivation modulate L2 learning (e.g., Leow, 2019; Masgoret & Gardner, 2003; Robinson et al., 2012; Schmidt, 2001; Ushioda, 2016; Ushioda & Dörnyei, 2012). We could then expect these factors to similarly influence long-term L2 learning via syntactic priming. Yet, during a priming task, high attention and motivation levels could support priming and learning because they make L2 speakers remember prime sentences and their structure better, for example by promoting deeper engagement in the task. If so, the language learning models of priming predict that such explicit memories could enhance immediate priming, potentially even more so in a context with lexical overlap (e.g., Chang et al., 2006; Reitter et al., 2011; but see Bernolet et al., 2016), but that they should not affect long-term priming.

Enhanced attention seems to increase the magnitude of immediate priming in L1 (Branigan et al., 2007; Bock et al., 1992; Ivanova et al., 2020; Reitter & Moore, 2014; Schoot et al., 2019; Weatherholtz et al., 2014) and in L2 speakers (McDonough & Fulga, 2015; Shin & Christianson, 2012; though see Michel & Smith, 2018), but its effect on long-term priming is largely unknown (but see Shin & Christianson, 2012). Moreover, while some research shows that L2 speakers do take

some conscious decisions regarding target structure use during L2 priming tasks (e.g., Grüter et al., 2021; Jackson & Ruf, 2018; Kim et al., 2020; Michel, 2018; Michel & O'Rourke, 2019; Michel & Stiefenhöfer, 2019; Ruf, 2011), no study has directly and systematically investigated the effect of such choices on priming and learning. As for motivation, no study has examined its effect on L2 priming to my knowledge.

In psycholinguistic terms, assessing the effect of conscious decisions, attention to linguistic input and language learning motivation on priming should tell us about the respective contribution of implicit and explicit processes to language learning via syntactic priming. It may also help us explain the widely observed individual differences in priming (for reviews see Jackson, 2018; Mahowald et al., 2016; Pickering & Ferreira, 2008). From a pedagogical perspective, such an exploration would reveal whether teachers can facilitate L2 learning via priming by, for instance, giving learners instructions to re-use the structures they are exposed to or to pay attention to certain aspects of the task. I investigate the effect of attention and motivation on priming and learning in **Chapters 3, 4, 5 and 6**, and the effect of conscious decisions in **Chapter 7**.

1.4 Which task characteristics affect L2 learning via syntactic priming?

If syntactic priming tasks foster language learning, then it is relevant for our understanding of L2 processing and learning to examine which task-related factors modulate such learning. Identifying these factors is also relevant to maximize priming tasks' L2 learning outcomes. In the L2 priming literature, past research has examined whether including lexical overlap (e.g., Kim & Mcdonough, 2008), giving instructions about the target structures (Shin & Christianson, 2012), asking participants to repeat the prime sentences (e.g., Jackson & Ruf, 2018; Kim & McDonough, 2016) or the proficiency of the interlocutor affect learning (McDonough & Mackey, 2008; McDonough & Kim, 2009; McDonough & Chaikitmongkol, 2010). However, the potential influence of many task characteristics which one could manipulate across priming activities is still unexplored. In this thesis, I assessed how priming and learning varied as a function

of language input modality, and of which and how many structures were targeted. I also explored how priming could be used in various contexts to promote L2 learning.

1.4.1 Syntactic priming as a function of language input modality

In L2 priming and SLA research, which of the spoken and written input modes best supports L2 learning is under-investigated (e.g., Kim & Godfroid, 2019; Kim et al., 2019, 2020; see Gilabert et al., 2016 for a review of SLA research on modalities), though we may expect processing L2 target structures to be easier with visual than with auditory stimuli. Written stimuli may make target structures more salient (Kim & Godfroid, 2019) and, overall, foster deeper processing of the linguistic input (Gilabert et al., 2016). During exposure to spoken language input, in contrast, L2 speakers may use a large part of their attentional resources to decode the L2 pronunciation (see Weatherholtz et al., 2014 for a similar reasoning regarding L1 speakers' processing of non-standard accent), and therefore process the syntax of stimuli more superficially.

Studies reveal that the magnitude of L1 immediate and long-term priming does not vary as a function of prime modality (Mahowald et al., 2016; see also Cleland & Pickering, 2006 and Hartsuiker et al., 2008 for instance). L2 speakers, however, prime more in written chat-based than in oral face-to-face interactions (Kim et al., 2019, 2020), which suggests that variation in modality may affect how they process syntax. While these findings could also indicate that the L2 speakers preferred to produce the target structure in the written that in the oral modality, no study has specifically investigated the effect of input modality on L2 priming and the resulting long-term learning. **Chapter 4** addressed these research questions by comparing L2 speakers' priming in conditions that differed in terms of prime modality (i.e., reading vs. listening), but kept the modality of target sentence production constant (i.e., writing).

1.4.2 Syntactic priming as a function of the targeted structure(s)

Though L2 priming effects occur for a variety of syntactic forms (Jackson, 2018), their magnitude varies widely across structures, even when the same participants are

tested with the same experimental design on different target forms. Within studies, L2 speakers have been found to prime differently on prepositional and double object datives (McDonough, 2006), double object datives and phrasal verbs (Shin and Christianson, 2012), and relative or adverbial clauses and passives (McDonough et al., 2015). There are at least two possible interpretations for these results, which both relate to how much prior knowledge speakers have for each targeted structure. Based on Costa et al. (2008), L2 speakers' likeliness to prime (automatically) should be higher for structures they have experienced frequently and therefore have the most prior knowledge of, as their syntactic representations should be less difficult to retrieve. By contrast, the language learning models of priming (e.g., Chang et al., 2006; Reitter et al., 2011) predict that speakers should exhibit more priming and learning with the structures they are the least familiar with, due to the inverse-frequency effects (see section 1.1).

Experimental results are mixed so far: some studies show that L2 speakers experience larger priming with more frequent L1 or L2 structures (Hurtado & Montrul, 2021a; Jackson & Ruf, 2018), while others report evidence of inverse-frequency effects in this population (Kaan & Chun, 2017; McDonough & Fulga, 2015; Shin & Christianson, 2012). Further research that directly compares, within speakers, priming on multiple structures which differ in their likely familiarity for participants is necessary. Additionally, since L2 speakers sometimes only exhibit long-term priming for structures they already have some knowledge of (Jackson & Ruf, 2018; McDonough, 2006; McDonough & Fulga, 2015), it is important to systematically examine whether long-term learning varies as a function of prior knowledge. Answering these questions would help assess whether certain states of knowledge are best-suited to foster learning of specific syntactic structures via priming activities (Jackson, 2018).

A second, unexplored question is whether priming supports learning of multiple structures targeted within one task. This is particularly relevant as, when teachers resort to authentic material (such as books) or peer-to-peer activities, L2 speakers may be exposed to many structures at the same time. As far as I know, no study has assessed priming and learning for several simultaneously-targeted structures within one priming task. Doing so would inform language instructors as to whether such settings foster learning for all structures or whether they should rather teach structures in isolation

Although I also tested participants on two syntactic alternations in Chapters 2-3, **Chapter 7** specifically examined the effect of prior knowledge and whether L2 speakers prime on and learn multiple target structures within one priming task.

1.4.3 Syntactic priming across contexts

Studies investigating L2 learning via syntactic priming have mostly been conducted in rather artificial laboratory- or web-based testing contexts (e.g., Hurtado & Montrul, 2021a; Kim & McDonough, 2016; McDonough & De Vleeschauwer, 2012; McDonough & Mackey, 2008). Likewise, this thesis includes studies carried out in traditional laboratory settings (Chapters 2, 3, 5), as well as in online settings, which are now, in light of the pandemic, common (Chapter 4). However, the last two chapters explored priming and learning in more naturalistic contexts: in high school classrooms of English in France (Chapter 6) and in written chat-based interactions (Chapter 7).

1.4.3.1 High school context

McDonough and colleagues' work has demonstrated that teachers can integrate syntactic priming activities into classroom-based L2 learning tasks (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013; see Hesketh et al., 2016 and Serratrice et al., 2015 for classroom-based priming studies with L1 children), but in spite of their obvious pedagogical relevance, such studies are rare and many factors which may affect learning via priming in this context remain unexplored.

A first relevant aspect concerns the way prime sentences that contain the model target structure are delivered to students. Broadly speaking, new grammatical structures can be presented by the teacher to the whole class, or by a student to another student in a peer-to-peer activity. Based on Interactionist perspectives in SLA according to which interacting in the L2 promotes L2 learning (Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994), one may expect students to experience more priming and learning in the latter more interactive setting. Yet so far, though research shows that priming can occur both in teacher-to-students (Favier et al., 2019) and in peer-to-peer conditions (e.g., McDonough & Chaikitmongkol, 2010), and that L1 and L2 priming occur in interactive (e.g., Branigan et al., 2000;

Kim & McDonough, 2008) and non-interactive contexts (Bock, 1986; Grüter et al., 2021; Ivanova et al., 2020), there exists no direct comparison of the two settings.

Furthermore, within a peer-to-peer task, students may themselves produce the prime sentences or hear them pronounced by their classmate to them. Past priming results do not clearly reveal whether one of these conditions fosters larger priming. For example, Mahowald et al.'s (2016) meta-analysis shows that priming does not differ between production-to-production and comprehension-to-production priming settings, but Gries' (2005) corpus study indicates that speakers prime slightly more when they produce both primes and targets than when they just hear the primes (but see Zawawi, 2017). Classroom-based studies have mainly implemented priming activities where students only heard the primes (McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013). Therefore, to evaluate whether L2 priming and learning vary between comprehension-to-production and production-to-production teaching settings, direct comparisons between these settings are still necessary.

I investigated these research questions in **Chapter 6**. Importantly, most classroom-based L2 priming and learning studies have tested university-level students (e.g., McDonough & Chaikitmongkol, 2010), but many people start learning a foreign language during their adolescence. While this population remains under-investigated in priming research, we cannot assume that they experience language learning the same way as older learners (cf. Favier et al., 2019). My study addressed this further issue by targeting high school-aged (adolescent) students.

1.4.3.2 Written chat-based interactions

Online chatting seems a promising medium for L2 learning (e.g., Gilabert et al., 2016; Ziegler, 2016). Written chat-based interactions are omnipresent in everyday life, easily accessible for language learners and gives them the possibility to interact with native speakers of various languages across the world. The permanent availability of the interlocutors' sentences on the screen allows learners to rely on self-paced processing and may, for instance, promote noticing of the target structure (Kim et al., 2020; Sauro, 2009; Ziegler, 2016), which could foster L2 learning (Schmidt, 1990; see Kerz et al., 2017 for a review). When chatting, L2 speakers also have more time to formulate sentences than in spoken discourse. Hence, written

chats could facilitate learners' processing of the linguistic input and production of the L2 and thereby overall, maximize the learning outcomes of L2 interactions.

A few studies have already reported significant L2 immediate and long-term priming effects in this context (Collentine & Collentine, 2013; Kim et al., 2019, 2020; Michel & Cappellini, 2019; Michel and Stiefenhöfer, 2019; Uzum, 2010), which in fact seems to foster larger priming than oral face-to-face interactions (Kim et al., 2019, 2020). L2 chat-based syntactic priming studies remain however rare and we need further research to evaluate how it supports long-term syntactic learning and which factors affect priming and learning in this environment. Specifically, given that chat-based interactions involve the use of multiple syntactic structures, I used this context to examine whether speakers could experience L2 learning for multiple simultaneously-targeted structures within one task and how this was affected by their prior knowledge of each structure (see section 1.4.2). Furthermore, since I expected that chat-based interactions would make noticing the target structures easier, I also explored the effect of L2 speakers' conscious decisions on priming and learning in this context (see section 1.3.2). I report this study in **Chapter 7**.

1.5 Thesis overview

Chapters 2 to 7 describe six empirical studies conducted during this PhD project. Chapter 8 summarizes and discusses their most important findings and implications.

Chapter 2 tested the predictions of the error-based (Chang et al., 2006) and the hybrid (Reitter et al., 2011) models of priming. To do so, I compared immediate (higher likeliness to produce the target structure after exposure to that structure vs. following exposure to an alternative structure) and long-term priming (measured as increases in target structure production in a post-test completed immediately after the immediate priming phase relative to a pre-test) effects in L2 speakers of French with English as an L1 and in L1 French speakers. Participants took part in an oral, interactive picture description and searching task with the experimenter. They were tested on two syntactic alternations, French fronted temporal adverbial phrases (Experiment 1a) and passive sentences (Experiment 2a), and I manipulated the presence or absence of lexical overlap between-subjects.

Chapter 3 explored how individual differences in attention (L2 and L1 speakers) and language learning motivation (L2 speakers) modulate immediate priming and long-term priming measured in an immediate post-test. I ran additional analyses with the datasets of Chapter 2 (Experiment 1b for fronted sentences, Experiment 2b for passives) to include self-reported measurements of attention to task, attention to syntax, noticing of the target structure, French learning motivation and task-specific motivation in the statistical models.

Chapter 4 investigated whether prime modality (reading vs. hearing primes) affects the magnitude of immediate and long-term priming (both in an immediate post-test and in a post-test delayed by a week) of English passives in L1 French speakers, learning English as an L2. Additionally, I examined whether how variation in self-reported attention and motivation modulated priming and learning depended on the two modality conditions. I also recruited English L1 speakers as a way to assess whether these factors impacted L2 priming more.

Chapter 5[2] further examined the role of attention in syntactic priming tasks by including a direct manipulation of what L2 English speakers with French as an L1 were instructed to pay attention to during the priming task. Specifically, I asked participants to search for mistakes either in the syntax of the prime sentences (syntax-focused condition) or in the pictures they were presented with (picture-focused condition). I also assessed how self-reported motivation related to priming and learning across these two conditions. I examined immediate priming and long-term priming in an immediate post-test of English passives and, as above, I tested English L1 speakers as a comparison group.

Chapter 6[1] was a classroom-based study investigating French L1 students' L2 learning via syntactic priming of English Wh-questions across learning contexts in a French high school. More precisely, it compared priming and learning between teacher-to-students (i.e., when the teacher delivers the prime sentences that contains the target structure to the class as a whole) and student-to-student conditions (i.e.,

[2]These two studies were unfortunately interrupted prematurely by the onset of the Coronavirus pandemic. Hence, I provide complete background and methodology sections for both studies but I was only able to include partial Analysis and Discussion sections for each of them.

when a student delivers the primes to another student), as well as between comprehension-to-production (i.e., when students hear the primes as delivered to them by another student) and production-to-production conditions (i.e., when student read the prime sentences themselves). I also assessed how self-reported individual differences in attention and motivation affected priming and learning across all conditions.

Chapter 7 tested whether written chat-based activities support syntactic priming and learning of multiple simultaneously-targeted L2 syntactic structures (English genitives, passives and datives) in Spanish L1 speakers learning English as an L2. This study also investigated how prior knowledge of the targeted structures and learners' decisions to use or avoid each structure affected priming in this context[3].

Chapter 8 explores what the results of the empirical chapters teach us regarding the various factors affecting L2 learning via syntactic priming. In this chapter, I also discuss what the findings show in terms of the nature and the mechanisms of syntactic priming in L2 (and in L1) speakers in light of the different psycholinguistic accounts of priming. Finally, I describe possible limitations of my studies and recommendations for future research.

[3]In Chapters 2, 3, 4, 5 and 7, I used post-tests completed by the participants immediately after the immediate priming task (immediate post-tests) to measure long-term priming, i.e., language learning. In Chapter 4, long-term priming was also assessed with a post-test delayed by one week, while Chapter 6 included two post-tests, delayed by one week or more.

Chapter 2

Variation and consistency in syntactic priming

We compared first (L1) and second (L2) language French speakers' production of fronted/non-fronted temporal phrases and active/passive structures when primed with and without lexical overlap to assess the predictions of the error-based (Chang et al., 2006) and the hybrid (Reitter et al., 2011) language learning models of syntactic priming. Our findings are compatible with the general predictions of the two models: we observed immediate and long-term priming, and lexical boost effects, and the L2 speakers sometimes experienced more priming than L1 speakers. However, the results concerning priming with overlap are more ambiguous. We found strong evidence that priming with and without lexical overlap rely on separate mechanisms, as defined in the error-based learning model, but L2 speakers showed larger lexical boosts than L1 speakers, which is more compatible with the hybrid account. Though our results do not clearly favour one of the two models, we present a series of novel findings relevant to our understanding of the psycholinguistics of priming. L2 speakers were overall more sensitive than L1 speakers to lexical overlap manipulations and speakers exhibited long-term priming even in conditions with overlap, which may imply that language learning still occurs in such contexts. Finally, the patterns of syntactic priming varied highly across syntactic alternations, even within individuals, thereby highlighting the importance of comparing priming of different structures within speakers.

Preregistration[4]: https://osf.io/4n86b?view_only=None

Material/ data availability: https://osf.io/k2tay/?view_only=1849e74a6c4e4c7180667bda6f9ff530

[4]For simplicity, and in contrast to the preregistration of the study, I decided not to include the analysis of cumulative priming, while the analysis of the effect of individual differences in attention and motivation on syntactic priming is reported in Chapter 3. Therefore, this chapter contains the analyses for priming effects of fronted sentences (Experiment 1a) and passives (Experiment 2a), and Chapter 3 contains the analyses of the effect of individual differences on priming of fronted sentences (Experiment 1b) and passives (Experiment 2b).

2.1 Introduction

Speakers' language production and comprehension is highly malleable throughout their life, be it in their first (L1) or their second (L2) language. L2 and L1 speakers might indeed produce a previously-dispreferred syntactic structure more frequently if that structure is over-represented in a given context (Jaeger & Snider, 2013; Kaan & Chun, 2017). This type of language malleability, known as syntactic priming, leads speakers and writers to re-use the syntactic form of sentences they have recently experienced in their own language production (Bock, 1986) and makes listeners and readers expect sentences to have the syntactic form of recently perceived sentences (e.g., Branigan et al., 2005). For instance, after exposure to a passive prime sentence (e.g., "the artwork was painted by Nicolas De Staël"), it becomes easier for language users to produce and understand a passive target sentence (e.g., "the sculpture was sold by the auctioneer") than if they have been exposed to an active sentence (e.g., "Nicolas de Staël painted the artwork"). Though priming effects are fairly ubiquitous as they occur across languages, modalities, groups of speakers and language structures, there is considerable variation in the degree to which priming effects are likely to occur, and in the magnitude and duration of such effects (for reviews see Jackson, 2018; Mahowald et al., 2016; Pickering & Ferreira, 2008). As such, the exact nature of the mechanism that underlies priming remains to be fully understood.

Examining how priming effects manifest across different groups of speakers and for different structures is one way to test the predictions of different explanations of priming, of which there are three prevalent types: activation-based models (Pickering & Branigan, 1998; Pickering & Ferreira, 2008), implicit error-based models (Chang et al., 2006, 2012; Dell & Chang, 2014; Jaeger & Snider, 2013), and hybrid models, which combine features of the former two types (Malhotra et al., 2008; Reitter et al., 2011). Furthermore, understanding what priming effects tell us about different speakers' representations of syntax and how their experiences of language change those representations is particularly useful for theories of language processing and language learning. This study therefore investigates whether patterns of immediate and long-term syntactic priming with and without lexical overlap in L2 and L1 speakers and for two different structural alternations are consistent with different models of priming.

2.1.1 Abstract syntactic priming in L2 and L1 speakers

2.1.1.1 Psycholinguistic mechanisms

Psycholinguistic models explain patterns of syntactic priming across sentences that contain unrelated lexical items in different ways. Activation-based models postulate that residual activation of the syntactic representation of a recently used grammatical structure promotes immediate reuse of that structure (Pickering & Branigan, 1998; Pickering & Ferreira, 2008). Such models cannot however easily explain long-term priming effects (e.g., Bock & Griffin, 2000; Grüter et al., 2021; Hurtado & Montrul, 2021a; Kaschak et al., 2011; McDonough & Chaikitmongkol, 2010) and therefore, other accounts define syntactic priming as supported by a language learning mechanism.

Error-based implicit learning models of syntactic priming (e.g., Chang et al., 2006, 2012) describe syntactic priming as the result of a language learning and processing mechanism. During exposure to language, or when exposed to prime sentences in a syntactic priming study, listeners and readers make predictions, based on their knowledge and experience of the language, and compare these predictions to the language input they receive. If there is a mismatch between the predicted and the perceived syntax, the generated error signal leads to adjustments of the relative weightings of the syntactic representations in the listener's or reader's language system. These modifications increase the weightings of those recently experienced syntactic structures and remain over time. This makes those structures more available for subsequent language production and leads to immediate and long-term syntactic priming effects.

Hybrid accounts of syntactic priming take elements of the activation-based model and add a learning architecture in order to explain patterns of long-term priming. In Reitter et al.'s (2011) model, syntactic structures are represented by syntactic nodes associated with a base-level activation which reflects speakers' familiarity with the structures. When language users perceive a given structure, spreading activation from the working memory buffer reaches the corresponding syntactic node and increases its base-level activation in long-term memory. This leads to immediate priming effects, as well as long-term changes in language production; unlike the original residual activation model, it can therefore explain long lasting priming. Malhotra et al. (2008) designed another hybrid model where

priming relied on incremental adjustments in base-level activation of a structure's syntactic node as well as on memory traces. However, this theory can only account for priming of a limited number of syntactic structures as it does not represent syntactic structures, but only retrieves them from a look-up table. Overall, in Reitter et al.'s (2011) model, abstract immediate and long-term priming are the result of increases in base-level activation of a structure in long-term memory, whereas in error-based learning models (Chang et al., 2006), abstract priming leads to long-term priming due to long-lasting changes in the connection weights of syntactic representations.

2.1.1.2 Between-group differences

In appealing to a learning architecture to explain long-lasting priming effects, these models generate a further basic prediction about priming effects: the magnitude of priming and the resulting learning should vary as a function of a language user's familiarity with the target language. More precisely, those with less familiarity with the target language, such as L2 speakers, should experience larger priming and learning than those more familiar with it, such as L1 speakers, when tested in the same language. The architecture of error-based learning models is such that the strength of priming depends on the degree of error a speaker experiences when processing a prime (e.g., Chang et al., 2006, 2012). This means that abstract syntactic priming should be larger in learners, such as L2 speakers who, overall, should experience larger prediction error than L1 speakers (Jackson & Hopp, 2020). Furthermore, if L2 speakers experience greater priming during the priming manipulation, then we should also observe more long-term priming in this group than in L1 speakers (Jackson & Hopp, 2020; see Messenger, 2021, for a discussion of similar predictions regarding between-group differences in L1 adults and children). The hybrid account of Reitter et al. (2011) makes similar predictions. Given their overall lower level of experience with the target language, L2 speakers should have lower base-level activation for L2 syntactic nodes than L1 speakers. Hence, adjustments in activation levels when exposed to the target structure should be comparatively larger in L2 speakers than in L1 speakers. This predicts that L2 speakers should experience more learning, and thus more immediate and long-term priming than L1 speakers (see Malhotra et al., 2008 for similar predictions). In sum,

the language learning models of priming predict that there should be between-group differences in the magnitude of immediate and long-term priming effects.

Nonetheless, the evidence regarding this expected between-group difference in abstract priming is limited so far and it remains unclear which factors determine whether this between-group difference emerges. Few studies have compared syntactic priming in L2 and L1 speakers tested in the same target language. Three studies found evidence for larger immediate priming in L2 than in L1 speakers (Flett, 2006, experiments 1 and 2; Jackson & Hopp, 2020), whereas others report similar priming effects across groups (Abrahams et al., 2019; Flett, 2006, experiment 3; Ruf, 2011). To our knowledge, only two studies, which targeted the fronted/non-fronted temporal or locative adverbial phrases alternation ("In the morning/ in the kitchen, the grandfather drinks hot chocolate" vs. "The grandfather drinks hot chocolate in the morning/ in the kitchen") have compared long-term priming effects in L1 versus L2 speakers. The results across studies are mixed and do not support the prediction for a between-group difference or its expected direction. Ruf (2011) found that L1 speakers experienced larger long-term priming than intermediate L2 speakers, while Jackson and Hopp (2020) observed that L2 speakers exhibited larger immediate but not long-term priming effects than L1 speakers. However, in the latter study, the interaction between prime structure and group for immediate priming was only marginally significant, which may explain why the group difference did not transfer to long-term priming.

While researchers have hypothesized that structure pre-test frequencies (Flett, 2006), L2 speakers' proficiency (Abrahams et al., 2019; Ruf, 2011) or priming strength in L1 speakers (Flett, 2006; Nitschke et al., 2014 in comprehension priming) could determine whether the between-group difference emerges, a further possibility is that the likeliness of observing this difference varies dependent on the syntactic structures being primed. The studies investigating immediate priming across speaker groups reported contrasting results but targeted different syntactic alternations such as the transitive alternation (Flett, 2006, experiments 1 and 2), the fronting alternation (Ruf, 2011; Jackson & Hopp, 2020) and the dative alternation (Abrahams et al., 2019; Flett, 2006, experiment 3). The only studies comparing L2 and L1 long-term priming both targeted the fronting alternation (Jackson & Hopp, 2020; Ruf, 2011). A between-group difference might be more likely to emerge with structures that are syntactically complex or infrequent, such as passives. Such structures may

be more likely to trigger greater prediction error or to be associated with lower base-level activation in L2 speakers than in L1 speakers, than those that are less complex or more frequent, such as fronted adverbial phrases. However, no study has tested the same L2 and L1 speakers on two different syntactic alternations. Such comparisons may shed light on why predicted between-group differences in immediate and long-lasting abstract priming do not always emerge.

2.1.2 Lexically-based syntactic priming in L2 and L1 speakers

The lexical boost to priming, greater priming in the context of overlapping lexical items between prime and target sentences, occurs in both L2 and L1 speakers (Branigan et al., 2000; Flett, 2006; Jackson & Ruf, 2017, 2018; Kim & McDonough, 2008; Mahowald et al., 2016; Pickering & Branigan, 1998; Ruf, 2011). Unlike abstract syntactic priming, it is a short-term effect that does not survive the inclusion of intervening trials between prime and target sentences (Branigan & McLean, 2016; Hartsuiker et al., 2008; Mahowald et al., 2016) and seems not to extend to post-test phases following a priming task with lexical overlap (Ruf, 2011). The short-lived lexical boost has been a key source of evidence for distinguishing and testing different models of priming. Activation-based models (Pickering & Branigan, 1998; Pickering & Ferreira, 2008) can account for lexical boost effects but not for the discrepancy in time courses between abstract and lexically-based priming because, in these models, priming with and priming without lexical overlap rely on the same mechanisms. By contrast, both error-based learning and hybrid models propose that the lexical boost relies on explicit short-term memory processes (but see Yan et al., 2018 for contrasting evidence), which accounts for the brevity of the effect. However, these models differ in their predictions regarding how lexical overlap should affect the magnitude of priming in L2 and L1 speakers.

In Chang et al.'s (2006, 2012) model, priming with lexical overlap relies on fleeting explicit memory processes rather than on the error-based mechanism: short-term memory for the use of a particular word in a particular structure cues the reuse of that word and that structure. As such, this dual-account predicts that there should be no between-group difference in lexically-based priming magnitude in L2 and L1

speakers, who should not systematically differ in their short-term memory capacities, nor any difference in magnitude related to differences in syntactic structures. However, in the hybrid account (Reitter et al., 2011), activation that spreads from the working memory buffer to the syntactic nodes stored in long-term memory receives an additional short-lived boost in the presence of lexical overlap thanks to explicit memory of the perceived lexical information. Hence, though it relies on explicit memories of prime sentences, priming with overlap in that model depends on the base-level activation of syntactic nodes like abstract priming does. This account therefore predicts that, even with lexical overlap, L2 speakers should manifest larger priming magnitudes than L1 speakers, and that the magnitude of priming should vary across structures as a function of their respective base-level activation. However, the two models both predict that the lexical boost to priming should be short-lived for both L2 and L1 speakers.

To our knowledge, whether lexical boost effects are short-lived and whether lexically-based priming primarily relies on short-term memory processes in L2 speakers, has not been extensively investigated so far. One study suggests that including lexical overlap does not indeed increase long term priming (Ruf, 2011; see also Jackson & Ruf, 2018 and McDonough, 2011). Moreover, only a few studies compare the immediate effect of lexical overlap in L2 versus L1 speakers. They suggest that overlap attenuates between-group variation in priming of fronted locative phrases (Ruf, 2011) and passive sentences (Flett, 2006) in line with the predictions of Chang et al.'s (2006) account. However, other work demonstrates that lexical overlap strongly affects L2 speakers' priming, particularly at low proficiency levels where they seem to experience larger lexical boost effects than more proficient speakers (Bernolet et al., 2013; Kim & McDonough, 2008). Mahowald et al. (2016) also report in their meta-analysis that L2 speakers experience larger lexical boost effects than L1 speakers. This implies that L2 speakers' representations may be more lexicalized than L1 speakers'. In their developmental trajectory of L2 speakers' syntactic knowledge, Hartsuiker and Bernolet (2017; see also Bernolet et al., 2013) postulate that low proficient speakers' language processing and production primarily rely on item-specific syntactic representations. Whether this is true at higher levels of proficiency is largely unclear.

Overall, the mechanism of priming with overlap in L2 speakers remains ambiguous and further research is required to understand how priming with lexical

overlap in that population relates to language learning and models of priming. In particular, it is unclear whether, in such conditions, lexical boost effects are short-lived in L2 speakers as predicted by hybrid and error-based models, and whether the magnitude of priming with lexical overlap differs across speaker groups and across syntactic structures within individuals, two predictions made by Reitter et al.'s (2011) model but not by the dual-account of Chang et al. (2006, 2012).

2.1.3 Syntactic priming across structures

As already described, comparing syntactic priming effects for different structures in L2 and L1 speakers can help to elucidate the mechanisms underlying their language processing and learning in priming contexts. In error-based learning models, abstract syntactic priming is determined by an individual's learning rate (Chang et al., 2006). This learning rate which is specific to each individual determines the extent to which the weights connecting syntactic representations in an individual's language system adapt to the language input based on prediction errors. In other words, this learning rate represents individuals' likelihood to prime (see Branigan & Messenger, 2016), i.e., the fact that certain speakers may be more likely than others to show priming across syntactic structures. Hence, the degree of abstract priming an individual exhibits on one structure should relate to the degree of abstract priming they show on another structure. This should be the case across speaker groups even if speakers, and in particular L2 speakers, may have different baseline knowledge or frequency of use of various structures, or may experience different degrees of surprisal for various syntactic forms. The architecture of the error-based learning model therefore predicts individually-consistent priming effects within speakers across target structures. By contrast, in the hybrid models (e.g., Reitter et al., 2011), the magnitude of priming for a given structure depends on its base-level activation, which suggests that within speakers, priming may vary widely across structures.

Though the magnitude of L2 and L1 abstract priming effects seems to vary widely across structures (Bock et al., 2007; Hartsuiker & Kolk, 1998; Mahowald et al., 2016; McDonough et al., 2015; Shin and Christianson, 2012), very few studies have directly compared abstract priming on different structures within the same speakers. Thus, further cross-structure comparisons within the same individuals are required to compare the predictions of the various models of priming.

2.1.4 Present study

The present study compared immediate and long-term priming effects with and without lexical overlap for two different syntactic structures in L2 and L1 speakers to assess whether the obtained pattern of results would support the predictions of the error-based learning model (Chang et al., 2006) and/or of the hybrid account of priming (Reitter et al., 2011). We tested two sets of predictions. First, we examined whether the magnitude of abstract and lexically-based syntactic priming would differ between L2 and L1 speakers. Second, we analysed whether across groups, speakers would show within-individual consistency in priming effects across structures in conditions with and without lexical overlap.

We predicted that if an error-based learning or a hybrid mechanism underlies syntactic priming, then immediate abstract syntactic priming would be larger in L2 than in L1 speakers and that this should lead to greater long-term priming in L2 than in L1 speakers. Furthermore, if priming with overlap relies on explicit memory processes, lexically boosted priming effects should not persist into the post-test in either group of speakers. However, Chang et al.'s (2006, 2012) model makes the prediction that priming with overlap should boost immediate priming to the same extent in both speaker groups and that the magnitude of lexically-based priming should be equivalent across speaker groups. In contrast, the hybrid account (Reitter et al., 2011) predicts that the boost to priming should be larger in L2 than in L1 speakers and that L2 speakers should exhibit larger lexically-based priming than L1 speakers. Finally, the error-based learning model predicts that both in conditions with and without overlap and across speaker groups, speakers' magnitude of immediate and long-term priming should be correlated across syntactic structures, while the hybrid accounts predict no such within-individual consistency in priming across structures neither with nor without overlap (see Table 1.1 in Chapter 1).

We tested these predictions in two three-phase experiments: one experiment targeted the fronted/non-fronted alternation of temporal adverbial phrases (TP), the other targeted the active/passive alternation. The same participants completed both experiments. We selected these structures because previous studies that directly compared syntactic priming in L2 and L1 speakers also targeted the fronting alternation (Ruf, 2011; see also Jackson & Hopp, 2020) and the transitive alternation

(Flett, 2006, experiments 1 and 2), but varied in whether they observed the expected between-group differences in abstract priming. This suggests that whether the group difference emerges may depend on the targeted structure, though no study so far has compared the same L2 and L1 speakers on two different syntactic alternations.

French L1 speakers and L2 French speakers, who were L1 speakers of English studying French at a UK university, described pictures to the experimenter as part of a search task (Branigan et al., 2000). In the first phase of each experiment, they described pictures without hearing syntactic primes; this pre-test phase assessed each group's preference for each structure. The middle phase was an immediate priming phase: participants described target pictures immediately after hearing prime descriptions from the experimenter. This phase measured the immediate effect of priming on L2 and L1 speakers' production of target structures. The last phase was a post-test in which once again participants described pictures without hearing primes; this post-test phase assessed the persistence of the priming effects established in the middle phase. We measured the frequency with which participants continued to produce dispreferred structures after the priming phrase. All participants completed all phases of each experiment (i.e., for both syntactic structures); half the participants were exposed to primes with overlap and half were exposed to primes without overlap. Since the fronted items included many active transitive sentences, the order of the experiments was fixed with transitive priming, which sought to prime passive transitive sentences, occurring before fronted priming for all participants.

2.2 Experiment 1a- Fronted/ non-fronted TP alternation

First, we examined syntactic priming for fronted/non-fronted temporal adverbial phrases (1a & b), with and without overlap between prime and targets in L1 speakers of French and in L1 speakers of English, learning French as an L2 (see Ruf, 2011, for a similar investigation). French and English fronted/non-fronted TPs are highly similar across languages:

1.a. Le cowboy porte un chapeau <u>en été</u>.
The cowboy wears a hat <u>in summer</u>.

b. En été, le cowboy porte un chapeau.
In summer, the cowboy wears a hat.

2.2.1 Methodology

2.2.1.1 Participants

104 English native speakers learning French as a second language (L2 speakers) and 100 native speakers of French (L1 speakers) participated in Experiment 1 and 2. Participants completed a language background questionnaire (adapted from the LEAP-Q questionnaire; Marian et al., 2007) to establish their status as L1 speakers of French or English and L2 speakers of French. They were all university students and received money as compensation for their participation. The study was approved by the Humanities and Social Sciences Research Ethics Committee at the University of Warwick. Informed consent was obtained prior to the test session.

We excluded three participants who were L1 speakers of both languages, ten who were not native speakers of French or English and one participant due to experimenter error. As a result, the analyses included 95 L2 speakers (76 female); 46 in the No Overlap condition and 49 in the Overlap condition, and 95 L1 speakers (76 female); 45 in the No Overlap condition and 50 in the Overlap condition. Participants were aged 18 to 28 years (*M*= 19.86).

2.2.1.2 Design

There were two between-participants variables: Overlap condition (overlap vs. no overlap) and Group (L1 vs. L2 speaker). Prime (fronted vs. non-fronted) for immediate priming and Section (pre-test vs. post-test) for long-term priming were within-subject variables.

2.2.1.3 Materials

2.2.1.3.1 Prime/target cards

We created 36 target items consisting of a French temporal adverbial phrase (e.g., *en été* (in summer)) and a transitive event (e.g., *le cowboy porte un chapeau* (the cowboy wears a hat)). We used three different types of adverbial phrases (*à* (at), *en/au* (in), *chaque* (every)) twelve times each with temporal references to times, days and seasons (e.g. , *à midi* (at midday), *à 14 heures* (at 2pm), *en été* (in summer),

au printemps (in spring), *chaque lundi* (every Monday), *chaque jeudi*, (every Thursday)). Each type of temporal adverbial phrase was used eight times in the priming phase (24 items), and twice in both the pre-test (6 items) and the post-test (6 items). Temporal adverbial phrases were paired with a transitive event. We used six verbs (*écouter* (listen), *rendre* (give back), *servir* (serve), *porter* (wear), *acheter* (buy), *faire* (go/do)) six times each with different combinations of animate agent characters and animate or inanimate patients. Each verb appeared once in the pre-test (6 items), four times in the priming phase (24 items) and once in the post-test (6 items).

For the priming phase, we created a prime item with and without overlap (of the adverbial phrase) for each target item. The same temporal adverbial phrases as used in the target sentences were combined with different transitive events to create 24 prime sentences. In the No Overlap condition, the prime had a different temporal adverbial phrase to the target item and a different transitive event; in the Overlap condition, the same temporal adverbial phrase (but a different transitive event) was used in the prime as in the target item. Prime pictures had an associated fronted and non-fronted description (Figure 2.1). We created four lists, two with overlap and two without so that one version of each experimental prime item (fronted or non-fronted) appeared in each list. Participants were randomly assigned to one of the four lists.

In the priming phase, prime-target pairs were separated by two filler pictures (resulting in a Prime-Target-Filler-Filler sequence) and in the pre-/post-test sections target pictures were separated by three filler pictures. We created 84 filler pictures in total using intransitive verbs (depicted with two characters, such "the monks are crying"), ditransitive verbs (depicted with two characters and an object, such as "the monk is selling the artist a cup") and sentences containing possessives (depicted with the possessor appearing in one corner of the picture, such "the ballerina eats the cake of her grandmother"). 36 appeared in the target set (6 in the pre-test, 24 in the priming phase and 6 in the post-test) and 48 in the prime set (12 in the pre-test, 24 in the priming phase and 12 in the post-test).

In total, there were 72 pictures (36 targets and 36 fillers) in the participant's description set and 72 pictures (24 primes and 48 fillers) in the experimenter's description set. Items were depicted on individual cards (10 cm x 10cm), which included word labels (nouns and verbs) to prevent problems of vocabulary retrieval. The temporal adverbial phrase was represented in a corner of the card (see Figure

2.1). The position of the pictures depicting the temporal adverbial phrases was counterbalanced to appear an equal number of times on the right and left side of the card.

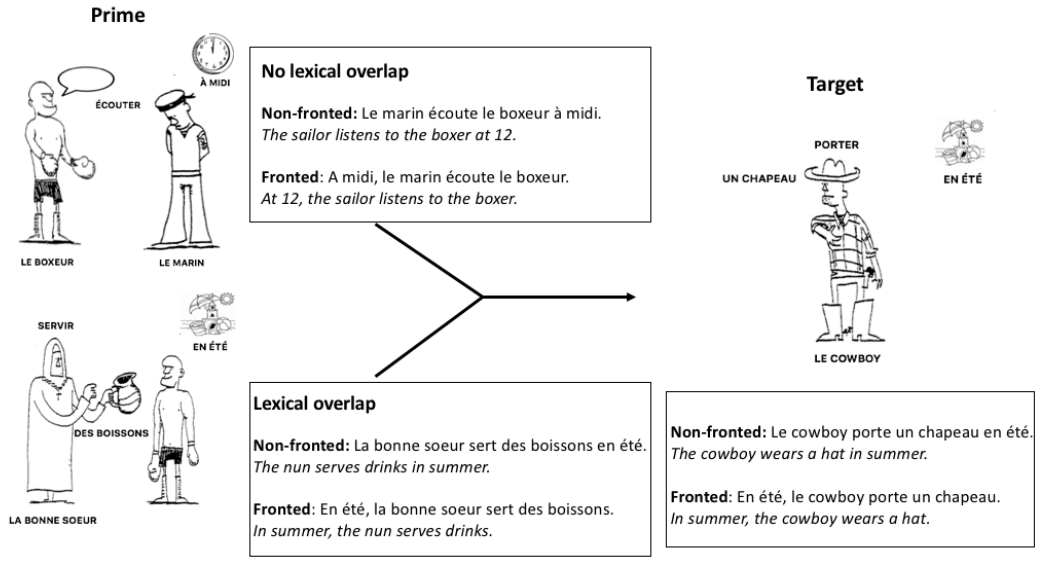


Figure 2.1 Stimuli of Experiment 1a. Example of fronted/non-fronted TP prime and target stimuli

2.2.1.3.2 Proficiency questionnaire

We used self-reported proficiency, which has been found to correlate with direct measures of proficiency (Lemhöfer & Broersma, 2012; Favier et al., 2019), as a control measure. Participants rated their speaking, understanding, reading and overall proficiencies on a scale from 0 (minimum score) to 10 (maximum score). We computed the average of the four proficiency scores (as in Bernolet et al., 2013). Overall, L2 speakers had an average rating of 6.31 (range 1.5-9). Those in the condition without overlap had a mean proficiency score of 6.5 (*SD*=2.0, range 1.5-9), those in the condition with overlap had a mean score of 6.13 (*SD*=1.82, range 1.5-9)[5].

[5]While the effect of proficiency on priming in L2 speakers was not a central question to this study, we ran an entire analysis with the dataset of the L2 speakers only where we did include it as an additional continuous variable. Proficiency never interacted with any of the other variables, but it did increase overall target structure production in the analysis for long-term priming. Thus, and since we wanted to compare priming in L2 and L1 speakers and therefore needed to include the data of both groups within the following models, we did not include proficiency as an additional continuous variable to the present analysis.

2.2.1.4 Procedure

We used a scripted comprehension-to-production priming task in which participants performed a picture description and searching task with the experimenter (Branigan et al., 2000). The participant and the experimenter, who was a French native speaker, sat at opposite ends of a table with two sets of picture cards in front of them: the searching set and the description set. A screen was placed on the table to prevent them from seeing each other's description and searching sets. The searching set was arranged as an array of cards facing upwards, organised in alphabetical order by verb to facilitate finding. The description set contained the cards to be described on each turn. The experimenter's descriptions were written on her cards to ensure the correct prime sentences were produced.

The participant and experimenter took turns to describe a card to their partner and to search for the card corresponding to the description of their partner. The experimenter started by reading the description of her first card taken from the top of her description set which was the first prime. The participant searched for the card matching that description in the searching set and put it aside. On the following turn, the participant described the first card taken from their description set, thereby producing the first target sentence. The experimenter searched for the corresponding card in her searching set and put it aside. The experiment continued this way until all cards from both description sets had been described. The task was audio-recorded with a Zoom H1 recorder.

Participants completed Experiments 1a and 2a within a single session. To create a break between the two priming experiments, they completed the language background and proficiency questionnaire on paper between the two experiments.

2.2.1.5 Scoring

We coded responses in which the temporal adverbial phrase appeared in sentence-initial position as fronted sentences, and those in which the temporal adverbial phrase was produced in sentence-final position as non-fronted sentences (Table 2.1). We excluded sentences in which the temporal adverbial phrase was not produced and unfinished sentences (where participants stopped at any point before the object was produced). We ignored morphosyntactic errors.

Table 2.1 Overview of response frequencies in Experiment 1a. Frequency of target responses by group, overlap condition and experiment phase.

			Responses		
Condition	**Group**	**Phase (prime)**	**Non-fronted**	**Fronted**	**Other**
No overlap	L1	Pre-test	180	83	7
		Priming (non-fronted)	274	258	4
		Priming (fronted)	206	328	7
		Post-test	129	136	5
	L2	Pre-test	187	75	13
		Priming (non-fronted)	324	215	10
		Priming (fronted)	251	298	5
		Post-test	132	136	10
Overlap	L1	Pre-test	200	83	17
		Priming (non-fronted)	405	184	7
		Priming (fronted)	227	368	5
		Post-test	154	139	7
	L2	Pre-test	203	80	11
		Priming (non-fronted)	458	120	9
		Priming (fronted)	172	407	7
		Post-test	150	139	4

2.2.2 Analysis and results

We compared immediate and long-term priming effects with and without overlap in L2 and L1 speakers.

As the response frequencies presented in Table 2.1 showed that both speaker groups produced more non-fronted than fronted TPs in the pre-test, we analysed the effect of priming on fronted TP responses (as in Ruf, 2011). Our dependent variable was binary, so we analysed the data with Generalized Logistic Mixed Models (GLMM) (Baayen et al., 2008; Jaeger, 2008) using the lme4 package (Version 1.1.21; Bates et al., 2014) in R, version 1.2.5042. The dependent variable was coded as 0= non-fronted TP, 1= fronted TP. The factorial predictors Prime (fronted vs. non-fronted TP), Section (pre-test vs. post-test), Overlap (overlap vs. no overlap), Group (L2 vs. L1 speakers) and Side (picture representing the adverbial phrase

located on the left vs. on the right side of the target picture) were sum contrast coded to have a mean of 0 and a range of 1 prior to analysis. We included Side as an additional predictor as we anticipated that participants could tend to produce more fronted sentences if the picture representing the temporal adverbial phrase appeared on the left corner of the card (i.e., if they adopted a strategy of 'reading' across the card (Figure 2.1); Jackson & Hopp, 2020).

For all analyses, we started with a full model including main effects and interactions, and maximal by-subject and by-item random effect structure justified by our experimental design (Barr et al., 2013). Then, we performed a step-wise "best-path" reduction procedure, removing interactions before main effects, to locate the best model that, as shown by ANOVA comparisons, did not differ significantly from the full converging model in terms of variance explained but did differ significantly from a model without interactions between the predictors and from a null model only including the intercept term as a predictor. Where models did not converge, we removed random slopes and interactions before main effects, starting with those accounting for the least variance. In the following sections, we report the results of the best models, except where, as stated, these failed to converge or did not provide a better fit than the model without interactions or the null model. When running further models to explore each significant interaction, we applied Bonferroni corrections with a corrected alpha level of 0.025. All p-values for individual predictors were obtained from the model summary output.

2.2.2.1 Immediate priming

We compared immediate priming in L1 vs. L2 speakers with and without overlap by building a full model with the fixed effects Prime, Overlap, Group, Side and the four-way interaction. The model included random intercepts for participants and items and by-subject random slopes for Prime and side and their interaction, and by-item random slopes for Prime, Overlap, Group and their interactions.

The best model revealed a significant main effect of Prime (Cohen's *d*=.83, SE=.02), whereby participants produced more fronted targets after fronted primes (*M*=0.62, *SD*=0.49) than after non-fronted primes (*M*=0.35, *SD*=0.48). There was a significant main effect of Side as participants produced more fronted sentences when the image representing the temporal adverbial phrases was on the left (*M*=0.52,

SD=0.5) than when it was on the right (*M*=0.45, *SD*=0.5), however, there was no interaction between Side and Prime. There was a significant two-way interaction between Prime and Overlap, reflecting a lexical boost effect across groups: fronted responses were 40% more likely following fronted primes than non-fronted primes with overlap whereas they were only 13.6% more likely following fronted primes than non-fronted primes without overlap. There was also a significant interaction between Prime and Group: irrespective of overlap condition, the L2 speakers produced 32.5% more fronted descriptions following fronted primes than non-fronted primes, whereas L1 speakers were 22.2% more likely to produce fronted descriptions following fronted than non-fronted primes. These were qualified by a significant three-way interaction between Prime, Overlap and Group suggesting that the effects of priming and overlap condition differed by group (Table 2.2, Figure 2.2).

We explored these effects for each overlap condition separately to examine between-group differences in priming for abstract vs. lexically-based priming. First, however, we confirmed that each group showed a significant boost to priming with lexical overlap. We split the data by Group and ran models containing the two-way interaction between Prime and Overlap. The models for both groups revealed a significant interaction between Prime and Overlap (L2 speakers: β=1.90 (*SE*=0.23), *Z*=8.30, $p<.001$; L1 speakers: β=1.11 (*SE*=0.22), *Z*=5, $p<.001$). Though this was a between-subject manipulation, both the L2 and the L1 speakers were more likely to produce a fronted sentence after a fronted sentence than after a non-fronted sentence when it contained the same fronted adverbial (49.5% vs. 30.6% priming, respectively) than when it contained a different fronted adverbial (14.4% vs. 12.9% priming, respectively). However, the L2 speakers experienced a larger lexical boost effect (35.1%) than the L1 speakers (17.7%).

To examine whether L2 speakers showed greater abstract priming than L1 speakers we built a model for the condition without overlap. This revealed a significant main effect of Prime, β=.91 (*SE*=0.11), *Z*=8.08, $p<.001$ such that participants produced more fronted sentences after fronted sentences (*M*=0.58, *SD*=0.49) than after non-fronted sentences (*M*=0.44, *SD*=0.50). There was also a significant main effect of Side, β = -0.64 (*SE*= 0.17), *Z*=-3.86, $p<.001$, as participants produced more fronted sentences when the image representing the

temporal adverbial phrase was on the left (M=0.56, SD=0.5) than when it was on the right (M=0.46, SD=0.5. However, there was no significant interaction between Prime and Group (p=.52). To confirm the null hypothesis of no difference in priming effects between groups, we used the Bayesian information criterion (BIC) values of the models to estimate the Bayes Factor as $e^{(AlternativeBIC - NullBIC) / 2}$ and quantify the likelihood of null effects. We compared a model with only the main effects of Prime and Group (Null model) to a model that contained the two-way interaction between these factors (Alternative model; Wagenmakers, 2007). Inverse BFs <1 favour the null hypothesis and values >1 favour the alternative hypothesis (Jarosz & Wiley, 2014). The Bayesian analysis confirmed the absence of a significant interaction between Prime and Group, with the inverse BF=.02 providing "strong" evidence in favour of the null hypothesis (Jarosz &Wiley, 2014; Raftery, 1995).

To compare lexically-based priming across groups, we built a model for the condition with overlap. This revealed a significant main effect of Prime, β=2.37 (SE=0.12), Z=19.89, p<.001 such that participants produced more fronted sentences after fronted sentences (M=0.66, SD=0.47) than after non-fronted sentences (M=0.26, SD=0.44). There was a significant interaction between Prime and Group, β=1.00 (SE=0.23), Z=4.38, p<.001, such that the L2 speakers were 49.5% more likely to produce fronted descriptions following fronted primes than non-fronted primes, whereas L1 speakers were 30.6% more likely to repeat the prime structure. Simple main effects analyses revealed a significant main effect of Prime in both the L2 speakers, β=2.76 (SE=0.17), Z=15.95, p<.001, and the L1 speakers, β=1.93 (SE=0.16), Z=11.84, p<.001.

To summarize, in both groups there was significant immediate priming with and without overlap, and increased priming with overlap. Unexpectedly, L2 speakers did not experience larger priming than the L1 speakers in the condition without overlap but the lexical boost to priming and the magnitude of lexically-based priming were greater in L2 than in L1 speakers. Side of presentation of the temporal adverbial phrase's picture only significantly affected target sentence production in the condition without lexical overlap for both groups[6], but it did not interact with priming.

[6]When splitting the dataset per group, we found that there only was a significant effect of Side for L1 speakers, β=-0.60 (SE=0.17), Z=-3.52, p<.001.

Table 2.2 Immediate priming model for Experiment 1a. Summary of the best model for immediate priming of fronted sentences across groups and overlap conditions. *The best model included the fixed effects Side and the three-way interaction between Prime, Group and Overlap and no random slopes.*

Fixed effects	**Estimate**	**Standard Error**	**Z-value**	***p*-value**
Intercept	-.12	.14	-.90	.37
Prime	1.63	.08	20.17	**<.001**
Group	-.26	.25	-1.04	.30
Overlap	-.35	.25	-1.39	.16
Side	-.44	.13	-3.37	**<.001**
Prime x Group	.57	.16	3.58	**<.001**
Prime x Overlap	1.51	.16	9.45	**<.001**
Group x Overlap	.38	.50	.76	.45
Prime x Group x Overlap	.85	.32	2.68	**<.01**

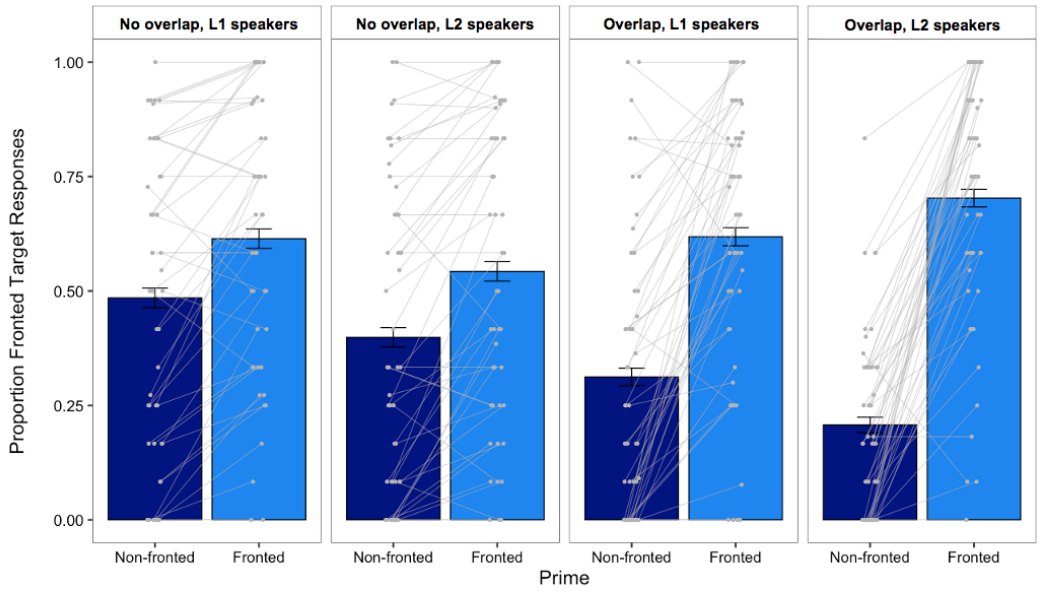


Figure 2.2 Fronted responses in the priming phase. Mean proportion of fronted responses out of all fronted and non-fronted responses by prime, overlap and group conditions in the immediate priming phase. Error bars indicate the standard error of the mean, grey dots indicate individual data points and grey lines individual priming effects.

2.2.2.2 Long-term priming

We analysed long-term priming with and without overlap in L1 vs. L2 speakers by building a model with the fixed effects Section, Overlap, Group, Side and the four-way interaction. We included random intercepts for subjects and items and by-subject random slopes for Section and Side and their interaction, and by-item random slopes for Group, Overlap and their interaction.

The best model revealed a significant main effect of Section (Cohen's *d*=.54, SE=.03), whereby participants produced more fronted sentences in the post-test (*M*=0.49, *SD*=0.5) than in the pre-test (*M*=0.29, *SD*=0.46) (Table 2.3; Figure 2.3). This effect shows that there was long-term priming across groups and overlap conditions. Bayesian analyses confirmed that there were no significant two-way interactions between Section and Overlap nor between Section and Group with their inverse BFs=.03 providing "strong" evidence in favour of the null hypothesis. Therefore, we conclude that these factors did not affect long-term priming of fronted sentences (Figure 2.3).

Table 2.3 Long-term priming model for Experiment 1a. Summary of the best model for long-term priming of fronted sentences across groups and overlap conditions. *The best model only included Section as fixed effect and no random slopes.*

Fixed effects	**Estimate**	**Standard Error**	**Z-value**	***p*-value**
Intercept	-.75	.27	-2.74	**<.01**
Section	1.54	.45	3.46	**<.001**

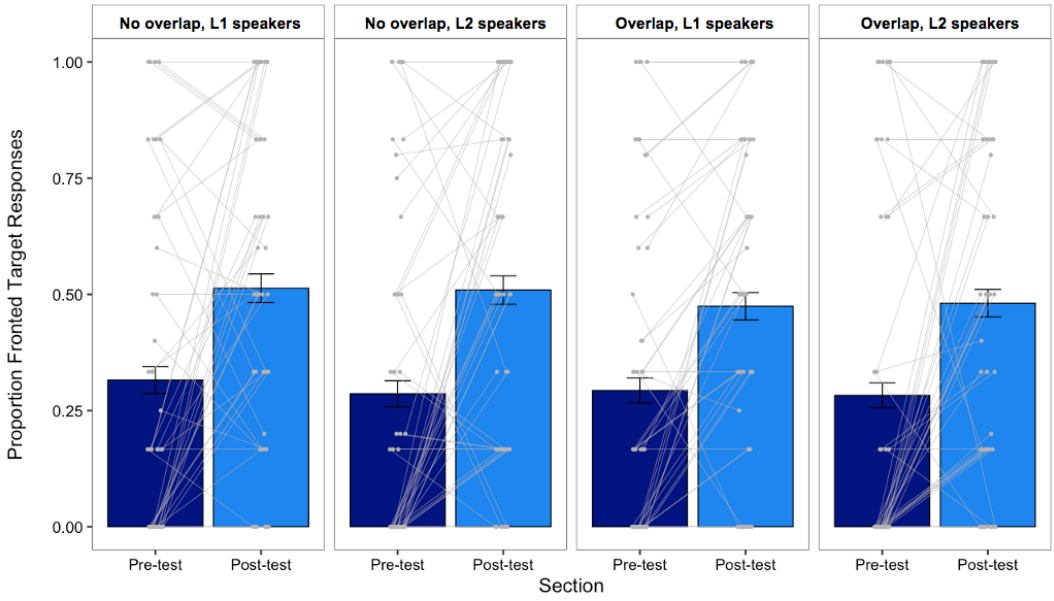


Figure 2.3 Fronted responses in the pre- and post-tests. Mean proportion of fronted descriptions in the pre- and post-tests out of all fronted and non-fronted descriptions by section, overlap and group condition. Error bars indicate the standard error of the mean, grey dots indicate individual data points and grey lines individual priming effects.

2.2.3 Discussion of Experiment 1a

Experiment 1a showed that both groups of speakers experienced immediate priming with and without overlap in line with previous research targeting fronting alternations (Jackson & Hopp, 2020; Jackson & Ruf, 2017, 2018; Ruf, 2011). Moreover, both groups experienced significant lexical boost effects (e.g., Branigan et al., 2000; Jackson & Ruf, 2017, 2018; Mahowald et al., 2016). However, contrary to the predictions of the language learning models of priming (Chang et al., 2006, 2012; Reitter et al., 2011), abstract immediate priming was not significantly larger in L2 than in L1 speakers (14.4% and 12.9% respectively; see Ruf, 2011 for similar results). The L2 speakers showed a greater lexical boost to immediate priming (35.1%) than L1 speakers (17.7%) as well as a larger priming magnitude (49.5%) than L1 speakers (30.6%) in the condition with overlap. This provides support for the predictions made by Reitter et al.'s (2011) account of priming but not by Chang et al.'s (2006, 2012) model. It could also suggest that L2 speakers' syntactic processing relies on more lexicalized representations than L1 speakers' (Mahowald et al., 2016). Finally, there was significant long-term priming in that the speakers

produced more fronted sentences in the post- than in the pre-test phase and as predicted there was no lexical boost to long-term priming (Ruf, 2011). However, unexpectedly, this learning was not greater for L2 speakers, perhaps due to the lack of significantly greater immediate priming effects (see Jackson & Hopp, 2020 for similar results). We discuss potential reasons for these findings in the general discussion.

One possible explanation for why some of our results were not in line with our predictions is that the syntactic alternation used in this experiment was not suitable for detecting between group differences. Previous studies comparing the magnitude of priming in L2 and L1 speakers have indeed reported mixed results regarding this prediction (Abrahams et al., 2019; Flett, 2006; Jackson & Hopp, 2020; Ruf, 2011) but they targeted different syntactic alternations. A between-group difference in abstract priming effects may be more likely to arise when the targeted structure has a lower pre-test frequency or is syntactically more complex. Therefore, in Experiment 2a, we tested priming on a target structure that may be less frequent and more complex: passive sentences. We expected there to be a larger difference in terms of baseline frequency of active versus passive sentences than of fronted versus non-fronted TPs. Furthermore, while both alternations involve a change at the levels of information structure and constituent structure between their two structures, the active/passive alternation additionally entails a change in grammatical role attribution, suggesting that it is syntactically more complex. The language learning models predict that both speaker groups should be more likely to experience (greater) prediction error (Chang et al., 2006) or changes in base-level activation (Reitter et al., 2011) when processing such primes leading to greater priming. However, these factors may affect L2 speakers more due to their reduced experience with the target language. It may thus be more likely to observe larger immediate and long-term priming effects in L2 than in L1 speakers.

2.3 Experiment 2a- Active/passive alternation

We examined syntactic priming for French active/passive syntactic structures (2a & b) with and without overlap between prime and targets in English-speaking learners of French and L1 speakers of French. French and English have similar possible constructions for active and passive sentences (but see section 2.3.1.5 for the

description of an alternative passive form in French, passive sentences with a reflexive pronoun):

2.a. Le pirate suit le marin.
The pirate is following the sailor.
b. Le marin est suivi par le pirate.
The sailor is being followed by the pirate.

2.3.1 Methodology

2.3.1.1 Participants

The same 104 L2 and 100 L1 speakers completed Experiment 2a[7]. We excluded 13 participants who reported being native speakers of both languages or who were not L1 or L2 native speakers of French or English, three participants due to experimenter error and two participants who produced only reversed actives (and non-reversed passives sentences). As a result, the analyses included 91 L2 speakers (72 female); 42 in the No Overlap condition and 49 in the Overlap condition, and 95 L1 speakers (75 female); 45 in the No Overlap condition and 50 in the Overlap condition. Participants were aged 18 to 28 years (*M*= 19.77). Overall, the L2 speakers included in the analysis for passives had an average proficiency rating of 6.31 (range 1.5-9). They had a mean proficiency score of 6.53 (*SD*=2.04, range 1.5-9) in the condition without overlap, and a mean score of 6.13 (*SD*=1.80, range 1.5-9) in the condition with overlap[8].

2.3.1.2 Design

Experiment 2a had the same design as Experiment 1a.

[7]Recall that Experiment 2a was actually completed first since the fronted items included many active transitive sentences that might have counteracted the passive priming we sought to elicit in this experiment.

[8]The entire analysis with the dataset of the L2 speakers only, where we included proficiency as an additional continuous variable, showed that it never interacted with any of the other variables, although it did increase overall target structure production in the analyses of both immediate and long-term priming. Therefore, and since we wanted to compare priming in L2 and L1 speakers and therefore needed to include the data of both groups within the following models, we did not include proficiency as an additional continuous variable to the present analysis.

2.3.1.3 Materials

2.3.1.3.1 Prime/target cards

We created 36 target items using six French verbs (*pourchasser* (chase), *suivre* (follow), *taper* (punch), *gronder* (scold), *embrasser* (kiss), *gifler* (slap)) six times each with different combinations of animate agent and patient characters. Items were based on stimuli from Branigan et al., (2000) and Hardy et al. (2017). Each target verb appeared once in the pre-test (6 items), four times in the priming phase (24 items) and once in the post-test (6 items).

For the priming phase, we created a prime item with and without overlap (of the verb) for each target item. To create 24 prime items with overlap, the target verbs were used four times each with new combinations of characters. To create 24 prime items without overlap we paired each target verb with one of six different verbs (*frapper* (kick), *pousser* (push), *toucher* (touch), *tuer* (shoot), *tirer* (pull), *chatouiller* (tickle)), each of which were used four times with different combinations of characters. Prime items had an associated active and passive description (Figure 2.4).

In the priming phase, prime-target pairs were separated by two filler pictures (a prime and a target filler picture) and in the pre-/post-test sections target pictures were separated by three filler pictures. We created 84 filler pictures in total using intransitive verbs (depicted with two characters, such as "the monks are crying") and ditransitive verbs (depicted with two characters and an object, such as "the monk is selling the artist a cup"). 36 appeared in the target set (6 in the pre-test, 24 in the priming phase and 6 in the post-test) and 48 appeared in the prime set (12 in the pre-test, 24 in the priming phase and 12 in the post-test).

In total, there were 72 pictures (36 targets and 36 fillers) in the participant's description set and 72 pictures (24 primes and 48 fillers) in the experimenter's description set. Items were depicted on individual cards (10 cm x 10cm), which included word labels (articles, nouns and verbs) to prevent problems of vocabulary retrieval. The position of the agent character was counterbalanced to appear an equal number of times on the right and on the left side of the card. We created four lists of stimuli, two with overlap and two without so that one version of each experimental prime item (active or passive) would appear in each list. Participants were randomly assigned to one of the four lists.

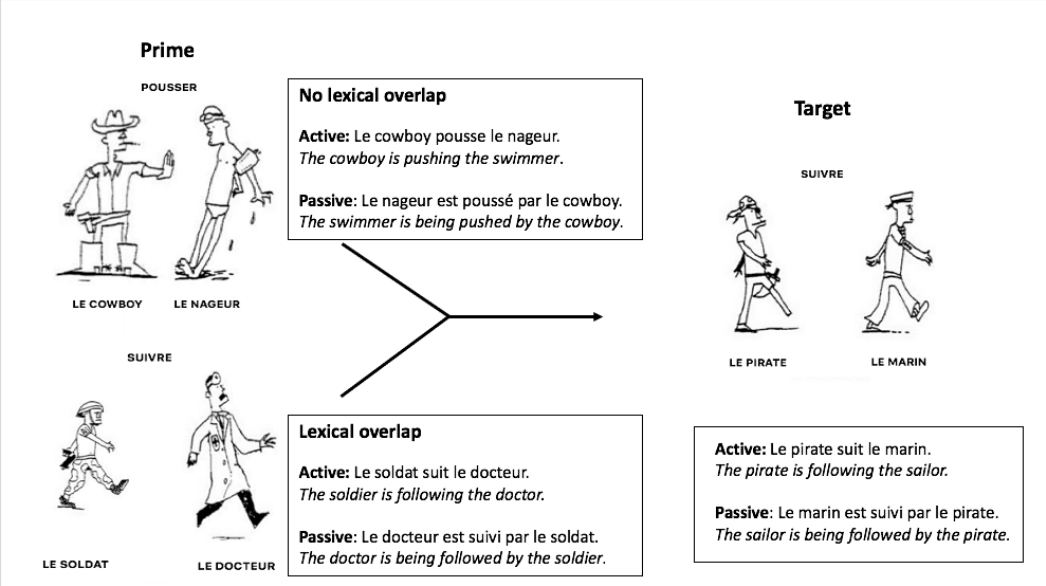


Figure 2.4 Stimuli of Experiment 2a. Example of active/passive prime and target stimuli.

2.3.1.4 Procedure

See Experiment 1a for a description of the procedure.

2.3.1.5 Scoring

The analysis included complete active sentences containing a subject noun phrase with the agent produced first, followed by the verb and finally, an object noun phrase with the patient, and complete passive sentences containing a subject noun phrase with a patient in first position, followed by a form of the verb "to be" (i.e., "être"), a past participle and finally, a by-phrase (headed by 'par') with an agent (Table 2.4). We ignored morphological errors, such as tense or agreement errors and naming errors in which participants used an alternative noun for a character (e.g., naming a character "le juge" (the judge) instead of "le professeur" (the teacher)). We included sentences in which one of the noun phrases was replaced by a pronoun or sentences in which two pronouns of distinct genders were produced, and sentences with complex noun phrases (e.g., "le professeur frappe le tibia du clown" (the teacher kicked the clown's leg)). All remaining responses, including reversed passives and actives (i.e., where the agent was described as a patient and vice versa), and responses that were not an active or passive, were coded as 'other' and excluded from the analyses. We also excluded passive sentences with a reflexive pronoun,

which were very few (1 in the pre-test, 24 in the priming phase and 9 in the post-test) and all produced by L1 speakers (see 3.a below).

3.a Le juge *se* fait frapper par le professeur.
The judge him-REFL.3SG make-PRS.3SG hit-INF by the professor
The judge is being kicked by the professor.

Table 2.4 Overview of response frequencies in Experiment 2a. Frequency of target responses by group, overlap condition and experiment phase.

			Response		
Condition	**Group**	**Phase (prime)**	**Active**	**Passive**	**Other**
No overlap	L1	Pre-test	229	2	39
		Priming (active)	451	41	48
		Priming (passive)	433	51	55
		Post-test	222	21	27
	L2	Pre-test	211	0	41
		Priming (active)	395	50	61
		Priming (passive)	357	87	53
		Post-test	184	43	24
Overlap	L1	Pre-test	246	1	53
		Priming (active)	482	59	58
		Priming (passive)	383	169	46
		Post-test	249	39	12
	L2	Pre-test	240	1	52
		Priming (active)	481	40	66
		Priming (passive)	191	280	113
		Post-test	172	90	32

2.3.2 Analysis and results

Unless otherwise stated, we followed the same procedure for statistical analysis as in Experiment 1a. We used the lme4 package (Version 1.1.21; Bates et al., 2014) for the analyses of immediate priming and the blme package (Version 1.0.4) for the analyses of long-term priming (where most participants did not produce passives in

the pre-test; such zero cells led to convergence issues for analyses in lme4). As the response frequencies presented in Table 2.4 confirmed that speakers of both groups were more likely to produce active than passive sentences in the pre-test, we analysed the effect of priming on passives. The dependent variable was coded as 0=active, 1=passive. The factorial predictors Prime (active vs. passive), Section (pre-test vs. post-test), Overlap (with vs. without) and Group (L2 vs. L1 speakers) were sum contrast coded to have a mean of 0 and a range of 1 prior to analysis.

As in Experiment 1a, we started with a full model which we then reduced to find the simplest model that did not significantly differ from the full model (best model).

2.3.2.1 Immediate priming

For immediate priming, we built a full model with the fixed effects Prime, Overlap, Group and the three-way interaction. The model included random intercepts for participants and items and by-subject random slopes for Prime and by-item random slopes for Prime, Overlap, Group and their interactions.

The best model revealed a significant main effect of Prime whereby participants produced more passive targets after passive primes (*M*=0.30, *SD*=0.46) than after active primes (*M*=0.10, *SD*=0.29) (Cohen's *d*=.79*, SE*=.02). We found a significant main effect of Overlap, whereby the speakers of both groups produced more passive targets with (*M*=0.26, *SD*=0.44) than without overlap (*M*=0.12, *SD*=0.33) and a significant main effect of Group as L2 speakers produced more passives overall (*M*=0.24, *SD*=0.43) than L1 speakers (*M*=0.15, *SD*=0.36). We found a significant two-way interaction between Prime and Overlap, reflecting a lexical boost effect: passives were 34.6% more likely following passive primes than active primes with overlap whereas they were only 5.2% more likely following passive primes than active primes without overlap. There was a significant two-way interaction between Group and Prime: the L2 speakers were 30.8% more likely to produce passives following passive primes than active primes, whereas L1 speakers were 11.6% more likely to prime. These effects were qualified by a significant three-way interaction between Prime, Overlap and Group suggesting that the effects of priming and overlap condition differed by speaker group (Table 2.5, Figure 2.5).

We explored these effects for each overlap condition separately to examine between-group differences in priming for abstract versus lexically-based priming versus priming. First, however, we tested whether each group experienced a significant lexical boost effect. We split the data by Group and ran models containing the two-way interaction between Prime and Overlap. The models for both groups revealed a significant interaction between Prime and Overlap (L2 speakers: β=3.50 (*SE*=0.63), *Z*=5.59, p<.001; L1 speakers: β=1.41 (*SE*=0.47), *Z*=3.04, p<.025). Both the L2 and the L1 speakers were more likely to produce a passive sentence after a passive sentence than after an active sentence when it contained the same verb (51.8% vs. 19.7% priming, respectively) than when it contained a different verb (8.3% vs. 2.2% priming, respectively), though the L2 speakers experienced a larger lexical boost effect (43.5%) than L1 speakers (17.5%).

When splitting the dataset by overlap condition, we found no main effect of Prime in the condition without overlap (p=.23), nor any significant interactions. This was confirmed by a Bayesian analysis with the data of the condition without overlap comparing a null model which only included the intercept term as a predictor to an alternative model that contained the main effect of Prime. The inverse BF=.26 provided "positive" evidence in favour of the null hypothesis. Conversely, there was a significant main effect of Prime in the condition with overlap, β=3.18 (*SE*=0.37), *Z*=8.57, p<.001, such that participants produced more passive sentences after passive primes (*M*=0.44, *SD*=0.50) than after active primes (*M*=0.09, *SD*=0.29). Additionally, there was a significant interaction between Prime and Group, β=2.03 (*SE*=0.54), *Z*=3.75, p<.001, whereby the L2 speakers were 51.8% more likely to produce passive descriptions following passive primes than active primes, whereas L1 speakers were 19.7% more likely to produce passives after passive primes than after active primes. Simple main effect analyses revealed a main effect of Prime in both L2, β=4.17 (*SE*=0.62), *Z*=6.74, p<.001 and L1 speakers, β=2.28 (*SE*=0.45), *Z*=5.09, p<.001.

To summarize, though priming without overlap was numerically larger for L2 (8.3%) than for L1 speakers (2.2%), it was not significant within either group, but the magnitude of priming was larger in L2 than in L1 speakers in the condition with overlap. Finally, there was a significant lexical boost across groups, but it was larger in L2 than in L1 speakers.

Table 2.5 Immediate priming model for Experiment 2a. Summary of the best model for immediate priming of passive sentences across groups and overlap conditions. *The best model included the three-way interaction between Prime, Group and Overlap and by-subject random slopes for Prime only.*

Fixed effects	**Estimate**	**Standard Error**	**Z-value**	***p*-value**
Intercept	-2.60	.20	-12.97	**<.001**
Prime	1.91	.27	7.16	**<.001**
Group	.64	.29	2.20	**<.05**
Overlap	1.14	.30	3.83	**<.001**
Prime x Group	1.22	.37	3.31	**<.001**
Prime x Overlap	2.45	.38	6.44	**<.001**
Group x Overlap	-.25	.58	-.43	.67
Prime x Group x Overlap	1.69	.74	2.29	**<.05**

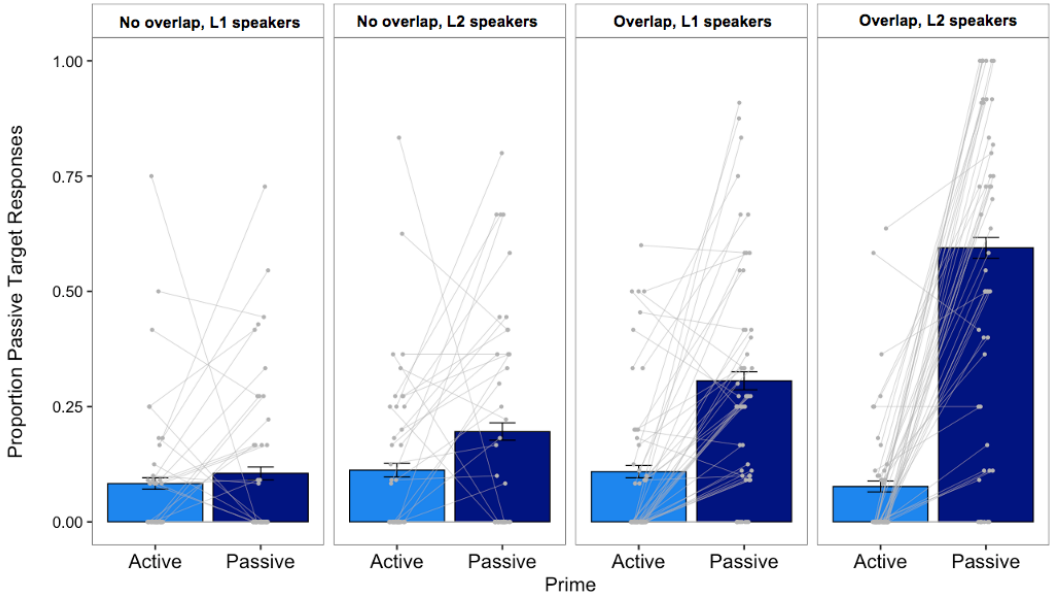


Figure 2.5 Passive responses in the priming phase. Mean proportion of passive responses out of all transitive descriptions by Prime, overlap and group conditions in the immediate priming phase. Error bars indicate the standard error of the mean, grey dots indicate individual data points and grey lines individual priming effects.

2.3.2.2 Long-term priming

For long-term priming, we built a model with the fixed effects Section, Overlap, Group and the three-way interaction. We included random intercepts for subjects and items as well as by-subject random slopes for Section and by-item random slopes for Group and Overlap and their interaction.

The best model, that did not significantly differ from the full converging model (p=.10) but was a better fit than the null model (p<.001), did not include any interactions between fixed effects (Table 2.6, Figure 2.6). It showed a significant main effect of Section (Cohen's d=1.05, SE=.02) whereby participants produced more passive sentences in the post- (M=0.19, SD=0.39) than in the pre-test (M=0.00, SD=0.07). Hence, both groups experienced long-term priming across overlap conditions. There was also a significant main effect of Group such that the L2 speakers produced more passives (M=0.14, SD=0.35) than the L1 speakers (M=0.06, SD=0.24) across overlap conditions and a significant main effect of Overlap such that, across groups, participants produced more passives with (M=0.13, SD=0.33) than without overlap (M=0.07, SD=0.26).

Since including interactions between fixed effects in the model did not improve its fit, we conclude that there were no significant interactions between Section, Overlap and Group. To confirm the null hypotheses of no significant interactions between Section and Group, between Section and Overlap and between Section, Group and Overlap, we turned to Bayesian analysis. For each target interaction, we compared a null model which only included the main effects of the targeted predictors to an alternative model that contained the targeted interaction. While the null hypothesis of an absence of significant three-way interaction between Section, Group and Overlap was confirmed (inverse BF=.17, providing "positive" evidence in favour of the null hypothesis), the inverse BFs for the two-way interactions were superior to 1. This suggests that these results have to be treated with caution. In fact, since participants of both groups produced passives for less than 0.5% of their transitive responses in the pre-test (Figure 2.6 and Table 2.4), the significant effects of Group and Overlap were likely driven by differences in passives production emerging in the post-test. In other words, the significant effect of Group seems to be driven by L2 speakers producing more passives than L1 speakers in the post-test. The significant effect of Overlap across groups is similarly

likely to be driven by participants producing more passives in the post-test in the overlap than in the no overlap condition.

To summarise, following the priming phase, participants continued to produce more passives in the post-test which did not contain primes than they had in the pre-test indicating long-term effects of the priming phase; these effects appeared greater in the L2 speakers and with overlap[9].

Table 2.6 Long-term priming model for Experiment 2a. Summary of the best model for long-term priming of passive sentences across groups and overlap conditions. *The best model included Section, Group and Overlap as fixed effects and no random slopes.*

Fixed effects	**Estimate**	**Standard Error**	**Z-value**	***p*-value**
Intercept	-4.60	.40	-11.37	**<.001**
Section	4.38	.67	6.52	**<.001**
Overlap	.92	.33	2.83	**<.005**
Group	1.40	.33	4.27	**<.001**

[9]We ran the same analysis as described below with a dataset that also included passives with a reflexive pronoun (dataset 2), as well as with another dataset that included passives with a reflexive pronoun and reversed actives and passives (dataset 3). The pattern of results for immediate priming was exactly the same across datasets. The pattern of results for long-term priming was highly similar to the one reported above. However, in the analysis with dataset 2, there was no significant main effect of Group but a significant interaction between Section and Group β=2.17 (*SE*=0.92), *Z*=2.36, $p<.05$, whereby L2 speakers showed more long-term priming than L1 speakers. In the analysis with dataset 3, there only was a significant main effect of Section, β=7.02 (*SE*=1.24), *Z*=5.65, $p<.001$.

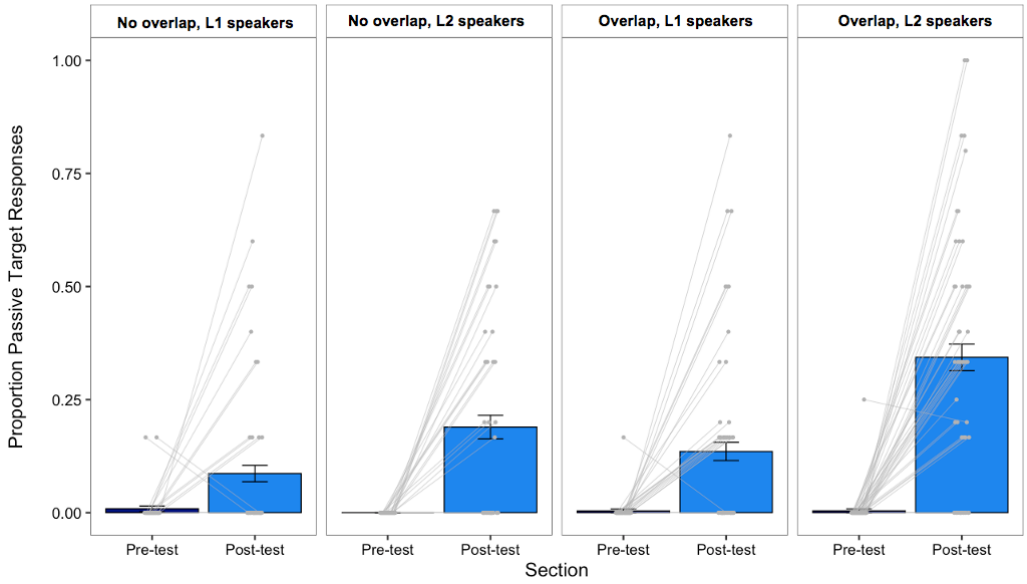


Figure 2.6 Passive responses in the pre- and post-tests. Mean proportion of passive responses out of all transitive responses by section, overlap and group conditions. Error bars indicate the standard error of the mean, grey dots indicate individual data points and grey lines individual priming effects.

2.3.3 Discussion of Experiment 2a

Contrary to our predictions, this experiment did not show significant immediate syntactic priming in either group when there was no overlap between prime and target sentences. However, both groups experienced significant (between participants) lexical boost effects. As in Experiment 1a, this effect was greater in L2 (43.5%) than in L1 speakers (17.5%) (Mahowald et al., 2016) and the magnitude of lexically-based priming was larger in L2 (51.8%) than in L1 speakers (19.7%). This runs counter to the prediction made by Chang et al.'s model (2006) that a between-group difference would only emerge in the case of abstract priming, but not with overlap and, by contrast, partially supports the prediction of the hybrid accounts of priming (e.g., Reitter et al., 2011). There was long-term priming as speakers produced significantly more passives in the post-test than in the pre-test (see Messenger, 2021; Savage et al., 2006 for studies with child L1 speakers). Although there was no interaction between experiment phases and speaker groups, we did find that L2 speakers produced more passives than L1 speakers when comparing the pre- and post-tests across overlap conditions. Since each group only produced passives in the post-test, this suggests a greater effect of long-term priming in L2 speakers,

although across overlap conditions. Interestingly, the main effect of overlap even suggests that long-term priming could be greater in the condition with overlap than in the condition without across groups. We discuss potential explanations for these results in the general discussion.

Strikingly, we see across Experiments 1a and 2a that the patterns of syntactic priming effects differed between alternations even though the same participants took part in both experiments. The same participants showed significant immediate abstract priming of fronted sentences but not of passives and L2 speakers showed increased production of passives across the experiment compared to L1 speakers but not of fronted sentences. The different language learning models of syntactic priming provide different predictions regarding within-speaker variation in priming across syntactic alternations. According to Chang et al. (2006), participants' abstract priming magnitude is determined by their individual learning rate (see section 2.1.3; Branigan & Messenger, 2016), which will in turn determine the extent of weight adjustments in speakers' language system following prediction errors. Therefore, even if speakers may have different levels of baseline knowledge or frequency of use for various structures, we would expect some participants to be overall more likely to prime than others across structures, and thus, individuals to show consistency in abstract priming magnitude across structures. Moreover, this model also predicts that there should be consistency in priming effects across structures in the presence of lexical overlap, if syntactic priming effects with overlap rely on individuals' short-term memory. Participants' short-term memory should indeed not systematically differ across structures. To summarise, based on Chang et al.'s (2006) model of priming, we would predict consistency in priming effects within individuals and overlap conditions across syntactic alternations. By contrast, since in the hybrid models (e.g., Reitter et al., 2011) the magnitude of priming for a given structure depends on its base-level activation both in conditions with and without overlap, we would not expect such within-individual consistency in abstract and lexically-based priming across structures. We ran a combined analysis of both experiments to assess whether the data of the present study would support any of these predictions.

2.4 Combined analysis of Experiments 1a and 2a

We ran a correlational analysis to examine whether individual magnitudes of immediate priming and of long-term priming for each syntactic alternation were related in each group of speakers in the priming conditions with and without overlap. The magnitude of immediate priming effects was calculated as the difference between the proportion of target structures (fronted sentences out of all fronted and non-fronted sentences for Experiment 1a; passives out of all transitive responses for Experiment 2a) produced after a prime sentence with the target structure vs. the alternative structure. Long-term priming corresponded to the increase in proportion of target structure production in the post-test relative to the pre-test.

We ran eight Pearson correlations to compare the magnitude of immediate priming and long-term priming effects for the two syntactic alternations for each speaker group and overlap condition separately (Table 2.7). We only included the 186 participants who participated in both experiments.

We found a significant correlation between the magnitude of immediate priming effects with overlap for the active/passive and for the fronted/non-fronted alternations for both L2 and L1 speakers (Figure 2.7). This shows that, participants who were more likely to prime on the active/passive alternation with overlap were also more likely to prime on the fronted/non-fronted TP alternation. There was a significant correlation in long-term priming with overlap for L1 speakers (Figure 2.8): participants who showed the most long-term priming on the active/passive alternation also experienced more long-term priming on the fronted/non-fronted TP alternation. There were no significant correlations for the conditions without overlap.

Table 2.7 Across-structure comparison. Pearson correlations across structures for magnitude of immediate priming and long-term priming effects per speaker group and lexical overlap condition.

Group	Priming type	Overlap	N	Passive M (SD)	Fronted M (SD)	r	*P* value
L2	Immediate priming	Overlap	49	.47 (.36)	.49 (.28)	.38	**.01**
		No overlap	42	.07 (.25)	.15 (.19)	.22	.15
	Long-term priming	Overlap	49	.32 (.29)	.19 (.41)	.09	.52
		No overlap	42	.19 (.24)	.20 (.40)	.23	.15
L1	Immediate priming	Overlap	50	.19 (.24)	.31 (.29)	.48	**<.001**
		No overlap	45	-.03 (.19)	.13 (.17)	.13	.40
	Long-term priming	Overlap	50	.13 (.21)	.17 (.29)	.35	**.01**
		No overlap	45	.09 (.20)	.20 (.40)	-.04	.81

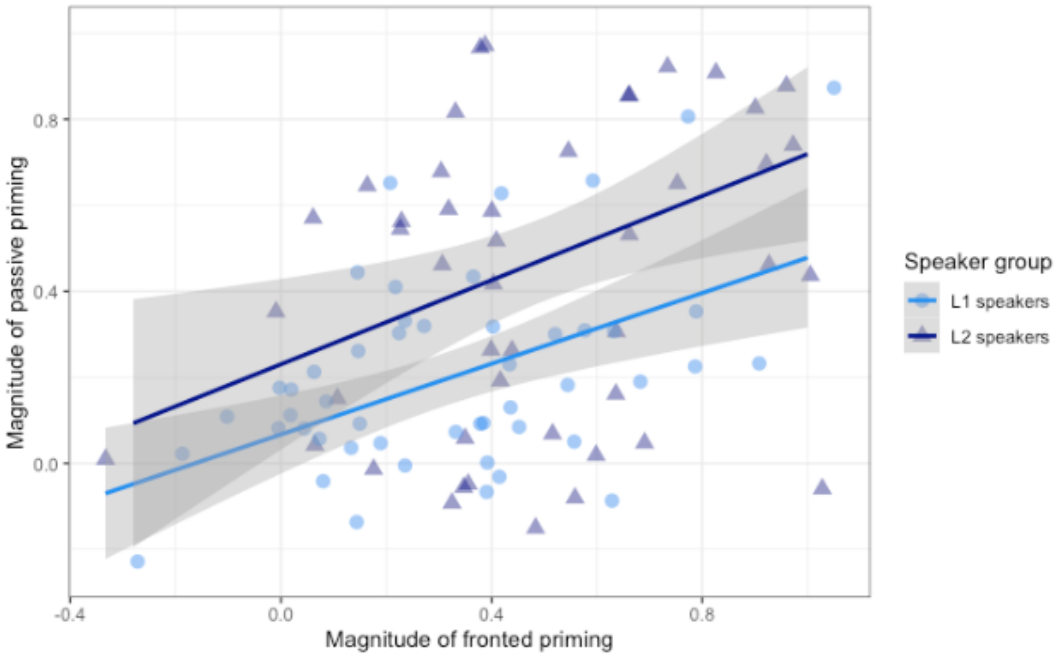


Figure 2.7 Relationship between immediate priming in Experiments 1a and 2a. Scatterplot representing the correlation between immediate priming for passives and fronted sentences in L2 and L1 speakers with Overlap. The grey areas represent the 95% confidence intervals.

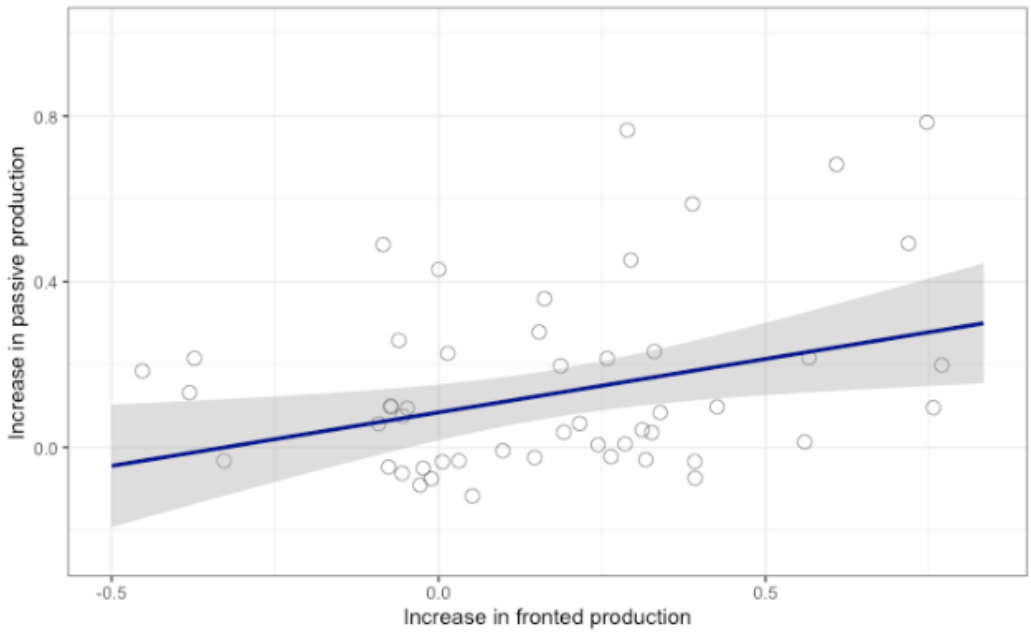


Figure 2.8 Relationship between long-term priming in Experiments 1a and 2a. Scatterplot representing the correlation between long-term priming for passives and fronted sentences in L1 speakers with Overlap. The grey area represents the 95% confidence interval.

2.5 General discussion

The present study tested and compared the predictions of the error-based learning model (Chang et al., 2006) and of the hybrid model of priming (Reitter et al., 2011). We assessed whether abstract immediate and long-term priming would be larger in L2 speakers than in L1 speakers and whether the lexical boost to priming would be short-lived across groups. We also examined whether, as predicted by Chang et al. (2006), lexically-based priming would not differ across groups or whether, as predicted by Reitter et al. (2011), priming with overlap would be larger in L2 than in L1 speakers. We tested these effects with two different structural alternations to examine whether the nature of the syntactic alternation also played a role in the degree of priming and any between-group differences. Finally, we assessed whether the degree of priming an individual showed on one structure related to the degree of priming they showed on another structure both with and without overlap, as predicted by the error-based learning model (Chang et al., 2006) but not by the hybrid model (Reitter et al., 2011).

The same participants showed abstract priming (i.e., without lexical overlap) for the fronting alternation (Experiment 1a) but not for the active/passive alternation (Experiment 2a), while they experienced significant long-term priming across experiments. There was no evidence of larger immediate or long-term priming effects in the absence of lexical overlap in L2 than in L1 speakers in either experiment. Priming with lexical overlap varied across groups: for both alternations, L2 speakers showed larger lexical boost effects and larger lexically-based priming than L1 speakers. Though the lexical boost to immediate priming of fronted sentences did not extend to the post-test phase, for passives, the effect did appear to persist with participants in the lexical overlap condition producing more passives in the post-test than those in the condition without overlap. The most striking result of the study is perhaps that syntactic priming patterns varied highly across syntactic alternations, even within individuals. However, lexical overlap seems to attenuate this variation, as indicated by the correlations across syntactic alternations for immediate priming in both groups and for long-term priming in L1 speakers. We consider in turn the implications of these findings for the language learning models of syntactic priming.

2.5.1 Between-group difference

2.5.1.1 Abstract syntactic priming

Language learning models of priming predict that syntactic priming should have both immediate and lasting effects on speakers' choice of structure. They also predict that the degree of syntactic priming should relate to the magnitude of error a speaker experiences when processing input sentences (Chang et al., 2006) or to the base-level activation of the target structure's syntactic node (Malhotra et al., 2008; Reitter et al., 2011). The error should be larger in speakers who are learners of the language as opposed to adult L1 speakers, and the base-level activations of syntactic nodes in L2 speakers should be lower than in L1 speakers. In other words, L2 speakers should experience larger immediate abstract priming effects than L1 speakers. Since the models propose that these learning experiences accumulate, larger immediate priming effects should lead to larger long-term learning effects of priming. Importantly, previous research indirectly suggests that whether the between-group differences emerge may depend on the target syntactic structure, but

this study is the first to directly compare priming across structures within the same groups of L2 and L1 speakers. Overall, our results provide mixed evidence regarding this ensemble of predictions.

2.5.1.1.1 Immediate syntactic priming

While there was immediate priming for the fronted TPs, in line with past L2 and L1 research (Jackson & Hopp, 2020; Jackson & Ruf, 2017, 2018; Ruf, 2011), the effect was equivalent across groups. For the active/passive alternation, though the magnitude of priming was numerically larger for L2 (8.2%) than for L1 speakers (2.2%), neither group showed a significant effect of priming in the condition without lexical overlap (see Gámez et al., 2009 for similar results with passives). We cannot fully rule out the possibility that this study may have been slightly underpowered to detect significant priming effects without overlap within each group: based on Mahowald et al.'s (2016) meta-analysis, with 24 items and on average 43 participants in the no-overlap groups, the study likely had ~70% power to detect abstract priming. However, when taking both groups together (i.e., 87 participants in the no-overlap condition in total), the study likely had more than 96% power to detect abstract priming. That this main effect was not significant across all participants suggests that the explanation may not be related to power.

Passives may be less sensitive to priming than fronted sentence for at least two reasons. First, Chang et al. (2006) mention that certain syntactic alternations may be more "flippable" than others, which may affect the magnitude of priming. In the present case, it could be that across groups, participants were more likely to show priming with fronted than with passive sentences because, spontaneously, both English and French speakers are more likely to alternate between fronted and non-fronted sentences than between passive and active sentences (c.f. the pre-test measurements in Tables 2.1 and 2.4 and Figures 2.3 and 2.6). However, a well-established finding that is well-accounted for by error-based and hybrid mechanisms is that less frequent structures prime more strongly (e.g., Hartsuiker & Westenberg, 2000; Kaan & Chun, 2017). This would lead us to expect larger priming for passives. Second, it may be that priming of at least certain forms of passives is less robust in Romance languages. A possible reason for this is that, while fronted sentences have only one French translation, English passives have at least two equivalent French

forms: the periphrastic passive, as described in section 2.3 (example (2b), “Le juge est frappé par le professeur”) and the reflexive passive, described in section 2.3.1.5 (example (3a), “Le juge *se* fait frapper par le professeur”). Our participants mostly produced French passives of the first type, but we did observe some production of the second type of passives with a reflexive pronoun (see section 2.3.1.5). Thus, priming passives in French actually meant priming across different related structures, which could have resulted in reduced priming effects. For instance, Gámez et al. (2009) observed that children’s production of Spanish *fue*-passives, which are equivalent to the French periphrastic passive, could not be primed, though their production of *se*-passives, which are equivalent to reflexive passives, did increase. However, as noted above, there were few passives of that form produced in this study and all were formulated by L1 speakers. These passives, or the possibility of priming two related forms, cannot therefore explain the absence of priming in L2 speakers nor the absence of between-group differences.

Another possibility for the lack of a significant abstract priming effect for passives is that, once priming was introduced, participants produced passives both after active and passive primes which actually reduced the effect of prime condition as measured on a trial-by-trial basis. By comparison to the baseline phase where no L2 speakers produced any passives and L1 speakers produced only two passives (less than 1% of responses), participants’ production of passives increased in the priming phase: 15.4% of L2 speakers’ and 9.4% of L1 speakers’ responses across the priming phase were passive (out of all transitive responses). However, these above baseline levels of production occurred in both prime conditions. Following active primes, 11.2% of L2 speakers’ and 8.3% of L1 speakers’ responses were passive, while following passive primes, 19.6% of L2 speakers’ and 10.5% of L1 speakers’ responses were passive, thus reducing the likelihood of observing a trial-by-trial priming effect. As such, though we did not observe immediate priming, contrary to many previous studies of syntactic priming (e.g., Bock, 1986; Flett, 2006; Hardy et al., 2017; Messenger, 2021; Savage et al., 2006), it would be premature to interpret this null effect as indicating that there was no effect of the syntactic primes since, relative to the pre-test phase, there was a clear increase in passive production within (and after) the priming phase. In future studies, it could be relevant to also assess priming by comparing production of the target structure in the priming phase across prime types relative to the pre-test, as an increase in structure production between

these two phases would still indicate that the priming manipulation has affected speakers' language production (as in Hurtado & Montrul, 2021a).

The fact remains that immediate priming of fronted TPs did not differ between L2 and L1 speakers despite a significant effect. Similarly, Jackson and Hopp (2020) only found a marginally significant interaction between prime syntax and speaker group when comparing priming of fronting of adverbial phrases in L2 and L1 speakers. Other studies comparing L2 and L1 speakers and targeting other structures have also failed to find the predicted difference in priming effects for learners versus L1 speakers (Abrahams et al., 2019; Flett, 2006, experiment 3; Ruf, 2011) and previous findings in the literature with other groups of speakers that differed in their level of linguistic knowledge have produced mixed results in this area. Studies with child learners of English similarly fail to show the interaction between priming effects and age group that would indicate stronger susceptibility to priming in children than adults (Branigan & MacLean, 2016; Branigan & Messenger, 2016; Messenger, 2021) though some studies have reported larger effects sizes for child priming than adult in the absence of a significant interaction (Rowland et al., 2012).

The absence of a group difference for the fronting alternation could be due to the lack of syntactic complexity or to the high pre-test frequency of the targeted structure across speaker groups. This could have either prevented L2 speakers from experiencing larger prediction error than L1 speakers or meant that L2 speakers had high base-level activation of the target structure. L1 speakers actually showed a greater increase in fronting production (23.4%) in the priming phase relative to the pre-test than did L2 speakers (18.5%), unlike for passive priming where L2 speakers exhibited a numerically larger increase (15.4%) in passive production in the priming phase relative to the pre-test than did L1 speakers (9.4%). These data provide a hint that L2 speakers may have been more influenced than L1 speakers by priming of more syntactically complex structures. An alternative explanation for our results is that our L2 speakers were not suitably non-proficient to show a greater magnitude of priming relative to L1 speakers. Future studies could try to specifically recruit L2 speakers of lower proficiency levels to answer this question.

2.5.1.1.2 Long-term syntactic priming

In line with language learning models of syntactic priming, we did observe long-term priming effects for both fronted and passive sentences, with participants producing more target structures in the post-test relative to the pre-test phases (e.g., Jackson & Ruf, 2017, 2018; Messenger, 2021; Ruf, 2011). Thus, repeated exposure to fronted and passive sentences across the priming phases impacted the participants' language representations for these structures. But our evidence regarding the strength of this effect in L2 versus L1 speakers was more mixed. There was no difference between speaker groups for fronted sentence priming. Given that we only anticipated group differences in long-term priming to occur if immediate priming was larger in L2 than in L1 speakers, this lack of effect is not surprising (see Jackson & Hopp, 2020 for similar results). Despite no significant difference in immediate priming of passives for L2 and L1 speakers, an additional analysis of the long-term priming data for passives in the condition without lexical overlap revealed a marginally significant effect of Group (p=.05), whereby the L2 speakers produced more passives than the L1 speakers across the pre- and post-tests. This result provides preliminary evidence supporting the predictions of the language learning models (Chang et al., 2006, 2012; Reitter et al., 2011) and our prediction that group differences may be more likely to emerge on more complex syntactic structures, though we did not predict that this effect would be isolated to long-term priming. Overall, our results indicate that the syntactic alternation being primed may be relevant to whether between-group differences in abstract priming emerge.

2.5.1.2 Lexically-based syntactic priming

Syntactic priming with lexical overlap is widely found to be larger than priming without and this lexical boost to priming is typically a short-lived effect (Hartsuiker et al., 2008; Mahowald et al., 2016). To explain this, the error-based implicit learning model of syntactic priming (Chang et al., 2006, 2012) postulates that when there is lexical overlap between prime and target sentences, boosted priming effects are based on the retrieval of the prime form from short-term memory. This implies that syntactic priming with lexical overlap should not lead to between-group differences that are based only on the magnitude of prediction error. Though in the hybrid account (Reitter et al., 2011) priming with lexical overlap relies on short-

lived explicit memories as well, priming in that condition still depends on the base-level activation of a structure's syntactic node. This model hence predicts that L2 speakers' lexical boost effects and lexically-based priming magnitudes should be larger than L1 speakers'.

2.5.1.2.1 Immediate syntactic priming

Both groups of speakers experienced larger priming effects with lexical overlap than without, as in previous research with L1 (Branigan et al., 2000; Mahowald et al., 2016; Pickering & Branigan, 1998) and L2 speakers (Flett, 2006; Jackson & Ruf, 2017, 2018; Kim & McDonough, 2008; Ruf, 2011). The lexical boost effect also appeared larger in L2 than in L1 speakers and the L2 speakers exhibited larger lexically-based priming magnitudes than L1 speakers for both alternations, in contrast to previous research (Flett, 2006; Ruf, 2011). These findings seem to better support the predictions of the hybrid account of priming, although they may also suggest that L2 speakers' syntactic representations are more lexicalized than those of L1 speakers (Mahowald et al., 2016). Past studies show that lexical overlap increases priming more relative to abstract priming in L2 speakers with low L2 proficiency than in more advanced learners (Bernolet et al., 2013; Hartsuiker & Bernolet, 2017; Kim & McDonough, 2008). Since our experiments did not aim to investigate the effect of L2 proficiency on priming patterns and since the tested L2 speakers varied highly in proficiency, it is difficult to establish whether our participants also had item-specific representations. Alternatively, one could hypothesize that, while both groups of speakers may rely more on explicit memory processes in the context of priming with lexical overlap, L2 speakers are more likely to do so than L1 speakers because they benefit more from such facilitation of their language production. For example, if the target verb form of the passive construction is provided, re-using that form may make L2 speakers feel more confident when producing their own sentences. It may even help them overcome a lack of knowledge of past participles.

2.5.1.2.2 Long-term syntactic priming

Since the lexical boost should be a short-lived effect, we did not expect to see it persist into the post-test phase (Chang et al., 2006, 2012; Reitter et al., 2011). The results of Experiment 1a, where overlap did not affect the magnitude of long-term

priming in any group of speakers (see Ruf, 2011 for similar results), support this prediction. Conversely, in Experiment 2a, participants in the lexical overlap condition did produce more passives across the experiment. This finding suggests that syntactic experiences with lexical overlap can accumulate and persist in the same way as those without (see Jackson & Ruf, 2018; McDonough, 2011; Ruf, 2011 for opposite results in L2 speakers). When processing prime sentences in the overlap condition, participants would still experience learning via prediction processes or increases in base-level activation. This would explain why we observed long-term priming effects in that condition. However, it is surprising that this persistence effect was greater in the condition where priming always involved lexical overlap for passives. That long-term priming could be boosted by short-term memory of the target structure is not clearly consistent with any current model of syntactic priming (Chang et al., 2006, 2012; Malhotra et al., 2008; Pickering & Branigan, 1998; Pickering & Ferreira, 2008; Reitter et al., 2011). It is also unlikely that this is due to the timing of the post-test phase since other research shows a rapid decay of priming with lexical overlap when measured on individual trials: one or two intervening fillers dampens the boost to priming from lexical overlap (Hartsuiker et al, 2008; Branigan & MacLean, 2016).

One possible explanation for why the boosted priming effects in the overlap condition led to greater use of passives beyond the priming phase is that it facilitated participants' production of this infrequently-used target structure. Essentially, speakers' increased production of passives during the immediate priming phase with lexical overlap (cf. the observed lexical boost effect) may have provided them with an extra opportunity to practice producing the target structure and the effects of this training then persisted into the post-test. This interpretation seems incompatible with the error-based mechanism whereby *comprehending* prime sentences is essential for speakers to learn from prediction errors (Chang et al., 2006). However, language production may lead speakers to process syntactic structures more deeply and support their encoding in memory (see Hopman & Macdonald, 2018 for further discussion) and, in Reitter et al.'s (2011) model, it could, like comprehension, foster increases in base-level activation. Alternatively, due to their rarity in oral interactions (as demonstrated by the pre-test measurements, Table 2.4 and Figure 2.6), passives may be particularly noticeable and participants' explicit memory of that structure may persist for a long time, thereby influencing their production for

longer (see Ferreira & Bock, 2006 for further discussion of the potential contribution of explicit processes to learning). Research measuring participants' noticing of the targeted structures and its relationship to long-term priming could yield further insight on that issue (see Chapter 3).

2.5.2 Within-individual consistency

According to Chang et al.'s (2006) account of syntactic priming, an individual's magnitude of priming without overlap is determined by their learning rate, which in turn determines the extent to which weights adjust in their language system, and their magnitude of priming with overlap relies on their short-term memory, which should not systematically differ across structures (see section 2.1.3 and 2.3.3 for further explanations). As such, the model predicts that the degree of priming an individual shows with one structure should relate to the degree of priming they show with the other structure across overlap conditions (see also Branigan & Messenger, 2016). However, if priming with and without overlap depends on a structure's base-level of activation (Reitter et al., 2011), observing such within-individual consistency in priming effects across structures should be less likely both in conditions with and without overlap. We observed within-individual consistency for priming across structures in overlap conditions, but abstract priming effects were only significant for the fronted/non-fronted alternation and there was no within-individual consistency in abstract priming between structures.

This pattern of results provides perhaps the most striking evidence for a dissociation between the mechanisms underlying priming with and without overlap, which potentially provides stronger support for the dual error-based learning account (Chang et al., 2006, 2012). However, the lack of consistency in individuals' immediate and long-term abstract priming magnitude across structures is not consistent with the predictions of this model. A possible explanation is that abstract priming of each structure relied on different mechanisms. For instance, Costa et al. (2008) argue that how automatically and implicitly speakers prime may vary across structures. Priming magnitude for a given structure may depend, for instance, on speakers' conscious decisions to re-use the structure or not. Further research should measure whether participants take such decisions during a priming task and how this relates to priming and the resulting learning to test this hypothesis (see Chapter 7).

Alternatively, these results could be better accounted for by the hybrid account (Reitter et al., 2011), which predicts no consistency in abstract priming across structures because these should vary in base-level activation.

In sum, the combined analysis revealed mixed results: the results for priming with overlap seem to better support the predictions that the error-based model makes, whereas the pattern for priming without overlap is more in line with the mechanisms of the hybrid account. However, further studies comparing priming patterns across different structures within the same participants are necessary to understand whether the observed discrepancies in abstract priming could result from differences in the involvement of implicit vs. explicit processes for different structures.

2.6 Conclusion

This study combined comparisons across different speaker groups and syntactic alternations to test the predictions of influential models of syntactic priming and language processing. First, the results show abstract long-term priming effects and provide preliminary support for the expected between-group variation predicted by both the error-based learning (Chang et al., 2006, 2012) and the hybrid model of priming (Reitter et al., 2011; see Malhotra et al., 2008 as well). However, testing L2 speakers with more varied proficiency levels would yield further insight on the latter issue. The findings regarding lexically-based priming are more ambiguous: the observed between-group differences seem more compatible with the hybrid account but the results also provide strong supporting evidence that syntactic priming with and without lexical overlap rely on distinct mechanisms, as proposed by the error-based learning account of priming. Further experiments that manipulate whether L2 and L1 speakers can rely on explicit memories or not, or that would directly manipulate the base-level of activation of the target structures (e.g., Kutta et al., 2017) in priming tasks with lexical overlap could help further explore which of the language learning models best account for lexically-based priming across speaker groups.

This study offers a series of additional novel findings. First, L2 speakers seem overall more sensitive to lexical repetition across primes and targets than L1 speakers and both groups experience long-term priming effects not only without but also with lexical overlap. While unexpected, this result suggests that learning

processes still take place in lexically-based priming contexts and we found that L2 speakers' syntactic learning via priming may even be enhanced in such conditions. Finally, we demonstrated that the type of syntactic structure used to test models of priming can themselves influence the findings and therefore experimental interpretations. Thus, this work highlights the necessity to run syntactic priming studies testing the same participants on several syntactic alternations as conclusions based on certain syntactic alternations may not apply to others.

Chapter 3

Do attention and motivation modulate first and second language syntactic priming?

Using the data of Chapter 2, we explored the effect of individual differences in first (L1) and second language (L2) speakers' attention and L2 speakers' language learning motivation on syntactic priming. We examined immediate and long-term priming of French fronted temporal adverbial phrases and passives with and without lexical overlap. We used self-report questionnaires to measure how attentive participants were to the task, to the syntax of the stimuli, whether they noticed the target structures, how motivated they were to learn the target language and to perform the priming task. Across overlap conditions and speaker groups, high attention and motivation levels decreased long-term priming and influenced overall production of fronted sentences, but not of passive sentences. However, they did not increase the magnitude of immediate and long-term priming for either structure, which suggests that language learning via syntactic priming may be a primarily implicit process[10].

Preregistration: https://osf.io/4n86b?view_only=None

Material/ data availability: https://osf.io/k2tay/?view_only=1849e74a6c4e4c7180667bda6f9ff530

[10]This chapter reports the analysis of the effect of individual differences in attention and motivation on the data of Experiments 1a and 2a of the previous chapter.

3.1 Introduction

Syntactic priming occurs when an individual's processing or production of language is influenced by previously perceived syntactic structures. For instance, speakers tend to re-use the structure of recently encountered sentences (i.e., prime sentences in a syntactic priming task) to formulate subsequent sentences (i.e., target sentences; Bock, 1986). This linguistic adaptation persists into post-tests without primes (Hartsuiker & Westenberg, 2000) and arises not only immediately after exposure to primes that contain the target structure, but also when unrelated sentences are included between primes and targets (Bock & Griffin, 2000). Adult native (L1) speakers and language learners, such as children acquiring their first language (L1) (Kidd, 2012; Messenger, 2021) and adults learning a second language (L2) (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Mackey, 2008; Shin & Christianson, 2012) all experience such immediate and long-term priming effects. However, the magnitude and duration of these effects, or even the likelihood of them arising at all, varies highly between speakers within each of these populations (for reviews see Jackson, 2018; Mahowald et al., 2016; Pickering & Ferreira, 2008). Why this is the case remains unclear and the present chapter explored whether individual differences in attention (in L2 and L1 speakers) and in motivation (in L2 speakers) could account for such variation.

3.1.1 Syntactic priming and the role of attention

3.1.1.1 Psycholinguistic models of syntactic priming

Psycholinguists have designed several types of models to account for syntactic priming effects. According to the residual activation model (Pickering & Branigan, 1998; Pickering & Ferreira, 2008), perception of a structure leads to the transient activation of its associated syntactic representation. This activation makes the structure more available for subsequent production and triggers priming effects. While this model cannot account for long-term priming since the boost in activation is short-lived (e.g., Bock & Griffin, 2000; Hurtado & Montrul, 2021a; Kidd, 2012; Jackson & Ruf, 2018; McDonough & Mackey, 2008; Messenger, 2021), other theories explain that the effects of priming persist over time because syntactic priming relies on a language learning mechanism. In the implicit error-based learning model of Chang et al. (2006; 2012), syntactic priming and language

learning derive from mismatches experienced by language users between their predictions of upcoming language input and actual comprehended input. These mismatches lead to long-term adaptation in the weights of the mappings between message-level representations and the abstract syntactic representation of the structure recently perceived in the language input. As a result, speakers' likelihood to re-use that structure to express a message similar to the one just comprehended increases, both immediately after exposure to the structure (i.e., immediate priming) and later on (i.e., long-term priming). Alternatively, Reitter et al. (2011) proposed that speakers' syntactic representations were associated with a base-level activation resulting from long-term experiences with their corresponding syntactic structure. Syntactic priming and learning in that case occur because exposure to a target structure increases the level of this activation and this boost in activation only slowly decays over time (see Malhotra et al., 2008 for another account of syntactic priming as learning also based on activation mechanisms).

These two models define the mechanisms supporting immediate and the resulting long-term abstract priming (i.e., priming without repeated lexical items between prime and target sentences) as being primarily implicit. In contrast, they both posit that short-lived explicit memories of prime sentences and their structure support priming with lexical overlap. This allows them to explain why lexical boost effects (i.e., boosted priming magnitude in the presence of lexical overlap between prime and target sentences) are typically found to be brief and not to influence long-term priming (Branigan & McLean, 2016; Hartsuiker et al., 2008; Mahowald et al., 2016): the lexical boost occurs because repeated words between prime and target sentences make retrieving the explicit memory of a prime sentence containing the same lexical item transiently more likely. More recently however, Bernolet et al. (2016) hypothesized that explicit memory processes contributed not only to lexically-based, but also to abstract immediate priming. According to them, explicit memories of prime sentences also increase priming when target sentences are formulated immediately after primes. Syntactic priming effects therefore appear to rely on both implicit and explicit processes though accounts differ in the extent to which at least immediate priming is considered to be explicit or implicit. One factor that may be related to the role of explicit memory in supporting immediate priming is attention.

Although attention is a complex psychological construct and there is no clear consensus regarding its definition (Indrarathne & Kormos, 2017), a common description is that attentional mechanisms help select information that is relevant for behaviour and sustain focus on it (Chun et al., 2011; Corder, 1967; Robinson et al., 2012 as well). In the context of a syntactic priming experiment, prime sentences may seem relevant to attentive participants to perform the priming activity or the accompanying cover task. Being attentive may then support the formation of explicit memories of these primes or make participants more likely to rely on such memories. In that case, the models of Chang et al. (2006), Reitter et al. (2011) and Bernolet et al. (2016) generate different predictions regarding how individual differences in attention could modulate syntactic priming. While the first two accounts predict that high attention levels should be particularly likely to further boost lexically-based immediate priming, the latter account predicts that they should enhance immediate priming both with and without lexical overlap. However, based on the three models, enhanced attention should not increase long-term priming since these accounts define effects relying on explicit memories as being short-lived. These predictions remain largely unexplored so far.

3.1.1.2 Attention and priming in L2 and L1 speakers

A few studies indicate that being highly attentive to the task increases the magnitude of L1 abstract immediate priming. For example, L1 speakers directly involved in an interaction such as when they take part in a dialogue (Schoot et al., 2019; but see Ivanova et al., 2020) or when primes are directly addressed to them (Branigan et al., 2007) prime more than participants in monologues or hearing primes as a side participant. These effects may arise because, in order to achieve understanding with their interlocutor, participants are more attentive to the stimuli and process them more deeply in the former than in the latter conditions. Being involved in a task where they have to reach a common goal with their interlocutor, which could require higher attention to the task at hand, also increases priming in L1 speakers (Reitter & Moore, 2014). Furthermore, Ivanova et al. (2020) used participants' reaction times on a picture verification task done in parallel to a priming task as an indicator of how attentive they were to the task. They found that participants who exhibited lower variability in reaction times on this additional task, which they interpreted as

reflecting higher levels of attention to the task, experienced larger priming. Finally, there is evidence that L1 speakers prime more when asked to pay attention to the syntatic form of experimental sentences rather than to their meaning (Bock et al., 1992). Being particularly attentive to the task and to the syntax of the stimuli therefore seems to increase abstract immediate priming in L1 speakers. These results seem more consistent with the account of Bernolet et al. (2016) than with the other two models (Chang et al., 2006; Reitter et al., 2011). However, no study has compared the effect of attention on priming with and without lexical overlap nor looked at whether it modulates long-term priming. Studying these effects would allow us to test the predictions of the three models described above and would thereby inform our understanding of the mechanism(s) by which attention affects the magnitude of priming.

Attention is particularly likely to modulate syntactic priming in L2 speakers. First, being attentive to the linguistic input might promote more accurate perception of the prime sentences (Robinson et al., 2012), and therefore the formation of more accurate memories of the primes. There is also evidence that L2 speakers spontaneously pay little attention to grammar when exposed to the L2 (VanPatten, 2004). More attentive learners may in contrast focus more on this aspect of the task, or be more likely to notice the target structure and, therefore, to re-use it. Second, though the models of Bernolet et al. (2016), Chang et al., (2006) and Reitter et al. (2011) define language learning via syntactic priming as an implicit process, many theories in Second Language Acquisition (SLA) attribute a important role to attention in L2 processing and learning (Leow, 2019; Morgan-Short et al., 2012). Learners can experience implicit L2 learning (e.g., Ellis, 2005), but explicit manipulations or other enhancement techniques that make L2 speakers more attentive to the stimuli and the target form of a task can facilitate L2 learning in implicit learning contexts (see Benati, 2016; Goo et al., 2015; Robinson et al., 2012 for reviews). Furthermore, the Noticing Hypothesis (Schmidt, 1990; Kerz et al., 2017 for a review) postulates that at least noticing a target structure (i.e., consciously registering its presence in the linguistic input) is necessary to learn it, while noticing and understanding it (i.e*.,* also having knowledge of the corresponding grammatical rule) is not necessary, but further facilitates learning (but see Robinson, 1995; Tomlin & Villa, 1994). For example, noticing of the syntactic patterns in the input, as indicated by subjects' capacity to describe the syntactic rules and structures

present in the stimuli, predicts successful learning of Russian inflectional morphology in English native speakers (Brooks & Kempe, 2013). Based on SLA theories and research, and if syntactic priming is a language learning mechanism, we may therefore expect attention to affect syntactic priming and the resulting learning, i.e., long-term priming, in L2 speakers.

In within-L2 priming research, one study found that participants needed to detect the targeted L2 (morpho)syntactic features to experience significant abstract immediate priming (McDonough & Fulga, 2015). Explicit instructions which potentially foster attention to the form of sentences presented in a priming task and noticing of the target structure seem to also increase abstract immediate priming (Shin & Christianson, 2012). Thus, being attentive to syntax, like in L1 speakers, and noticing the target form appear to enhance immediate priming without lexical overlap in L2 speakers. Shin & Christianson (2012) also examined the effect of instructions on long-term priming and found that they boosted immediate but not long-term priming measured in a delayed post-test. This may indicate that these instructions reinforced short-lived explicit memories of the primes, thereby promoting immediate re-use of their syntactic form, while long-term language learning remained largely implicit. These findings provide support for the predictions of the language learning models of priming (Bernolet et al., 2016; Chang et al., 2006; Reitter et al., 2011). However, the explicit instructions in Shin and Christianson's study (2012) may also have boosted L2 speakers' confidence to produce the target form, leading them to show more priming than participants not receiving such instructions. In that case however, that the instructions did not increase long-term priming may not indicate that the influence of attention is short-lived. Rather this result may reflect that the L2 speakers did not benefit from the boost in confidence provided by these instructions (provided during the main priming task) in the delayed post-test anymore. Hence, further research that specifically measures variation in attention is needed to confirm this pattern of results and to determine how attention to linguistic input relates to long-term priming.

In summary, past priming studies with L2 and L1 speakers suggest that individual differences in attention to task, attention to syntax and noticing of the target structure may modulate the magnitude of abstract immediate priming. This makes attention a suitable potential candidate to account for individual variation in

priming. Investigating the effect of attention on long-term priming in experiments with and without lexical overlap and in L1 vs. L2 speakers is necessary to understand the nature of the relationship between attention, priming and language learning in different groups of speakers.

3.1.2 Motivation and L2 syntactic priming

Another factor that may be relevant to explaining variation in syntactic priming effects in L2 speakers is motivation. Motivation determines the reasons why a speaker chooses to learn a target language as well as how much they will persist in doing so and the amount of effort they will dedicate to it (Dörnyei & Skehan, 2003). SLA research has showed that the nature and the intensity of one's motivation are key determiners of achievement in L2 learning (Gardner, 1985; Gardner & Lambert, 1972; Masgoret & Gardner, 2003; Ushioda & Dörnyei, 2012; but see Slevc & Miyake, 2006). Therefore, one could expect it to similarly affect L2 learning via syntactic priming although, to our knowledge, no experimental work has investigated this relationship.

To study the multifaceted nature of motivation as a psychological construct, researchers in SLA typically create subcategories targeting different aspects of motivation. The following categories have specifically been found to relate to L2 production and achievement, and could thus also influence L2 learning via syntactic priming: intrinsic motivation (Cheng et al., 2014; Kang, 2001; Noels et al., 2001**;** Wen, 1997), extrinsic motivation (Kang, 2001; Wen, 1997), motivational intensity (Cocca & Cocca, 2019; Gardner, 1985**;** Noels et al., 2001; Serafini, 2013) and task motivation or attitude towards the task (Dörnyei, 2002; Dörnyei & Kormos, 2000**;** Kormos & Dörnyei**,** 2004). Intrinsic motivation and extrinsic motivation respectively reflect an inherent desire to learn a language for the affective rewards of engaging with learning activities (e.g., *"I enjoy the experience of surpassing myself when practicing French")* versus learning to obtain a reward or avoid a punishment (e.g., *"I don't want to fail the French course"*) (Deci & Ryan, 1985). Motivational intensity is an indicator of the strength of engagement in language learning activities (e.g., "*I am working hard at learning French")* (Gardner & Lambert, 1972). Finally, task motivation can be conceptualized as a combination of task enjoyment (e.g., *"I*

found the task interesting") (Eccles, 1993) and reported effort (e.g.,*"I put a lot of effort in doing the task*) (Boekaerts, 2002).

Individual differences in motivation could also affect syntactic priming by influencing learners' attention and noticing during a task (Crookes & Schmidt, 1991; Ushioda, 2016). The nature of participants' motivation and their language learning goals may determine which aspects of the task they pay attention to. For instance, Takahashi (2005) found that participants with strong intrinsic motivation noticed the target linguistic features of a task more. Saito et al. (2017) also observed that participants' progress in comprehensibility depended on how strongly they wanted to speak comprehensible English. Similarly, L2 speakers motivated to learn grammar could focus more on this aspect of the task. Additionally, participants may be more motivated by a task and thus, more attentive to it, if they think it is useful to reach their language learning goals (Wigfield & Eccles, 2000).

Overall, like attention, high motivation levels could support the L2 speakers' formation of explicit memories of the prime sentences. This could be the case if, thanks to such motivation, learners are more engaged in the task or if they decide to deliberately copy the syntax of their interlocutor to practice the target language (Costa et al., 2008). Being highly motivated would then be particularly likely to enhance either lexical boost effects (Chang et al., 2006; Reitter et al., 2011), or immediate priming in general (Bernolet et al., 2016). In all these scenarios, however, it is unclear whether higher motivation levels would lead to more long-term priming and hence, more L2 learning. SLA research would predict so (e.g., Ushioda & Dörnyei, 2012) but in the language learning models of priming, short-lived explicit memories should not increase long-term implicit learning (Bernolet et al., 2016; Chang et al., 2006; Reitter et al., 2011).

As far as we know, no study has examined the effect of motivation on L2 priming and researchers usually investigate the link between motivation and L2 achievement by using grades and general L2 proficiency measures as indicators of L2 achievement (for exceptions, see Dörnyei & Kormos, 2000; Kormos & Dörnyei, 2004; Saito et al., 2017). Examining the direct relationship between motivation and language learning task performance such as syntactic priming tasks constitutes an opportunity to understand how motivation relates to the acquisition of specific L2 target structures (Ushioda, 2016).

3.1.3 Present study

The present study used the data of Chapter 2 to explore whether individual differences in attention (L2 and L1 speakers) and in motivation (L2 speakers) influenced syntactic priming. We compared the effect of these factors on immediate and long-term priming with and without lexical overlap for two different structural alternations in the two groups of speakers. Participants' individual differences in attention to syntax, attention to task and noticing of the target syntactic forms as well as L2 speakers' individual differences in motivation were assessed with self-report questionnaires.

If enhanced attention and motivation levels support the formation of explicit memories of the prime sentences or make speakers more likely to rely on such memories, then they should increase immediate priming with lexical overlap (Bernolet et al., 2016; Chang et al., 2006, 2012; Reitter et al., 2011) and/or without lexical overlap (Bernolet et al., 2016). Whether these factors would also lead to larger long-term priming was unclear. The three models indeed define language learning via syntactic priming as a largely implicit mechanism and thereby predict that these factors should not increase long-term priming. However, SLA research has identified attention and motivation as important contributors to language learning (e.g., Leow, 2019; Ushioda & Dörnyei, 2012). Thus, if attention and motivation did modulate long-term priming, we expected them to be more likely to do so in the L2 than in the L1 speakers. As in Chapter 2, we tested these predictions on two different structures that differed in complexity.

3.2 Experiment 1b- Fronted/ non-fronted TP alternation

First, we examined the effect of individual differences in attention and motivation on syntactic priming of French fronted/non-fronted temporal adverbial phrases (e.g., *En été, le cowboy porte un chapeau* (In summer, the cowboy wears a hat) vs. *Le cowboy porte un chapeau en été* (The cowboy wears a hat in summer)).

3.2.1 Methodology

3.2.1.1 Participants and Design

The participants, the experimental design, the prime/target cards and the scoring system for target sentences were the same as in Experiment 1a of Chapter 2.

3.2.1.2 Materials

3.2.1.2.1 Attention questionnaire

The attention questionnaire assessed three aspects of attention: attention to syntax, attention to task, and noticing of the target structures. First, participants were asked to provide a rating on a scale from 1 (minimum score) to 7 (maximum score) of the extent to which they paid attention to and were interested in 1) what the experimenter was saying, 2) the picture description task in general, 3) the meaning, 4) the vocabulary, 5) the pronunciation, 6) the syntactic structures of the sentences they heard and produced.

Second, participants had to answer three open-ended questions designed to measure their capacity to describe the syntactic rules and structures present in the stimuli (Brooks & Kempe, 2013; McDonough & Fulga, 2015): (1) “explain, in your impression, what was the experiment about?”, (2) “did you notice any grammatical rules of French underlying the sentences you heard in the picture description task?”, and (3) “can you name and/or describe what the rules were that were illustrated by the sentences you saw during the picture description task?”.

3.2.1.2.2 Motivation questionnaire

Previous research has not investigated the relationship between motivation and syntactic priming in L2 speakers, or indeed the relationship between motivation and language learning tasks more generally (Ushioda, 2016). As such, we created a motivation questionnaire, based on motivational factors previously found to relate to L2 achievement or which we hypothesized could influence syntactic priming.

Participants read statements and rated how strongly they agreed with them on a scale of 1 (strongly disagree) to 7 (strongly agree). The questionnaire items assessed externally regulated motivation (9 items), intrinsic motivation (8 items), task motivation (6 items), motivational intensity (8 items), how important learning French was important for the participants (2 items), participant’s metacognition

about the task and the language (6 items) and participant's language learning goals (9 items) among which 5 items specifically assessed whether participants were interested in improving their grammatical knowledge of French (grammar learning goal) (see OSF for a complete list). Where possible we used items from existing, pre-tested questionnaires (Boekaerts, 2002; Deci & Ryan, 1985; Dörnyei & Taguchi, 2010; Gardner, 1985; Noels et al., 2000; Saito et al., 2017; Serafini, 2013; Wiegfield, 1994) but some items were necessarily created by us. The presentation of items was randomized across categories and participants.

3.2.1.3 Procedure

The procedure was the same as in Experiment 1a of Chapter 2. Participants completed the attention questionnaire (L2 and L1 speakers) and the motivation questionnaire (L2 speakers only) on a laptop after Experiment 2a.

3.2.1.4 Scoring

3.2.1.4.1 Attention questionnaire

Each participant received three attention scores. We averaged participants' scores on question 1 and 2 of the questionnaire to create a measure of participants' attention to task (Branigan et al., 2007; Ivanova et al., 2020; Schoot et al., 2019). L2 French speakers showed a mean score of 5.58 (range 3.5-7) and L1 speakers showed a mean score of 5.19 (range 1.5-7) for attention to task (Table 3.1). We used their rating for question 6 to assess their attention to syntax specifically (Bock et al., 1992). L2 French speakers showed a mean score of 5.16 (range 1-7) and L1 speakers showed a mean score of 5.19 (range 1-7) (Table 3.1).

Regarding noticing, we assessed participants' responses to the second part of the questionnaire. They received a score of 2 if they had understood and noticed the fronting/non-fronting alternation (Schmidt, 1990), i.e. they were able to name, describe or give examples of the fronted vs. non-fronted sentences. They received a score of 1 if they only mentioned that there were temporal adverbial phrases or "time indication" in the stimuli but did not describe the structural alternation. They received a score of 0 if they did not refer to fronted vs. non-fronted alternation in any way. 27.4% of L2 French speakers scored 2, 15.8% scored 1 and 56.8% scored 0,

whereas 30.5% of L1 French speakers scored 2, 7.4% scored 1 and 62.1% scored 0 (Table 3.2).

3.2.1.4.2 Motivation questionnaire

While we originally planned to use the 7 distinct categories of motivation in the analyses, preliminary inspection of the data revealed that the scores for items coming from distinct motivation categories were highly inter-related. To reduce the number of motivation dimensions, we conducted a Principal Component Analysis with the L2 speakers' scores on 44 Likert-scale survey items, which identified correlated responses across the different categories of motivation. From the language learning goal category, we only included the items related to the desire to learn French grammar as these were judged the most likely to relate to syntactic priming effects (grammar learning goal). The PCA analysis[11] revealed that two principal components (PCs) accounted for the most variance in the data, with PC1 explaining 15.65% of variance and PC2 explaining 10.69%. The Cronbach alpha for PC1 was .87 and .59 for PC2. Subsequent dimensions did not differ enough from each other (see OSF for detailed results of the analysis).

We selected the items loading on each of these two PCs and avoid cross-loadings by following Takahashi's (2005) cut-off criterion of .45 correlation level. The final two motivation scores we included in the analysis corresponded to these two PCS and were calculated by averaging an individual's scores of all the items loading on each PC respectively. While grouping motivation categories into PCs would not allow us to investigate the effect of each motivation aspect as originally planned, we interpreted PC1 as representing motivation to learn French in general and PC2 as representing task-specific motivation. PC1 included all items measuring how important it was for participants to learn French (2 items), 7 items came from the original intrinsic motivation category (out of 8 items), 3 items from the grammar learning goal category (out of 5 items), 6 items from the motivational intensity category (out of 8 items) and one item from the external motivation category (out of 9 items). PC2 included 4 items from the metacognition category (out of 6 items), 4 items from the task motivation category (out of 6 items) and one item from the

[11]To ensure we would have enough data points for the PCA analysis, we ran it with the scores of the participants included in the final analysis for Experiment 1a (N=95).

external motivation category (negatively correlated) (see the OSF for further details). L2 speakers had an average rating of 5.36 (range 2.53-6.65) for French motivation and 5.15 (range 3.44-6.22) for task-specific motivation (Table 3.1).

Table 3.1 Individual differences descriptive statistics of Experiment 1b. Mean scores (SD) and ranges (*in italics*) for each measure by group and overlap condition.

		L2		L1	
Measure		**No overlap**	**Overlap**	**No overlap**	**Overlap**
Attention	Syntax	5.22 (1.16) *2-7*	5.10 (1.37) *1-7*	5.11 (1.37) *1-7*	5.26 (1.32) *2-7*
	Task	5.47 (0.96) *3.5-7*	5.68 (0.80) *4-7*	5.2 (1.11) *3-7*	5.18 (1.22) *1.5-7*
Motivation	French learning motivation (PC1)	5.39 (0.69) *3.35-6.65*	5.33 (0.76) *2.53-6.65*	-	-
	Task-specific motivation (PC2)	4.84 (0.59) *3.56-6.22*	5.08 (0.69) *3.44-6.22*	-	-

7 was the maximum score for the attention and motivation scales.

Table 3.2 Noticing statistics of Experiment 1b. Raw number (percentage) of participants scoring 0, 1 and 2 per group per condition.

		L2		L1	
Measure		**No overlap**	**Overlap**	**No overlap**	**Overlap**
Noticing	0	28 (60.9%)	26 (53.1%)	30 (66.7%)	29 (58%)
	1	10 (21.7%)	5 (10.2%)	2 (4.4.%)	5 (10%)
	2	8 (17.4%)	18 (36.7%)	13 (28.9%)	16 (32%)

3.2.2 Analysis and results

We examined the effect of individual differences in attention (L2 and L1 speakers) and motivation (L2 speakers) on syntactic priming across overlap conditions by running separate models for immediate and long-term priming and for each attention and motivation measurements. We added these factors as predictors to the full

models described in Experiment 1a of Chapter 2. All continuous predictors (attention to syntax, attention to task, French learning motivation and task-specific motivation) were centered. Noticing was defined as a categorical factor with three levels where 0=not noticing the target structure at all, 1=noticing it (Noticing 1) and 2=noticing it and understanding it (Noticing 2). This factor was also sum contrast coded to have a mean of 0 and a range of 1 and we used multiple contrasts to compare not noticing (-0.66) to Noticing 1 (0.33) and Noticing 2 (0.33) combined, and to compare Noticing 1 (-0.5) to Noticing 2 (0.5).

To be able to directly compare the effect of attention on priming in L1 vs. L2 speakers, we ran models on the data of both L2 and L1 speakers together, including the factor Group as a fixed effect. For motivation, the analysis included the L2 speakers only. For both attention and motivation, we started with full models with all the required fixed effects and the maximal by-subject and by-item random effect structure (Barr et al., 2013) and tried to locate the best model that did not differ significantly from the full (converging) model in terms of variance explained. Where models did not converge, we removed random slopes and interactions before main effects, starting with those accounting for the least variance. We compared each best model which included the targeted individual differences score to the same model without the score (henceforth, the "simplest model"; Weatherholtz et al., 2014) and we report the results of the best models which provided a better fit than their corresponding simplest model. All p-values for individual predictors were obtained from the model summary output, and we only report in text the results directly involving effects of attention and motivation.

3.2.2.1 Attention in the L2 and L1 speakers

3.2.2.1.1 Immediate priming

The full models included as fixed effects Prime, Overlap, Group, Side, the targeted attention score and the five-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Prime and Side and their interaction, and by-item random slopes for Prime, Overlap, Group and their interaction. The best models for attention to syntax, attention to task and noticing did not significantly differ from their corresponding simplest models (p=.52, p=.17 and

p=.12 respectively). Hence, individual differences in attention did not influence immediate priming for the fronting alternation.

3.2.2.1.2 Long-term priming

The full models included as fixed effects Section, Overlap, Group, Side, the targeted attention score and the five-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Section and Side and their interaction, and by-item random slopes for Group and Overlap and their interaction. The best model for attention to syntax did not significantly differ from the simplest model (*p*=.44) but the best model for attention to task did (*p*< .001). It revealed a significant interaction between Section and the attention score (Table 3.3). With increased attention to the task, participants were less likely to show an increase in proportion of fronted sentences produced between the pre- and post-test (Figure 3.1). The best model for Noticing significantly differed from the simplest model (*p*<.001) and showed a significant main effect of Noticing 1. Participants who at least noticed or noticed and understood the target structure (*M*=.42, *SD*=.49) were more likely to produce it than participants who did not notice it at all (*M*=.38, *SD*=.48) across the pre- and post-tests (Table 3.4, Figure 3.2). To summarize, high levels of attention to task decreased participant's likelihood to experience long-term priming across groups, while noticing the target structure increased production of that structure across test phases but did not relate to priming itself.

Table 3.3 Model for attention to task and long-term priming. Summary of the best model examining the effect of attention to task on long-term priming of fronted sentences. *This model included the factors Section, Group, Overlap, Attention to task and Side, the two-way interactions between Section, Group, Overlap and Attention to task, and by-item and by-subject random intercepts.*

Fixed effects	**Estimate**	**Standard Error**	**z-value**	***p*-value**
Intercept	.20	.96	.21	.83
Section	4.39	.79	5.53	**<.001**
Group	-.61	1.87	-.32	.75
Overlap	.94	1.76	.53	.60
Attention to task	-.19	.17	-1.10	.27
Side	-.58	.33	-1.77	.08
Section x Group	.49	.25	1.99	**.05**
Section x Overlap	.07	.25	.27	.79
Section x Attention to task	-.52	.12	-4.18	**<.001**
Group x Overlap	.28	.69	.40	.69
Group x Attention to task	.11	.34	.34	.74
Overlap x Attention to task	-.22	.32	-.70	.49

Table 3.4 Model for noticing and long-term priming. Summary of the best model examining the effect of noticing on long-term priming of fronted sentences. *This model included the factors Section, Group, Overlap, Noticing and Side, the three-way interactions between Section, Group, Overlap and Noticing, and by-item and by-subject random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Intercept	-.43	.33	-1.31	.19
Section	1.52	.44	3.49	**<.001**
Group	-3.66	5.77	-.63	.53
Overlap	-3.58	5.77	-.62	.53
Noticing 1	.91	.44	2.07	**.04**
Noticing 2	.56	.75	.76	.45
Side	-.60	.34	-1.75	.08
Section x Group	6.10	11.51	.53	.60
Section x Overlap	5.93	11.51	.52	.61
Section x Noticing 1	-.19	.31	-.62	.54
Section x Noticing 2	.31	.54	.58	.57
Group x Overlap	1.42	1.04	1.38	.17
Group x Noticing 1	-5.62	8.75	-.64	.52
Group x Noticing 2	-11.48	17.31	-.66	.51
Overlap x Noticing 1	-4.58	8.76	-.52	.60
Overlap x Noticing 2	-10.52	17.31	-.61	.54
Section x Group x Overlap	.11	.54	.20	.84
Section x Group x Noticing 1	8.04	17.44	.46	.64
Section x Group x Noticing 2	20.25	34.52	.59	.56
Section x Overlap x Noticing 1	8.59	17.44	.49	.62
Section x Overlap x Noticing 2	18.24	34.52	.53	.60
Group x Overlap x Noticing 1	3.28	1.74	1.89	.06
Group x Overlap x Noticing 2	3.16	2.97	1.07	.29

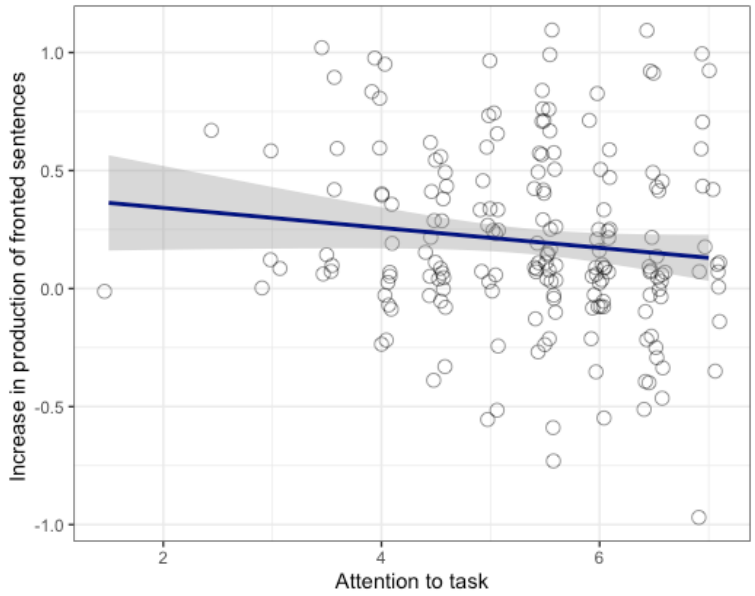


Figure 3.1 Attention to task in Experiment 1b. Increase in production of fronted sentences between the pre- and post-test as a function of Attention to task. The grey area represents the confidence interval.

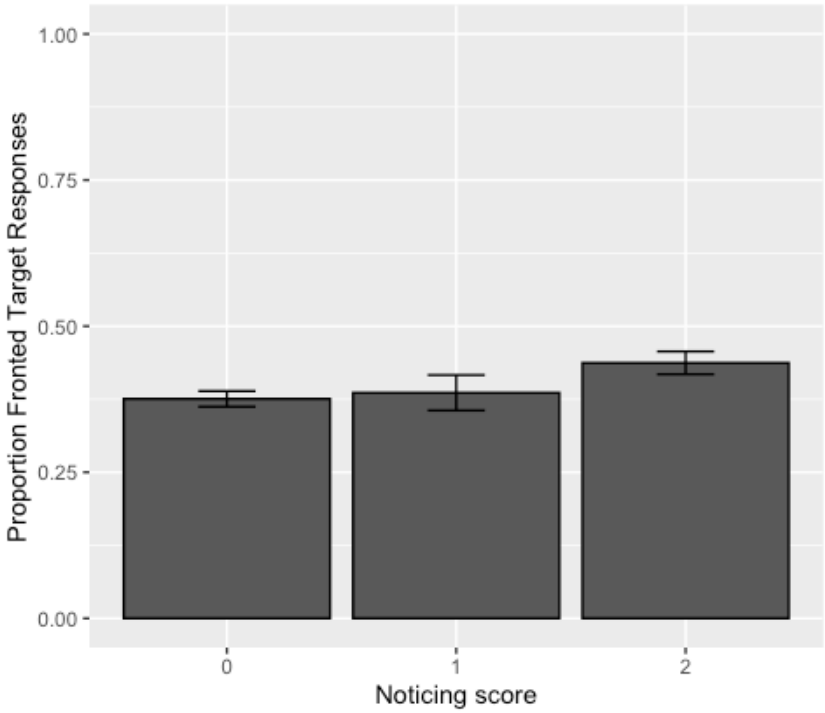


Figure 3.2 Noticing in Experiment 1b. Mean proportion of fronted responses by Noticing scores across the pre- and post-tests. The bars represent the standard error. 0=not noticing the target structure at all, 1=noticing it (Noticing 1) and 2=noticing it and understanding it (Noticing 2).

3.2.2.2 Motivation in the L2 speakers

3.2.2.2.1 Immediate priming

The full models included as fixed effects Prime, Overlap, Side, the targeted motivation score and their four-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Prime and Side and their interaction, and by-item random slopes for Prime and Overlap and their interaction. The best model for task-specific motivation did not significantly differ from the simplest model (p=.15) but the best model for French learning motivation did (p<.05). It showed a significant interaction between Side and this type of motivation (Table 3.5). To further examine this interaction, we split the data by Side, and applied Bonferonni corrections with a threshold value of .025 to assess significance levels. There was a main effect of motivation, β=.66 (SE=0.27), Z=2.47, p<.025, only with pictures presented on the right. Hence, when the picture representing the temporal adverbial phrase was presented on the right, participants more motivated to learn French were more likely to produce a fronted sentence. In sum, French learning motivation related to fronted sentences production in the condition where the presentation of the temporal phrase did not align spatially with sentence position (i.e., to the left). This suggests that more motivated learners were able to overcome this presentational bias. However, French learning motivation did not relate to priming per se as there was no interaction between motivation and Prime. Finally, the main effect of Prime in the model for French learning motivation was here marginal.

Table 3.5 Model for French learning motivation and immediate priming. Summary of the best model examining the effect of French learning motivation on immediate priming of fronted sentences. *This model included the factors Prime, Overlap, French learning motivation and Side, their two-way interactions, and by-item and by-subject random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Intercept	-2.20	1.25	-1.76	.08
Prime	1.62	.88	1.83	.07
Side	-2.70	.84	-3.22	**<.005**
Overlap	-1.19	2.49	-.48	.63
French learning motivation	.36	.23	1.58	.11
Prime x Side	-.15	.22	-.70	.49
Prime x Overlap	1.91	.23	8.31	**<.001**
Prime x French learning motivation	.05	.16	.31	.76
Side x Overlap	.14	.22	.64	.52
Side x French learning motivation	.45	.15	2.93	**<.005**
Overlap x French learning motivation	.20	.46	.43	.67

3.2.2.2.2 Long-term priming

The full models included as fixed effects Section, Overlap, Side, the targeted motivation score and their four-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Section and Side and their interaction, and by-item random slopes for Overlap. The best model for task-specific motivation did not significantly differ from the simplest model (p=.40) but the best model for French learning motivation did (p<.01). It revealed a significant interaction between Section and French learning motivation score, whereby, as L2 speakers' motivation increased, they showed less long-term priming (Table 3.6, Figure 3.3). There was also a significant interaction between Side and French learning motivation and to understand this interaction better, we split the data by Side and applied Bonferroni correction. These additional models revealed that there only was a significant interaction between Section and French learning

motivation when the picture was presented on the left, β=-.78 (*SE*=0.65), *Z*=-2.48, $p<.025$. In other words, as their French learning motivation increased participants were less likely to show long-term priming when the picture was presented on the left. Thus, only French learning motivation related to long-term priming of fronted sentences and only in the context of overcoming a bias to produce fronted sentences when the temporal phrase was presented to the left of the picture.

Table 3.6 Model for French learning motivation and long-term priming.
Summary of the best model examining the effect of French learning motivation on long-term priming of fronted sentences. *This model included the factors Section, Overlap, French learning motivation and Side, their two-way interactions, and by-item and by-subject random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Intercept	-3.37	1.81	-1.86	.06
Section	5.64	1.45	3.88	**<.001**
Overlap	1.76	3.56	.49	.62
Side	-4.78	1.39	-3.45	**<.001**
French learning motivation	.47	.33	1.43	.15
Section x Overlap	-.06	.35	-.18	.86
Section x Side	-.05	.65	-.08	.93
Section x French learning motivation	-.73	.26	-2.86	**<.005**
Side x Overlap	.58	.35	1.68	.09
Side x French learning motivation	.78	.25	3.14	**<.005**
Overlap x French learning motivation	-.35	.66	-.54	.59

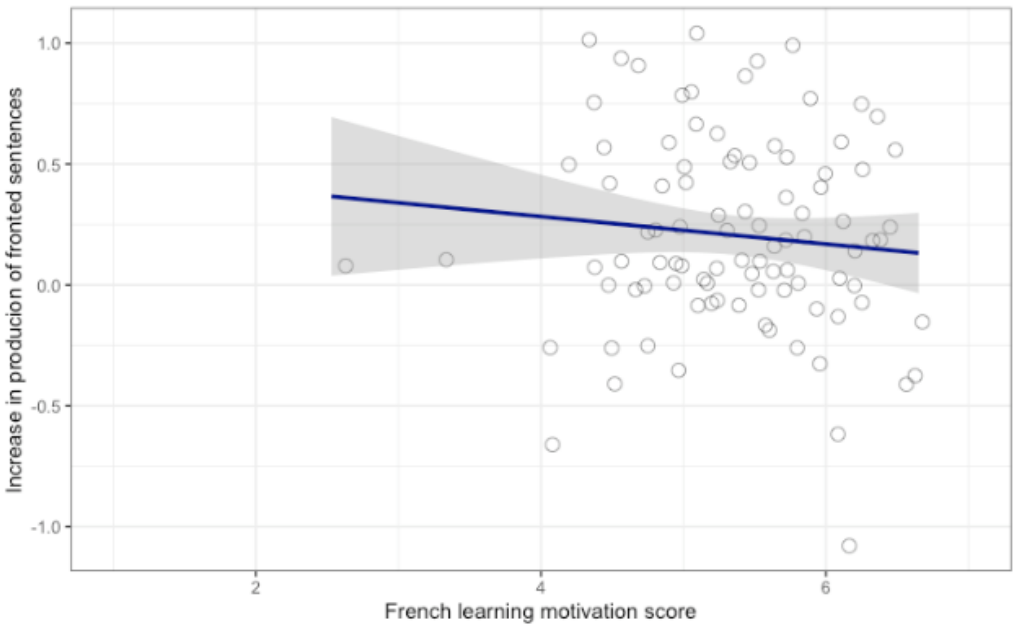


Figure 3.3 French learning motivation in Experiment 1b. Increase in production of fronted sentences between the pre- and post-test as a function of French learning motivation. The grey area represents the confidence interval.

3.2.3 Discussion of Experiment 1b

In contrast to previous research (e.g., Bock et al., 1992; Ivanova et al., 2020) and the predictions of the models (Bernolet et al., 2016; Chang et al., 2006; Reitter et al., 2011), individual differences in attention and motivation did not affect immediate priming in either group, neither with nor without lexical overlap. We discuss potential explanations for this in the General Discussion. However, both factors modulated target structure production and long-term priming. Noticing fronted sentences increased L2 and L1 speakers' likeliness to produce them across the pre- and post-tests, regardless of overlap condition. This could indicate that, once noticed, the target structure was more available for production, at least in the unprimed sections of the experiment. Additionally, with increased attention to task, both groups appeared less likely to show long-term priming. That enhanced attention did not increase long-term priming suggests that long-term language learning via syntactic priming is supported by implicit processes, as per the models of Chang et al. (2006), Reitter et al. (2011) and Bernolet et al. (2016). Furthermore, the decrease in long-term priming magnitude with higher attention may reveal that participants deliberately chose to use the preferred non-fronted form or to avoid the dispreferred

target form. Alternatively, it may be that with higher attention to task participants were attentive to other aspects of the task than language forms.

Motivation showed a significant relationship with participants' production of fronted sentences in relation to the side of the picture on which the temporal phrase was depicted. In the immediate priming phase, learners more motivated to learn French overcame a bias to produce non-fronted sentences when the picture appeared on the right. This effect was unrelated to priming. More motivated L2 speakers were also less likely to show long-term priming, particularly when the picture appeared on the left. Thus, it seems that L2 speakers with a higher motivation to learn French relied less on the visual cues of the stimuli to produce target sentences. That more motivated participants did not experience larger long-term priming seems to provide further evidence that language learning via syntactic priming is implicit (Bernolet et al., 2016; Chang et al., 2006; Reitter et al., 2012).

In Experiment 2b, we examined our predictions regarding the effect of attention and motivation on priming and learning with the passive structure.

3.3 Experiment 2b- Active/passive alternation

We examined the effect of attention and motivation on syntactic priming of the French active/passive syntactic structures (e.g., *Le pirate <u>suit</u> le marin* (The pirate is following the sailor) vs. *Le marin <u>est suivi</u> par le pirate* (The sailor is being followed by the pirate)).

3.3.1 Methodology

The participants, the experimental design, the prime/target cards, the procedure and the scoring system for target sentences were the same as in Experiment 2a of Chapter 2. We used the same questionnaires as above in Experiment 1b to assess individual differences in attention, motivation and proficiency.

3.3.1.1 Scoring of individual differences

We used the results of the attention the motivation questionnaires, as described above in Experiment 1b. To assess noticing of the target structure (which was specific to the priming task), participants' responses were given a score of 2 if they

had noticed and understood the alternations (Schmidt, 1990), i.e., they were able to name, describe or give examples of the passive/active sentences. They received a score of 1, which corresponded to noticing only (Schmidt, 1990) if they mentioned some aspect of the passive, for example, the use of past participles or past tense, or "indirect vs. direct form" to describe the actions or that who was doing what to whom mattered. They received a score of 0 if they did not refer to the passive/active alternation or its features in any way.

Although the same participants took part in Experiment 1 and 2, we did not exclude exactly the same participants from both experiments (see Chapter 2, sections 2.2.1.1/2.3.1.1). Thus, we report in Tables 3.7 and 3.8 the descriptive statistics for the participants who were included in the analysis of Experiment 2b. L2 French speakers showed a mean score of 5.59 (range 3.5-7) and L1 speakers showed a mean score of 5.19 (range 1.5-7) for attention to task (Table 3.7). For attention to syntax, L2 French speakers showed a mean score of 5.18 (range 1-7) and L1 speakers showed a mean score of 5.20 (range 1-7) (Table 3.7). With regards to noticing, 25.3% of L2 French speakers scored 2, 25.3% scored 1 and 49.4% scored 0, whereas 36.8% of L1 French speakers scored 2, 28.4% scored 1 and 34.7% scored 0 (Table 3.8). L2 speakers had an average rating of 5.37 out of 7 (range 2.53-6.65) for French learning motivation and 4.98 (range 3.44-6.22) for task-specific motivation (Table 3.7).

Table 3.7 Individual differences descriptive statistics of Experiment 2b. Mean scores (SD) and ranges (*in italics*) for each measure by group and overlap condition.

		L2		L1	
Measure		**No overlap**	**Overlap**	**No overlap**	**Overlap**
Attention	Syntax	5.26 (1.20) *2-7*	5.10 (1.37) *1-7*	5.13 (1.37) *1-7*	5.26 (1.32) *2-7*
	Task	5.49 (0.95) *3.5-7*	5.68 (0.80) *4-7*	5.2 (1.11) *3-7*	5.18 (1.22) *1.5-7*
Motivation	French learning motivation (PC1)	5.42 (0.70) *3.35-6.65*	5.33 (0.76) *2.53-6.65*	-	-
	Task-specific motivation (PC2)	4.85 (0.57) *3.67-6.22*	5.08 (0.69) *3.44-622*	-	-

7 was the maximum score for the attention and motivation scales.

Table 3.8 Noticing statistics in Experiment 2b. Raw number (percentage) of participants scoring 0, 1 and 2 per group per condition

		L2		L1	
Measure		**No overlap**	**Overlap**	**No overlap**	**Overlap**
Noticing	0	23 (54.8%)	22 (44.9%)	19 (42.2%)	14 (28%)
	1	17 (40.5%)	6 (12.2%)	24 (53.3%)	3 (6%)
	2	2 (4.8%)	21 (42.9%)	2 (4.4%)	33 (66%)

3.3.2 Analysis and results

As in Experiment 1b, to examine the effect of individual differences in attention (L2 and L1 speakers) and motivation (L2 speakers) on syntactic priming across overlap conditions, we ran separate models for immediate and long-term priming and for each attention and motivation measurements. We added these factors as predictors to the full models described in Experiment 2a of Chapter 2 and followed the same procedure of analysis as in Experiment 1b in this chapter.

3.3.2.1 Attention in the L2 and L1 speakers

3.3.2.1.1 Immediate priming

The full models included as fixed effects Prime, Overlap, Group, the targeted attention score and the four-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Prime, and by-item random slopes for Prime, Overlap, Group and their interaction. The best models for attention to syntax and to task did not significantly differ from the simplest model (p=.28 and p=.78 respectively) and the best model for Noticing did not reveal any significant effect of Noticing (ps>.69).

3.3.2.1.2 Long-term priming

The full models included as fixed effects Section, Overlap, Group, the targeted attention score and the four-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Section, and by-item random slopes for Group and Overlap and their interaction. The best models for attention to syntax and to task did not significantly differ from the simplest model (p=.18 and p=1 respectively) but the best model for Noticing did (p<.001). It revealed significant interactions between Group and Noticing 2 and between Overlap and Noticing 1 (Table 3.9). The first interaction could reflect that the L1 speakers were more likely to notice and understand (N=35) than to just notice passives (N=27), whereas the L2 speakers did not show this effect (N=23 in both cases). The L1 speakers may have had more metalinguistic knowledge about the target structure. The second interaction may indicate that, in the condition with overlap, participants were more likely to at least notice passives (N=63) than to not notice them at all (N=36), but that there was no such noticing difference in the condition without overlap (N=45 and 42 respectively). The latter result suggests that lexical overlap boosted noticing of the target structure across speaker groups. However, when we explored the effect of noticing in each group and then in each overlap condition separately, there was no effect of noticing in either group, nor in any overlap condition with Bonferroni corrections applied (ps>.025). The differences between groups and overlap conditions may not have been numerically large enough to surface when we split the data. Finally, the model for noticing showed no significant main effects of Group and Overlap, contrary to Chapter 2. These discrepancies could

indicate that the differences between groups and overlap conditions partly relied on the extent to which speakers noticed the target structure, so that once this factor was introduced the effects of Group and Overlap disappeared.

Therefore overall, there were no clear relationships between individual differences in attention and immediate or long-term priming of passive sentences.

Table 3.9 Model for noticing and long-term priming. Summary of the best model examining the effect of Noticing on long-term priming of passives. *This model included the factors Section, Group, Overlap and Noticing, their two-way interactions, and by-item and by-subject random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Intercept	-4.41	.43	-10.16	**<.001**
Section	4.14	.70	5.88	**<.001**
Group	.66	.56	1.18	.24
Overlap	.52	.72	.72	.47
Noticing 1	1.05	.65	1.61	.11
Noticing 2	-.14	.86	-.16	.88
Section x Group	2.12	.99	2.13	**.03**
Section x Overlap	.32	1.24	.26	.80
Section x Noticing 1	.89	1.11	.81	.42
Section x Noticing 2	-.84	1.41	-.60	.55
Group x Overlap	-.90	.83	-1.08	.28
Group x Noticing 1	-.43	.70	-.62	.53
Group x Noticing 2	-2.33	.95	-2.45	**.01**
Overlap x Noticing 1	-1.83	.80	-2.30	**.02**
Overlap x Noticing 2	-.44	1.15	-.38	.70

3.3.2.2 Motivation in the L2 speakers

3.3.2.2.1 Immediate priming

The full models included as fixed effects Prime, Overlap, the targeted motivation score and the three-way interaction. They also included random intercepts for

participants and items and by-subject random slopes for Prime, and by-item random slopes for Prime, Overlap and their interaction. The best models for French learning motivation and task-specific motivation did not significantly differ from the simplest model (p=.75 and p=.26 respectively), thereby showing that motivation did not influence immediate priming.

3.3.2.2.2 Long-term priming

The full models included as fixed effects Section, Overlap, the targeted motivation score and the three-way interaction. They also included random intercepts for participants and items and by-subject random slopes for Section, and by-item random slopes for Overlap. The best models for French learning motivation and task-specific motivation showed that motivation did not affect priming (p=.18 and p=.57 respectively).

3.3.3 Discussion of Experiment 2b

As in Experiment 1b, neither abstract nor lexically-based immediate priming were influenced by individual differences in attention and motivation in either speaker group. The results for attention stand in contradiction with previous research findings (e.g., Bock et al., 1992; Ivanova et al., 2020). That these factors also did not modulate long-term priming of passives, however, seems to provide further evidence that language learning via syntactic priming is a primarily implicit process (Bernolet et al., 2016; Chang et al., 2006; Reitter et al., 2011). We discuss further the reasons for and the implications of these findings in the General Discussion.

3.4 General discussion

In this chapter, we used the data of Experiments 1a and 2a (Chapter 2) to explore the effect of individual differences in attention and motivation on immediate and long-term priming of fronted temporal adverbial phrases and passives in L2 and L1 speakers. These factors did not relate to immediate priming for either of the two structures, neither with nor without overlap. Furthermore, attention and motivation affected long-term priming and production of fronted sentences, but not of passive sentences. These effects, or lack thereof, were equivalent across speaker groups and

overlap conditions. We discuss the implications of these findings for our understanding of the nature of priming in the following sections.

3.4.1 Priming, attention and motivation

High attention and motivation levels, by promoting engagement in the task, may support the formation of explicit memories of primes sentences or make participants more likely to rely on such memories during a priming task. In that case, the priming accounts of Chang et al. (2006) and Reitter et al. (2011) predict that enhanced attention and motivation could further boost immediate priming in a context with lexical overlap, while the model of Bernolet et al. (2016) predicts that it could increase both lexically-based and immediate priming. However, since the three models define language learning via syntactic priming as an implicit process, they all predict that being more attentive or motivated should not lead to larger long-term priming.

In line with these predictions, we found that attention and motivation did not increase the magnitude of long-term priming of fronted and passive sentences. This corroborates that language learning via syntactic priming results from primarily implicit processes. However, higher attention and motivation levels also failed to foster larger immediate priming, both in the absence and in the presence of lexical overlap. Though Michel and Smith (2018) similarly report data suggesting that overt visual attention assessed with eye-tracking methods does not relate to the magnitude of lexical priming, our results concerning attention remain surprising. They contradict previous findings whereby enhanced attention to task and to syntax or noticing the target structure triggered larger immediate abstract syntactic priming effects (e.g., Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015).

This absence of an effect of attention on immediate priming here might be the product of methodological differences between the present study and past work. Unfortunately, the methods of the cited studies vary a lot, be it in terms of task settings or targeted structures and languages, making it difficult to detect which exact difference(s) in experimental paradigms could be the source of this discrepancy. One key difference is perhaps that many of these studies did not directly manipulate or measure individual differences in attention. Rather, that their pattern of results may reflect differences in attentional levels is often an

interpretation the authors formulated a posteriori (but see Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015). In other words, the differences between conditions observed in these studies may be due to other factors, not or only partially related to variation in attention.

An alternative explanation is that our measurements of attention to task and syntax in particular were not perfectly accurate in measuring individual differences in attention, as we only used subjective self-report questionnaires. The effect of these factors on priming may be better assessed by directly manipulating what participants are asked to pay attention to during the priming task (e.g., as in Bock et al., 1992). It might also be more accurate to directly quantify variation in attention with eye-tracking (e.g., Michel & Smith, 2018) or with measurements such as reaction times on a task performed in parallel to the main priming task (e.g., as in Ivanova et al., 2020; see Chapter 8 for further discussion). However, McDonough and Fulga's study (2015) observed that measuring noticing with self-report questionnaires leads to the same results as measuring it by calculating d prime, a sensitivity index elaborated based on Signal Detection Theory (Macmillan & Creelman, 2005) that helped the authors determine whether participants had detected the target construction. This finding reveals that using self-reports was, in contrast, most likely appropriate to assess variation in noticing across participants.

A final possibility for the absence of such effects is that, in spite of high attention levels and even if they noticed the target structure, participants may have chosen not to rely on their explicit memories of primes to formulate target sentences. In other words, the influence of primes on participants' production of target sentences could have remained largely implicit. Previous research indicates that participants sometimes take such decisions such as if, for instance, they do not want to be repetitive (Ruf, 2011), or deem producing the target structure as being too difficult (Kim et al., 2020; Costa et al., 2008). Such an interpretation could explain the way attention and motivation modulated target structure production and negatively impacted long-term priming of fronted sentences. Noticing the fronted sentences made participants more likely to produce them in the pre- and post-tests, which could reflect a deliberate choice to use them. This is not unlikely as, in other studies, participants sometimes report having decided to re-use the syntax of the sentences they have been exposed to during a priming task (e.g., Grüter et al., 2021; Michel, 2018; Michel & O'Rourke, 2019; Ruf, 2011). By contrast, L2 and L1

speakers more attentive to the task appeared less likely to show long-term priming for fronted sentences. These participants may have decided to stop using the dispreferred structure in the post-test and to rely on their baseline preferences instead (cf. Flett, 2006 for a similar argument). This "negative" effect of attention on the fronting alternation is somewhat in line with other studies also targeting priming of fronted/non-fronted adverbial phrases. For instance, in Jackson and Ruf's study (2018), while many of their participants reported having noticed the targeted form, they did not all report relying on the syntax of their interlocutor to formulate their own sentences. We note though that participants may also have experienced less long-term priming with higher attention to task because they were then more attentive to other aspects of the task than to its syntactic forms. Finally, in the immediate priming phase, learners more motivated to learn French overcame a bias to produce non-fronted sentences when the picture appeared on the right (across target sentences that were primed and not primed with fronted sentences). They were also less likely to show long-term priming, particularly when the picture appeared on the left. Thus, enhanced French learning motivation made L2 speakers more able to resist the influence of the position of a visual cue on the presented picture on the structure of the sentences they produced, which may reflect that they decided to ignore this cue.

Motivation may overall have had limited influence on syntactic priming because the tested L2 speakers did not vary enough in terms of motivational profiles for an effect to be detectable: they mostly reported high levels of motivation both towards learning French and towards the task. Most participants were recruited in the French department of the university and had therefore chosen to study French, and all participants were volunteers for the study and thus may represent a particularly motivated subset of learners within this group. Further research investigating the effect of motivation on learning may need to recruit participants with more varied motivational profiles.

As a final comment, it is particularly striking that individual differences in attention and motivation only related to long-term priming or production of fronted sentences, but not of passive sentences. This may seem very surprising since a larger proportion of the participants across speaker groups at least noticed passives (58.1%) than fronted sentences (40.5%). In other words, even if they often noticed the passive form, this pattern of results could indicate that priming of passives was

overall more implicit than priming of fronted sentences. Why this is case remains largely unclear at this point. Additional research asking participants whether they have taken deliberate decisions to re-use or avoid a given target structure and why they have taken such decisions depending on the structure could help understand the reason(s) for these cross-structure differences (cf. Chapter 7).

3.5 Conclusion

This study provides preliminary evidence that language learning via syntactic priming may be a primarily implicit process, as individual differences in attention and motivation did not modulate the magnitude of immediate priming and did not increase long-term priming. However, further research that directly manipulates what participants pay attention to during the priming task and that tests L2 speakers with more varied motivational profiles is necessary to clarify whether these two factors do not relate to priming.

Chapter 4

Second language learning via syntactic priming: The effects of modality, attention and motivation

We examined whether language input modality and individual differences in attention and motivation influence second language (L2) learning via syntactic priming. In an online study, we compared 235 French L2 English and L1 English speakers' primed production of English passives in reading-to-writing vs. listening-to-writing priming conditions. We measured immediate priming (producing a passive immediately after exposure to the target structure) and short- and long-term learning (producing more target structures in immediate and delayed post-tests without primes relative to pre-tests). Both groups showed immediate priming, short- and long-term learning though L2 speakers produced more passives with immediate priming and showed greater long-term learning. Learning was unaffected by modality, but immediate priming was largest in the listening-to-writing condition across groups. Individual differences in attention and motivation did not influence priming or learning. Thus, syntactic priming fosters long-term L2 learning regardless of input modality, but participants may be sensitive to the frequency of passives in spoken vs. written language during immediate priming.

Preregistration: https://osf.io/7mykb

Material/ data availability: https://osf.io/43efz/?view_only=223d2e120ac445cb950c5a4666ddd3ff

4.1 Introduction

Second language (L2) speakers, like first (L1) language speakers, tend to adopt the syntactic structure of recently experienced sentences to formulate subsequent sentences, in a phenomenon known as syntactic priming (Bock, 1986; McDonough & Chaikitmongkol, 2010). For example, exposure to a passive (prime) sentence (e.g., "the song is being played by the musician") may increase L2 speakers' likeliness to produce a passive (target) sentence (e.g., "the teacher is being imitated by the student") compared to exposure to an active sentence (e.g., "the musician is playing the song"). Researchers have hypothesised that adaptive language learning mechanisms underlie this syntactic priming effect (Bock & Griffin, 2000) and indeed syntactic priming effects are long-lasting in L2 speakers: L2 speakers' prior experience of prime sentences influences their sentence formulation in post-tests that follow the priming session immediately or a few weeks later (e.g., McDonough & Chaikitmongkol, 2010). Priming tasks also help L2 speakers learn how to produce native-like L2 structures over successive experiences of L2 input (e.g., Kim et al., 2019). These findings suggest that syntactic priming may underlie the acquisition of L2 syntactic knowledge (Jackson, 2018).

Many task and learner characteristics that potentially affect L2 learning via syntactic priming remain unexplored. It is unknown whether the modality of the language input influences L2 speakers' priming behaviour and the resulting syntactic learning. Moreover, how these might be related to individual variation in learners' attention and language learning motivation is also unclear. Understanding the respective roles of these factors can elucidate the extent to which L2 learning and syntactic priming are supported by language learning mechanisms that are implicit and automatic or that are also susceptible to explicit processes. The present study therefore examined the effect of prime modality and individual differences in attention and motivation on L2 learning via syntactic priming.

4.1.1 Language input modality and L2 learning

Second Language Acquisition (SLA) research has not widely investigated which of the spoken and written input modes best supports L2 learning (Gilabert et al., 2016). However, we might reasonably predict that L2 speakers more easily learn a target syntactic structure experienced through the visual rather than through the auditory

modality. When presented with spoken input, L2 speakers may be distracted by the task of trying to decode speech. Written sentences, in contrast, may free up attentional resources and allow them to focus more on sentence form, making target structures more salient (Gilabert et al., 2016; Kim & Godfroid, 2019). Given its untimed nature, as opposed to the fleeting nature of auditory input, the written modality also gives L2 speakers the opportunity to read sentences repeatedly and rely on self-paced processing. This may foster deeper processing of the linguistic input: rather than simply registering new linguistic information, L2 speakers may engage in intake processing which should support language learning (Gilabert et al., 2016). Finally, reading rather than listening to stimuli may increase L2 speakers' likeliness to perceive them in their entirety. With spoken stimuli, L2 speakers may miss part of the language input if they have difficulties understanding the pronunciation or if the speech rate is too fast for them. Thus, written stimuli could facilitate L2 syntactic processing and language learning more than spoken stimuli.

Wong (2001) found that L2 learners obtained better comprehension scores, as assessed with free recalls, with written than with spoken L2 input. This supports the idea that L2 speakers processed written language more accurately than spoken. Yet Kim and Godfroid (2019) directly compared the effect of exposure to written or spoken stimuli during a language training phase on L2 learning and found that the two types of input modality led to the same amount of learning as measured on post-training grammaticality judgment tests (though input modality did modulate the *type* of knowledge acquired). However, across training modalities, participants were asked to repeat the stimuli out loud during training meaning that, even in the reading condition, participants were exposed to auditory input (Zhao et al., 2021). Therefore, understanding the effect of input modality on L2 learning requires further research.

4.1.2 Syntactic priming as L2 learning and prime modality

Syntactic priming provides an alternative means for measuring syntactic knowledge (Branigan & Pickering, 2017). All models of priming assume that priming effects reflect a speaker's abstract syntactic knowledge (Messenger et al., 2020): priming occurs because the learner uses the same syntactic representation to process the input and formulate subsequent sentences, whilst lacking such representations should prevent abstract priming effects (i.e., priming without repeated lexical items between

prime and target sentences) from arising (Hartsuiker & Bernolet, 2017). Early psycholinguistic models explained syntactic priming effects in terms of residual activation associated with the representation of a given syntactic structure. Upon exposure to a structure, its representation would retain activation leading the speaker to re-use that structure instead of its structural alternative (Pickering & Branigan, 1998). However, the persistence of priming effects (Bock & Griffin, 2000) suggests that priming is supported by a language learning mechanism (e.g., Chang et al., 2006; Malhotra et al., 2008; Reitter et al., 2011). The implicit, error-based language learning model of Chang et al. (2006) postulates that priming effects result from language acquisition processes still operating after L1 syntactic representations have been acquired. Listeners predict upcoming language and mismatches between their predictions and the language input generate prediction errors that force adjustments to the connections between message-level information and syntactic representations. Speakers become more likely to subsequently use the same structure to express a similar message. These changes are lasting and therefore indicative of learning. Alternatively, Reitter et al. (2011) propose a model in which syntactic nodes corresponding to target syntactic structures are associated with a base-level activation reflecting speakers' familiarity with the structures. Perceiving target structures results in long-term changes in this activation and triggers learning in terms of increased likelihood to use a particular structure to express a particular message in the future. Such effects are thought to be implicit and automatic.

L2 speakers experience long-term priming effects indicating learning via priming (e.g., Grüter et al., 2021; McDonough & Chaikitmongkol, 2010). We can thus examine the effect of input modality on L2 learning by investigating how prime modality affects L2 priming strength. If L2 speakers process the L2 more deeply when reading (Gilabert et al., 2016; Wong, 2001), then this type of input could increase the magnitude of L2 immediate priming relative to auditory input. Concretely, written language input may support mismatch detection or the formation of predictions (Chang et al., 2006), or increase the likelihood of syntactic representations being activated (Reitter et al., 2011). Stronger priming is more likely to strengthen connections between message-level information and syntactic representations (Chang et al., 2006) or increase base-level activation (Reitter et al., 2011) leading to learning. As such, L2 speakers should display more immediate priming when reading than when listening to prime sentences. Because of these

changes, the degree of immediate priming should determine the degree of long-term priming such that, if L2 speakers are more likely to experience syntactic priming from one input modality, they should be more likely to show long-term learning from that modality too.

Few studies have explored the effect of prime modality on syntactic priming. A meta-analysis revealed that, in L1 speakers, priming strength is the same across modalities, regardless of whether researchers use auditory, visually presented or read aloud primes (Mahowald et al., 2016). Moreover, L1 long-term priming effects are similar within each modality (Hartsuiker et al., 2008). By contrast, two studies reported larger immediate L2 priming effects in written chat-based than in oral face-to-face interactions (Kim et al., 2019, 2020). This could suggest that contrary to L1 speakers, L2 speakers process syntax differently in the spoken and in the written modality. The latter findings could also indicate that the L2 speakers preferred to produce the target structures in the written than in the oral modality; further research is needed to investigate the effect of input modality on L2 priming and its resulting long-term learning.

4.1.3 Individual differences in L2 learning

Individual differences in learner characteristics could also influence the magnitude of L2 syntactic priming and the resultant learning. Both individuals' motivation to learn or their attention to the linguistic input have been shown to affect L2 learning (e.g., Robinson et al., 2012; Ushioda & Dörnyei, 2012) and this influence could vary depending on the nature of the task (see below). However, given that the learning that results from syntactic priming is typically thought to be unconscious and implicit, it is not immediately obvious how current psycholinguistic models of priming as language learning can be linked to SLA research demonstrating that other cognitive processes influence L2 learning. On the other hand, syntactic priming may itself involve both implicit and explicit processes: Ferreira and Bock (2006) attribute greater priming in the syntax-focused condition of Bock et al.'s (1992) study to possible explicit memory or attentional effects strengthening learning. Furthermore, Chang et al. (2006) suggest that individual characteristics, such as motivation and attention, may explain variation in priming magnitudes. As such, individual

differences in learner characteristics may be relevant to understanding how syntactic priming can support L2 learning.

4.1.3.1 Motivation and attention in SLA

Individual differences in motivation and attention can influence L2 learning and achievement (Robinson et al., 2012; Ushioda & Dörnyei, 2012; Ushioda, 2016). SLA research shows that the following types of motivation affect L2 production and achievement: intrinsic and extrinsic motivation, which respectively reflect an inherent desire to learn a language for the affective rewards of engaging with learning activities (e.g., *"I enjoy the experience of surpassing myself when practicing English"*), and learning to be rewarded or to not be punished (e.g., *"I don't want to fail the English course"*) (Deci & Ryan, 1985; see Cheng et al., 2014; Noels et al., 2001); high motivational intensity and high task motivation or positive attitude towards the task, which respectively reflect how strongly participants engage in language learning activities (e.g., *"I am working hard at learning English"*) (Gardner & Lambert, 1972), and a combination of task enjoyment (e.g., *"I found the task interesting"*) (Eccles, 1993) and reported effort (e.g., "I put a lot of effort in doing the task) (Boekaerts, 2002; see Cocca & Cocca, 2019; Noels et al., 2001).

Motivation could also determine what learners pay attention to during an interaction (see Ushioda, 2016 for a discussion). Highly intrinsically-motivated participants tend to notice target linguistic features more (Takahashi, 2005) and whether a learner improves in L2 comprehensibility relates to how strongly they want to progress in that regard (Saito et al., 2017). Considering a task to be useful to reach one's language learning goal may also make participants more motivated and thus more attentive to it (Wigfield & Eccles, 2000). In other words, participants' learning goals may affect their strategy for focusing attention on certain aspects of the task.

Importantly, experimental manipulations that make L2 speakers more attentive to the stimuli containing the target structure, such as explicit instructions or other enhancement techniques, foster learning of these structures (Robinson et al., 2012). Furthermore, the Noticing hypothesis (Schmidt, 1990) states that noticing a target structure (i.e., consciously registering a specific grammatical form in the stimuli) is necessary to learn it, while noticing it and understanding it (i.e., also knowing the grammatical rules) facilitates learning further. For example, Brooks and

Kempe (2013) found that English L1 speakers who were able to describe the syntactic rules and structures present in experimental stimuli learned Russian inflectional morphology more successfully. SLA research thus shows that motivation and attention relate to L2 learning, but whether these factors could similarly increase L2 learning via syntactic priming remains largely unclear.

4.1.3.2 Motivation, attention and syntactic priming

Current models of syntactic priming (Chang et al., 2006; Reitter et al., 2011) define syntactic priming and the resulting learning in particular as being largely implicit processes (i.e. error-based learning via prediction or activation of representations), in which case, long-term priming (learning) should not affected by more explicit processes such as motivation and attention. According to Chang et al.'s (2006) and Reitter et al.'s (2011) models, explicit memory processes can exert a short-lived influence on priming, particularly in the context of priming with lexical overlap (Hartsuiker et al., 2008), but do not relate to their respective language learning mechanisms. As such, L2 speakers motivated to learn the language could be more likely to (explicitly) choose to copy the structure of an L2 prime sentence in order to practice the target language (Costa et al., 2008) and enhanced attention could help speakers to (explicitly) remember prime sentences better. If so, high motivation and attention could promote immediate reuse of a prime's structure but should not increase language learning via syntactic priming.

However, another possibility is that enhanced motivation and attention increase learning because they contribute to the processes that underlie language learning via syntactic priming. Being highly motivated or attentive could support the formation of predictions about the upcoming linguistic input (see Grüter et al., 2021 for a discussion) and such predictions drive the learning process when errorful (Chang et al., 2006). Alternatively, higher motivation and attention, if they lead to deeper processing of prime sentences (Branigan et al., 2007), could strengthen the mappings between message-level and structure-representations and thus foster larger changes in connection weights, in the framework of Chang et al.'s (2006) account (see also Ferreira & Bock, 2006). Such deeper processing could lead to larger activation of syntactic nodes in the model of Reitter et al. (2011; see Branigan et al., 2007 and Ivanova et al., 2020 for similar reasoning). Consequently, if more

motivated and attentive participants experience these deeper effects of immediate priming, they should also experience larger long-term effects.

Only one study to our knowledge has examined the relationship between motivation, priming and L2 learning (Chapter 3). This study found no clear relationships between motivation and priming. However, the results did suggest an influence of the visual features of the stimuli on this relationship, which may had confounded the priming effects. The findings may also have been limited by the participant sample who were as whole highly motivated. Moreover, there is limited research examining whether attention influences L2 learning via syntactic priming. Past research, largely conducted with L1 speakers, provides preliminary (and mostly indirect) evidence that speakers experience more immediate priming when they are more attentive to the syntax of stimuli or to the priming task. L1 speakers instructed to pay attention to the syntactic form of the stimuli rather than to their semantic content show increased priming effects (Bock et al., 1992). Likewise, participants experience more priming when completing a shared goal with their interlocutor (Reitter & Moore, 2014) or when hearing primes in a dialogue or directly addressed to them (versus hearing them in a monologue or as side participants; Branigan et al., 2007; Schoot et al., 2019; but see Ivanova et al., 2020). These conditions may all make participants more attentive to the task and its stimuli, in order to help them achieve the task or mutual understanding with their interlocutor. One study assessed L1 speakers' individual differences in attention to task more directly: Ivanova et al. (2020) measured participants' reaction times on a picture verification task performed in parallel to a priming task, assuming that lower variability in reaction times would reflect higher levels of attention to the task. Reduced variability in reaction times was associated with larger priming effects further suggesting that attention to task increases priming.

In L2 speakers, being more attentive to syntax and noticing the target structure seems to increase immediate priming. In one study, only learners who detected the target form experienced immediate priming (McDonough & Fulga, 2015) whilst explicit manipulations to make L2 speakers pay attention to syntax or notice the target form can also lead to larger priming (Shin & Christianson, 2012). Hence, previous research suggests that noticing the target structure and attention to the syntax or task can increase the magnitude of immediate priming.

There is little evidence as to whether these effects lead to increased *learning* via syntactic priming. Shin & Christianson, (2012) found that explicit instructions provided to L2 speakers, which potentially increased attention to syntax or promoted noticing of the target structure, boosted immediate but not long-term priming on a delayed post-test. These instructions may have increased reliance on explicit memory of the prime sentences, which led to structure repetition across adjacent prime and target sentences but not long-term learning. In Chapter 3, enhanced attention to task, enhanced attention to syntax and noticing of the target structure as measured on self-report questionnaires did not increase abstract immediate priming nor long-term priming of fronted temporal adverbial phrases and passives in L1 and L2 speakers. Unexpectedly, enhanced attention to task even reduced long-term priming for fronted sentences. However, given SLA findings suggest a clear role for attention in supporting L2 learning (Robinson et al., 2012), further research on the relationship between individual differences in attention and long-term priming is warranted.

Moreover, whether modality has any influence on priming may be related to the (potential) effect of motivation and attention on syntactic priming. If written language input facilitates syntax processing for L2 speakers (see section 1.1), then higher motivation and attention may be more helpful in the spoken modality where processing prime sentences is more difficult. It may be more difficult for L2 speakers to pay attention not only to meaning, but also to grammar when exposed to auditory L2 input as opposed to written L2 input (see Morgan-Short et al., 2012 for a review). Hence, being more attentive to the linguistic input may increase L2 priming, and consequently, increase learning more with spoken than with written prime sentences.

4.1.4 Present study

The present study investigated the effects of prime modality and individual differences in attention and motivation on L2 learning via syntactic priming. We compared immediate priming and learning from the spoken modality (listening-to-writing) to priming from the written modality (reading-to-writing). We conceptualized learning as producing more passives in post-tests following a priming phase, than in the pre-test.

We also compared these effects in L2 speakers to L1 speakers to assess in what ways these factors particularly affect L2 speakers. Whilst attention can modulate priming in L1 speakers (e.g., Ivanova et al., 2020), some research indicates that modality does not (e.g., Mahowald et al., 2016). Therefore, to disentangle the relative contributions of speaker proficiency (L1 vs. L2) and attention to any effects of priming modality, we compared syntactic priming across modality conditions in both speaker groups and used questionnaires to assess their attention (L2 and L1 speakers), their motivation and proficiency levels (L2 speakers only).

We expected both groups to show immediate and long-term priming. However, whilst we predicted that L1 speakers would experience the same priming strength across modality conditions, we expected L2 speakers to exhibit more immediate priming, and consequently more learning, when reading than listening to prime sentences. In both speaker groups, we predicted that being more attentive to syntax or task, and noticing the target structure would increase immediate priming, and we expected higher motivation levels to lead to larger immediate priming in L2 speakers. If this leads to larger learning, it would indicate that priming mechanisms are susceptible to such factors. Finally, since we expected prime modality not to influence the priming magnitude in L1 speakers, we expected attention to have the same effect across modalities in that group. By contrast, we expected that attention and motivation would boost (at least immediate) priming more in the listening-to-writing than in the reading-to-writing condition in L2 speakers, as we anticipated that processing prime sentences would be more difficult in the former than in the latter condition for them.

We tested these predictions in a two-part web-based picture description task. We asked L2 English learners who were French L1 speakers, and English L1 speakers to describe pictures of transitive events. The target structure was the passive transitive (2). The active (1) and passive (2a) transitive constructions of French and English are highly similar in terms of word order and morphosyntax. However, French speakers use the passive form less frequently both in French and in English than English speakers (Fivet, 1995) making it a suitable structure to assess whether priming supports language learning.

1. The pirate <u>is following</u> the sailor.
   Le pirate <u>suit</u> le marin.

2. The sailor is being followed by the pirate.

   Le marin est suivi par le pirate

4.2 Methodology

The first part of the study comprised a pre-test, an immediate priming phase and an immediate post-test. The second part was a delayed post-test completed at least a week after the first part. In the pre-test, participants described pictures without exposure to syntactic primes – this measured their preference for active versus passive sentences. In the immediate priming phase, participants described target pictures immediately after listening to or reading prime picture descriptions. This phase targeted immediate priming effects. In the immediate and delayed post-tests, participants described pictures without experiencing primes. These post-tests measured whether priming effects established in the immediate priming phase persisted over time as short- and long-term learning.

4.2.1 Participants

We tested 122 L2 and 123 L1 speakers of English. Participants were aged 17 to 28 years old (M=19.77). We used a questionnaire to obtain information on participants' language background. We recruited the L2 speakers via French universities and Prolific Academic; a screening survey ensured the learners recruited via Prolific Academic came from a similar demographic to the other participants. They received reimbursement via Prolific Academic or as Amazon vouchers. The L1 speakers were first year Psychology students at the University of Warwick. They received course credit for their participation. The study was approved by the Humanities and Social Sciences Research Ethics Committee at the University of Warwick. All participants provided informed consent online before the test session.

We excluded one L2 speaker who wrote target sentences in French and one who provided active and passive versions of each target sentence. We excluded one L1 speaker who reported being an L1 speaker of both languages, three who produced only "other" sentences and one L2 and three L1 speakers due to technical issues. Therefore, the first part of the experiment (immediate priming and immediate post-test) included 119 L2 speakers (57 female; listening condition: 60, reading condition:

59); 116 L1 speakers (102 female; listening condition: 56, reading condition: 60). For the second part of the experiment (delayed post-test), we excluded nine further participants who completed the delayed post-test more than 10 days after the priming task (delay range: 11 days–2 months), and two participants who did not produce any transitive sentences. A further 13 participants did not attempt the delayed post-test. Thus, the analysis for long-term learning included 103 L2 speakers (listening condition: 54, reading condition: 49) and 109 L1 speakers (listening condition: 52, reading condition: 57). On average, L2 speakers completed the delayed post-test 7.6 days after the priming task, and L1 speakers 7.8 days.

We assessed L2 speakers' self-reported proficiency, previously found to correlate with direct measures of proficiency (Lemhöfer & Broersma, 2012). They rated their speaking, understanding, reading, and writing proficiencies on a scale from 0 to 10 and we computed the average of these scores (Bernolet et al., 2013). L2 speakers had an average proficiency rating of 7.47 (range 3.5-10). The two groups (listening vs. reading condition) did not differ significantly in any proficiency measurements (see Appendix S1).

4.2.2 Materials

4.2.2.1 Prime and target pictures

For the first part of the experiment, we created 36 target items using six verbs (chase, follow, punch, scold, kiss, slap) six times each with different combinations of animate agent and patient characters (based on stimuli from Hardy et al., 2017). Each target verb appeared once in the pre-test (6 items), four times in the priming phase (24 items) and once in the immediate post-test (6 items).

For the priming phase, we paired each target verb with one of six different verbs (kick, push, touch, shoot, pull, tickle), each of which were used four times with different combinations of characters to create 24 prime items that had no lexical overlap with the paired target items. Prime items had an associated active and passive description (Figure 4.1).

In the priming phase, prime-target pairs were separated by two filler pictures (resulting in a prime-target-filler-filler sequence) and in the pre-test and in the immediate post-test sections target pictures were separated by three filler pictures. We created 84 filler pictures using intransitive verbs (represented with two

characters: "the monks are crying") and ditransitive verbs (represented with two characters and an object: "the monk is selling the artist a cup"); 18 were in the pre-test, 48 in the priming phase and 18 in the immediate post-test.

For the delayed post-test, we created 12 additional target sentences using the 6 prime and 6 target verbs and 12 additional intransitive and ditransitive filler sentences such that target sentences were separated by one filler sentence.

The target pictures included word labels (articles, nouns and verbs) to prevent problems of vocabulary retrieval. The agent characters appeared an equal number of times on the right versus left side of the picture across pictures. For the listening condition, prime sentences were recorded by a female L1 English speaker who was instructed to read the stimuli as clearly and naturally as possible. We created two lists of stimuli so that one version of each experimental prime item (active or passive) would appear in each list in both the listening and reading conditions. Participants were randomly assigned to one list in one of the modality conditions.

4.2.2.2 Picture-sentence matching task

To ensure that participants would pay attention to the prime sentences, we asked them to judge whether each prime sentence corresponded to the picture presented with it. We included three mismatches corresponding to filler trials in the pre-test, 16 in the priming phase and three in the post-test.

4.2.2.3 Attention questionnaire

The attention questionnaire targeted three aspects of attention: attention to syntax, attention to the task, and noticing of target structures. First, participants provided a rating on a scale from 1 (no attention/interest) to 7 (paid attention/very interested) to indicate the extent to which they paid attention to and were interested in 1) what sentences they were exposed to during the task, 2) the picture description task in general, 3) the meaning, 4) the vocabulary, 5) the pronunciation, and 6) the syntactic structures of the sentences included in the syntactic priming task (see OSF for the full questionnaire). Second, we assessed participants' capacity to describe the syntactic rules and structures present in the stimuli (Brooks & Kempe, 2013; McDonough & Fulga, 2015) with three open-ended questions: (1) "explain, in your

impression, what was the experiment about?", (2) "did you notice any grammatical rules of English underlying the sentences you heard/read and produced?", and (3) "can you name and/or describe what the rules were that were illustrated by the sentences you heard/read and produced during the picture description task?".

4.2.2.4 Motivation questionnaire

The motivation questionnaire targeted aspects of motivation previously established as modulators of L2 achievement and production or which we hypothesized could influence syntactic priming. Some items came from existing, pre-tested questionnaires (Boekaerts, 2002; Deci & Ryan, 1985; Dörnyei & Taguchi, 2010; Saito et al., 2017; Serafini, 2013), whilst others were created specifically for this study. It included items targeting externally regulated motivation (8 items), intrinsic motivation (7 items), task motivation (6 items), motivational intensity (6 items), how important learning English was important for the participants (2 items), participants' metacognition about the task (5 items) and participants' language learning goals (9 items) among which 5 specifically assessed whether participants were interested in improving their grammatical knowledge of English (grammar learning goal). The presentation of items was randomized across categories and participants.

4.2.3 Procedure

Participants completed the study online in the survey programme Qualtrics (https://www.qualtrics.com). Upon clicking the link to the study, participants were randomly assigned by Qualtrics to the listening or reading condition. They first completed the consent form, followed by the proficiency questionnaire.

The picture-description task then started with the pre-test: participants judged whether filler sentences matched the presented picture by selecting one of two options, "yes" or "no", appearing below the picture as a multiple-choice question. On the next screen, participants were shown a target picture and instructed to write a sentence describing it in a text response box below. The priming phase immediately followed the pre-test. In the reading condition, the prime picture appeared with the prime sentence below it for 7 seconds. In the listening condition, the prime picture appeared for 7 seconds without the written prime sentence. Instead, the recorded prime sentence played automatically when they reached the page and participants

were instructed to listen to it only once. We constrained the time spent on this page in order to ensure that participants could only listen to the sentence once. Participants indicated whether the prime sentence corresponded to the presented picture and then were shown a target picture and instructed to write a description (Figure 4.1). Participants viewed prime and target pictures in alternation until all trials were completed, they then completed the immediate post-test, structured like the pre-test. Finally, participants filled in the motivation questionnaire (L2 speakers only) followed by the attention questionnaire (L2 and L1 speakers) by providing answers on sliders or in response boxes.

A week after completion of the first part, all participants were invited to complete the delayed post-test where they described target pictures as in the pre-test and immediate post-test.

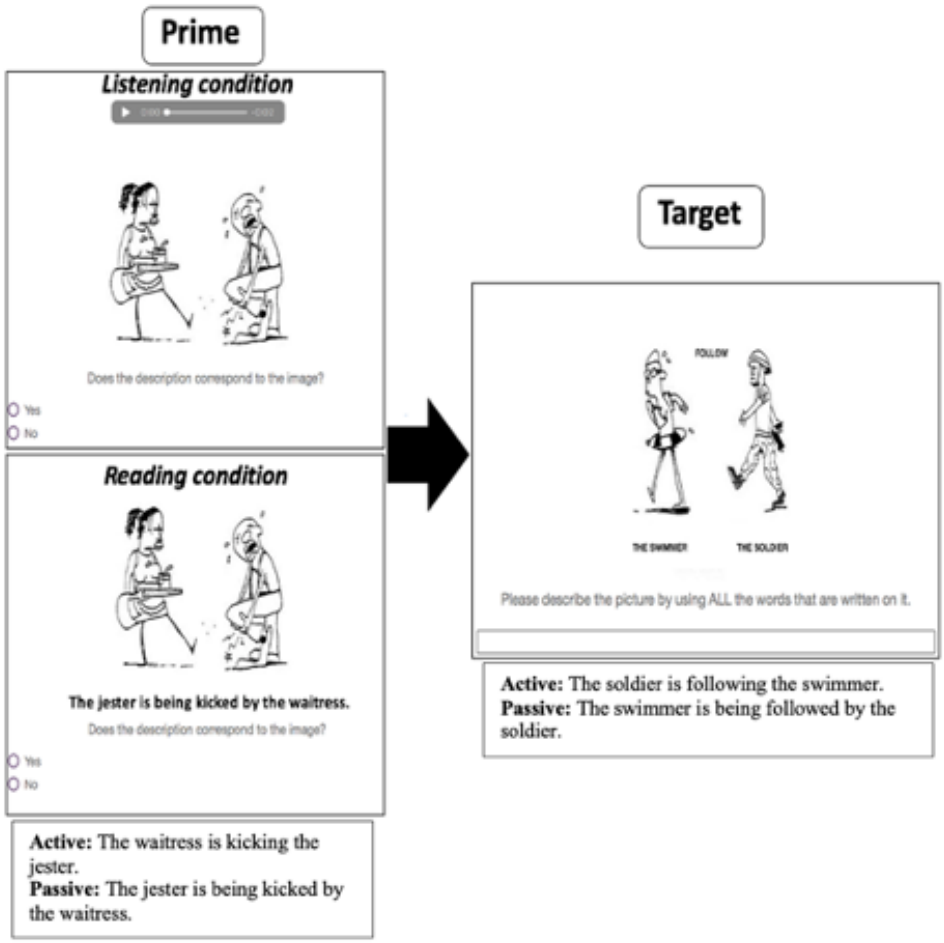


Figure 4.1 Example of a prime-target trial

4.2.4 Scoring

4.2.4.1 Target sentences

Target sentences were coded for whether they were active or passive sentences, or other. Complete active sentences contained a subject noun phrase with the agent produced first, followed by the verb and finally, an object noun phrase with the patient. Complete passive sentences contained a subject noun phrase with a patient in first position, followed by a form of the verb "to be", a past participle and finally, a *by*-phrase with an agent. We ignored morphological errors, such as tense or agreement errors and naming errors in which participants used an alternative noun for a character (e.g., naming a character "the judge" instead of "the teacher"). We included sentences where one of the noun phrases was replaced by a pronoun or where two pronouns of distinct genders were produced, sentences with complex noun phrases (e.g., "the teacher kicked the clown's leg"), with an added auxiliary (e.g., "the waitress does kick the jester") or with negation (e.g., "the fighter does not chase the robber"). All remaining responses, including reversed passives and actives and active sentences that were not paraphrasable with a passive (e.g., with a modal auxiliary), were coded as 'other' and excluded from the analyses.

4.2.4.2 Attention questionnaire

We calculated three attention scores for each participant. To measure participants' attention to task, we averaged their scores on questions 1 and 2 of the attention questionnaire. We used their rating for question 6 to assess their attention to syntax. Participants' responses to the open-ended questions were scored so as to distinguish noticing from noticing and understanding (Schmidt, 1990). Participants received a score of 2 (henceforth "Noticing 2") if they indicated they had noticed and understood the alternations, i.e., they were able to name, describe or give examples of the passive/active sentences. They received a score of 1, which corresponded to noticing only (henceforth "Noticing 1") if they mentioned some aspect of the passive, such as the use of past participles or past tense, or "indirect vs. direct form" to describe the actions or that who was doing what to whom mattered. They received a score of 0 if they did not refer to the passive/active alternation or its features in any way.

4.2.4.3 Motivation questionnaire

We conducted a Principal Component Analysis with the L2 speakers' scores on the 43 Likert-scale survey items to identify correlated responses across the different categories of motivation and reduce the number of motivation dimensions. The PCA analysis revealed that two principal components (PC's) accounted for the most variance in the data, with PC1 explaining 17.7% of variance and PC2 explaining 9.4%. The rest of the PCs only accounted for 5% or less variance and did not differ enough from each other. The Cronbach alpha for PC1 was .88 and .80 for PC2.

We selected the items loading on each of these two PC's and avoided cross-loadings by following Takahashi (2005)'s cut-off criterion of .45 correlation level. The final two motivation scores we included in the analysis corresponded to these two PC's and were calculated by averaging an individual's scores of all the items loading on each PC respectively. PC1 included all items measuring how important it was for participants to learn English (two items), six of the seven items from the original intrinsic motivation category, six of the nine items from the learning goal category, of which three specifically targeted grammar learning, four of the six items from the motivational intensity category and one of the eight items from the external motivation category. PC2 included four of the five items from the metacognition category and four of the six items from the task motivation category. We interpreted PC1 as representing motivation to learn English and PC2 as representing task-specific motivation (see OSF for detailed results).

4.3 Results and Analysis

4.3.1 Descriptive statistics

Table 4.1 reports participants' response frequencies in the immediate priming phase and post-test; Table 4.2 reports response frequencies in the delayed post-test (recall that some participants were excluded from the analysis of long-term learning). The pre-test confirmed that speakers preferred to use active responses but overall, participants produced more passives following priming.

Table 4.1 Response frequencies 1. Frequency of target responses by group, modality and experiment phase for immediate priming and long-term priming in the immediate post-test.

			Response		
Group	**Condition**	**Phase (prime)**	**Active**	**Passive**	**Other**
L2	Listening	Pre-test	315	6	39
	(N=60)	Priming (active)	609	80	31
		Priming (passive)	490	195	35
		Immediate post-test	299	47	14
	Reading	Pre-test	310	4	40
	(N=59)	Priming (active)	585	83	40
		Priming (passive)	523	140	45
		Immediate post-test	287	56	11
L1	Listening	Pre-test	255	5	76
	(N=56)	Priming (active)	595	13	64
		Priming (passive)	517	89	66
		Immediate post-test	304	9	23
	Reading	Pre-test	289	6	65
	(N=60)	Priming (active)	587	33	100
		Priming (passive)	531	88	101
		Immediate post-test	290	23	47

Table 4.2 Response frequencies 2. Frequency of target responses by group, modality and experiment phase for long-term priming in the delayed post-test.

			Response		
Group	**Condition**	**Phase**	**Active**	**Passive**	**Other**
L2	Listening	Pre-test	282	6	36
	(N=54)	Delayed post-test	517	111	20
	Reading	Pre-test	259	4	33
	(N=49)	Delayed post-test	473	85	30
L1	Listening	Pre-test	240	3	69
	(N=52)	Delayed post-test	543	28	53
	Reading	Pre-test	279	6	57
	(N=57)	Delayed post-test	590	30	64

All participants performed above chance level (i.e., 50% correct answers) on the picture-sentence matching task. L2 speakers made 1.43 mistakes on average (range 0-12) and L1 speakers 1.19 (range 0-12) (Table 4.3). For attention to task, L2 speakers showed a mean score of 5.22 (range 1-7), and L1 speakers 4.72 (range 1-7). For attention to syntax, L2 speakers showed a mean score of 5.03 (range 2-7), and L1 speakers 4.59 (range 1-7). Regarding noticing, 45.4% of L2 speakers scored 2, 14.3% scored 1 and 40.3% scored 0. 14.7% of L1 speakers scored 2, 9.5% scored 1 and 75.9% scored 0. L2 speakers had an average rating of 5.08 (range 2.65-6.85) for English motivation and 3.71 (range 1.13-5.88) for task-specific motivation (Tables 4.3 and 4.4).

Table 4.3 Individual differences descriptive statistics. Mean scores (SD) and ranges (in italics) by group and modality.

		L2		L1	
Measure		**Listening**	**Reading**	**Listening**	**Reading**
Attention	Syntax	5.18 (1.19)	4.86 (1.19)	4.75 (1.64)	4.43 (1.65)
		2-7	*2-7*	*1-7*	*1-7*
	Task	5.09 (1.23)	5.32 (1.04)	4.95 (1.09)	4.5 (1.04)
		1-7	*3-7*	*1-7*	*2-6.5*
Motivation	English learning motivation (PC1)	5.66 (0.66)	4.49 (0.58)	-	-
		3.2-6.85	*2.65-5.45*		
	Task-specific motivation (PC2)	3.70 (1.1)	3.72 (0.67)	-	-
		1.13-5.63	*2-5.88*		
N picture-sentence matching mistakes		1.13 (2.44)	1.73 (2.51)	0.77 (1.21)	1.58 (2.26)
		0-6	*0-12*	*0-7*	*0-12*

Table 4.4 Noticing statistics. Raw number (percentage) of participants per group per condition whose responses were scored 0, 1 and 2

		L2		L1	
Measure		**Listening**	**Reading**	**Listening**	**Reading**
Noticing	0	24 (40%)	24 (40.7%)	40 (71.4%)	48 (80%)
	1	9 (15%)	8 (13.6%)	6 (10.7%)	5 (8.3%)
	2	27 (45%)	27 (45.8%)	10 (17.9%)	7 (11.7%)

4.3.2 Analysis

We compared priming effects across modality conditions and speaker groups over the three different time courses: immediate priming, and long-term priming in the immediate post-test and in the delayed post-test. Then, we explored the effects of individual differences on each priming type in each modality condition.

4.3.2.1 Priming across modality conditions

We analysed the effect of priming on passive responses, as participants dispreferred passives in the pre-test. Since our dependent variable was binary, coded as 0=active

and 1=passive, we analysed the data with Generalized Logistic Mixed Models (Baayen et al., 2008; Jaeger, 2008) using the lme4 package (Version 1.1.21; Bates et al., 2014) in R, version 1.2.5042. We explored the effects of two between-participants variables, Modality (listening vs. reading) and Group (L2 vs. L1 speakers), and one within-participant variable, Prime (active vs. passive primes) for immediate priming, Section (pre-test vs. immediate post-test) for long-term priming in the immediate post-test, or Session (pre-test vs. delayed post-test) for long-term priming in the delayed post-test, on participants' likelihood of producing passives. These factorial predictors were sum contrast coded to have a mean of 0 and a range of 1 prior to analysis.

All analyses started with a full model including main effects and interactions and the maximal by-subject and by-item random effects structure justified by our experimental design (Barr et al., 2013): all models included random intercepts for participants and items and by-subject random slopes for within-participant factors (Prime, Section, Session) and by-item random slopes for within-item factors (Prime, Group, Modality) and their interactions. Where models did not converge, we removed random slopes and interactions before main effects, starting with those accounting for the least variance. Then, we performed a stepwise "best-path" reduction procedure, removing interactions before main effects, to locate the simplest (best) model that did not differ significantly from the full (converging) model in terms of variance explained but did differ significantly from a null model with only the intercept term as a predictor. We report the results of the best models with all p-values for individual predictors coming from the model summary outputs. We applied an alpha level of .05, but when splitting datasets to explore significant interactions, we applied Bonferroni correction with a corrected alpha level of 0.025.

Since the interactions between priming, modality and group were critical to our research questions, in the case of non-significant results, we used the Bayesian information criterion (BIC) values of the models to estimate the Bayes Factor as $e^{(\text{AlternativeBIC} - \text{NullBIC}) / 2}$ and quantify the likelihood of null effects. We compared a model with only the main effects of the factors (Null model) to a model that contained the three-way interaction between these factors (Alternative model; Wagenmakers, 2007). We interpreted inverse BFs following Jarosz and Wiley's (2014) suggestions and effect sizes based on Cohen's (1977) guidelines.

4.3.2.2 The effect of individual differences

We examined the effect of individual differences in attention and motivation across modality conditions on each priming type. For attention, we added each individual difference measure and its interactions with the other factors as fixed effects to the best models obtained in the first part of the analysis[12]. For motivation, since the analysis only included the L2 speakers, we started with a full model of the L2 priming data only, including all the required fixed and random effects for each priming type. All continuous predictors (attention to syntax, attention to task, English learning motivation and task-specific motivation) were centred except proficiency, which had a scale starting at a meaningful 0. Noticing was defined as a categorical factor with three levels where 0=not noticing the target structure at all, 1=noticing it (Noticing 1) and 2=noticing it and understanding it (Noticing 2). This factor was sum contrast coded and we used multiple contrasts to compare not noticing (-0.66) to Noticing 1 (0.33) and Noticing 2 (0.33) combined, and to compare Noticing 1 (-0.5) to Noticing 2 (0.5). We compared each model which included the targeted individual differences score to the same model without the score (henceforth, the "simplest model"; Weatherholtz et al., 2014). We report the results of the models that provided a better fit than the simplest model.

4.3.3 L2 vs. L1 immediate and long-term priming in the listening and reading conditions

4.3.3.1 Immediate priming

We investigated the effect of modality on immediate priming across groups with a model including Prime, Modality, Group and the three-way interaction as fixed effects (Table 4.5). We found a significant effect of Prime: participants produced more passive targets after passive primes (*M*=0.20, *SD*=0.40, 95% Confidence Interval (CI)[0.18, 0.21]) than after active primes (*M*=0.08, *SD*=0.27, CI[0.07, 0.09]), with a priming effect of 12% (CI[8%, 15%], Cohen's *d*=.54 [medium], *SE=0.02*). There was a significant effect of Group: L2 speakers produced more passives (*M*=0.18, *SD*=0.39, CI[0.17, 0.20]) than L1 speakers (*M*=0.09, *SD*=0.29, CI[0.08, 0.10]). Finally, we found a significant interaction between Prime and

[12] An additional analysis with attention scores added to the full models instead showed the same results as described below.

Modality: participants experienced 14.8% priming in the listening condition (CI[9%, 20%], Cohen's *d*=.68 [medium-to-large], *SE*=.03) whereas they experienced 8.8% priming in the reading condition (CI[4%, 13%], Cohen's *d*=.40 [medium], *SE*=.02). The interaction between Prime, Modality and Group was not significant; the inverse BF=.0003 provided "very strong" evidence in favour of the null hypothesis. Thus, participants manifested larger priming when listening to than when reading primes, but this effect did not vary by group (Figure 4.2).

Table 4.5 Immediate priming model. Summary of the best model[a] for immediate priming of passives across groups and modalities.

Fixed effects	**Estimate**	**SE**	**Z-value**	***p*-value**
Intercept	-3.30	.20	-16.18	**<.001**
Prime	1.58	.30	5.21	**<.001**
Group	1.40	.32	4.44	**<.001**
Modality	.10	.28	.36	.72
Prime x Group	-.53	.42	-1.27	.20
Prime x Modality	-.80	.41	-1.97	**.049**
Group x Modality	-.79	.57	-1.40	.16
Prime x Group x Modality	.27	.81	.33	.74

[a]included by-subject random slopes for Prime and by-item random slopes for Group.

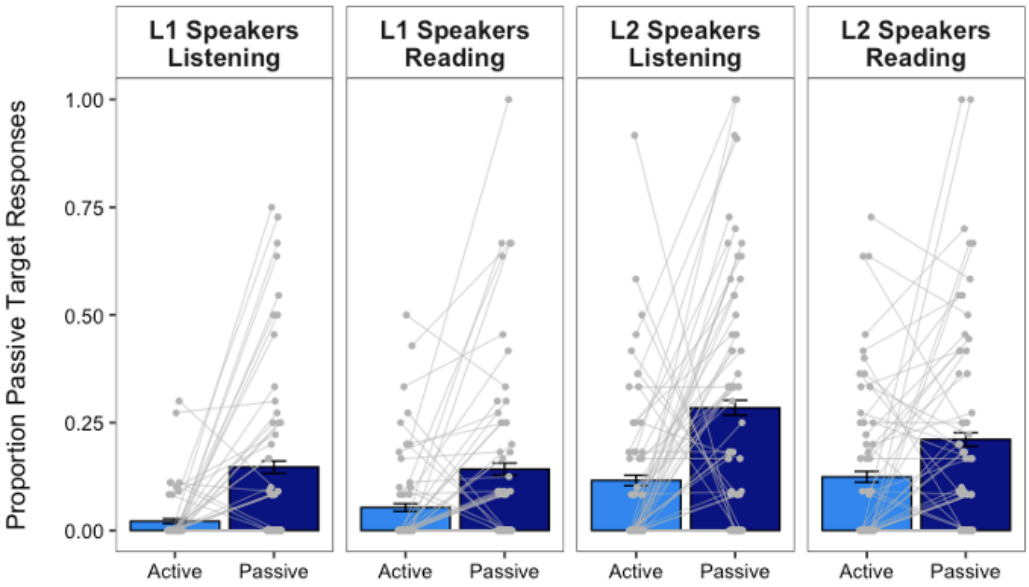


Figure 4.2 Passive responses in the immediate priming phase. Mean proportion of passive responses by Prime, Modality and Group. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

4.3.3.2 Long-term priming in the immediate post-test

We analysed the effect of modality on long-term priming in the immediate post-test across groups with a model including Section, Modality, Group, and the three-way interaction as fixed effects (Table 4.6). We found a significant effect of Section: participants produced more passives in the immediate post-test (*M*=0.10, *SD*=0.30, CI[0.09, 0.12]) than in the pre-test (*M*=0.02, *SD*=0.13, CI[0.01, 0.03]), with an average increase of 8% (CI[6%, 11%], Cohen's *d*=0.57 [medium], *SE=0.01*). The three-way interaction between Section, Modality and Group was not significant; the inverse BF<.0067 providing "very strong" evidence in favour of the null hypothesis. Therefore, participants experienced learning, but neither prime modality nor group influenced the magnitude of this learning (Fig 4.3).

Table 4.6 Model for long-term priming in the immediate post-test. Summary of the best model[a] for long-term priming of passives in the immediate post-test across groups and modalities.

Fixed effects	Estimate	SE	z-value	*p*-value
Intercept	-6.77	.61	-11.04	**<.001**
Section	5.81	1.20	4.85	**<.001**
Group	.73	.64	1.14	.25
Modality	.27	.63	.42	.67
Section x Group	2.05	1.23	1.66	.097
Section x Modality	.91	1.23	.74	.46
Group x Modality	-.73	1.27	-.57	.57
Section x Group x Modality	-.27	2.46	-.11	.91

[a]included by-subject random slopes for Section.

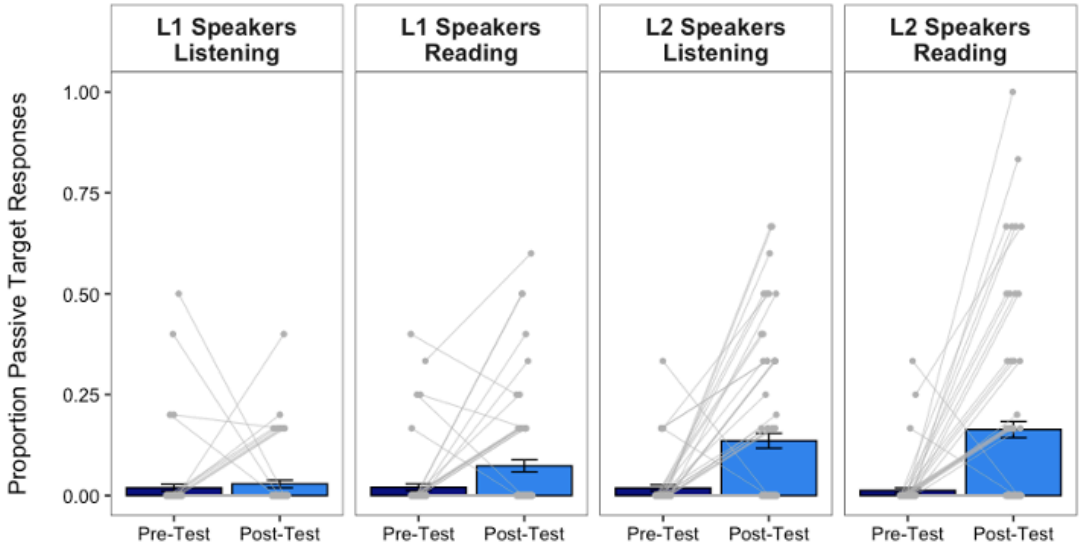


Figure 4.3 Passive responses in the pre- and immediate post-tests. Mean proportion of passive responses by Section, Modality and Group.

4.3.3.3 Long-term priming in the delayed post-test

We examined the effect of modality on long-term priming in the delayed post-test across groups with a model including Session, Modality, Group, and the three-way

interaction as fixed effects (Table 4.7). We found a significant effect of Session: participants produced more passive sentences in the delayed post-test (*M*=0.11, *SD*=0.31, CI[0.09, 0.12]) than in the pre-test (*M*=0.02, *SD*=0.13, CI[0.01, 0.03]), indicating an average long-term priming effect of 9% (CI[6%, 12%], Cohen's *d*=0.57 [medium], *SE*=0.01). There was a significant effect of Group: L2 speakers produced more passives sentences overall (*M*=0.12, *SD*=0.32, CI[0.10, 0.13]) than L1 speakers (*M*=0.04, *SD*=0.19, CI[0.03, 0.05]). There was no significant three-way interaction between Session, Modality and Group (the inverse BF=0.02 providing "strong" evidence in favour of the null hypothesis), but there was a significant interaction between Session and Group. Further exploration with the data split by Group revealed that both L2 and L1 speakers experienced a significant effect of Session: L2 speakers produced more passives in the delayed post-test (*M*=0.17, *SD*=0.37) than in the pre-test (*M*=0.02, *SD*=0.13; β=3.16 (*SE*=0.57), *Z*=5.60, *p*<.025); as did L1 speakers (*M*=0.05, *SD*=0.22 vs. *M*=0.02, *SD*=0.13; β=1.50 (*SE*=0.45), *Z*=3.31, *p*<.025). However, this long-term priming effect was larger in L2 (15%; CI[11%, 20%], Cohen's *d*=0.82 [large], *SE*=0.02) than in L1 speakers (3%; CI[0%, 6%], Cohen's *d*=0.26 [small-to-medium], *SE*=0.01). Thus, L2 speakers showed larger long-term priming than L1 speakers in the delayed post-test but there was no effect of modality (Fig 4.4).

Table 4.7 Model for long-term priming in the delayed post-test. Summary of the best model[a] for long-term priming in the delayed post-test of passives across groups and modalities.

Fixed effects	Estimate	SE	z-value	*p*-value
Intercept	-5.67	.47	-11.95	**<.001**
Session	2.26	.42	5.40	**<.001**
Group	1.35	.55	2.46	**.01**
Modality	-.05	.54	-.09	.93
Session x Group	1.68	.56	3.01	**.003**
Session x Modality	-.07	.55	-.13	.90
Group x Modality	-.92	.98	-.94	.35

[a]included two-way interactions between the factors only and no random slopes.

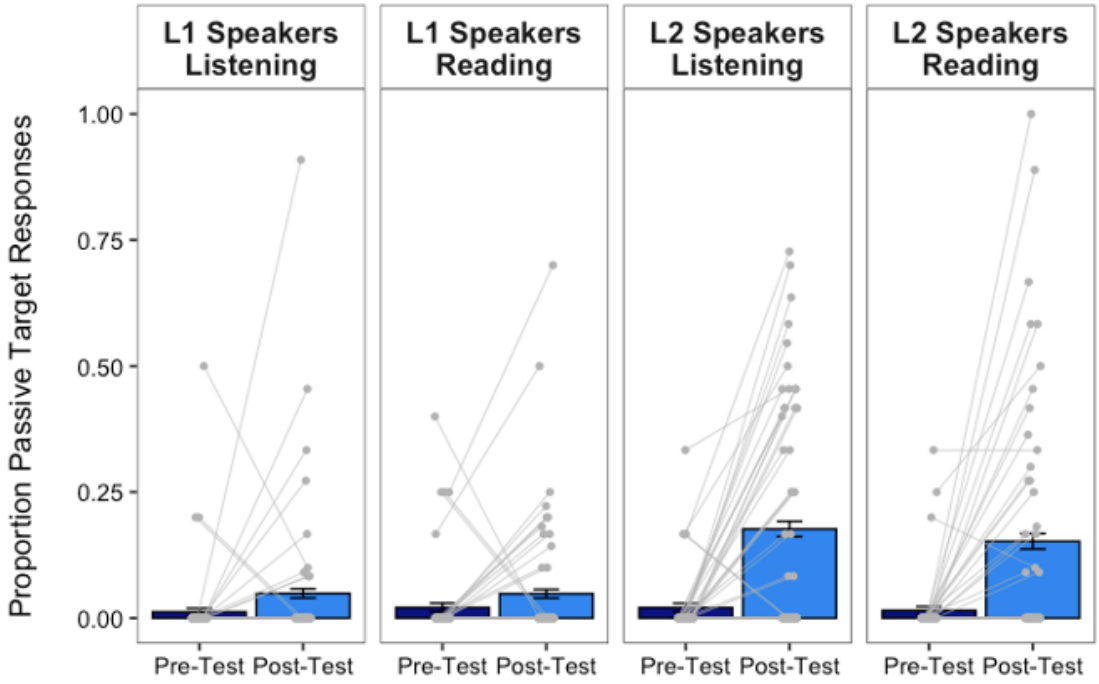


Figure 4.4 Passive responses in the pre- and delayed post-tests. Mean proportion of passive responses by Session, Modality and Group.

Thus, both L2 and L1 speakers showed immediate and lasting priming effects, but long-term priming was greater in the delayed post-test in L2 than L1 speakers. Immediate priming was stronger in the listening than in the reading group, but lasting priming effects did not differ by prime modality.

4.3.4 Effects of individual differences

We first examined whether proficiency related to syntactic priming in L2 speakers to determine whether we would include it as a covariable in the models for each priming type. The converging models showed that proficiency did not relate to immediate priming (*p*s>.09), long-term priming in the immediate post-test (*p*s>.26) nor long-term priming in the delayed post-test (*p*s>.2). Thus, we did not include it in any of the models exploring individual differences.

4.3.4.1 Attention and motivation

The models for attention to syntax, task, English learning motivation and task-specific motivation did not significantly differ from the simplest models for immediate priming (*p*s>.28); long-term priming in the immediate (*p*s>.13) and in the

delayed post-test (*p*s>.39). Though the converging model for noticing did significantly differ from the simplest models for all three priming analyses (*p*s<.05), no analyses revealed a significant effect of noticing (*p*s>.11; see Appendix S2 for details). Thus overall, individual differences in attention and motivation did not significantly relate to any of the three priming types.

4.4 Discussion

We investigated the effects of prime modality, that is, reading versus listening to the prime sentences, on L2 learning via syntactic priming and examined how this related to individual differences in attention and motivation. Both L2 and L1 speakers experienced immediate priming, and long-term priming in the immediate and in the delayed post-test. Interestingly, L2 speakers produced more passives than L1 speakers in the immediate priming phase and showed larger long-term priming than L1 speakers when tested a week later. Participants across speaker groups experienced more immediate priming when listening to than when reading primes, but prime modality did not affect long-term priming in either group. Finally, individual differences in attention and motivation did not modulate priming effects. We discuss the implications of these results for models of syntactic priming and for L2 learning.

4.4.1 Syntactic priming effects

In line with the predictions of the models defining syntactic priming as a language learning mechanism (e.g., Chang et al., 2006; Reitter et al., 2011), both groups exhibited immediate priming and long-term learning in the immediate and the delayed post-tests (see also e.g., Grüter et al., 2021; McDonough & Chaikitmongkol, 2010).

Overall, the L2 speakers produced more passives than L1 speakers in the immediate priming phase. Since both groups produced very few passives in the pre-test, this greater increase for the L2 speakers implies that they were more affected by the passive primes than the L1 speakers. The L2 speakers may have used the prime sentences as models for native-like language production and deliberately decided to re-use their structure to formulate their own sentences; Costa et al. (2008) hypothesize that learners may choose to do this to improve their L2 skills. However,

this explanation is difficult to reconcile with the observation that noticing did not affect priming and that the L2 speakers also experienced larger long-term priming than the L1 speakers in the delayed post-test. Explicit processes, such as copying the structure of prime sentences based on explicit memories, are typically thought to have a short-lived influence on priming effects (e.g., Hartsuiker et al., 2008).

Alternatively, these results may corroborate key predictions of the language learning models of priming. The error-based mechanism of priming predicts that L2 speakers who have less experience with the target language should be more likely to experience prediction error and therefore more syntactic priming and learning than L1 speakers (Chang et al., 2006). Alternatively, given their inexperience, L2 speakers' syntactic representations should have lower base-level activation which should lead to increased production and more learning than representations with higher base-level activation (Reitter et al., 2011; but see Schoonbaert et al., 2007). L1 speakers have more entrenched knowledge of the target structure and its associated frequency and as a result may need more exposure to passives to see their normal biases affected in the long-term. Importantly, not only did we find that the L2 speakers produced more passives than the L1 speakers in the immediate priming phase, but they also showed greater long-term priming than the L1 speakers. Our results thus strongly support the predictions of the language learning models of priming (Chang et al., 2006; Reitter et al., 2011) that priming manipulations should affect L2 speakers more than L1 speakers, both in immediate and long-term priming contexts.

Additionally, whereas most of the L2 speakers were living in France when tested and thus less likely to be exposed to English between test phases, the L1 speakers were based in the UK and would have been exposed to English between the end of the priming task and the delayed post-test. This may have reduced the long-term effect of priming in the latter group. The significant learning observed across groups suggests that the effects of priming were nonetheless lasting for both groups. Thus, the results provide strong evidence that syntactic priming tasks help L2 learners strengthen syntactic representations of dispreferred structures for immediate use. Additionally, this acquired knowledge can be re-used across sessions, without re-exposure to prime sentences (McDonough & Chaikitmongkol, 2010).

4.4.2 The effect of prime modality

Participants across speaker groups experienced more immediate priming in the listening than in the reading condition. This contradicts our predictions and previous research reporting no effect of modality on L1 priming (Hartsuiker et al., 2008; Mahowald et al., 2016) or larger L2 priming in written than in oral interactions (Kim et al., 2019, 2020).

This result could indicate that the participants experienced inverse frequency effects, another prediction of the language learning models of priming (Chang et al., 2006; Reitter et al., 2011). The passive structure tends to be more common in written than in spoken language (Roland et al., 2007). Therefore, the participants in the listening condition may have experienced larger surprisal and hence larger prediction error (Chang et al., 2006) or larger increases in base-level activation (Reitter et al., 2011) triggering larger priming when exposed to passives in this modality, than participants in the reading condition. That modality affected priming to the same extent across speaker groups could indicate that the L2 speakers had the same awareness as the L1 speakers of the frequency of passives in the spoken vs. in the written modality in English. Future research should examine the effect of modality when targeting structures which occur with the same frequency across modalities to further assess the effect of this factor on priming and learning.

However, contrary to our expectations, this effect of modality did not extend to the post-test phases: greater immediate priming in the listening condition did not translate into greater long-term priming compared to the reading condition. This suggests that the effect of modality was short-lived. This is surprising given that across *speaker groups*, we observed that greater immediate effects of priming led to greater long-term effects. Such a null effect is difficult to interpret, therefore further research is needed to explore this pattern of results.

Since participants experienced significant priming and learning across modalities, the present results demonstrate further that L2 speakers can re-use syntactic knowledge regardless of input modality of the target structures (Kim & Godfroid, 2019). They also show that priming and learning can arise within- (reading-to-writing) and between- (listening-to-writing) modalities in L2 speakers (Kim & Godfroid, 2019), thereby suggesting that, at higher proficiency levels, syntactic representations are shared across modalities. Future research should test

less proficient L2 speakers to assess whether modality influences L2 priming more in the earlier stages of learning.

4.4.3 The effects of attention and motivation

We expected attention to linguistic input across speaker groups and enhanced motivation levels in L2 speakers to increase immediate priming, (e.g., Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015; Ushioda, 2016), and to be more likely to do so in the listening than in the reading condition. The possible long-term effects of these factors were less clear (e.g., Shin & Christianson, 2012).

However, attention and motivation did not relate to short- or long-term priming: noticing the target structure, being highly motivated or attentive to the syntax or to task did not increase immediate priming or language learning via syntactic priming across speaker groups (see Shin & Christianson, 2012 for similar results in L2 speakers).

Our results concerning attention contrast with previous findings whereby higher attention to syntax and to task or noticing the target structure triggered larger immediate syntactic priming effects (e.g., Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015). This discrepancy may result from methodological differences between the present study and past work. In previous studies reporting an effect of attention on immediate priming, the activities took place entirely in the oral modality, i.e., participants heard prime sentences, sometimes repeated them and produced spoken target sentences. Noticing or paying more attention to the task or target structures may influence oral production more than written production. Participants may be more likely to rely on their default preferred structure despite higher attention levels when writing sentences because, for instance, typing active rather than passive sentences is less effortful or quicker (Kim et al., 2020).

Our measurements of attention to task and syntax may also have been not perfectly accurate in measuring individual differences in attention, as we only used explicit and subjective self-report questionnaires. Such self-reports may reflect participants' memory for the target structure or other aspects of the task. The effect of attention on priming may be better assessed by directly manipulating what participants are asked to pay attention to during the priming task (Bock et al., 1992), or by directly quantifying variation in attention with implicit methods, such as eye-

tracking (Michel & Smith, 2018) or with measurements such as reaction times (Ivanova et al., 2020).

Although we considered the passive construction to be suitably infrequent and difficult to pose a challenge for learners to spontaneously produce, attention and motivation may not influence L2 priming here because being attentive or motivated is more helpful to learn more complex structures (Carr & Curran, 1994; Takahashi, 2005), such as object relative clauses (e.g., "Sara saw the puppy that she liked"). Alternatively, these factors may play a larger role with targets structures which do not exist in learners' L1, unlike English passives, which are highly similar to French passives. Targeting structures for which learners cannot rely on cross-linguistic transfer for processing might lead them to benefit more from deeper processing triggered by high attention and motivation levels. Further across-structure comparisons are needed to test these hypotheses. Finally, while SLA research typically examines the effect of motivation on overall L2 abilities (Ushioda, 2016), motivation may not relate to the learning of specific linguistic features, as promoted in syntactic priming tasks.

4.5 Conclusion

This study shows that syntactic priming tasks support the long-term acquisition of L2 syntactic knowledge. While this occurs regardless of prime modality, L2 and L1 speakers' immediate priming magnitude may vary depending on the frequency of the target structure in each modality. These results, combined with the larger production of passives and larger learning magnitudes in L2 than in L1 speakers, provide support for the mechanisms of the language learning models of syntactic priming (Chang et al., 2006; Reitter et al., 2011). Finally, syntactic priming and the resultant learning seem unaffected by individual differences in attention and motivation. Further research is required to investigate the impact of language input modality and individual differences on such learning of other structures or in learners with lower levels of proficiency, for whom these factors may be more critical.

Chapter 5

Does attention to syntax facilitate second language learning via syntactic priming?

This study investigated the effect of individual differences in attention on second language (L2) learning via syntactic priming. We examined the primed production of English passives in 128 French L2 English and native (L1) English speakers and manipulated between-subjects whether participants needed to search for mistakes either in the syntax of the stimuli or in the pictures of the experiment. This allowed us to compare speakers' immediate and long-term priming (i.e., language learning) in a syntax-focused vs. in a picture-focused condition. We also assessed whether self-reported language learning motivation affected priming and learning across these conditions. The current results provide preliminary evidence that, across groups of speakers, participants in the syntax-focused condition experienced more immediate priming than those in the picture-focused condition. However, completing data collection is needed to confirm or refute these results, in order to understand how attention relates to L2 long-term priming, to assess whether these effects vary across speaker groups and, finally, to explore how L2 learning motivation influences priming and learning[13].

Preregistration: https://osf.io/qwexc

Material/data availability: https://osf.io/238ka/?view_only=6f16c15039bf4d1da8fa78b3ab6250e7

[13]I had originally planned to run this study between October 2019 and June 2020. Unfortunately, the Covid-19 pandemic interrupted testing around March 2020 and prevented me from recruiting the total number of participants. In this chapter, I thus include the theoretical reasoning behind the study, its predictions, its methodology, partial results and a preliminary discussion.

5.1 Introduction

Over more than a decade, an increasing number of studies have shown that second language (L2) syntactic priming, L2 speakers' increased likeliness to produce a syntactic structure after exposure to it (Bock, 1986; see Jackson, 2018 for a review of syntactic priming in L2 speakers), supports L2 learning (e.g., McDonough & Mackey, 2008; Trofimovich & McDonough, 2011). This phenomenon leads L2 speakers to more frequently and more accurately produce the structure(s) targeted in priming tasks both during and following the priming task (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008; McDonough & De Vleeschauwer, 2012). Furthermore, these effects occur in various contexts, including L2 classrooms environments (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013), and for various L2 syntactic structures which may or may not exist in the speakers' first language (L1) (e.g., Flett et al., 2013; Kim et al., 2019; Shin & Christianson, 2012). Syntactic priming tasks therefore appear to be a potentially useful L2 learning and teaching tool, but these findings also indicate that we can use syntactic priming to deepen our understanding of how speakers acquire syntactic knowledge in the L2.

In the psycholinguistic literature, researchers have defined syntactic priming as an *implicit* language learning mechanism (e.g., Chang et al., 2006, 2012; Dell & Chang, 2014; Jaeger & Snider, 2013; Malhotra et al., 2008; Reitter et al., 2011). There is evidence however in Second Language Acquisition (SLA) research that L2 learning is particularly sensitive to learners' variation in attention to linguistic input and language learning motivation (see for instance the reviews of Robinson et al., 2012 and Ushioda and Dörnyei, 2012). These are two factors which could make learners rely on *explicit* copying strategies in the context of a priming task to facilitate their learning. Therefore, it is unclear whether attention and motivation could also influence L2 learning via syntactic priming. Investigating whether this is the case has the potential to enhance our understanding of the psycholinguistic mechanisms underlying syntactic priming and to inform language learning and teaching practices. This would also contribute to the recurring debate in SLA concerned with examining the respective contribution of implicit and explicit

processes to L2 learning (Leow, 2019; Morgan-Short et al., 2012; Norris & Ortega, 2000).

To investigate these issues, in the present study, we manipulated between-subjects whether participants were instructed to be specifically attentive to the syntax of the sentences presented in the experiment or to the pictures associated with them, and measured participants' individual differences in language learning motivation. We tested whether the instruction to pay attention to syntax during the experiment would increase immediate and long-term priming effects, and whether the effect of motivation on learning would vary across the two priming contexts.

5.1.1 Psycholinguistic accounts of L2 learning via syntactic priming

Psycholinguistic models initially explained syntactic priming effects in terms of activation-based mechanisms (Pickering & Branigan, 1998; Pickering & Ferreira, 2008). In such frameworks, syntactic priming results from transient activation of the syntactic node associated with a target structure, which triggers immediate re-use of that structure. However, both L2 and L1 speakers experience not only immediate but also long-term priming effects: they can exhibit significant priming even when unrelated filler sentences are included between prime and target sentences or when comparing target structure production in post- vs. pre-tests without exposure to that structure (e.g., Bock & Griffin, 2000; Grüter et al., 2021; Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Chaikitmongkol, 2010; Shin & Christianson, 2012). While activation-based models do not contain a mechanism that could account for these persistent effects of priming, error-based implicit learning models (Chang et al., 2006, 2012; Dell & Chang, 2014; Jaeger & Snider, 2013) and hybrid models (Malhotra et al., 2008; Reitter et al., 2011) propose that syntactic priming supports language learning. According to Chang et al.'s (2006) model, during comprehension, speakers' language system generates predictions about upcoming words. In the case of a mismatch between a prediction and the actual language input, the resulting prediction error leads to adjustments in the mappings between message-level and syntactic representations of recently experienced sentences. These adjustments increase the availability of the corresponding syntactic structure (to express a similar message in the future) and are long-lasting, which triggers both

immediate and long-term syntactic priming effects. In Reitter et al.'s (2011) model, speakers' familiarity with a target structure determines the base-level activation of its corresponding syntactic representation. This base-level activation increases upon exposure to the structure and only decays slowly over time, which leads to both immediate and long-term priming as well (see Malhotra et al., 2008 for another hybrid account of syntactic priming).

Both error-based and hybrid language learning models thus predict that syntactic priming should foster L2 syntactic learning and, in turn, multiple studies provide support for this prediction. For instance, syntactic priming tasks make L2 speakers produce unfamiliar structures more frequently (Kaan & Chun, 2017; Kim & McDonough, 2008; McDonough & Fulga, 2015; Shin & Christianson, 2012), and increase their likeliness, after exposure to multiple well-formed instances of a target syntactic structure, to adopt that well-formed version of the structure while reducing their production of its interlanguage alternative (Kim et al., 2019; McDonough & Chaikitmongkol, 2010; McDonough & De Vleeschauwer, 2012; McDonough & Mackey, 2008). However, research also shows that there is wide individual variation in L2 immediate priming and the resulting learning effects. As an illustration, in Chapters 2 and 4, we observed that L2 speakers experienced between 0 and 100% immediate priming and between 0 and 100% long-term priming (see Figures 2.5 and 2.6 in Chapter 2 and Figures 4.2 and 4.3 in Chapter 4). The reasons for such individual differences in L2 syntactic priming remain largely unexplored (see for example McDonough & Kim, 2016; Muylle, 2020). Given previous SLA and L1 and L2 priming research, as well as the design of the language learning models of syntactic priming, variation in attention seems a plausible candidate to account for variation in priming and learning.

5.1.2 Attention in SLA and priming research

5.1.2.1 The effect of attention on L2 learning

How variation in attention affects L2 learning has been an important question in both psycholinguistics and applied linguistics research. Multiple psycholinguistic models assume that attention to linguistic input plays an important role in L2 processing and learning (Leow, 2019; Morgan-Short et al., 2012) and a critical issue for applied linguists has been to examine whether providing learners with instructions that direct

their attention to linguistic form during language processing helps them acquire the L2 grammar (e.g., Morgan-Short et al, 2012; Norris & Ortega, 2000).

Grammar learning can occur in implicit L2 input conditions (e.g., Brooks & Kempe, 2013; Rebuschat et al., 2015; but see Gass et al., 2003), but exposing L2 speakers to explicit instructions or using other enhancement techniques to make them more attentive to the stimuli or to their syntactic form, facilitates their learning of targeted grammatical structures (e.g., Indrarathne & Kormos, 2017; and see Benati, 2016; Goo et al., 2015; Robinson et al., 2012 for reviews). Such manipulations may ensure that L2 speakers perceive and register the grammar of the language input to be further processed (Corder, 1967; see also Doughty & Williams, 1998; Sharwood Smith, 1993), whereas empirical observations show that, when processing the L2 input, learners tend not to spontaneously attend to grammar (VanPatten, 2004). An additional way through which increased attention to linguistic input may foster L2 grammar learning is by promoting noticing of the target structure. Schmidt (1990; see Kerz et al., 2017 for a review), in particular, hypothesized that L2 learners needed to notice a target structure (i.e., consciously register it) to learn it, while also understanding it (i.e., knowing the grammatical rule that underlies its formation) facilitated learning further (but see Robinson, 1995; Tomlin & Villa, 1994). In line with this, Brooks and Kempe (2013) implicitly exposed English L1 speakers to Russian inflectional morphology and observed that the most successful learners were the ones who, at the end of the experiment, were able to describe the syntactic rules and structures presented in the stimuli. Hence, one could expect variation in attention to also determine how much L2 speakers learn from an L2 syntactic priming task.

5.1.2.2 Attention and syntactic priming

Whether attention could also influence L2 language learning via priming is largely unclear given that psycholinguistic models describe priming that leads to language learning as a primarily implicit process (e.g., Chang et al., 2006, 2012; Reitter et al., 2011; but see Ferreira & Bock, 2006). For example, if high attention levels allow L2 speakers to better remember prime sentences, the generated explicit memories could make speakers more likely to copy the structure of prime sentences in immediately following target sentences (see in particular Bernolet et al., (2016)'s multifactorial

account of priming). In that case however, the language learning models predict that enhanced attention should not increase L2 learning via priming, as these explicit memories are short-lived and should not influence their respective language learning mechanisms. However, the architectures of these models do not fully rule out the possibility that attention could influence priming processes that supports language learning. In error-based models (e.g., Chang et al., 2006), higher attention levels, if they foster deeper processing of the prime sentences (Branigan et al., 2007) could potentially foster the formation of predictions during exposure to the L2 input (cf. discussion of Grüter et al., 2021) or strengthen further the connections of the mappings between message- and syntax-representations. Since the magnitude of priming depends on prediction errors and on changes in these connections, being more attentive would then trigger larger abstract priming. In the hybrid accounts (Reitter et al., 2011), enhanced attention could make priming stronger by generating larger activation of syntactic representations (see Branigan et al., 2007; Ivanova et al., 2020 for similar reasoning about how attention could influence priming in these models). In both types of accounts, such increases in the magnitude of immediate priming should in turn result in larger long-term priming effects, given that syntactic priming is a language learning mechanism.

Work conducted with L1 speakers suggests that being more attentive to the experimental task overall can increase immediate priming magnitude (but see Chapters 3 and 4). For instance, L1 speakers' strength of priming is enhanced in conditions where they need to be particularly attentive to a task and its stimuli in order to complete it, such as when they are asked to reach a shared goal with a partner (Reitter & Moore, 2014). Likewise, they experience larger priming when they need to pay attention to a task to achieve successful communication with an interlocutor, such as in dialogues as opposed to monologues, (Schoot et al., 2019; but see Ivanova et al., 2020) or when prime sentences are directly addressed to them rather than when they hear them as side participants (Branigan et al., 2007). Ivanova et al. (2020) assessed the effect of individual differences in attention on priming perhaps more directly by measuring L1 speakers' reaction times on a picture verification task which they had to perform in parallel to a priming task. Their results revealed that the participants who exhibited the most priming were the ones with lower variability in reaction times on this additional task. The authors interpreted

reduced variability in reaction times as showing that the participants were highly attentive during the study.

Being more attentive to the syntax of the stimuli also seems to foster larger L1 immediate priming. Weatherholtz et al. (2014) indirectly observed that being less attentive to the syntactic form of sentences can decrease priming magnitude. In their experiment, they compared L1 speakers' priming when exposed to primes pronounced with a standard vs. non-standard accent and found reduced priming in the latter condition. The authors interpreted that, in that condition, participants had to allocate more attention to decoding the pronunciation of the speaker which potentially distracted them from the syntactic aspects of the task. Furthermore, Bock et al. (1992) examined L1 speakers' primed production of passive sentences in meaning-focused vs. form-focused conditions. Their participants performed a cover memory test during a priming task where they needed to indicate whether they had already seen previously the sentence presented to them on a given trial. In the meaning-focused condition, participants were instructed to consider that two sentences were equivalent as long as they had the same meaning and, crucially, even though they had differing syntactic structures. In the form-focused condition, by contrast, two sentences were considered the same only if they had the same meaning and the same syntactic structure. Though the participants experienced significant priming in both conditions, the magnitude of priming was larger in the form-focused condition. This corroborates that paying attention to syntax can foster larger abstract immediate priming.

As described earlier, SLA research suggests that L2 speakers should be particularly sensitive to variation in attention during syntactic priming tasks and that this, as a result, should also impact long-term L2 learning. Yet, fewer studies have investigated and discussed the effect of attention on L2 priming. McDonough and Fulga (2015) found that L2 speakers could only experience significant priming if they detected the form targeted in a syntactic priming task, whilst Shin and Christianson (2012) observed that explicit instructions about the target form fostered larger priming. These studies therefore provide preliminary evidence that being attentive to sentence form or noticing the target structure during a priming task can increase L2 immediate priming. By contrast, in Chapters 3-4, we found that individual differences in attention as measured by self-report questionnaires did not modulate immediate priming magnitude in L2 speakers. Concerning long-term

priming, the explicit instructions provided to participants in Shin and Christianson (2012)'s study increased immediate but not long-term priming in a delayed post-test. Likewise, in Chapters 3-4, individual differences in attention did not increase long-term priming either, neither in L2 nor in L1 speakers. Thus, research so far suggests that high attention levels do not lead to more learning via syntactic priming across groups of speakers, while the results regarding the effect of attention on L2 immediate priming are more mixed.

Importantly, in most of these studies discussing the potential role of attention in determining priming magnitude, participants' attention was rarely directly manipulated or measured (see Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015). That variation in attention could explain the studies' respective patterns of results was largely based on speculations. Moreover, in Chapters 3-4, we only measured attention with self-report questionnaires. Since the participants filled in these questionnaires at the end of the experiment, it is unclear whether the measurements always reflected variation in attention during the task or participants' memory for the structure or certain aspects of the task after it (but see McDonough & Fulga, 2015). This could explain why we never found that the variable attention to syntax related to priming in any condition or group of speakers, as opposed to previous research (e.g., Bock et al., 1992; Shin & Christianson, 2012). Less subjective measurements (e.g., Ivanova et al., 2020; Michel & Smith, 2018) or directly manipulating whether participants are asked to specifically pay attention to the syntax of the stimuli during a priming task may be a better way to assess the influence of such attention on priming and learning (e.g., Bock et al., 1992).

To sum up, based on past priming research, how attention relates to immediate and long-term L2 priming remains unclear, though SLA research designates this factor as an important modulator of L2 learning. At the moment, more systematic investigations that directly manipulate what participants pay attention to in a priming task, and which measure both immediate and long-term priming, are needed to more precisely examine the influence of individual differences in attention on priming and the resulting learning.

5.1.3 Motivation, L2 learning and priming

L2 learners come in various guise and may differ, for instance, in their motivation to learn the target language or to perform a learning task. SLA research studies have shown that such variation in motivation can affect L2 learning (Masgoret & Gardner, 2003; Ushioda, 2016; Ushioda & Dörnyei, 2012; but see Slevc & Miyake, 2006). For example, individual differences in intrinsic (i.e., the inherent desire to learn a language) and extrinsic (or externally regulated) motivation (i.e., the desire to learn a language to obtain a reward or avoid a punishment, Deci & Ryan, 1985), motivational intensity (i.e., how much one engages in language learning activities, Gardner & Lambert, 1972), and task motivation or attitude towards the task (i.e., task enjoyment and reported efforts, Eccles, 1993; Boekaert, 2002) have all been found to influence L2 learning and achievement (Cheng et al., 2014; Cocca & Cocca, 2019; Dörnyei, 2002; Dörnyei & Kormos, 2000; Gardner, 1985; Kang, 2001; Kormos & Dörnyei**,** 2004; Noels et al., 2001; Wen, 1997). Thus, these aspects of motivation could similarly influence L2 learning via syntactic priming.

Another way in which language learning motivation could relate to L2 learning is by affecting learners' level of attention (Miller & Unsworth, 2021) or what they notice or pay attention to in a task (Schmidt, 2001; Ushioda, 2016). How much learners think the task helps them work towards their language learning goals could determine their likeliness to pay attention to the task (Wigfield & Eccles, 2000). Furthermore, enhanced levels of intrinsic motivation, for instance, foster noticing of the target linguistic features (Takahashi, 2005). In the context of a syntactic priming task, L2 speakers who think that the task will help them progress in the target language or who wish to acquire L2 syntactic knowledge may also be particularly attentive to the task and the syntax of its stimuli. A final possibility is that when highly motivated to learn the target language, L2 speakers could take the decision to re-use the syntax of their interlocutor in order to practice the language (Costa et al., 2008). Based on these arguments, higher levels of motivation are likely to foster larger immediate priming. However, as discussed above for attention, it is unclear whether they would also increase long-term priming and learning, in particular if they make L2 learners rely on explicit strategies or explicit decisions to re-use the structure or not (Costa et al., 2008).

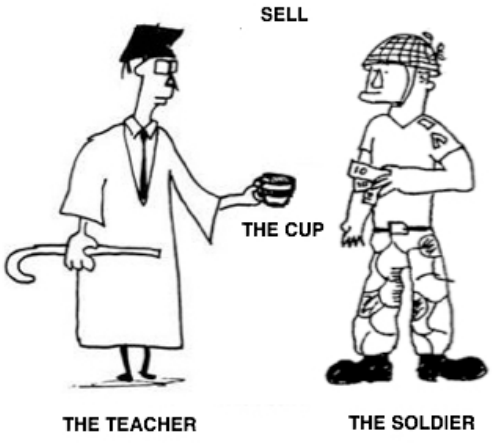
Only two studies to our knowledge have directly assessed the effect of self-reported motivation on L2 immediate and long-term priming. Both Chapters 3 and 4 demonstrated that higher motivation did not lead to larger priming and learning of passives and fronted sentences. The absence of an effect of motivation in Chapter 3, the most relevant chapter to the present study given their respective experimental designs (i.e., both were conducted in oral interactive tasks while the study of Chapter 4 was run in an online non-interactive context) could reflect that the participants of that study were all students studying French voluntarily. They were therefore highly motivated to learn the language and to take part in the priming task. Testing participants who are more likely to vary in their motivational profiles (e.g., students who are not majoring in the target language) might be a more suitable way to assess the effect of motivation on priming. Furthermore, the influence of motivation on priming and learning may vary between settings that differ with respect to whether they bias learners to pay attention to the syntax of the stimuli or not. If motivation determines how learners attend to and process syntax in a syntactic priming task, then high motivation levels may facilitate syntactic learning to a larger extent under conditions where learners are not instructed to focus on syntax, and where processing this aspect of prime sentences is, as a result, potentially more difficult.

To sum up, SLA research predicts that individual differences in motivation could affect L2 learning, but further investigation is necessary to understand how motivation relates to L2 immediate and long-term priming, and whether the observed effects differ across learning contexts.

5.1.4 Present study

The present study investigated how manipulating attention to different aspects of the task influences L2 learning via syntactic priming and whether this would be modulated by L2 speakers' individual differences in language learning motivation. We targeted the transitive alternation (active vs. passive sentences) and manipulated L2 speakers' attention during a syntactic priming task by asking them to search for mistakes either in the prime sentences they heard (i.e., grammatical errors, syntax-focused condition) or in the pictures they saw (picture-focused condition) (Figure 5.1). This allowed us to compare syntactic priming when participants were specifically biased towards paying attention to the syntax of the prime sentences

versus when they were distracted by having to examine the pictures instead (see Bock et al., (1992) for a similar design). We also measured participants' attention levels and noticing of the target structure with a post-test self-report questionnaire, in order to further explore the effect of our manipulation. L2 speakers' individual differences in motivation were measured with a self-report questionnaire.



Mistake in the picture-focused condition: The teacher sells the **cake** to the soldier.
Mistake in the syntax-focused condition: The teacher **selled** the cup to the soldier.

Figure 5.1 Example of picture-focused vs. syntax-focused mistakes.

We tested both L2 and L1 speakers in order to assess whether L2 learners would benefit from increased attention to the same extent as L1 speakers do, or whether they would particularly benefit from increased attention to grammar in a syntactic priming task. We expected that, in both speaker groups, participants would show more priming in the syntax-focused than in the picture-focused condition (Bock et al., 1992). However, we expected the difference between conditions to be larger in the L2 speakers than in the L1 speakers, based on SLA research indicating that L2 processing and learning is particularly affected by variation in attention to linguistic input (e.g., Leow, 2019; Morgan-Short et al., 2012; Norris & Ortega, 2000). Whether this difference in priming magnitude across conditions would also be reflected in long-term priming was unclear: SLA research shows that being attentive to syntax can facilitate L2 learning but psycholinguistic models define language learning via syntactic priming as an implicit process (Chang et al., 2006, 2012; Reitter et al., 2011; see also Chapters 3-4). If being attentive to syntax

increases priming by helping participants remember prime sentences (explicitly) better, then it should not lead to larger long-term priming than the picture-focused condition. In contrast, if enhanced attention fostered language learning via syntactic priming, participants were expected to manifest larger long-term priming effects in the syntax-focused than in the picture-focused condition. Similarly, in the L2 speakers, whether high motivation levels would increase immediate or long-term priming was also unclear given that, as for attention, motivation does modulate L2 learning (Ushioda & Dörnyei, 2012) but past priming research has provided no supporting evidence (Chapter 3 and 4). Overall, we predicted that motivation would be less likely to affect priming and learning in the syntax-focused condition than in the picture-focused condition, where processing the syntax of prime sentences might have been more difficult.

Participants took part in a picture description task conducted in English and were either L2 English speakers who were French L1 speakers or English L1 speakers. We targeted priming of the passive transitive structure (2). French and English have similar active (1) and passive (2a) transitive constructions but there also exists a passive form that contains a reflexive pronoun (2b) in French. Given that this additional form has no English equivalent, we did not expect it to affect priming in the present study which targeted English.

1. The pirate is following the sailor.
   Le pirate suit le marin.
2. The sailor is being followed by the pirate.
   a. Le marin est suivi par le pirate
   b. Le marin se fait suivre par le pirate.
      The sailor him-REFL.3SG make-PRS.3SG follow-INF by the pirate.

The task comprised a pre-test, an immediate priming phase and an immediate post-test. In the pre-test, participants described pictures without being exposed to syntactic primes – this baseline phase measured each group's ability to use active vs. passive sentences. In the immediate priming phase, participants described target pictures immediately after listening to prime picture descriptions. This phase was designed to assess immediate priming effects. In the immediate post-test, participants once again described pictures without being exposed to primes. The self-

report questionnaires for attention (both L2 and L1 speakers) and motivation (L2 speakers only) were filled in at the end of the experiment as well as the LexTALE test (http://www.LexTALE.com/takethetest.html) which was used to assess L2 speakers' proficiency.

5.2 Methodology

5.2.1 Participants

While we were planning to recruit 160 participants (i.e., 40 per condition), testing was interrupted early due to the pandemic and only 73 native speakers of English (L1 speakers) and 68 French native speakers, speaking English as a second language (L2 speakers) performed this experiment. Participants completed a language background questionnaire (adapted from the LEAP-Q questionnaire; Marian et al., 2007) to establish their status as native speakers of French or English and learners of English. They were all university students and, importantly, the L2 speakers were not majoring in English (vs. Chapter 3) though they were studying in English. Participants all received money as compensation for their participation. To promote participants' engagement in the mistake searching task, they were additionally entered into a prize draw to win £25. They were instructed that the top 10% scorers for spotting mistakes would be selected for the prize draw. The study was approved by the Humanities and Social Sciences Research Ethics Committee at the University of Warwick. Informed consent was obtained prior to the test session.

We excluded from the analysis seven participants who reported being L1 speakers of both languages or who were not English L1 speakers in the group of L1 speakers or not French L1 speakers in the group of L2 speakers; four participants whose testing could not be performed adequately due to software issues or experimenter error; and two participants who exhibited a high number of false alarms, i.e., reporting mistakes when there weren't any (two L2 speakers showed 23 and 26 false alarms). As a result, the analyses included 63 L2 speakers (53 female); 32 in the syntax-focused condition and 31 in the picture-focused condition, and 65 L1 speakers (49 female); 27 in the syntax-focused condition and 38 L1 speakers in the picture-focused condition. Participants were aged 16 to 34 years old (M=20.60, SD=2.50).

5.2.2 Design

We used a 2 x 2 x 2 design with two between-participants variables Focus (syntax-focused vs. picture-focused condition) and Group (L2 vs. L1 speakers), and one within-participant variable which was either Prime (active vs. passive) for immediate priming or Section (pre-test vs. post-test) for long-term priming.

5.2.3 Materials

5.2.3.1 Prime/ target pictures

We created 48 target items using six verbs (chase, follow, punch, scold, kiss, slap), eight times each with different combinations of animate agent and patient characters. Items were based on stimuli from Chapters 2 (Experiment 2a) and 4. Each target verb appeared once in the pre-test (6 items), four times in the priming phase (36 items) and once in the post-test (6 items).

For the priming phase, we paired each target verb with one of six prime verbs (kick, push, touch, shoot, pull, tickle), each of which were used six times with different combinations of characters to create 36 prime pictures. Prime pictures had an associated active and passive description (Figure 5.2).

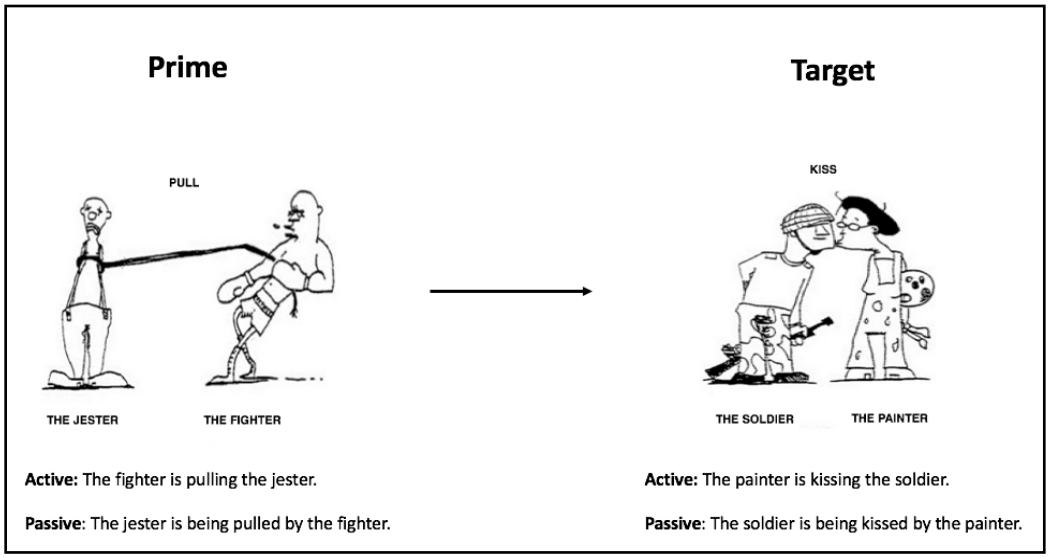


Figure 5.2 Example of prime-target trial.

In the priming phase, prime-target pairs were separated by two filler pictures (a prime and a target filler pictures, resulting in the sequence prime-target-filler-filler) and in the pre- and post-tests target pictures were separated by three filler

pictures (resulting in the sequence filler-filler-filler-target). We created 108 filler pictures in total using intransitive verbs (depicted with two characters, such as "the monks are crying") and ditransitive verbs (depicted with two characters and an object, such as "the monk is selling the artist a cup"). 48 appeared in the target set (6 in the pre-test, 36 in the priming phase and 6 in the post-test) and 60 appeared in the prime set (12 in the pre-test, 36 in the priming phase and 12 in the post-test).

In total, there were 96 pictures (48 targets and 48 fillers) in the participant's description set and 96 pictures (36 primes and 60 fillers) in the experimenter's description set. The pictures included word labels (articles, nouns and verbs) to prevent problems of vocabulary retrieval. The position of the agent characters was counterbalanced to appear an equal number of times on the right vs. left side of the picture.

16 filler primes in the experimenter's set were associated with either a picture mistake or a syntactic mistake: 3 in the pre-test, 10 in the priming phase and 3 in the post-test[14]. We created four lists of stimuli, two for the syntax-focused condition and two for the picture-focused condition so that one version of each experimental prime item (active or passive) would appear in each list. Participants were randomly assigned to one of the four lists.

5.2.3.2 Attention questionnaire

This questionnaire was implemented in Qualtrics (https://www.qualtrics.com) and assessed attention to syntax, attention to meaning, attention to task and noticing of the target structures (cf. Chapters 3-4). First, participants were asked to provide a rating on a scale from 1 (minimum score) to 7 (maximum score) of the extent to which they paid attention to and were interested in 1) what the experimenter was saying, 2) the picture description task in general, 3) the meaning, 4) the vocabulary, 5) the pronunciation, 6) the syntactic structures of the sentences they heard and produced.

Second, participants were asked to answer three questions designed to measure their capacity to describe the syntactic rules and structures present in the stimuli (Brooks & Kempe, 2013; McDonough & Fulga, 2015; Chapters 3 and 4): (1)

[14]Overall, the participants were exposed to between 12 and 16 mistakes because some syntactic mistakes were misproduced/mispronounced by the experimenters (see OSF for detailed statistics).

"explain, in your impression, what was the experiment about?", (2) "did you notice any grammatical rules of English underlying the sentences you heard in the picture description task?", and (3) "can you name and/or describe what the rules were that were illustrated by the sentences you saw during the picture description task?". Participants' responses to these questions were scored so as to distinguish noticing from noticing and understanding (Schmidt, 1990; see scoring section for more details).

5.2.3.3 Motivation questionnaire

The present questionnaire was an adaptation of the motivation questionnaire of Chapter 4. Participants read statements and rated how strongly they agreed with them on a scale of 1 (strongly disagree) to 7 (strongly agree) in a Qualtrics-based survey. The questionnaire items assessed externally regulated motivation (7 items), intrinsic motivation (6 items), task motivation (6 items), motivational intensity (5 items), participant's metacognition about the task and the language (5 items) and participant's interest in improving their grammatical knowledge of English (4 items, grammar learning goal) (see the OSF for a complete list). The presentation of items was randomized across categories and participants.

5.2.3.4 Proficiency assessment

Participants' English proficiency was assessed with the English LexTALE test (Lemhöfer & Broersma, 2012) and with a self-report proficiency questionnaire as a control measure. Results on such questionnaires have been found to correlate with direct measures of proficiency (Lemhöfer & Broersma, 2012; Favier et al., 2019). Participants rated their speaking, understanding, writing, reading and overall proficiency on a scale from 0 (minimum score) to 10 (maximum score) in a survey programmed with Qualtrics.

5.2.4 Procedure

We used a comprehension-to-production priming task and participants performed a picture description and mistake searching task with one of the experimenters (Branigan et al., 2000). The participant and the experimenter sat at opposite ends of a

table each with a laptop in front of them. The participant and the experimenter could not see each other's screen.

Participants were first invited to fill in the self-reported proficiency questionnaire on the laptop in Qualtrics. Before starting the syntactic priming experiment, participants were told that they would take turns with the experimenter to describe a picture to their partner and search for mistakes in the partner's description. Depending on the condition they were assigned to, participants were instructed to either search for mistakes in the pictures they would see or in the sentences they would hear. On each trial, after hearing the experimenter's description, participants were instructed to say either "yes, mistake" if they had identified a mistake and "no mistake" if they thought there was no mistake in the stimulus. In the picture-focused condition, the experimenter also pretended to be searching for mistakes in the pictures the participants were describing. This was not the case in the syntax-focused condition as it would have been unlikely for speakers, especially L1 speakers, to make mistakes in the sentences they were producing. However, given that the mistakes were included in the fillers, this difference between the two conditions is unlikely to have affected the priming and the focus manipulations. The participant and the experimenter first performed a few practice trials before proceeding to the actual task. The experiment always started with the experimenter, whose sentences were scripted, providing the first prime. The task was audio-recorded with a Zoom H1 recorder. Participants then completed the attention questionnaire and finished with the LexTALE test (L2 speakers only).

5.2.5 Scoring

5.2.5.1 Target sentences

The analysis included complete active sentences containing a subject noun phrase with the agent produced first, followed by the verb and finally, an object noun phrase with the patient, and complete passive sentences containing a subject noun phrase with a patient in first position, followed by a form of the verb "to be", a past participle and finally, a by-phrase (headed by 'by') with an agent. We ignored morphological errors, such as tense or agreement errors and naming errors in which participants used an alternative noun for a character (e.g., naming a character "the judge" instead of "the teacher"). We included sentences in which one of the noun

phrases was replaced by a pronoun or sentences in which two pronouns of distinct genders were produced, sentences with complex noun phrases (e.g., "the teacher kicked the clown's leg") and sentences with an added auxiliary (e.g., "the waitress does kick the jester") and a negation (e.g., "the fighter does not chase the robber"). All remaining responses, including reversed passives and actives and responses that were not an active or passive, were coded as 'other' and excluded from the analyses (Table 5.1).

Table 5.1 Overview of response frequencies. Frequency of target responses by group, Focus condition and experiment phase.

			Response		
Group	**Condition**	**Phase (prime)**	**Active**	**Passive**	**Other**
L2	Syntax-focused	Pre-test[15]	167	0	19
		Priming (active)	485	53	38
		Priming (passive)	430	100	46
		Post-test	166	14	6
	Picture-focused	Pre-test	149	0	37
		Priming (active)	460	52	46
		Priming (passive)	444	66	48
		Post-test	163	14	9
L1	Syntax-focused	Pre-test	147	1	14
		Priming (active)	444	13	28
		Priming (passive)	397	42	48
		Post-test	142	10	10
	Picture-focused	Pre-test	206	1	21
		Priming (active)	611	18	54
		Priming (passive)	582	43	60
		Post-test	207	7	14

5.2.5.2 Attention questionnaire

We used the questionnaire to compute two attention scores for each participant. We used participants' rating for question 6 to assess their attention to syntax and for

[15]One L2 speaker was removed from the analysis of long-term priming as they only produced "other" responses in the post-test.

question 3 to assess their attention to meaning specifically (Bock et al., 1992). L2 English speakers showed mean scores of 5.30 (range 1-7) and 4.83 (range 1-7), and L1 speakers showed mean scores of 5.18 (range 1-7) and 4.23 (range 1-7), for attention to syntax and attention to meaning respectively. We computed the average of participants' ratings for questions 1 and 2 to assess their overall attention to task. L2 English speakers showed a mean score of 5.79 (range 2.5-7) and L1 speakers showed mean scores of 5.75 (range 2-7; Table 5.2).

We assessed whether participants had noticed the target structure during the priming task. Participants' responses received a score of 2 (henceforth "Noticing 2") if they had noticed and understood the alternations (Schmidt, 1990), i.e. they were able to name, describe or give examples of the passive/active sentences. They received a score of 1, which corresponded to noticing only (Schmidt, 1990) (henceforth "Noticing 1") if they mentioned some aspect of the passive, for example, the use of past participles or past tense, or "indirect vs. direct form" to describe the actions or that who was doing what to whom mattered. They received a score of 0 if they did not refer to the passive/active alternation or its features in any way. 50.8% of L2 English speakers scored 2, 12.7% scored 1 and 36.5% scored 0, whereas 32.3% of L1 English speakers scored 2, 18.5% scored 1 and 49.2% scored 0 (Table 5.3).

5.2.5.3 Motivation questionnaire

Although we had originally planned to run a Principal Component Analysis to reduce the number of motivation dimensions and prevent the risk of running into intercorrelations issues (as in Chapters 3-4), we could not do so due to an insufficient number of participants. Hence, we only report descriptive statistics for each of the motivation categories.

We computed participants' average ratings across items for each motivation category (Table 5.2). The students showed a mean score of 4.87 for externally regulated motivation (range 2.57-6.57, Cronbach alpha=.86), 5.81 for intrinsic motivation (range 2.83-7, Cronbach alpha=.69), 5.73 for motivational intensity (range 3.6-7, Cronbach alpha=.71), 4.75 for task motivation (range 2.67-6.33, Cronbach alpha=.67), 4.15 for how useful they thought the task was to reach their

language learning goals (range 1.8-5.8, Cronbach alpha=.81), and 6.06 for their motivation to learn English grammar (range 4-7, Cronbach alpha=.17).

5.2.5.4 Proficiency

We calculated the average of the five proficiency scores participants reported on the self-report scales for speaking, understanding, writing, reading and overall proficiency (as in Bernolet et al., 2013). Overall, L2 speakers had an average self-reported proficiency rating of 8 (range 5.2-10). On the LexTALE test, they scored an average of 81.81 (range 60-100) (Table 5.2)[16].

5.2.5.5 Mistake searching task

To ensure that participants performed the mistake searching task as instructed, we explored how many mistakes they correctly spotted across conditions. We first checked whether the experimenters had produced the mistakes correctly and removed from the analysis any trials where they had not. L2 speakers correctly identified 83% (range 30-100%) of the mistakes on average across conditions, while L1 speakers correctly identified 91% (range 67-100%) of the mistakes on average across conditions. Hence, overall participants performed well above chance level (i.e., 50% accuracy; Table 5.2).

[16]The participants' self-report proficiency and LexTALE scores were significantly correlated ($r(56)=.50$, $p<.001$). We ran an additional model with the LexTALE scores only to examine whether participants' LexTALE scores related to immediate priming. There was no significant difference between the best model and the model without the LexTALE score ($p=.22$), therefore we concluded that proficiency did not relate to immediate priming in L2 speakers.

Table 5.2 Individual differences descriptive statistics. Mean scores (SD) and ranges (in italics) for each measure by group and condition.

Measure		L2		L1	
		Syntax-focused	**Picture-focused**	**Syntax-focused**	**Picture-focused**
Attention	Syntax	5.53 (1.37) *1-7*	5.06 (1.52) *1-7*	5.44 (1.34) *2-7*	5 (1.49) *1-7*
	Task and stimuli	5.59 (0.92) *2.5-7*	5.98 (0.84) *4-7*	5.48 (1.17) *2-7*	5.95 (0.81) *3-7*
	Meaning	4.91 (1.61) *2-7*	4.74 (1.57) *1-7*	4.33 (1.33) *2-7*	4.16 (1.83) *1-7*
Motivation	Externally regulated motivation	4.97 (0.96) *2.71-6.57*	4.76 (1.13) *2.57-6.29*	-	-
	Intrinsic motivation	5.95 (0.73) *3.5-6.83*	5.67 (0.92) *2.83-7*	-	-
	Grammar learning goal	6.18 (0.53) *5-7*	5.94 (0.70) *4-7*	-	-
	Motivational intensity	5.78 (0.75) *4-7*	5.69 (0.72) *3.6-7*	-	-
	Task motivation	4.77 (0.82) *3-5.83*	4.74 (0.88) *2.67-6.33*	-	-
	Metacognition	4.31 (0.87) *2.2-5.8*	3.99 (1.11) *1.8-5.8*	-	-
Proficiency	Self-report	8.16 (0.72) *6.2-9.4*	7.84 (1.12) *5.2-10*	-	-
	LexTALE results	81.71 (9.24) *60-97.5*	81.90 (10.28) *60-100*	-	-
Proportion of correctly identified mistakes		0.81 (0.18) *0.30-1*	0.85 (0.11) *0.56-1*	0.89 (0.09) *0.69-1*	0.92 (0.09) *0.67-1*

7 was the maximum score for the attention scales; 10 for the self-report proficiency scale.

Table 5.3 Noticing statistics. Raw number (percentage) of participants scoring 0, 1 and 2 per group and condition

Measure		L2		L1	
		Syntax-focused	**Picture-focused**	**Syntax-focused**	**Picture-focused**
Noticing	0	16 (50%)	7 (22.6%)	12 (44.4%)	20 (52.6%)
	1	1 (3.1%)	7 (22.6%)	8 (29.6%)	4 (10.5%)
	2	15 (46.8%)	17 (54.8%)	7 (25.9%)	14 (36.8%)

5.3 Analysis and results

We first examined the effect of Focus on immediate and long-term syntactic priming in L2 vs. L1 speakers. We had then planned to explore the effect of individual differences in motivation on L2 priming across focus conditions (see preregistration on the OSF) but could not do so given that we were unable to run the PCA analysis for motivation. Instead, we report exploratory analyses examining how participants' self-reported levels of attention to syntax, attention to meaning, attention to task and noticing of the target structure varied across Focus conditions, which we performed to explore the effect of the Focus manipulation on participants' attention.

We analysed the effect of priming on passive responses. Since our dependent variable was binary, we analysed the data with Generalized Logistic Mixed Models (GLMM) (Baayen et al., 2008; Jaeger, 2008). We used the lme4 package (Version 1.1.21; Bates et al., 2014) for the analyses of immediate priming and the blme package (Version 1.0.4) for the analyses of long-term priming (given that most participants did not produce passives in the pre-test, zero cells would have prevented the models to converge with lme4). The dependent variable was coded as 0=active, 1=passive. The factorial predictors Prime (active vs. passive), Section (pre-test vs. post-test), Focus (picture-focused vs. syntax-focused condition), and Group (L1 vs. L2 speakers) were sum contrast coded to have a mean of 0 and a range of 1 prior to analysis.

5.3.1 Priming across groups and focus conditions

All analyses started with a full model that included main effects and interactions and the maximal by-subject and by-item random effects structure justified by our

experimental design (Barr et al., 2013). All models included random intercepts for participants and items and by-subject random slopes for within-participant factors (Prime or Section) and by-item random slopes for within-item factors (Prime, Group, Focus) and their interactions. Then, we performed a stepwise "best-path" reduction procedure, removing interactions before main effects, to locate the simplest (best) model that did not differ significantly from the full (converging) model in terms of variance explained but did differ significantly from a null model with only the intercept term as a predictor. We report the results of the best models. All p-values for individual predictors were obtained from the model summary output.

5.3.1.1 Immediate priming

We investigated the effect of Focus on immediate priming across groups by building a full model with Prime, Focus, Group and their three-way interaction as fixed effects. The best model indicated a significant effect of Prime, whereby participants produced more passives after passive primes (*M*=0.12, *SD*=0.32) than after active primes (*M*=0.06, *SD*=0.24), with an overall priming effect of 6% (Cohen's *d*=0.37, *SE=0.02*; Figure 5.3; Table 5.4). There was a significant effect of Group, whereby L2 speakers produced more passives (*M*=0.13, *SD*=0.34) than L1 speakers (*M*=0.05, *SD*=0.23). There was a marginally significant interaction between Prime and Focus (*p*=.057): participants experienced 8% priming in the syntax-focused condition whereas they experienced 3.4% priming in the picture-focused condition. To further assess the significance of this interaction, we used the Bayesian information criterion (BIC) values to estimate the Bayes Factor as $e^{(\text{AlternativeBIC} - \text{NullBIC}) / 2}$ and quantify the likelihood of null effects. We compared a model with only the main effects of the factors of Prime, Focus and Group (Null model) to a model that contained the two-way interaction between Prime and Focus and the main effect of Group (Alternative model; Wagenmakers, 2007). The inverse BF (=.06) provided 'positive' evidence in favour of the null hypothesis, i.e. of the absence of a significant interaction between Prime and Focus (Jarosz & Wiley, 2014; Raftery, 1995). The interaction between Prime, Group and Focus was not significant. The inverse BF resulting from the comparison between a model with only the two-way interactions between the factors (Null model) to a model that contained the three-way interaction between them (Alternative model) was inferior to 1 (=.00) and provided 'very strong' evidence in

favour of the null hypothesis (Jarosz & Wiley, 2014; Raftery, 1995). Thus, Focus did not affect immediate priming magnitude in either group of speakers.

Table 5.4 Immediate priming model. Summary of the best model[a] for immediate priming of passive sentences across groups and Focus conditions.

Fixed effects	**Estimate**	**Standard Error**	**Z-value**	***p*-value**
Intercept	-3.56	.22	-16.11	**<.001**
Prime	1.27	.34	3.71	**<.001**
Group	1.38	.35	3.96	**<.001**
Focus	.21	.35	.62	.54
Prime x Group	-.73	.48	-1.53	.13
Prime x Focus	.90	.47	1.90	.06
Group x Focus	.25	.69	.37	.72
Prime x Group x Focus	-.38	.94	-.40	.69

[a]included by-subject random slopes for Prime only.

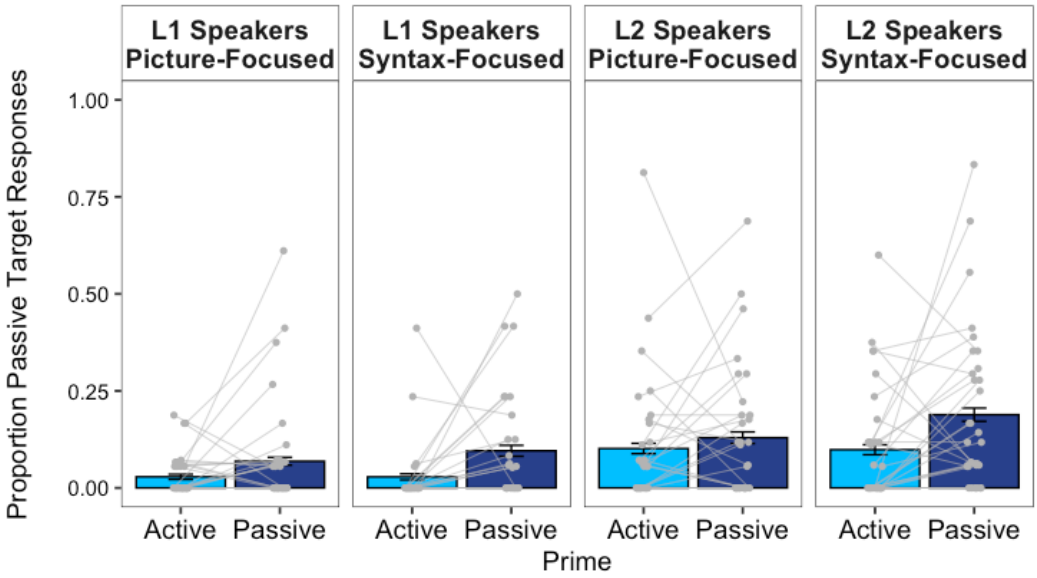


Figure 5.3 Passive responses in the immediate priming phase. Mean proportion of passive responses by Prime, Group and Focus. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

5.3.1.2 Long-term priming

We analysed the effect of Focus on long-term priming across groups by building a full model with Section, Focus, Group and their three-way interaction as fixed effects. The results showed no significant long-term priming as the null model was a significantly better fit than the full model (p=.01; Figure 5.4)[17].

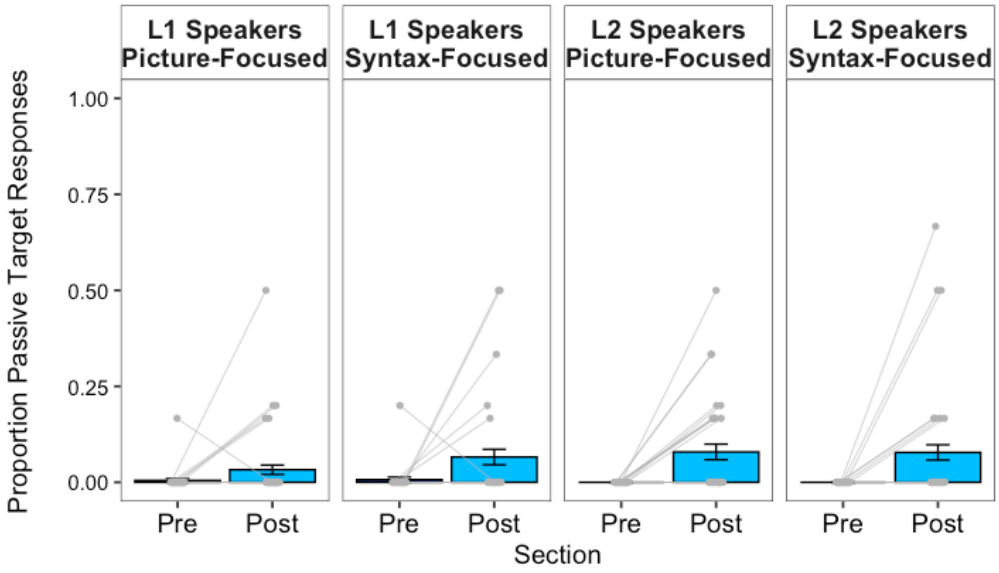


Figure 5.4 Passive responses in the pre- and post-tests. Mean proportion of passive responses by Section, Group and Focus. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

5.3.2 Exploratory analyses

We examined whether attention to syntax, attention to meaning, attention to task and noticing of the target structure differed across Focus conditions. Since Shapiro tests revealed that the attention scores were not normally distributed, we performed these analyses with a series of unpaired two-samples Wilcoxon tests. We used a Chi square test to examine variation in noticing across Focus conditions.

5.3.2.1 Attention across focus conditions

Participants across groups were significantly more attentive to syntax and to meaning in the syntax-focused (syntax: M=5.49, SD=1.36; meaning: M=4.64,

[17]An analysis ran with reversed actives and reversed passives included in the datasets revealed the same pattern of results for both immediate and long-term priming.

SD=1.52) than in the picture-focused condition (syntax: *M*=5.03, *SD*=1.50, *p*<.001; meaning: *M*=4.42, *SD*=1.74, *p*<.001). In contrast, they were significantly more attentive to the task in the picture-focused (*M*=5.96, *SD*=0.83) than in the syntax-focused condition (*M*=5.54, *SD*=1.04, *p*<.001). This suggests that our manipulation was effective. Finally, there was no significant relationship between Focus condition and noticing (*p*=.62), suggesting that whether participants noticed the target structure was unaffected by Focus condition.

5.4 Discussion

The present (incomplete) study examined how variation in attention influences L2 learning via syntactic priming. We manipulated between-subjects whether we asked participants to pay attention to the pictures (picture-focused condition) or to the syntax of the sentences (syntax-focused condition) they were exposed to during the priming task by means of a mistake searching task. We also tested whether the manipulation would affect L2 speakers more than L1 speakers. The results showed significant immediate priming effects across groups, though L2 speakers produced more passives than L1 speakers overall. However, the attention manipulation did not affect the magnitude of priming in either group, contrary to our predictions, and neither L2 nor L1 speakers experienced significant long-term priming.

5.4.1 Overall priming results

The L2 and the L1 speakers of the present study exhibited significant immediate priming for passives as in previous research (e.g., Flett, 2006). That the L2 speakers produced the target structure more than L1 speakers overall is somewhat in line with previous studies reporting between-group differences (Jackson & Hopp, 2020; Flett, 2006, experiments 1 and 2 and the results for long-term priming effects in Chapters 2 and 4) and provides indirect support for the predictions of both types of language learning models of syntactic priming. Chang et al.'s (2006) account predicts that priming strength should increase with the size of prediction errors experienced by speakers during prime processing. This makes L2 speakers likely to exhibit larger priming than L1 speakers due to their lower level of experience with the target language. Likewise, given this inexperience, L2 speakers' syntactic representations should have lower-base level activation than L1 speakers'. In Reitter et al.'s model

(2011; see also Malhotra et al., 2008), this should result in larger adjustments in activation levels in L2 than in L1 speakers upon exposure to the target structure, which should make priming larger in the former than in the latter group. Though the magnitude of priming itself did not differ across groups in this study, our results do suggest that the L2 speakers were overall more impacted than L1 speakers by the priming manipulation.

It is particularly surprising that the participants in the present study did not experience significant long-term priming effects. This finding strongly contradicts the predictions of the language learning models (e.g., Chang et al., 2006; Malhotra et al., 2008; Reitter et al., 2011) as well as a large amount of literature reporting significant long-term effects across speaker groups and with a wide variety of structures and language combinations (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Chaikitmongkol, 2010; Messenger, 2021; Chapters 3 and 4). Since Chapter 4 recruited a similar population of participants (French L2 English speakers and English L1 speakers) and used similar experimental items, the absence of long-term effects should not be related to these factors. Rather, it could be that drawing attention to the immediate context with our attention manipulation triggered more explicit, short-lived priming effects overall. This interpretation is highly speculative and data collection must be completed for us to confirm or refute this result first.

5.4.2 The effect of attention

As in previous priming research, we predicted that participants would show more immediate priming in the syntax-focused than in the picture-focused condition (Bock et al., 1992). We also expected the difference between conditions to be larger in L2 than in L1 speakers, based on SLA research demonstrating that L2 processing and learning is particularly sensitive to variation in attention to linguistic input (e.g., Leow, 2019; Morgan-Short et al., 2012; Norris & Ortega, 2000). However, it was unclear whether these differences between attention conditions would also surface in long-term priming, given that the models of Chang et al. (2006) and Reitter et al. (2011) define language learning via syntactic priming as being implicit.

The present data provide preliminary support for the expected priming differences between attention conditions: we observed a marginally significant

interaction between priming conditions and focus manipulations reflecting that, at least numerically, participants experienced larger immediate priming in the syntax-focused (8%) than in the picture-focused condition (3.4%). At the moment, there is however no evidence for the expected between-group difference for the attention manipulation, nor for an effect of the attention condition on long-term priming. Evidently, the analysis in its current state may be lacking statistical power and completing data collection is required, as explained above, to either confirm or disconfirm this pattern of results. If confirmed, these findings would indicate that paying attention to the syntax of the stimuli in particular rather than to other aspects of the task increases priming in L2 as in L1 speakers, in line with previous research (e.g., Bock et al., 1992; Shin & Christianson, 2012). To determine whether being attentive to syntax led to increased priming because participants in that condition better (explicitly) remembered the prime sentences or because it increased language learning via syntactic priming, we will need to examine the relationship between attention condition and long-term priming at the end of data collection. In the former case, we would expect long-term priming not to differ between conditions, while in the latter case, participants should experience larger learning effects in the syntax-focused than in the picture-focused condition.

Comparing the results of the self-report questionnaires across focus conditions allows us to explore the effect of our experimental manipulation on participants' attention. Self-reported attention to syntax and to meaning of sentences appeared significantly higher in the syntax-focused than in the picture-focused condition. This confirms that the mistake searching manipulation was efficient to bias participants to be more attentive to syntax in the former than in the latter condition. They also reveal that, in the picture-focused condition, participants were overall less attentive to the sentences, both in terms of syntax and in terms of meaning. However, noticing of the target structure did not significantly vary across attention conditions. Though surprising at first glance, since it was filled in at the end of the experiment, the noticing questionnaire may have prompted the participants to remember the structures they had been exposed to during the priming task a posteriori so that the survey assessed memory rather than noticing. However, McDonough & Fulga's study (2015) suggests that using such questionnaires to assess noticing is as accurate as computing d prime, a sensitivity index inspired from Signal Detection Theory (Macmillan & Creelman, 2005) that reflects participants'

detection of a target structure. Alternatively, this finding may suggest that participants were paying attention to another aspect of grammar rather than to the passive/active alternation itself. This could be because the grammar mistakes we introduced targeted conjugation (e.g., “the soldiers is smiling”) or morphosyntax (e.g., “the swimmers falled”), rather than the passive and active forms themselves, or because the mistakes were included in the fillers rather than in the experimental sentences. The absence of noticing differences across attention conditions also indicates that simply asking participants to focus on the syntax of sentences does not necessarily make them notice the target structure. From a pedagogical perspective, this suggests that L2 teachers wanting to attract learners’ attention to a specific form may need to provide them with specific instructions regarding that structure, while general instructions to be attentive to grammar are not sufficient.

5.5 Conclusion

The study at this stage provides preliminary evidence that biasing participants to pay more attention to syntax rather than to other aspects of the task fosters larger immediate priming in both L2 and L1 speakers. However, completing data collection is necessary to confirm this pattern of result, to inspect the effect of attention on long-term language learning and to understand how L2 learning motivation relates to priming and learning across these contexts.

Chapter 6

Learning a second language via syntactic priming in the classroom: The effect of teaching settings and individual differences

The present study examined the effects of teaching settings and individual differences in attention and motivation on classroom-based second language (L2) learning via syntactic priming. We tested students at a French high school who were learning English as an L2 and assessed whether priming activities would help them learn how to produce English Wh-questions accurately. The students were assigned to one of four conditions: a condition where the primes containing models of the target structure were delivered by a teacher to the whole class (Teacher-to-Students condition), a condition where they produced themselves in a peer-to-peer task (Self Priming condition), a condition where they heard the primes delivered to them by a fellow student in a peer to peer task (Student-to-Student condition), or a condition without exposure to primes (Control condition). We measured students' variation in attention and motivation with self-report questionnaires and analysed both immediate and long-term priming (i.e., producing the target structure more accurately immediately after exposure to primes or in delayed post-tests relative to pre-tests) in order to assess L2 learning. The preliminary data confirmed that English Wh-questions are a particularly challenging structure for young French learners. However, they also only revealed minimal priming differences across teaching settings and seem to show that one priming session is not enough for students to improve in accuracy. Completing data collection is required to further understand the current pattern of results and to understand how teaching settings and individual differences relate to L2 learning via syntactic priming in this context[18]. **Material/ data availability:** https://osf.io/avk5t/?view_only=16d2c83acf5645559699fa9cb4d6e35f

[18]We had originally planned to run this study in March-April 2020. Testing started on March 9th, 2020 but due to the Covid-19 pandemic, we were unfortunately not able to complete it. In this chapter, we thus report the theoretical reasoning behind the study, its predictions, design and preliminary results.

6.1 Introduction

One way through which second language (L2) speakers may acquire L2 grammar in the classroom is by experiencing syntactic priming effects, language users' tendency to copy the syntactic structures of recently perceived sentences (Bock, 1986; McDonough & Mackey, 2008; Trofimovich & McDonough, 2011; see Jackson, 2018 for a review of syntactic priming in L2 speakers). Psycholinguistics and applied linguistics research reveal that, for instance, when repeatedly exposed to a target syntactic structure in prime sentences, L2 speakers start producing that structure more frequently and more accurately, relative to pre-tests, in target sentences produced immediately after exposure to the prime structure (immediate priming) or in post-tests without exposure to the prime structure (long-term priming) (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008; McDonough & De Vleeschauwer, 2012). Accordingly, several psycholinguistic models define syntactic priming as a language learning mechanism (e.g., Chang et al., 2006, 2012; Reitter et al., 2011). Syntactic priming tasks therefore seem an appropriate pedagogical tool to foster the acquisition of L2 syntactic knowledge in L2 speakers.

While a large number of studies explores L2 learning via syntactic priming in laboratory- or web-based testing contexts (e.g., Hurtado & Montrul, 2021a; Kim & McDonough, 2016; McDonough & De Vleeschauwer, 2012; McDonough & Mackey, 2008), few studies examine how syntactic priming supports L2 syntactic learning in classroom settings (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013). One unexplored factor, for instance, is whether such learning is influenced by teaching settings. Syntactic priming tasks embedded within classroom-based, peer-to-peer collaborative activities have been found to promote native-like production of target forms (e.g., McDonough, 2011; McDonough & Chaikitmongkol, 2010) but students also experience priming in their first language (L1) when primes are presented to the class as a whole (Favier et al., 2019). Whether one of these two types of settings is more appropriate to support L2 learning is unknown. It is also unclear whether learners benefit more from priming when they themselves produce the model sentences containing the well-formed target structure than when they just listen to them. A final unexplored question is whether learners' levels of attention and

motivation modulate L2 learning via syntactic priming in this context, though these factors are known to affect L2 learning (Masgoret & Gardner, 2003; Robinson et al., 2012; Takahashi, 2005; Ushioda, 2016; Ushioda & Dörnyei, 2012) and may vary widely between students in a classroom.

Therefore, the goal of the present study was to investigate how classroom-based L2 syntactic priming activities support French students' acquisition of English Wh-questions. Specifically, we examined how syntactic priming and the resulting learning vary as a function of teaching setting, and individual differences in attention and motivation.

6.1.1 Syntactic priming across teaching settings

Syntactic priming activities can be integrated into school-based L2 teaching and learning practices to support grammar instruction (see for example McDonough & Chaikitmongkol, 2010 or Trofimovich et al., 2013). Teachers may for instance embed such tasks into meaning-focused activities (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough & de Vleeschauwer, 2012; Trofimovich et al., 2013). Priming activities are therefore particularly well-suited to implementing Communicative Language Teaching, the paradigm guiding current foreign language teaching practices in Europe (Council of Europe, 2009), according to which languages should be taught by focusing primarily on the communicative rather than on the formal aspects of language. Furthermore, priming methods can be incorporated into and maximize the teaching potential of peer-to-peer activities (e.g., McDonough & Chaikitmongkol, 2010; McDonough et al., 2015) which are thought to foster L2 learning (cf. the Interaction hypothesis in Second Language Acquisition (SLA) research, Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994). Priming manipulations allow teachers to control the complexity and the accuracy of the structures students are exposed to within such activities and gives them the opportunity to ensure that students practice new grammatical structures even in an exercise with minimal instructor intervention (McDonough, 2006; Trofimovich et al., 2013). These activities also entail exposure to and production of the targeted structures with a variety of lexical items, which may allow learners to generalize the acquired syntactic knowledge across lexical contexts (McDonough, 2006;

McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008; Trofimovich et al., 2013).

In spite of this promising pedagogical profile, few studies have investigated whether syntactic priming activities support L2 teaching and learning in foreign language classrooms (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013) and none has examined the effect of different teaching settings on students' L2 learning outcomes.

6.1.1.1 Teacher-to-students vs. student-to-student syntactic priming

Though there exist many possible teaching settings when it comes to grammar instruction (see Hedge, 2008 for a review), in the present study we focused on the following two: settings where a student is exposed to a target grammatical structure as it is presented by the teacher to the whole class (teacher-to-students setting) as opposed to settings where they hear it from a classmate in a collaborative exercise (student-to-student setting). Instructors may implement syntactic priming tasks in these two ways as prime sentences may be presented to the whole class by the teacher (Favier et al., 2019) or by a student to another student (e.g., McDonough & Chaikitmongkol, 2010).

Both syntactic priming and SLA theories predict that L2 speakers should experience more priming and learning in a student-to-student setting than in a teacher-to-students setting. First, Pickering and Garrod (2004, 2006) define syntactic priming as one of the mechanisms allowing interlocutors to achieve mutual understanding in a dialogue. If syntactic priming effects are a way to ensure communicative success in an interaction, they should be more likely to arise in highly interactive contexts such as student-to-student settings than in non-interactive contexts like teacher-to-students settings. In the latter condition, students do not need to achieve mutual understanding with the teacher and may feel less involved in the exchange overall than in peer-to-peer tasks. This may lead them to pay less attention to the prime sentences and to process them more superficially. At least one study provides support for this hypothesis: Branigan et al. (2007) observed that L1 speakers experienced larger priming when hearing primes being directly addressed to them than when overhearing them as side participants. The authors attributed this between-group difference to the fact that participants in the latter condition may

have been less attentive to the primes or may have tried less to understand them fully than participants in the former condition. Though this theory and this study do not indicate whether more interactive settings should increase long-term priming (i.e., language learning), they at least predict that such settings should increase immediate priming. Furthermore, interactionist perspectives in SLA research (Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994) postulate that interactive activities foster L2 learning by, for instance, allowing learners to receive (implicit) interactional feedback from their partner (Long, 2006) or increasing their likeliness to become aware of the targeted language forms (Ellis, 1991; Gass, 1997, 2003; Long, 1996; Schmidt, 1995, 2001; Swain & Lapkin, 1995). These theories hence predict that more interactive student-to-student priming tasks should be better suited to support L2 learning via syntactic priming than teacher-to-students activities.

Past research provides mixed results regarding the effect of interactivity on priming magnitude. Speakers experience priming both in interactive settings such as when they interact with a confederate (e.g., Branigan et al., 2000; Kim & McDonough, 2008; McDonough & Kim, 2009) or with another L2 speaker (e.g., McDonough & Chaikitmongkol, 2010; McDonough et al., 2015) and in non-interactive settings, such as when they overhear a conversation (Branigan et al., 2007) or in the absence of an interlocutor (e.g., Bock, 1986; Ivanova et al., 2020; Chapter 4). Furthermore, some studies with L1 speakers report larger priming in dialogues than in monologues (Schoot et al., 2019), while others show that the magnitude of priming does not differ between interactive and non-interactive designs (Schoot et al., 2014; Ivanova et al., 2020). However, to our knowledge, no study has directly compared priming effects in interactive and non-interactive settings in L2 speakers, nor tested whether one of the two settings described above supports long-term priming, and hence L2 learning, better.

6.1.1.2 Comprehension-to-production vs. production-to-production syntactic priming

Another aspect of grammar instruction that may vary across teaching settings is whether learners are only exposed to the model sentences that contain the well-formed syntactic structures (comprehension-to-production priming) or whether they produce these model sentences themselves (production-to-production priming). On

the one hand, production-to-production conditions give L2 speakers an additional opportunity to practice formulating accurate versions of the targeted grammatical structures and may therefore boost L2 priming and learning (see Hopman & MacDonald, 2018 for further discussion of the potential benefits of production for language learning). On the other hand, the psycholinguistic models according to which language learning via syntactic priming relies on an error-based language learning mechanism (e.g., Chang et al., 2006, 2012) predict that *comprehending* prime sentences is necessary for such learning to arise. In this theory, during language comprehension, a speaker's language system constantly predicts upcoming language input and compares these predictions to the sentences actually perceived. Priming effects and the resulting learning emerge when predictions and language input are dissimilar, and the language system adapts to this error. Based on this account, one would thus expect comprehension-to-production conditions to be more likely to trigger priming and learning than production-to-production conditions.

It is difficult to establish expectations regarding which of the two conditions should foster larger priming magnitudes by examining previous research. In L1 speakers, Mahowald et al.'s (2016) meta-analysis suggests that there are no differences between comprehension-to-production and production-to-production priming conditions, while Gries' (2005) corpus study reveals that priming is slightly higher when speakers produce both prime and target sentence themselves than when they hear the primes pronounced by someone else (but see Zawawi, 2017). Results comparing priming in conditions where participants only comprehend prime sentences to conditions where they both comprehend and repeat them have also provided mixed evidence. Priming seems not to differ between these two priming conditions neither in L1 adults and older children (Bock et al., 2007; Huttenlocher et al., 2004; Savage et al., 2003), nor in highly proficient L2 speakers (Chen et al., 2013; McDonough, 2006). In contrast, younger children only appear to show significant L1 priming in prime repetition conditions (Gámez & Shimpi, 2015; Shimpi et al., 2007). Similarly, L2 learners of low to intermediate proficiency levels asked to repeat prime sentences show larger immediate priming and are more likely to exhibit long-term priming than other learners who only listen to them (Kim & McDonough, 2016; Jackson & Ruf, 2018). Such results may reflect the fact that participants who repeat primes are exposed to twice as many primes as participants in comprehension only conditions. Yet, Jackson & Ruf (2018) reported that L2

speakers who repeated primes exhibited greater priming magnitude than participants tested in another study who were exposed to the same number of prime sentences but without prime repetition (Jackson & Ruf, 2017). Thus, these latter studies potentially demonstrate that producing prime sentences rather than just listening to them facilitates access to syntactic representations (Shimpi et al., 2007) or increases their activation in L2 speakers (Kim & McDonough, 2016). However, McDonough and Chaikitmongkol (2010) found that the number of accurate English Wh-questions L2 speakers produced during a priming task correlated with the number of target structures they had previously produced, but not with the number of primes they had previously heard or formulated. Based on this literature, it thus appears difficult to determine which of comprehension-to-production conditions or production-to-production conditions would better support L2 priming.

Since McDonough and colleagues' work, the main research group working on classroom-based L2 priming activities, has mainly targeted conditions where students both listened to and produced the primes (McDonough & Chaikitmongkol, 2010; McDonough et al., 2015; Trofimovich et al., 2013), direct comparisons between comprehension-to-production and production-to-production teaching settings are necessary to clearly establish whether L2 priming and learning vary across these settings.

To summarise, teaching tasks embedding a syntactic priming manipulation can vary in terms of who delivers the primes to the learners and of whether the learners have the opportunity to produce the prime sentences themselves or not. While we would expect L2 speakers to show more priming, and thus L2 learning, in a student-to-student condition than in a teacher-to-students condition, which of the production-to-production and comprehension-to-production conditions best supports priming is unclear. No study has directly examined these issues in a classroom context but addressing all these questions should shed light on how to best implement syntactic priming tasks to support L2 learning in the classroom.

6.1.2 Individual differences in syntactic priming

6.1.2.1 SLA, attention and motivation

SLA research has shown that attention to linguistic input plays an important role in L2 grammar learning (Robinson et al., 2012; Takahashi, 2005; Schmidt, 2001; but

see Slevc & Miyake, 2006) and multiple psycholinguistic models of L2 learning include attention or awareness as a key component (Leow, 2019, Table 1). While L2 speakers tend not to pay attention to grammar when processing the L2 input (VanPatten, 2004), being more attentive in a language learning activity or paying attention specifically to the grammar of the perceived sentences may ensure that linguistic form is selected to be further processed among what is available to be learned in the L2 environment (Corder, 1967; see also Doughty & Williams, 1998; Sharwood Smith, 1993). Some studies reveal, for instance, that providing explicit instructions or using input enhancement techniques to direct students' attention towards the structures to be learned fosters their learning, especially in implicit language learning tasks (e.g., Indrarathne & Kormos, 2017; see Benati, 2016 and Robinson et al., 2012 for reviews). Additionally, the Noticing Hypothesis postulates that L2 speakers need to notice a target syntactic structure to be able to learn it (Schmidt, 1990; see Kerz et al., 2017 for a review; but see Robinson, 1995; Tomlin & Villa, 1994). Consistent with this, English L1 speakers' capacity to describe the syntactic rules and structures present in Russian stimuli, i.e., their awareness of the target structure, predicts how successful they will be in learning Russian inflectional morphology (Brooks & Kempe, 2013). We may thus expect individual differences in attention to linguistic input to similarly modulate L2 learning via syntactic priming.

SLA research has identified motivation, i.e., learners' desire to learn the L2 and the amount of effort they dedicate to it (Dornyei & Skehan, 2003), as another powerful modulator of L2 learning (Gardner, 1985; Masgoret & Gardner, 2003; Ushioda, 2016; Ushioda & Dörnyei, 2012) and many aspects of language learning motivation have been found to relate to L2 production and learning achievements. For example, Deci and Ryan (1985) claim that intrinsic motivation, learners' inherent desire to learn a language that makes them engage with the learning activities (e.g., *"I enjoy the experience of surpassing myself when practicing French")*, may be a central motivator in the educational process. Moreover, intrinsic and extrinsic motivation, learners' tendency to learn to obtain a reward or avoid a punishment (e.g., *"I don't want to fail the French course"*), have both been found to affect L2 production and achievement (Cheng et al., 2014; Kang, 2001; Noels et al., 2001). Having a high level of motivational intensity (Gardner & Lambert, 1972), an indicator of the extent of engagement in language learning activities (e.g., "*I am working hard at learning French"),* and a strong ideal L2 self, i.e., a clear vision of

the proficiency level one would like to reach as compared to their current language competence, also seems to support L2 learning (Cocca & Cocca, 2019; Gardner, 1985; Noels et al., 2001; Serafini, 2013).

Students' language learning goals may also influence their L2 achievements. For example, Saito et al. (2017) observed that the progress of their participants in how comprehensible they were in their L2 (English) depended on how strongly they wanted to speak comprehensible English in the future. Likewise, one could expect students interested in learning grammar to be more attentive to and learn more from a task designed to support grammar learning (Crookes and Schmidt, 1991; Ushioda, 2016). Finally, L2 learning may also be affected by students' task motivation or attitude towards the task (Dörnyei, 2002; Dörnyei & Kormos, 2000; Kormos & Dörnyei, 2004), here conceptualized as a combination of task enjoyment (e.g., *"I found the task interesting"*) (Eccles, 1993), reported effort (e.g., *"I put a lot of effort in doing the task"*) (Boekaerts, 2002), and how useful students think the task is to reach their language learning goals (Wigfield & Eccles, 2000).

In sum, these findings indicate that students' overall motivational profile towards learning the target language, their learning goals and how motivated they are to complete the activity could determine how much they learn from a syntactic priming task. Importantly though, studies investigating the effect of motivation on L2 learning usually measure learning in terms of global L2 achievements (Ushioda, 2016). It is thus left largely unclear whether and how this factor affects learning of a specific grammatical structure (but see Saito et al., 2017; Segalowitz et al., 2009; Takahashi, 2005).

6.1.2.2 Syntactic priming, attention and motivation

Few studies have examined how individual differences in attention to linguistic input influence L2 priming and learning, but some experimental work suggests that both overall attention to the task and attention to syntax could affect immediate priming. L1 speakers tend to prime more when they take part in a priming activity that supposedly leads them to be particularly attentive to the task such as when they have to complete a goal shared with their interlocutor (Reitter & Moore, 2014), or when they hear primes in a dialogue rather in a monologue (Schoot et al., 2019; but see Ivanova et al., 2020) or as directly addressed to them rather than as addressed to

somebody else (Branigan et al., 2007). Moreover, Ivanova et al. (2020) measured participants' reaction times on a picture verification task performed in parallel of a syntactic priming task to assess their level of attention during the experiment. They found that lower variability in reaction times on that parallel task, which they assumed reflected higher levels of attention, were associated with larger immediate priming. Being instructed to specifically pay attention to the syntactic form of the stimuli rather than to their semantic content also enhances L1 speakers' priming magnitude (Bock et al., 1992). Similarly, in L2 speakers, explicit manipulations which make them more likely to pay attention to syntax or to notice the target syntactic structure (Shin & Christianson, 2012) and detect the target form (McDonough & Fulga, 2015) lead to larger priming. In the previous chapters, however, although biasing participants to pay attention to syntax seems to have triggered larger immediate priming (Chapter 5), self-reported attention did not relate to such priming in Chapters 3-4. Hence, lab-based research so far provides mixed results regarding how variation in attention to linguistic input relates to the magnitude of immediate priming. Furthermore, our results in Chapters 3-5 do not indicate that motivation relates to immediate priming.

Whether attention and motivation should modulate long-term priming is less clear because psycholinguistic models define language learning via syntactic priming as a primarily implicit process (e.g., Chang et al., 2006, 2012; Malhotra et al., 2008; Reitter, et al., 2011). If, for example, being more attentive or more motivated makes participants more likely to explicitly remember the form of prime sentences or to explicitly choose to copy their syntactic structure (Costa et al., 2008), then these factors should not impact long-term priming. This question remains largely understudied but, in line with this prediction, Shin and Christianson (2012) found that explicit instructions about the target form did not increase long-term priming measured on a delayed post-test. However, the present thesis revealed that attention can affect long-term priming in L2 and L1 speakers as, in Chapter 3, being more attentive to the task reduced long-term priming of fronted sentences. Moreover, we found preliminary evidence that motivation can modulate (Chapter 3) long-term priming.

As far as we know, no study has looked at the effect of attention and motivation on priming in more naturalistic contexts, such as in a classroom. Such research is evidently important to inform teaching practices but may also be a

particularly well-suited setting to investigate the effect of these factors on L2 learning. L2 lab-based studies rather target participants who chose to take part in the experiment and may therefore tend to be highly attentive to the task or to the syntax of its stimuli or highly motivated to learn the target language. For instance, in Chapter 3, most L2 speakers were students of French and thus, highly motivated to do the experimental tasks as a way to further practice the language. In a classroom-based context in contrast, students' attentional and motivational levels as well as the object of their attention is likely to vary more between individuals, depending on their personal interests and aspirations but also because learning of the target language is often compulsory for them. We may then expect students who are more attentive to syntax (e.g., Chapter 5; Shin & Christianson, 2012) or more motivated to perform the priming task (Chapter 3) to experience more priming or learning.

Furthermore, though this remains unexplored, the effect of attention and motivation on priming and learning could depend on the learning context. The design of teaching activities may influence students' attention and motivation. Learners may be overall more attentive in interactive settings, when they are directly and individually addressed (see Branigan et al., 2007; Ivanova et al., 2020 and section 6.1.1.1 for a similar reasoning) or more likely to notice the target form in such settings (Ellis, 1991; Gass, 1997, 2003; Long, 1996; Schmidt, 1995, 2001; Swain & Lapkin, 1995) than in non-interactive settings. Learner-centered activities and peer interactions are also positively perceived by learners and seem to increase their motivation (McCombs & Whistler, 1997; Sato, 2013). If students are more attentive and more motivated in interactive settings than in non-interactive settings, we may expect them to experience larger priming in the former than in the latter condition. Perhaps more importantly, this also means that higher levels of attention and motivation may benefit students more in non-interactive than in interactive settings.

In sum, SLA and priming research provide mixed findings regarding whether L2 speakers who are more attentive to the task or to the syntax of experimental stimuli, and L2 speakers with high motivation levels experience larger immediate priming, and more long-term learning via priming. However, no study has examined how students' attention and motivation during classroom-based syntactic priming activities influence L2 learning outcomes depending on the teaching setting.

6.1.3 L2 syntactic priming across sessions

If syntactic priming tasks support L2 learning, it is highly relevant for L2 pedagogy to determine how many sessions are needed to foster priming and learning and lead to significant improvements in target structure production. Past research suggests that L2 speakers are only able to experience significant priming for a given structure if they already have some prior knowledge of it. For example, McDonough (2006) observed that only participants who had produced at least one double object dative in a baseline phase could experience significant immediate priming for that structure (see McDonough & Fulga, 2015 as well). In line with this, Hartsuiker and Bernolet's (2017) developmental trajectory of L2 syntactic representations predicts that in early L2 learning stages, L2 speakers should not be able to exhibit priming in the absence of lexical overlap between prime and target sentences, whereas within-L2 abstract priming (i.e., priming without lexical overlap) should only arise at higher levels of proficiency. Thus, when targeting a syntactic structure the L2 speakers are not familiar with, one could expect them not to be able to experience priming during the first priming session.

Once priming is established, psycholinguistic models that define syntactic priming as a language learning mechanism (Chang et al., 2006, 2012; Malhotra et al., 2008; Reitter et al., 2011) all predict that priming magnitude should be initially large and then decrease over time. This pattern is expected because speakers should experience large surprisal when encountering the target structure for the first few times in the priming task, and hence larger adaptation in their language system, while this surprisal should diminish as their language system and its syntactic representations adapt to the language input. However, sustained attention and motivation across sessions may foster equivalent priming across time if these two factors support priming (see Ivanova et al., 2020 for a similar reasoning regarding attention).

To our knowledge, several groups of researchers have implemented L2 priming studies with several sessions (e.g., Kim & McDonough, 2016; McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough & De Vleeschauwer, 2012; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough et al., 2015) but only Muylle et al. (2021) have clearly examined how priming magnitude varied across sessions. Muylle et al. (2021) taught Dutch L1 speakers an artificial

language with transitive and ditransitive structures implicitly (i.e., via exposure to the form, sentence-video matching tasks and sentence production tasks) and had them perform five syntactic priming sessions over five days. Their learners experienced significant short-term priming even during the first session, and their priming magnitude decreased after the first day, in line with the predictions of the language learning models (e.g., Chang et al., 2006; Reitter et al., 2011). Since the target structures taught to the participants in that study were very similar to Dutch transitives and ditransitives, it is unclear whether priming would emerge as early for L2 speakers learning a structure that is cross-linguistically more different from their L1 equivalent. In addition, how such priming would evolve over time and relate to individual variation in attention and motivation across sessions is also unknown.

6.1.4 Present study

6.1.4.1 Research questions, predictions and set up

The present study aimed to examine the effect of teaching settings and individual differences in attention and motivation on classroom-based L2 learning via syntactic priming. We were also interested in determining how many priming sessions were necessary for L2 speakers to start priming. We defined priming and learning here as producing the target L2 structure more accurately than in a pre-test preceding the syntactic priming tasks (as in McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough & de Vleeschauwer, 2012). We planned to compare syntactic priming in teacher-to-students (Teacher-to-Students condition) vs. student-to-student conditions where the primes were either delivered by a teacher to the whole class or by a fellow student in a student-to-student task respectively. In addition, in the student-to-student task, we wanted to examine whether priming would differ between the student who was delivering the prime sentences (Self-priming condition) and the one who would only hear the primes as read by their partner (Student-to-Student condition). We aimed to compare students' production of the target structure in these conditions to the production of target sentences in a group of students who would not have performed the syntactic priming activities (Control condition). We planned to examine both immediate and long-term syntactic priming in order to measure L2 learning effects.

We tested French L1 speakers who were L2 speakers of English in a French high school. We designed six testing sessions for students to complete over five weeks: a pre-test, three intermediate syntactic priming sessions and two delayed post-tests (Table 6.1).

Table 6.1 General procedure of the experiment.

Session	**Programme**
Pre-test	• Question formulation exercise • Proficiency assessment • Motivation questionnaire 1
Intermediate session 1	• Priming activity 1 • Question formulation • Attention questionnaire 1 • Motivation questionnaire 2
Intermediate session 2	• Priming activity 2 • Question formulation • Attention questionnaire 1 • Motivation questionnaire 2
Intermediate session 3	• Priming activity 3 • Question formulation • Attention questionnaire 1 • Motivation questionnaire 2
Post-test 1	• Question formulation exercise
Post-test 2	• Question formulation exercise • Attention questionnaire 2

We designed the pre- and post-tests to assess students' accuracy in target structure production without exposure to prime sentences. In the three intermediate sessions, students would have completed a priming activity. Instead of looking at the production of target structures immediately after exposure to a single prime for the immediate priming manipulation, as in Chapters 2-5, we planned to expose the students to a series of primes and then have them produce a series of target sentences (see for instance Kutta et al., 2017 or Huttenlocher et al., 2004 for a similar design). We targeted written sentence production, rather than oral production, because many

language instructors resort to the written modality in their teaching and assessment practices. Immediate priming would have been measured by comparing the frequency of accurately produced structures in the series of target sentences in the intermediate sessions vs. in the pre-test. Overall, based on the Interactive Alignment theory (Pickering & Garrod, 2004, 2006) and on Interactionist perspectives in SLA (Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994), we predicted that there would be more priming in the student-to-student conditions than in the Teacher-to-Students condition, and in both these two conditions than in the Control condition. Within the student-to-student conditions, it was unclear whether the students who read and produced the primes (Self priming condition) would prime more than the ones who only listened to them (Student-to-Student condition) (Jackson and Ruf, 2018; McDonough & Chaikitmongkol, 2010). Given the limited amount of previous research targeting this question, we had no specific prediction regarding whether the students would experience significant priming in the first intermediate priming session already. The two delayed post-tests were designed to assess long-term priming and thus, L2 learning. More specifically, these would assess whether participants produced more accurate structures in the post-tests relative to the pre-test. We predicted that the condition in which students would show most improvements in accuracy in the intermediate sessions would also be the condition in which they would show most improvements in accuracy in the post-tests.

Finally, we also planned to examine whether individual differences in attention and motivation affected syntactic priming and the resulting learning across teaching settings. To do so, we assessed students' motivation at the beginning of the study to measure their overall motivation towards learning English and were planning to measure task-specific motivation and attention to linguistic input during each of the three intermediate sessions. At the end of the study, students would have been asked if they had noticed the targeted structures. We predicted that the students would be more attentive, more likely to notice the target form and more motivated toward the task in the student-to-student setting than in the Teacher-to-Students condition (e.g., Long, 1996; Sato, 2013). We also predicted that with increased attention, increased motivation and when noticing the target structures, students would be more likely to show priming in the intermediate sessions, especially in the less interactive setting. However, whether high attention and motivation levels would also lead to more long-term priming was less clear (cf. Chapters 3-5).

6.1.4.2 Target structures

We examined students' production of English Wh-questions. We chose this syntactic structure because, in a survey conducted with French high school teachers before designing the study, teachers identified question formation as a particularly challenging English grammatical structure for French students (as in Kim et al., 2020; McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough & Kim, 2009; McDonough & Mackey, 2008; McDonough & de Vleeschauwer, 2012). More specifically, we targeted be-questions (1a, see 1b-d for examples of how these are expressed in French) and do-questions (2a, see 2b-d for examples of how these are expressed in French).

French and English questions differ in many ways which may all challenge French L1 speakers when formulating questions. On the one hand, the main challenge of English be-questions resides in the fact that they require subject-verb inversions which can occur (1b) but are not compulsory in French questions (1c and 1d). However, it is worth noting that when a person's name ("why is *Charlotte* happy?" vs. "why is *she* happy?") is included in a French question, inverting the verb and the subject pronoun may lead to a duplication of the subject ("Pourquoi Charlotte est-elle contente?": "*Why Charlotte is-she happy?"*) which is not the case in English.

1a. Why is she happy?
b. Pourquoi est-elle contente ?
why is-she happy?
c. Pourquoi est-ce qu'elle est contente ?
why (est-ce-que) she is happy?
d. Pourquoi elle est contente ?
why she is happy?

On the other hand, do-questions (2a-d) are particularly hard for French students as they require the inclusion of "do", an auxiliary that does not exist in French.

2a. What does the mayor read?

b. Que lit le maire ?

what reads the mayor ?

c. Qu'est-ce que le maire lit ?

what (est-ce que) the mayor read?

d. Le maire lit quoi ?

the mayor reads what?

Finally, a common difference for both types of questions between English and French is that French speakers may insert "est-ce que" in questions (1c and 2c). While this "est-ce que" (literally, *"is this that"*) does not exist in English, the teacher of the students included in this study reported that her students often struggled with English questions as they were trying to translate this phrase into English. Thus, overall, English questions were expected to be particularly challenging for French students since they could not rely on word-by-word translation to formulate accurate English Wh-questions.

6.2 Methodology

The whole study, which was originally planned to last over 5 weeks, is described below, however, we were only able to run the first week of testing due to the lockdown in France in March 2020. All targeted classes took part in the pre-test and all but one of them had time to do the first syntactic priming session. We report the preliminary results of these first two testing sessions in the combined preliminary results and discussion section.

6.2.1 Participants

109 French L1 speakers, learning English as an L2, took part in the study. They were recruited in a French high school in classes from two educational levels: première (second year) and terminale (third and final year). Première students received between 3 and 5 hours of English lessons per week and terminale students received 2 hours. The study was approved by the Humanities and Social Sciences Research Ethics Committee at the University of Warwick and by the Rectorat de l'Académie de Montpellier. Informed consent was obtained prior to the test session.

We excluded from the (preliminary) analysis the participants who only participated in the pre-test. As a result, the analyses included 91 students: 18 in the Teacher-to-Students condition (mean age=16.83 years old, 11 female), 23 in the Self priming condition (mean age=16.71 years old, 12 female), 25 in the Student-to-Student condition (mean age=16.72 years old, 16 female), and 25 in the Control Condition (mean age=16.67, 13 female). Students from the different levels and classes were randomly allocated to each condition to try to have the same number of students from each study year in each condition. Across levels, students were on average 16.73 years old and had started to learn English on average 7.84 years ago (see Table 6.2 for detailed demographics per condition).

Table 6.2 Distribution of the students in each condition per study year. *TS= Teacher-to-Students condition; SP= Self Priming condition; SS= Student-to-Student condition; C= Control condition.*

	Première					Terminale				
Condition	**TS**	**SP**	**SS**	**C**	**Total**	**TS**	**SP**	**SS**	**C**	**Total**
N	9	12	13	13	47	9	11	12	12	44
Mean age	16.44	16.17	16.31	16.31	16.31	17.22	17.44	17.17	17.10	17.23

6.2.2 Task and Materials

6.2.2.1 Syntactic priming activities

To elicit Wh-question production, we created question formulation exercises. In these exercises, students were given a series of word prompts and an associated answer and were asked to use the word prompts to formulate questions matching the provided answers (Figure 6.1). In the syntactic priming conditions, this exercise was preceded by a priming activity whereas in the control condition it was preceded by an unrelated writing exercise (see Procedure section).

Words to use: ***Anarchy Tour- where- take place***
Question BQ3:_____
Answer : In the UK.

Words to use: ***British youth- be- angry- why***
Question BQ4:_____
Answer : Because of the bad state of the economy in the UK and high unemployment rates.

Figure 6.1 Example of stimuli in the question formulation exercises.

The teacher selected six texts from textbooks designed for students of Première in order to ensure that students of both levels could understand them. These texts were related to various topics such as The Hunger Games or the birth of the Punk movement in the UK. They did not contain any Wh-questions and their length was between 273 and 466 words. For each text, we prepared a list of 10 target questions, five be-questions and five do-questions, and 10 associated word prompts lists. For three of these texts, we also created a list of 10 prime questions, five be-questions and five do-questions. For be-questions, we used one of the following Wh-words: *when*, *why*, *where*, *how* and *how many*. These questions were of the form: wh-word + be + subject + adjective/ past participle (for passive sentences)/ prepositional phrase (e.g., "*Where was the economy in a bad state?".* For do-questions, we used one of the following Wh-words: *when*, *where*, *why*, *how*, *what*, *with whom*, *which*, *how long*, *how many* and *who*. These questions were of the form: wh-word + do + subject + verb (+ prepositional phrase/ indirect or direct object phrase/ adverb) (e.g., "*Where did the punk scene appear?"*). We did not create prime questions for the three other texts as they were used for the pre-test and the two delayed post-tests, where students' question formulation was to be measured without the influence of primes. The lists of word prompts always contained the Wh-word, the verb, its subject and whichever complements were required, but they never contained articles. The word prompts of each list as well as the be-questions items and the do-questions items for the prime questions and the target questions were presented in a random order.

Overall, students of all groups across all sessions would produce 60 questions, 30 of each type, which were presented in the same order for all. All students in the priming conditions would be exposed to 30 correctly formulated

questions, 15 for each type, in the same order for all as well. For the control condition, instead of the 10 prime questions, the teacher created an unrelated writing activity for each of the texts in the intermediate sessions, such as "Please collect information about the British society in the 1970's and explain how these relate to punk music"[19].

6.2.2.2 Attention assessments

We created two attention questionnaires. The first questionnaire targeted session-specific attention and would have been given to students in the three intermediate sessions. The students rated on a scale from 1 (strongly disagree) to 7 (strongly agree) how focused they were during the exercise (question BA1) and how attentive to grammar they were during the task (question BA5). The second questionnaire asked students which structures they thought the study was targeting and was to be filled in by the students at the end of the last session.

6.2.2.3 Motivation assessments

We created two motivation questionnaires (adapted from the ones used in Chapters 4-5) in which the students read statements and rated how strongly they agreed with them on a scale of 1 (strongly disagree) to 7 (strongly agree). The first questionnaire targeted students' general motivation towards learning English and English classes by measuring externally regulated motivation (6 items), intrinsic motivation (7 items), motivational intensity (8 items), how important it was for students to learn English (2 items), ideal self (8 items) and participant's linguistic goals (9 items), among which 5 specifically targeted their motivation to learn English grammar. This questionnaire was given to the students in the first session of the study. The second questionnaire measured students' task motivation (6 items) and their metacognition about the task, i.e., how useful they thought the task was to help them reach their language learning goals (5 items). This second questionnaire was to be filled during the three intermediate sessions. The presentation of items was randomized across categories.

[19]All the materials are available on the OSF (see front page).

6.2.2.4 Proficiency assessments

Students' English proficiency was measured with a self-report questionnaire. Self-reported proficiency has been found to correlate with direct measures of proficiency (Lemhöfer & Broersma, 2012; Favier et al., 2019). Participants rated their English speaking, understanding, writing, reading and overall proficiencies on a scale from 0 (minimum score) to 10 (maximum score). We also asked students to indicate for how many years they had been learning English[20].

6.2.3 Procedure

We created six booklets per student, one for each session, to record their written answers. All the instructions were provided in French to make sure all students understood them. Wherever possible, we planned to try to have the same amount of time between each session for all classes[21].

6.2.3.1 Pre-test

For the pre-test, students of all conditions received the same booklet with the text to read, the question formulation exercise and the proficiency questionnaire and the first motivation questionnaire. Students were first given a maximum of 10 minutes to read the text. They then had a maximum of 10 minutes to do the question formulation exercise. Finally, students filled in the proficiency and motivation questionnaires.

6.2.3.2 Intermediate sessions

6.2.3.2.1 Teacher-to-students condition

In the teacher-to-students condition, the teacher played the role of the primer, while students were all listeners. At the beginning of the session, all students in this condition received the same booklet containing the text to read, blank spaces to write their answers to the primer's questions, the question formulation exercise, the first attention questionnaire and the second motivation questionnaire. Students were first given a maximum of 10 minutes to read the text. The teacher then asked a series of

[20]Originally, we also planned to ask the teacher to rate each student on the same five English proficiency scales and to attribute each student a CEFR-based assessment of their level (Council of Europe, 2009).
[21]For the classes we tested, the pre-test and the first priming session were separated by between a few hours and three days.

10 questions one at a time (repeated once) to the whole class. These constituted the prime questions. Students were given around 1 minute between each question asked by the teacher to try to find the answer in the text and write it down. After having heard all the questions, students were given a maximum of 10 minutes to do the question formulation exercise. They then filled in the short attention and motivation questionnaires. The role of the teacher was played by the experimenter.

6.2.3.2.2 Student-to-student condition

In the student-to-student condition, students were divided into two groups: primers (Student-to-Student condition) and listeners (Self Priming condition). Each primer was randomly paired up with a listener in the first intermediate session and all pairs would be kept the same for the next two intermediate sessions if possible. At the beginning of the session, the listeners were distributed the same booklet as the students in the teacher-to-students condition whereas the primers received a booklet containing the text to read and the questions they would have to read to their partner, the question formulation exercise, the first attention questionnaire and the second motivation questionnaire. Both students of the pair were first given a maximum 10 minutes to read the text. Then, the primers played the teacher's role in the teacher-to-students condition and read the same series of 10 questions (one at a time, repeated once maximum) to their partner. The listener was instructed to only listen to but not to read the questions. Both students were instructed to search for the corresponding answers in the text on their own and write them down. They were given 1 minute between each question asked by the primer. After having read (for the primer) or heard (for the listener) all the questions and after the experimenter had collected the first section of the booklets to prevent students from reading the primes again, both students of the pair were given a maximum 10 minutes to do the question formulation exercise. They then filled in the attention and motivation questionnaires. If in that condition a student was absent so that a pair could not be formed, the student left alone performed the control activity instead. These sessions were supervised by the experimenter.

6.2.3.2.3 Control condition

At the beginning of the session, the students in the control condition received a booklet with the text to read, the writing activity, the question formulation exercise, the first attention questionnaire and the second motivation questionnaire. They were first given 10 minutes maximum to read the text. They then had 10 minutes to perform the writing activity. Then, they had 10 minutes maximum to do the question formulation exercise, before finally filling in the motivation and attention questionnaires. The teacher supervised these sessions.

6.2.3.3 Post-tests

At the beginning of the first post-test, all students would receive the same booklet with the text to read and the question formulation exercise. The booklet of the second post-test also contained the second attention questionnaire. In both sessions, students would be first given 10 minutes maximum to read the text. They then would have had 10 minutes maximum to do the question formulation exercise. In the last post-test, students would have ended by filling in the attention questionnaire.

6.2.4 Scoring

6.2.4.1 Target structures

For each question type, we established a six-category coding system corresponding to the type of mistakes students were expected to make when formulating Wh-questions. For both categories of questions, we ignored morphosyntactic errors such as mistakes of number, tense or agreement as well as errors unrelated to questions such as spelling mistakes, since such factors seem not to affect priming (McDonough, 2011; Pickering & Branigan, 1998).

6.2.4.1.1 Be-questions

We categorised students' formulated be-questions as follows:

Table 6.3 Scoring of Be-questions.

Category	Question form	Example(s)	Accuracy
1	Wh-word + BE (any conjugated form) + subject	Why was the mayor distressed?	Accurate
2	Wh-word + subject + BE (any conjugated form)	Why mayor was distressed?	Inaccurate
3	Wh-word + be + attribute + subject	Why is distressed mayor?	Inaccurate
4	Wh-word + adjective + verb + subject	Why distressed is mayor?	Inaccurate
5	Wh-word + adjective + subject + verb	Why distressed mayor was?	Inaccurate
6	All other questions, such as questions containing the wrong verb (e.g., "have" instead of "be"), that included an extra pronoun, or where the verb "be" was not conjugated	Why she was tributes in danger? Why be mayor distressed?	Inaccurate

6.2.4.1.2 Do-questions

We categorised students' formulated do-questions as follows:

Table 6.4 Scoring of Do-questions.

Category	Question form	Example(s)	Accuracy
1	Wh-word + DO/DID + subject + verb	What did the mayor read?	Accurate
2	Questions where the auxiliary was in an incorrect position	Why we do need/ why need we do..?	Inaccurate
3	Questions missing the Wh-word	Do take place Hunger Games?	Inaccurate
4	Questions without auxiliary of the form: wh-word + subject + verb	What the mayor read?	Inaccurate
5	Questions without auxiliary of the form: wh-word + verb + subject	When take place the Hunger Games?	Inaccurate
6	All other questions, such as questions with an extra pronoun or verb	What do you capitol in district 13? What are read mayor?	Inaccurate

6.2.4.2 Attention assessments

To evaluate students' attention levels during the first priming session, we report their scores on questions BA1 and BA5: The students showed a mean score of 5.01 (range 1-7) for overall attention to the exercise and of 4.05 (range 1-7) for attention to grammar during the exercise (Table 6.5).

6.2.4.3 Motivation assessments

We computed participants' average ratings across items for each motivation category. The students showed a mean score of 4.05 for externally regulated motivation (range 1-7, Cronbach alpha=.35), 4.64 for intrinsic motivation (range 1.57-7, Cronbach alpha=.74), 4.31 for motivational intensity (range 1.38-6.38, Cronbach alpha=.73), 4.08 in terms of how important it was for them to learn English (range 1-7, Cronbach alpha=.34), 4.60 for ideal self (range 1.25-7, Cronbach alpha=.78) and 4.29 for their motivation to learn English grammar (range 1.25-7,

Cronbach alpha=.80). In the first priming session, the students showed a mean score of 4.61 for task motivation (range 2-7, Cronbach alpha=.72) and of 3.86 for how useful they thought the task was to reach their language learning goals (1-6.4, Cronbach alpha=.47; Table 6.5).

6.2.4.4 Proficiency assessments

We averaged students' ratings for their reported speaking, understanding, writing, reading and overall proficiencies to create a proficiency score (Bernolet et al., 2013). Overall, the students had an average proficiency rating of 5.90 (range 1.8-9.2) (Table 6.5).

Table 6.5 Individual differences descriptive statistics. Mean scores (SD) and ranges (in italics) for each measure by group and teaching setting. *TS= Teacher-to-Students condition; SP= Self Priming condition; SS= Student-to-Student condition; C= Control condition.*

Measure		TS	SP	SS	C
Attention	Overall attention to exercise	5.39 (1.29) *3-7*	4.74 (1.81) *1-7*	4.68 (2.04) *1-7*	5.24 (1.42) *2-7*
	Attention to grammar during the exercise	4.5 (1.54) *2-7*	3.87 (1.66) *1-7*	3.48 (1.69) *1-6*	4.36 (1.68) *1-7*
Motivation	Externally regulated motivation	4.05 (1.67) *1-7*	4.16 (1.36) *1.83-6.25*	3.90 (1.32) *1.17-6*	4.11 (1.42) *2-6.67*
	Intrinsic motivation	4.47 (1.39) *1.71-6.71*	4.41 (1.40) *1.86-6.71*	4.38 (1.17) *1.57-6.71*	5.21 (1.22) *2.71-7*
	Personal value	3.69 (1.71) *1-7*	4.01 (1.78) *1-7*	4.01 (1.25) *2-6.5*	4.48 (1.82) *1-7*
	Grammar learning goal	4.41 (0.92) *2.2-6*	3.90 (1.12) *2-5.8*	4.41 (1.05) *1.8-6*	4.44 (0.80) *2.4-5.8*
	Ideal self	4.44 (1.45) *1.25-7*	4.60 (1.33) *2.5-7*	4.63 (1.36) *2.38-6.88*	4.69 (1.45) *2.25-7*
	Motivational intensity	4.63 (1.19) *1.63-6.38*	3.86 (1.31) *1.38-6*	4.17 (1.03) *2-5.5*	4.64 (0.90) *2.5-6.25*
	Task motivation	5.11 (1.09) *3.33-6.83*	4.34 (0.92) *2.5-6.67*	4.15 (1.14) *2-6.33*	4.95 (0.94) *3.17-7*
	Metacognition	3.81 (1.64) *1-6.2*	3.75 (1.21) *1-6*	3.58 (1.41) *1.4-6*	4.29 (1.44) *1-6.4*
Proficiency		5.69 (1.64) *2.4-8.8*	5.69 (1.91) *1.8-8.4*	6.08 (1.71) *3.4-9*	6.13 (1.76) *2.4-9.2*

7 was the maximum score for the attention and motivation scales; 10 for the proficiency scales.

6.3 Combined preliminary results and discussion

Since we could not run the entire study, we only provide descriptive statistics of the preliminary data and we combined the results and discussion sections[22].

6.3.1 Priming

Overall, the students produced 79 (8.7%) accurate English Wh-questions (i.e., those included in category 1) in the pre-test. More specifically, the pre-test showed that overall, students were more accurate when producing be-questions than when producing do-questions as they produced 56 (12.3%) accurate be-questions but only 23 (5%) accurate do-questions (Tables 6.6 and 6.7). Following the first syntactic priming task, the students produced 90 (9.9%) accurate Wh-questions across question types and teaching settings. Hence, the first priming session did not lead to large improvements in accuracy of Wh-questions production (1.2% improvement; see Muylle et al., 2021 for differing results).

Regarding be-questions, students in the Teacher-to-Students condition produced 5.6% more accurate questions in the first priming session than in the pre-test while students in the Self priming and the Student-to-Student conditions did not seem to improve (+0.8% and -0.1% respectively). Finally, students in the Control condition produced 3.2% less accurate questions in the priming session than in the pre-test.

Regarding do-questions, students in the Teacher-to-Students condition produced no accurate questions in the pre-test, nor in the priming session. While students in the Self priming and in the Control conditions did not show any large changes between the pre-test and the priming session (+0.9% and -1.6% respectively), students of the Student-to-Student condition increased their production of accurate questions by 8%.

[22]A plan of the analysis we planned to run can be found on the OSF (see front page for the link).

Table 6.6 Results for Be-questions. *TS= Teacher-to-Students condition; SP= Self Priming condition; SS= Student-to-Student condition; C= Control condition. The inaccurate category represents all questions that were not scored as 1.*

Condition	Session	Accurate	Inaccurate
TS	Pre-test	2 (2.2%)	88 (97.8%)
	Intermediate 1	7 (7.8%)	83 (92.2%)
SP	Pre-test	11 (9.6%)	104 (90.4%)
	Intermediate 1	12 (10.4%)	103 (89.6%)
SS	Pre-test	21 (16.9%)	103 (83.1%)
	Intermediate 1	21 (16.8%)	104 (83,2%)
C	Pre-test	22 (17.6%)	103 (82.4%)
	Intermediate 1	18 (14.4%)	107 (85.6%)

Table 6.7 Results for Do-questions. *TS= Teacher-to-Students condition; SP= Self Priming condition; SS= Student-to-Student condition; C= Control condition. The inaccurate category represents all questions that were not scored as 1.*

Condition	Session	Accurate	Inaccurate
TS	Pre-test	0 (0%)	90 (100%)
	Intermediate 1	0 (0%)	90 (100%)
SP	Pre-test	5 (4.3%)	110 (95.7%)
	Intermediate 1	6 (5.2%)	109 (94.8%)
SS	Pre-test	9 (7.2%)	116 (92.8%)
	Intermediate 1	19 (15.2%)	106 (84.8%)
C	Pre-test	9 (7.2%)	116 (92.8%)
	Intermediate 1	7 (5.6%)	118 (94.4%)

These preliminary data indicate that Wh-questions are particularly challenging target structures for young French learners of English (cf. pre-test measurements), as reported by the teachers in the pilot study. Moreover, do-questions seem more difficult than be-questions for these students, potentially because the auxiliary “do” does not exist in French. The present data may provide preliminary evidence for the existence of priming differences between teaching settings. While students never produced more target structures in the priming session than in the pre-test in the Self Priming and in the Control conditions, both the Teacher-to-Students condition and the Student-to-Student condition seem to have led

to a slight increase in accurate target structure production for at least one of the two question types (for be-questions and for do-questions respectively). However, these differences between teaching settings are minimal at the moment and, evidently, data collection needs to be completed for us to confirm or refute this pattern of results. Finally, the observed increases in priming magnitude in the first intermediate session seem small overall which may suggest that multiple syntactic priming sessions, as originally planned and as in previous classroom-based priming research (McDonough, 2011; McDonough & Chaikitmongkol, 2010; McDonough & De Vleeschauwer, 2012; McDonough et al., 2015), may be required to foster L2 learning via syntactic priming in this population and context.

6.3.2 Attention and motivation

We examined whether Overall attention to the exercise, Attention to grammar during the exercise, Task motivation and Metacognition varied across the four teaching settings (in R, version 1.2.5042). After assessing whether each of the four measurements met the basic assumptions for homogeneity of variance and normal distribution to apply parametric tests, we computed two Kruskal-Wallis tests and two one-way ANOVAs to compute the comparisons. A post-hoc Tukey test revealed that there were significant differences in Task motivation between the Student-to-Student and the Teacher-to-Students conditions (p=.02) and between the Student-to-Student and the Control conditions (p=.03). This revealed that students were more motivated by the task in the Teacher-to-Students and in the Control conditions than in the Student-to-Student condition during the first priming session. Though this result is surprising (McCombs & Whistler, 1997; Sato, 2013), it could indicate that students were less motivated to perform a language learning task in a peer-to-peer setting than in settings where they did not interact with a peer, because, in the former condition, they were more distracted or rather interested in discussing other topics with their interlocutor. There were no other significant differences in attention and motivation between teaching settings.

6.3.3 Limitations

One limitation of the present study is that we cannot guarantee that the students in the Self Priming condition correctly delivered the prime sentences to their partner

during the priming task. Though the experimenter tried to monitor students' production, further research implementing a similar method would benefit from recording the language productions of the students during the activity (e.g., as in McDonough, 2011).

6.4 Conclusion

These preliminary data provide both useful methodological information for future research and pedagogically relevant information. From a methodological point of view, Wh-questions appeared to be a challenging structure to learn for young French L1 speakers which designates them as a suitable structure to investigate L2 learning effects in that population. In terms of pedagogical implications, we observed that a single priming session was not enough to foster improvements in accuracy. We only observed minimal priming differences between teaching settings at this point but finishing data collection is necessary to obtain a complete picture and to assess the effect of multiple sessions and individual differences in attention and motivation on school-based L2 learning via syntactic priming. To finish, we would like to highlight that, once completed, this project will be one of the rare studies investigating L2 learning via syntactic priming in adolescent populations, rather than in university students. Such research seems essential given that many young students start learning English at this age or even younger across European countries, for instance (see Schurz & Coumel, 2020 for example).

Chapter 7

Learning multiple L2 syntactic structures via chat-based priming: What is the role of learners' prior knowledge and conscious decisions?

This study investigated whether written chat-based activities foster syntactic priming and learning of multiple simultaneously-targeted second language (L2) syntactic structures. It further examined how these were affected by prior knowledge of the targeted structures and learners' decisions to use or avoid each structure. We tested 47 Spanish first language (L1) speakers learning L2 English. In a chat-based activity with an L1 English speaker, we examined syntactic priming in the production of three target structures that differed in their likely familiarity for participants (genitives, passives and datives) by comparing target structure production after experimental primes versus unrelated primes. We also compared target structure production and performance on a grammaticality judgment test (GJT) in post-tests relative to pre-tests to assess learning and we asked participants whether they made conscious decisions to use or avoid the structures. The learners experienced chat-based syntactic priming across structures, as well as learning in terms of target structure production but not on the GJT. Although prior knowledge and decisions did not significantly affect syntactic priming and learning, more prior knowledge and choosing to use the targeted structures increased overall target structure production. Thus, chat-based activities are well-suited to support L2 grammar learning, even when they embed multiple structures. However, instructors may need to encourage learners to explicitly use the targeted structures to maximize the language learning outcomes of syntactic priming tasks.

Preregistration: https://osf.io/kjcvp/?view_only=94529c8719f94464a70f6ee6d606ac19
Data/ material availability: https://osf.io/9vsdj/?view_only=80aa1fc129db4da1ba8ecc99a07dcf57

7.1 Introduction

Syntactic priming in language production occurs when interlocutors engaged in an interaction reuse each other's syntactic structures to formulate sentences (Bock, 1986). While interactionist perspectives in Second Language Acquisition (SLA) postulate that interactions foster second language (L2) learning (Gass, 2003; Gass & Mackey, 2007; Long, 1996; Pica, 1994), McDonough and Chaitkitmongol (2010) propose that this could be the case because such interactions involve syntactic priming. Accordingly, psycholinguistic and applied linguistic research conducted with L2 learners suggest that syntactic priming effects help learners acquire L2 syntactic knowledge (Jackson, 2018; McDonough & Mackey, 2008; McDonough & Trofimovich, 2008).

However, syntactic priming research with L2 learners has overlooked three key issues that are directly relevant to L2 pedagogy. First, L2 syntactic priming studies typically target one syntactic structure at a time (but see Shin & Christianson, 2012). None have investigated syntactic priming and learning effects across multiple syntactic structures within one task, although language learning activities may embed exposure to a variety of structures. Second, though the magnitude of syntactic priming and resultant learning effects varies widely across structures, it remains unclear why this is the case and what the implications are for our understanding of the mechanisms of syntactic priming and for L2 learning and teaching. Third, while most L2 syntactic priming studies focus on oral interactions, text-based chatting is an under-studied but promising medium for L2 learning (Gilabert et al., 2016), that may help L2 learners process the target language (Ziegler, 2016). Since learning and teaching increasingly takes place online (Maican & Cocorada, 2021), and governments encourage the development of digital tools for language teaching (European Union, 2019), it is highly relevant to explore the suitability of this medium for syntactic priming.

Thus, we assessed whether L2 learners exhibit syntactic priming for three different syntactic structures in a written chat interaction and how this relates to L2 syntactic learning. We also examined which factors could account for between-structure differences in syntactic priming.

7.1.1 L2 syntactic priming and learning

Several psycholinguistic theories define syntactic priming as the outcome of an implicit language learning mechanism (Chang et al., 2006, 2012; Dell & Chang, 2014; Jaeger & Snider, 2013; Malhotra et al., 2008; Reitter et al., 2011) and there is much evidence that syntactic priming indeed supports L2 learning. Via syntactic priming, L2 learners learn to produce native-like language forms (Kim et al., 2019; McDonough & Chaikitmongkol, 2010; McDonough & De Vleeschauwer, 2012; McDonough & Mackey, 2008), or to produce a previously dispreferred or unfamiliar structure more frequently (Kim & McDonough, 2008; McDonough & Fulga, 2015; Shin & Christianson, 2012), and this learning can persist over time (e.g., Hurtado & Montrul, 2021a; Jackson & Ruf, 2018; McDonough & Mackey, 2008). From a pedagogical point of view, syntactic priming tasks seem an appropriate tool for language instructors to use in order to model and elicit structures which are infrequent, syntactically complex or which learners do not spontaneously produce, within meaning-focused activities and with a variety of lexical items (McDonough, 2006; McDonough & Chaikitmongkol, 2010; McDonough & Mackey, 2008).

However, previous research reports varying patterns of syntactic priming for different syntactic structures (see Jackson, 2018 for a review). In face-to-face interactions, for instance, syntactic priming effects differ between dative structures (McDonough, 2006), datives and phrasal verbs (Shin & Christianson, 2012) and relative or adverbial clauses and passives (McDonough et al., 2015). This may have important implications for models of syntactic priming and consequently L2 pedagogy. Though syntactic priming is typically defined as an automatic and implicit process (e.g., Chang et al., 2006, 2012), Costa et al. (2008) hypothesize that the extent to which L2 learners experience automatic and implicit syntactic priming, and therefore experience syntactic priming across structures, varies according to other factors. Specifically, learners' experience with the target language determines their ability to automatically retrieve a specific linguistic representation and conscious processes may influence their choice to re-use or not a specific structure. These predictions remain largely unexplored so far.

7.1.1.1 Syntactic priming, automaticity and prior knowledge

Costa et al. (2008) predict that L2 learners should show reduced automatic syntactic priming on structures they have experienced the least frequently and of which they have, as a result, the least prior knowledge. The linguistic representations of such structures should be difficult to retrieve. In line with this, there is evidence that syntactic representations of infrequent structures are less available for syntactic priming: German learners of Spanish display small syntactic priming effects on Spanish subjunctives (Michel & Stiefenhöfer, 2018), possibly because subjunctives are generally infrequent both in Spanish and German. By contrast, L2 learners exhibit larger syntactic priming with the structures that are more frequent in their first language (L1) or their L2 (Hurtado & Montrul, 2021a; Jackson & Ruf, 2018). Such patterns of results contradict the predictions of implicit language learning models of syntactic priming. For example, error-based learning models state that participants should exhibit more syntactic priming with less frequent structures as they are more likely to experience prediction error with them (Chang et al., 2006, 2012; Jaeger & Snider, 2013). In Reitter et al.'s base-level learning model (2011), exposure to a target structure increases its base-level activation and such increases benefit infrequent structures more, triggering larger syntactic priming for these structures. Some L2 syntactic priming studies provide empirical support for these predictions (Kaan & Chun, 2017; McDonough & Fulga, 2015; Shin & Christianson, 2012).

Therefore, the evidence for how prior knowledge of a structure modulates within-L2 syntactic priming is mixed, and direct within-participants comparisons of structures that vary in their likely frequency and their existence in the L2 learners' L1 remain rare. Moreover, it is still unclear how such knowledge relates to long-term learning from syntactic priming, although some research suggests that syntactic priming only translates to long-term priming if participants have some minimal initial knowledge of the target structure (Jackson & Ruf, 2018; McDonough, 2006; McDonough & Fulga, 2015).

7.1.1.2 Syntactic priming and conscious processes

Costa et al. (2008) also propose that L2 learners' conscious decisions could determine whether they display syntactic priming or not for a specific structure.

Post-test questionnaires in syntactic priming studies reveal that learners often become aware of the structures targeted in syntactic priming activities (Chapters 3, 4 and 5; Grüter et al., 2021; Jackson & Ruf, 2018; Kim et al., 2020; Michel, 2018; Michel & Stiefenhöfer, 2019). Such awareness could allow learners to deliberately choose to use or avoid producing the target structure(s) (Costa et al., 2008; Ruf, 2011).

Relatedly, there is evidence that noticing the target structure can boost syntactic priming. Explicit manipulations to make L2 learners notice the target form increase syntactic priming (Shin & Christianson, 2012) and one study reported that only L2 learners who detected the target form experienced immediate priming (McDonough & Fulga, 2015; but see Chapters 3, 4 and 5). Noticing may enhance syntactic priming because L2 learners deliberately decide to re-use the syntax of their interlocutors (e.g., Grüter et al., 2021). For instance, in post-syntactic priming task interviews, participants frequently report using their partner's language while composing their own sentences (Michel, 2018; Michel & O'Rourke, 2019). When interacting with a native speaker, learners could take such a decision if they are particularly interested in improving their L2 skills (Costa et al., 2008), want to seize the opportunity to practice producing the target structure or if they wish to sound like a native speaker (Ruf, 2011).

However, L2 learners may also decide to avoid producing a target structure they notice (Jackson & Ruf, 2018; Michel & Stiefenhöfer, 2019; Ruf, 2011). For example, learners sometimes report producing the structure requiring the least amount of effort, such as the one that is faster to type, or the least syntactically complex (Kim et al., 2020). L2 learners' metalinguistic knowledge about their ability to produce the target structure may also affect their decision to repeat it or not (Costa et al., 2008). Although they did not relate it to explicit avoidance decisions, Shin and Christianson (2012) observed that their learners aligned less on more syntactically complex forms. In Chapter 4, one participant reported deciding to use active rather than passive sentences because they felt more confident doing so and they were worried about making "silly mistakes" when producing passives.

To sum up, there is evidence that L2 syntactic priming may be influenced not only by speakers' prior knowledge of the prime syntactic structure, but also by deliberate decisions to use or avoid producing it. Thus, as Costa et al. (2008) predict, syntactic priming patterns could vary across structures because, while L2 learners

may experience some implicit syntactic priming from interactions, their prior knowledge and conscious decisions could operate in different ways for different structures (e.g., depending on their complexity). Yet, the effects of these two factors on syntactic priming behaviour and the resulting learning remain largely unexplored. By directly comparing syntactic priming across structures within learners, we can investigate more systematically their impact on syntactic priming and learning.

7.1.2 L2 learning via syntactic priming in chat-based interactions

Most L2 syntactic priming studies have examined face-to-face, oral interactions but text-based chat interactions may benefit L2 learners more (Smith, 2005), and thus facilitate L2 learning via syntactic priming. This context preserves most of the interactivity of face-to-face conversations but is also like conversing in slow motion (Beauvois, 1992): the sentences of the interlocutors remain on the screen, learners can scroll up and down the conversation and have more time to formulate their own sentences. The written modality also gives L2 learners the opportunity to rely on self-paced processing and may make the target syntactic structures particularly salient (Kim & Godfroid, 2019; Sauro, 2009). This could in turn help L2 learners to understand and process the linguistic input (Gilabert et al., 2016), and notice the targeted structure(s) (Kim et al., 2020; Ziegler, 2016), which is thought to foster L2 learning (Doughty & Long, 2003; Long, 1996; Schmidt, 1990; see Kerz et al., 2017 for a review).

A recent SLA meta-analysis comparing learning outcomes between chat-based and face-to-face interactions revealed that learners' L2 productive skills benefit more from the former type of interaction (Ziegler, 2016). The few L2 syntactic priming studies conducted in chatting environments indicate that priming does occur in this context (Collentine & Collentine, 2013; Kim et al., 2019, 2020; Michel & Cappellini, 2019; Michel and Stiefenhöfer, 2019; Uzum, 2010) and that it may be larger than in face-to-face interactions (Kim et al., 2019, 2020). Moreover, chat-based syntactic priming tasks seem to lead to long-term learning in language production (Kim et al., 2019, 2020).

However, such studies are rare and more research is needed to determine the conditions of syntactic priming in this environment and its impact on long-term

learning. For example, whether syntactic priming in this context extends beyond the use of a single syntactic structure or alternation is unknown. By including a variety of structures in a chat-based interaction, we can determine whether L2 learners experience priming effects and language learning when exposed to multiple syntactic structures simultaneously. Moreover, it is still not well understood whether learners' knowledge or conscious decisions to use a given structure influence chat-based syntactic priming. However, if chat-based interactions indeed promote noticing of the target structures, they should provide an ideal environment to test whether syntactic priming in L2 learners is influenced by conscious decisions. To our knowledge, Kim et al. (2020) is the only study to consider the possible effects of these factors on priming in this context but it did not systematically test the effect of decisions on syntactic priming. Finally, past studies have examined the effects of syntactic priming on L2 language production (i.e., whether it increases production of target structure in a post-test relative to a pre-test; e.g., Kim et al., 2019, 2020; Ruf, 2011) but it remains largely unclear whether such tasks also lead to improvements in explicit metalinguistic knowledge of the targeted structure(s). Shin and Christianson (2012) did find that, following a syntactic priming activity, L2 learners' explicit metalinguistic knowledge, as measured in pre- and post-test grammaticality judgment tasks (GJT), improved marginally, but the task was conducted in the oral modality. If chatting makes the target structure more salient and helps with processing the linguistic input, the likelihood of L2 learners improving on GJTs may be higher in this context.

As well as addressing theoretical questions about models of priming, investigating these issues is particularly relevant for L2 pedagogy. First, it will allow us to assess whether it is possible to foster practice and learning of multiple structures, both in terms of language production and explicit metalinguistic knowledge, within a single syntactic priming task. This cross-structures comparison will also reveal which structures can best be learned via priming activities depending on the learners' state of knowledge (Jackson, 2018). Finally, understanding the nature of syntactic priming and how much it relies on implicit versus explicit (i.e., conscious decisions) processes will yield further insights on how each type of process relates to long-term language learning. This could help instructors identify whether giving learners explicit instructions to copy structures supports L2 learning further.

7.1.3 Present study

This study addressed the following research questions:

1. Do learners exhibit syntactic priming in a chat-based interaction that includes multiple syntactic structures?
2. Does such syntactic priming lead to long-term syntactic learning in language production and in explicit metalinguistic knowledge?
3. Do learners' prior knowledge of the target structures and their conscious decisions affect the magnitude of syntactic priming and the resulting learning?

To do this, we invited Spanish L1 speakers learning English to interact with the experimenter in a chat-based syntactic priming task conducted in English. We measured syntactic priming by comparing participants' production of the target structures following prime sentences that contained the target structures relative to syntactically-unrelated prime sentences. We examined whether this led to (long-term) syntactic learning, measured as increased production of target structures and as improvements in accuracy on a GJT in post-tests that followed the priming task relative to pre-tests. We assessed the learners' syntactic priming and learning of three English syntactic structures: 'of' genitives (e.g., "The laptop of the girl"), passives (e.g., "The surgeon is being followed by the policeman"), and double object (DO) datives (e.g., "The monk is giving the judge the apple"). We chose these target structures because participants were likely to have experienced them with varying frequency levels in their L1 and L2 and therefore, to have varying degrees of prior knowledge for each them. We also expected participants to take different decisions regarding the use or avoidance of each of them, as described below.

7.1.3.1 Target structures

7.1.3.1.1 'Of' genitives

In English, genitives can be formed in two ways: by placing the owner of the object after the object that is owned (1a) in a preposition phrase headed by 'of' or by placing the owner before the object that is owned with possession marked by ''s' on the owner ('s genitives, 1b). Genitives in Spanish can only be formed in a preposition phrase with 'de' (of) and follow the same word order as English 'of'

genitives (1c). Thus, we expected L2 learners to have experienced the 'of' genitive structure more frequently and to have more prior knowledge of it than of 's genitives overall. It was unclear whether they might consciously? decide to use 'of' genitives because they would be more familiar with them or whether they might avoid 'of' genitives because they would be longer to type.

(1) a. The mirror of the seller.

b. The seller's mirror.

c. El espejo del vendedor.
The mirror of-the seller.

7.1.3.1.2 Passives

English passive sentences require a subject noun phrase with a patient in first position, followed by an auxiliary verb, a past participle and optionally, a "by-phrase" with an agent (2a). Spanish has both this periphrastic structure (2c) and impersonal passives, which use the pronoun *se* (2d). While passives do lead to within-L2 syntactic priming effects (e.g., Flett, 2006), they are more syntactically complex than actives (2b) and usually highly dispreferred (see Gámez et al., 2009 for a discussion). Thus, we expected L2 learners' Spanish and English prior knowledge would make the active form more available than the passive form. We also expected them to be more likely to decide to avoid producing passive sentences because they would be longer to type and more difficult than active sentences.

(2) a. The adults are being followed by the kids.

b. The kids are following the adults.

c. Los adultos están siendo seguidos por los niños.
The adults are being followed by the kids.

d. *Se* está siguiendo a los adultos.
REFl.3SG is following to the adults.
The adults are being followed.

7.1.3.1.3 DO Datives

English has two structures for expressing dative (transfer) events: the DO dative where the recipient is placed immediately after the verb and before the theme (3a) and the prepositional object (PO) dative in which the theme of the transfer event is expressed immediately after the verb and before the recipient which appears in a preposition phrase (3b). By contrast, Spanish only has PO datives (3c), with an optional pre-verbal dative clitic agreeing with the recipient. Thus, we expected L2 learners to have experienced PO datives more frequently than DO datives, making the former more likely to be the automatically-selected structure. Whilst learners might decide to use DO datives since they would be shorter to type, we expected learners to be more likely to choose to avoid them as they would be less familiar and therefore less confident with them (Costa et al., 2008).

(3) a. The girl is giving the adult the bag.

b. The girl is giving the bag to the adult.

c. La niña (le) está dando la bolsa al adulto.
The girl (him) is giving the bag to-the adult.

7.1.3.2 Predictions

Overall, we expected L2 learners to experience chat-based syntactic priming and learning in terms of language production across structures (e.g., Hurtado & Montrul, 2021a; Kim et al., 2019, 2020). Whether they would also exhibit learning in terms of metalinguistic explicit knowledge was less clear (Shin & Christianson, 2012). If learners experience more syntactic priming on structures whose linguistic representations are the most available (Costa et al., 2008), they should show the most syntactic priming on 'of genitives', followed by passives and DO datives. This is because 'of' genitives are the only option in Spanish, passives exist in Spanish but

are less frequent than actives and DO datives do not exist in Spanish. If learners are influenced by conscious decisions to align, as Costa et al. (2008) propose, they should experience the least syntactic priming when choosing to avoid producing a target structure and the most when deciding to use it. On the contrary, if syntactic priming largely relies on implicit language learning mechanisms (e.g., Chang et al., 2006; 2012; Reitter et al., 2011), learners should show the most syntactic priming on structures they have the least prior knowledge of (i.e., DO datives) and show syntactic priming regardless of their decisions. How decisions relate to long-term priming was an exploratory question[23].

We tested these predictions in a two-part online experiment. Participants completed a picture description task to assess their baseline production, and a GJT to assess their baseline explicit metalinguistic knowledge of the targeted structures. Then, they interacted with an experimenter via an online chat in a joint picture-searching task designed to induce syntactic priming. They then completed a second picture-description task and a second GJT to measure learning and were questioned on their conscious decisions.

7.2 Methodology

7.2.1. Participants

We tested 47 Spanish L1 speakers (30 female), learning English as a second language. They were students recruited by contacting universities in Spain, and all received a €15 Amazon voucher as reimbursement. The study was approved by the Humanities and Social Sciences Research Ethics Committee at the University of Warwick. Informed consent was obtained prior to the test session. Participants were aged between 18 and 25 years old (M= 19.18) and their proficiency scores on the English LexTALE test (Lemhöfer & Broersma, 2012) ranged from 53.75 to 95 (M= 73.20, SD= 10.79). Hence, while the participants were of upper intermediate proficiency on average (LexTALE scores between 60 and 80% correspond to a B2 level), they exhibited a wide range of proficiency levels with LexTALE scores below

[23]We did not explore the effect of prior knowledge and conscious decisions on improvements in GJT scores because Costa et al.'s (2008) predictions regarding the effect of these factors only concern priming.

59% corresponding to a B1 level (or lower) and scores between 80 and 90% representing C1 and C2 levels (Lemhöfer & Broersma, 2012).

7.2.2. Materials

7.2.2.1 Production task

Participants completed a pre- and a post-test production task on Qualtrics which assessed whether they experienced learning in terms of target structure production. Participants were instructed to describe 24 pictures per task. We created 6 target images per structure, and 6 filler images (showing intransitive events) using different verbs and different combinations of objects and characters for each test (based on the stimuli from Chapters 2, 4, 5 and Jackson & Ruf, 2018). Each picture contained word labels for the characters, objects and verbs they depicted to aid vocabulary retrieval. For the transitive, dative and intransitive targets, participants were prompted with "what is happening in this picture?". The position of the agent characters was counterbalanced to appear an equal number of times on the right vs. left side of the pictures for the transitive and dative events. The pictures targeting the genitive alternation contained two characters with the same object. To ensure that participants would use genitive constructions, one of the characters' objects was coloured and participants' descriptions were prompted by "which <OBJECT> is blue?" (cf. Bernolet et al., 2013, Figure 7.1). In addition, we explicitly instructed participants to use the form "the _____ is blue". The order of presentation of pictures was randomized across participants.

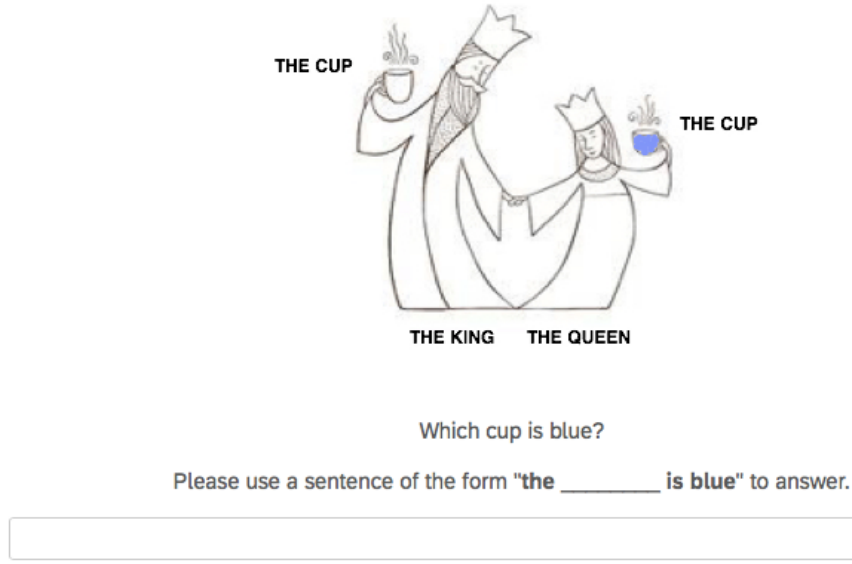


Figure 7.1 Production task stimulus. Example of a genitive trial.

7.2.2.2 Grammaticality judgment task

Participants completed a pre- and a post-test GJT to allow us to measure whether they would experience improvements in explicit metalinguistic knowledge (i.e., whether they would obtain higher GJT scores in the post- than in the pre-test). In this task, participants were presented with written sentences and asked to indicate for each item whether it was "correct" or "incorrect" or that they did not know. We created a total of 36 target items (12 per structure) and each target sentence was associated with an image that was simultaneously displayed to the participants to ensure that they would understand what the sentence was supposed to mean (Figure 7.2). Each item had a grammatical and an ungrammatical version (see Table 7.1 for examples and the OSF for a detailed list of stimuli). We created two lists so that each item would appear as grammatical in one list and as ungrammatical on the other one, while each list contained 6 correct items and 6 incorrect items per structure (as in Kim et al., 2019; Shin and Christianson, 2012). The order of presentation of sentences was randomized across participants and participants were assigned randomly to each list.

Table 7.1 Stimuli in the GJT. Example of grammatical and ungrammatical stimuli for each target structure.

Target structure	Grammatical form	Ungrammatical form
DO dative	The teacher is giving the dancer the book.	The teacher is giving the book the dancer.
'of' genitive	The scarf of the teacher.	The teacher of scarf the.
Passive	The monk is being tickled by the waitress.	The monk is being tickled the waitress.

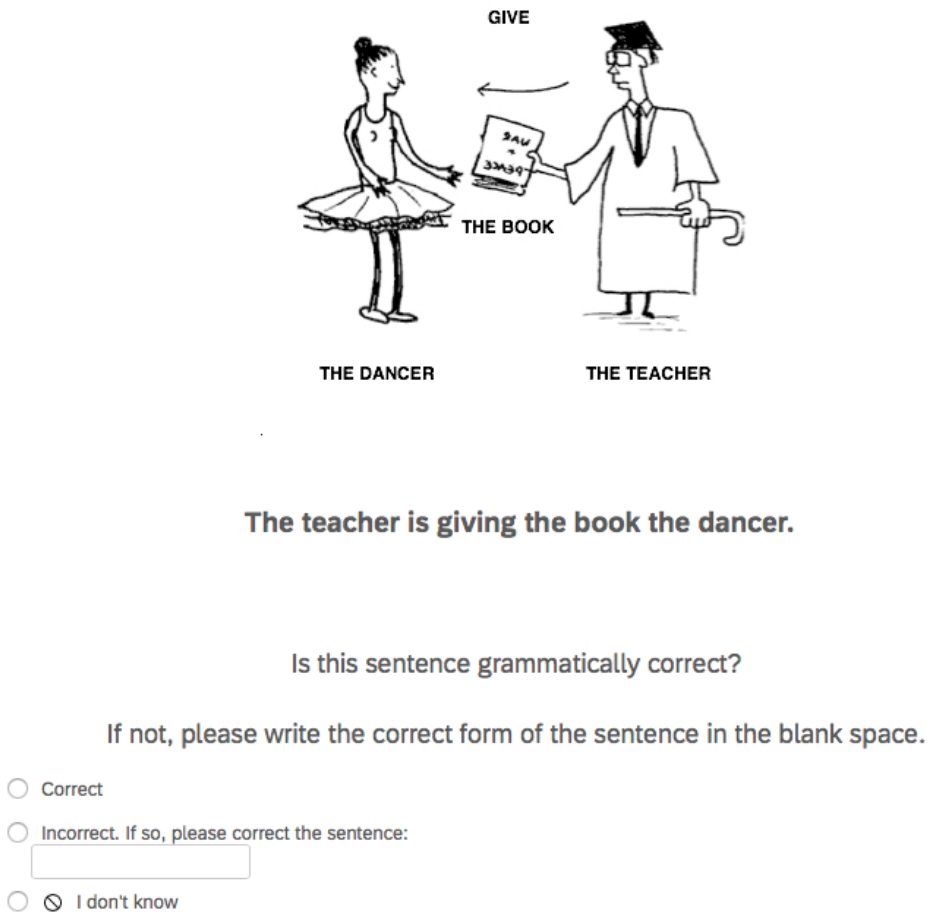


Figure 7.2 GJT stimulus. Example of a dative trial.

7.2.2.3 Syntactic priming task

The syntactic priming task was embedded within a picture-searching task in which participants labelled items for their chat partner to find within a larger picture. The chat therefore involved exchanging descriptions and possible locations for the item in the larger picture and determining whether the item was in that location. We divided four "Where's Wally?" pictures into grid squares designated by combining a letter and number reference (e.g., A2, C4, …) according to their row and column in the grid. Using these four pictures, we created 72 experimental target items (24 per syntactic structure) describing either an action (for passives and DO datives) or a character and their object (for 'of' genitives) depicted in one of them (Table 7.2). Each target item was associated with an experimental prime which contained the target structure and an unrelated prime which contained an unrelated syntactic form (e.g., an intransitive form). We created 36 experimental primes (12 per structure) containing different verbs, objects and characters in order to avoid lexical overlap and 36 unrelated primes (12 per structure) based on other actions and objects in the pictures. Each prime (experimental or unrelated) was associated with two target sentences.

Table 7.2 Stimuli in the syntactic priming task. Example of unrelated prime-target and experimental prime-target combinations for each target structure.

Target structure	Unrelated prime	Experimental prime	Target sentence
DO dative	The kids are running.	The woman is throwing the man the ball.	The woman is showing the boy the towel.
'of' genitive	The woman is swimming.	The scarf of the girl.	The shovel of the boy.
Passive	The man is suffering.	The man is followed by the girl.	The boy is being scolded by the woman.

We distributed the 72 experimental trials equally between the four "Where's Wally?" pictures. Therefore, each picture was associated with 18 target sentences (6 passives, 6 'of' genitives and 6 DO datives), 9 experimental primes (3 per structure)

and 9 unrelated primes (all intransitive). We created two different lists with the same 72 target structures so that a given target sentence was paired with an experimental prime on one list, and with an unrelated prime on the other; participants were randomly assigned to a list. This created eight picture description sets: four experimenter sets containing the prime sentences and four participant sets containing the target sentences. Each set corresponded to one of the four "Where's Wally?" pictures. The participant sets showed close-up pictures of the target items (Figure 7.3). On each picture, label words for the characters, the objects and the verbs were provided to prevent problems of vocabulary retrieval and avoid code-switching or lexical overlap between the prime and target sentences. The word position was counterbalanced across items. For the genitive target sentences, the word labels corresponding to the targeted objects (e.g., "bag" in the genitive "the bag of the woman") were coloured in red to indicate to participants that the experimenter had to find the object as well as the character, and therefore that a genitive description was required. The experimenter's picture description sets provided the prime sentences corresponding to each picture to ensure correct production of the prime sentences. The order of the pictures was pseudo-randomized so that there were never two consecutive target sentences targeting the same syntactic structure. The order of prime-target pairings was the same for all participants. Additionally, all picture description sets designated a grid reference where the target item might be found (Figure 7.3). To create the searching task, only 25% of these references were accurate.

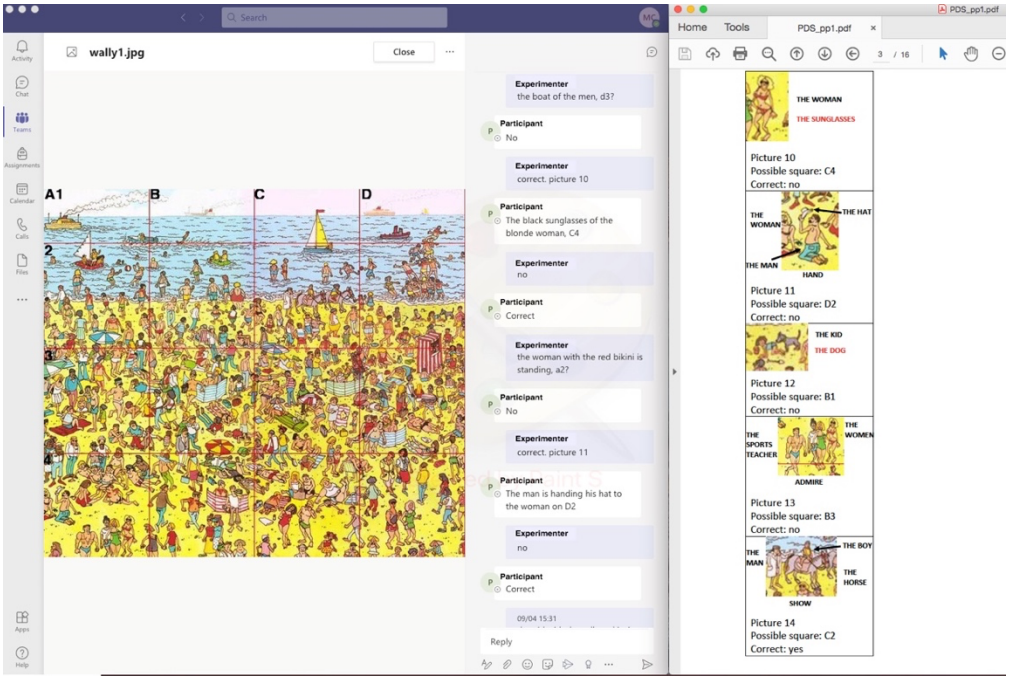


Figure 7.3 Set up of the syntactic priming task. Participant set up.

7.2.2.4 Post-test questionnaire

We evaluated whether participants noticed the target structures and relied on conscious decisions during the syntactic priming task in a post-test questionnaire on Qualtrics, which also probed the reasons underlying these decisions. We showed participants the name of each targeted grammatical structure, three sentences containing the structure in question and an explanation of how to build it. For each structure, we first asked participants whether they had noticed the target structure during the collaborative syntactic priming task; possible answers were “yes”, “no”, “maybe”. Then, we asked about participants’ conscious decisions by asking them whether they deliberately tried to (1) avoid, (2) use/copy or (3) neither avoid nor use the structure during the chat. If they selected option 1 or 2, they were presented with a further question asking them why they had taken that decision.

7.2.3 Procedure

Participants were informed that the study was about how people chat in a second language. The study was split into two parts. In the first part, after signing the informed consent, participants completed a language background questionnaire,

followed by the English LexTALE test, the pre-test production task and the pre-test GJT.

The second part of the study was performed at least five days after the first part to prevent participants from being influenced by the structures they had been exposed to in the GJT in the syntactic priming task. Participants first completed the syntactic priming task on Microsoft Teams (Figure 7.3) which was divided into four blocks corresponding to each "Where's Wally?" picture. Each picture was saved in the Teams meeting channel. Before each block, the participant was asked to open the corresponding picture description set on their desktop and the "Where's Wally?" picture in the Teams meeting channel. The Teams conversation function, which appears as an instant messaging conversation on the side of the open picture file, was used for the chat. Participants were told that they would be interacting with an English L1 speaker. At the beginning of each prime-target trial, the experimenter wrote a description (prime sentence) in the chat as well as a grid reference. The participant indicated whether the described element was in the indicated grid square by searching in the "Where's Wally?" picture and typing their response ('yes' or 'no'). The experimenter provided feedback to the participant ('correct' or 'incorrect'). Next, the participant wrote a description of the first picture presented in their picture description set in the chat (target sentence) and cited the provided grid reference. They were instructed to use the label words to formulate their descriptions but were allowed to use additional adjectives or complements to make their descriptions more precise (e.g., "the horse of the man *with the grey t-shirt"*). The experimenter then checked whether the described picture element was in the indicated grid square and typed their response. The participant was asked to provide feedback before the next trial started. Once all target pictures had been described, participants were sent a link to reach the post-test production and GJT tasks, and the questionnaire. There was no time constraint on any of the tasks.

7.2.4 Scoring

7.2.4.1 Production and syntactic priming tasks

Target sentences were coded for whether they were 'of' or 's genitives, active or passive sentences, PO or DO datives, or 'other'. Complete 's genitives contained a possessor marked with an 's followed by the possessed object; complete 'of'

genitives contained a possessor placed after the possessed object with the preposition "of" between them. Complete active sentences contained a subject noun phrase with the agent produced first, followed by the verb and finally, an object noun phrase with the patient; complete passive sentences contained a subject noun phrase with a patient in first position, followed by a form of the verb "to be", a past participle and finally, a by-phrase with an agent. Complete PO datives contained a ditransitive verb followed by a noun phrase with the theme role followed by another noun phrase with the recipient/goal role introduced by the preposition "to"; complete DO datives contained a ditransitive verb followed by a noun phrase with the recipient/goal role followed by another noun phrase with the theme role.

We ignored morphological errors, such as tense or agreement errors and naming errors in which participants used an alternative noun for a character (e.g., naming a character "the judge" instead of "the teacher"). We included 's genitives where the apostrophe was missing ("The boys shovel"). For dative and transitive sentences, we included sentences with complex noun phrases (e.g., "the teacher kicked the clown's leg"), sentences with an added auxiliary (e.g., "the waitress does kick the jester") or with negation (e.g., "the fighter does not chase the robber") as well as sentences with inverted nouns[24] ("The doctor is being followed by the ballerina" instead of "The ballerina is being followed by the doctor" or "The doctor is giving the boy the gun" instead of "The boy is giving the doctor the gun"). All other responses were excluded, including actives that were not paraphrasable with a passive (e.g., with a modal auxiliary), incomplete sentences (e.g., with a missing complement) and misaligned trials (Table 7.3).

[24]While we excluded reversed sentences from the statistical analyses in the previous chapters, we decided to include them here as, due to the ambiguous nature of some of the pictures?, we judged it as not unlikely that participants could misunderstand which of the two characters in a picture they had to describe was the agent or the patient.

Table 7.3 Overview of response frequencies in the syntactic priming task.

Frequency of target responses by structure and experiment phase.

		Response		
Structure	**Phase (prime)**	**Target**	**Alternative**	**Other**
DO dative	Pre-test	16	246	20
	Unrelated prime	56	433	75
	Experimental prime	88	414	62
	Post-test	34	239	9
'of'	Pre-test	31	221	30
genitive	Unrelated prime	179	289	96
	Experimental prime	223	283	58
	Post-test	53	205	24
Passive	Pre-test	29	241	12
	Unrelated prime	48	473	43
	Experimental prime	62	458	44
	Post-test	36	245	1

7.2.4.2 Grammaticality judgment task

We scored the results of the GJT in terms of accurate (i.e., correctly identifying a correct sentence as correct or an incorrect sentence as incorrect) versus inaccurate responses (i.e., incorrectly identifying an incorrect sentence as correct and vice versa) as in Gutierrez, 2013 (Table 7.4). The participants did not provide any "I don't know" answers but we scored missing answers as "other" data[25].

[25]Due to experimenter error, we excluded the data of 16 participants from the GJT genitive scores as they did not perform the pre-test for genitives. Additionally, 24 participants experienced 7 incorrect DO datives and 5 correct DO datives (instead of 6 of each) and 15 participants experienced only 5 (instead of 6) correct 'of' genitives in the GJT post-test.

Table 7.4 Overview of response frequencies in the GJTs. Frequency of response type by accuracy of the target structure, structure and experiment phase. *"Accurate"/ "inaccurate" refer to the accuracy of participants' responses, e.g., whether they accurately identified an incorrect sentence as being incorrect.*

		Response				
Structure	**Phase**	**Incorrect**		**Correct**		**Other**
		Accurate	**Inaccurate**	**Accurate**	**Inaccurate**	
DO dative	Pre-test	255	22	124	152	11
	Post-test	258	38	151	103	14
'of' genitive	Pre-test	178	6	128	57	3
	Post-test	163	17	148	23	22
Passive	Pre-test	234	47	276	4	3
	Post-test	206	69	272	8	9

7.2.4.3 Conscious decisions

We grouped participants by their response on the conscious decision questions for each structure as Avoid, Use or No Decision. For the purpose of the analyses, the Avoid group were coded 0, the No Decision group were coded 1, and the Use group were coded 2 (Table 7.5).

Table 7.5 Conscious decisions statistics. Number (percentage) of participants selecting each decision per structure.

		'of' genitives	**Passives**	**DO datives**
Decisions	**Avoid**	14 (29.8%)	7 (14.9%)	7 (14.9%)
	Neither	11 (23.4%)	24 (51.1%)	29 (61.7%)
	Use	21 (44.7%)[1]	16 (34.0%)	11 (23.4%)

[1]One participant did not provide an answer regarding their decision for 'of' genitives. Their data were removed from the analyses that included Decision as a factor.

7.3 Analysis and results

Since our dependent variables were binary, we analysed the data for syntactic priming and learning effects with Generalized Logistic Mixed Models (GLMM)

(Baayen et al., 2008; Jaeger, 2008). The dependent variable was coded as 0=alternative structure (i.e., 's genitive, active or PO dative) and 1=target structure (i.e., 'of' genitive, passive or DO dative). When examining learning in terms of explicit metalinguistic knowledge (GJT tasks), the dependent variable was coded as 0=inaccurate and 1=accurate responses. Participants' LexTALE scores were centred. The factorial predictors Prime (experimental vs. Unrelated prime) and Section (pre-test vs. post-test) were sum contrast coded to have a mean of 0 and a range of 1 prior to analysis. We applied treatment contrast coding for the predictor Structure and defined 'of' genitives as the reference level since we expected learners to be most likely to experience priming on this structure. The contrast 'Structure 1' compared the production of passives to 'of' genitives and 'Structure 2', compared datives to 'of' genitives. We used multiple contrasts to compare syntactic priming in the Avoid decision group (-0.66) to the Use (0.33) and No Decision (0.33) groups combined (Decision 1), and to compare the Use (-0.5) to No Decision (0.5) groups (Decision 2). We chose this contrast because we expected participants to show the least priming in the Avoid group, the most in the Use group, and priming to be more variable in the No Decision group.

Each analysis started with a full model including maximal by-subject and by-item random effect structure (Barr et al., 2013) and we tried to locate the best model that did not differ significantly from the full (converging) model in terms of variance explained but did differ from a null model which only included the intercept term as a predictor, as shown by ANOVA comparisons. Where models did not converge, we removed random slopes and interactions before main effects, starting with those accounting for the least variance. We report the results of the best models. All p-values for individual predictors were obtained from the model summary output.

We could not reach converging models that contained the three-way interactions of interest between Decision, Structure and Prime/Section. Therefore, we first examined syntactic priming or learning by structure (Prime/Section x Structure); we then explored the overall effect of Decision on syntactic priming and learning across all structures (Prime/Section x Decision); finally, we analysed the effect of Decision for each structure separately. We tested non-significant interactions between Prime/Section and Structure or Decision using the Bayesian information criterion (BIC) values of the models to estimate the Bayes Factor (BF) as $e^{(\text{AlternativeBIC} - \text{NullBIC}) / 2}$ to confirm whether our data supported the null hypothesis. We compared a model

with only the main effects of the factors (Null model) to a model that contained the interaction between these factors (Alternative model; Wagenmakers, 2007). Inverse BFs <1 favour the null hypothesis and values >1 favour the alternative hypothesis; in particular, values below .0067 provide "very strong" evidence in favour of the null hypothesis, values between .05 and .03 "strong" evidence, and values between .33 and .10, "positive" evidence (Jarosz & Wiley, 2014; Raftery, 1995).

7.3.1 Syntactic priming effects

The best model for syntactic priming by structure revealed a significant main effect of Prime (Table 7.6): Participants produced more target sentences after experimental primes (*M*=0.25, *SD*=0.43) than after unrelated primes (*M*=0.19, *SD*=0.39), with an overall priming effect of 5.3% (Cohen's *d*= 0.34, Figure 7.4a). The contrasts Structure 1 and Structure 2 were both significant: irrespective of the prime, participants produced significantly more 'of' genitives (*M*=0.42, *SD*=0.49) than passives (*M*=0.11, *SD*=0.31) and DO datives (*M*=0.15, *SD*=0.35). Proficiency did not relate to target structure production and there was no interaction between Prime and Structure (inverse BF=.0006, i.e., "very strong" evidence in favour of the null hypothesis, Figure 7.4b): syntactic priming did not vary by structure.

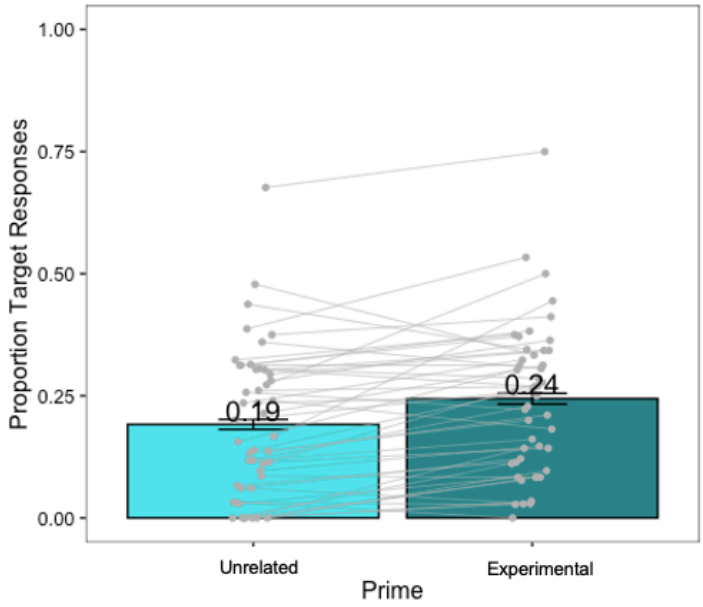
The best model for the effect of conscious decisions on syntactic priming (collapsed across structures) showed significant main effects of Prime, Decision 1 and Decision 2. Participants in the No Decision and Use groups combined produced significantly more target structures (*M*=0.24, *SD*=0.43) than those in the Avoid group (*M*=0.12, *SD*=0.32). They also produced significantly more target structures in the Use (*M*=0.32, *SD*=0.47) than in the No Decision group (*M*=0.19, *SD*=0.39). There was no significant interaction between Prime and Decision (inverse BF=.0003, i.e., "very strong" evidence in favour of the null hypothesis, Figure 7.5a). When analysed by structure, there was a significant effect of Decision 1 for 'of' genitives, β=4.51 (*SE*=1.55), *Z*=2.9, $p<.05$. Participants in the Avoid group produced fewer 'of' genitives (*M*=0.18, *SD*=0.39) than the No Decision and Use groups combined (*M*=0.52, *SD*=0.50). Decision did not significantly predict syntactic priming or target structure production for DO datives or passives (Figure 7.5b). However, even if some of these differences are minimal, for DO datives and passives as well, learners in the Use group produced more target structures (DO: *M*=0.24, *SD*=0.43; passives:

M=0.13, *SD*=0.34) as did those in the No Decision group (DO: *M*=0.12, *SD*=0.33; passives: *M*=0.11, *SD*=0.31) than those in the Avoid group (DO: *M*=0.09, *SD*=0.28; passives: *M*=0.04, *SD*=0.19 respectively).

Table 7.6 Syntactic priming model. Summaries of the best models for syntactic priming. *The best model included the main effects Prime, Structure and LexTALE and by-subject and by-item random intercepts. The best model for syntactic priming per decision included the main effects of Prime and Decision and by-subject and by-item random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Syntactic priming across structures				
Intercept	-1.72	1.33	-1.30	.19
Prime	.40	0.11	3.63	**<.001**
Structure 1	-2.21	.19	-11.78	**<.001**
Structure 2	-1.86	.18	-10.32	**<.001**
LexTALE	0	.02	0	.99
Syntactic priming per decision				
Intercept	-3.48	.31	-11.26	**<.001**
Prime	.46	.11	4.33	**<.001**
Decision 1	1.55	.22	6.99	**<.001**
Decision 2	1.82	.20	9.19	**<.001**

a) Overall priming



b) Priming by structure

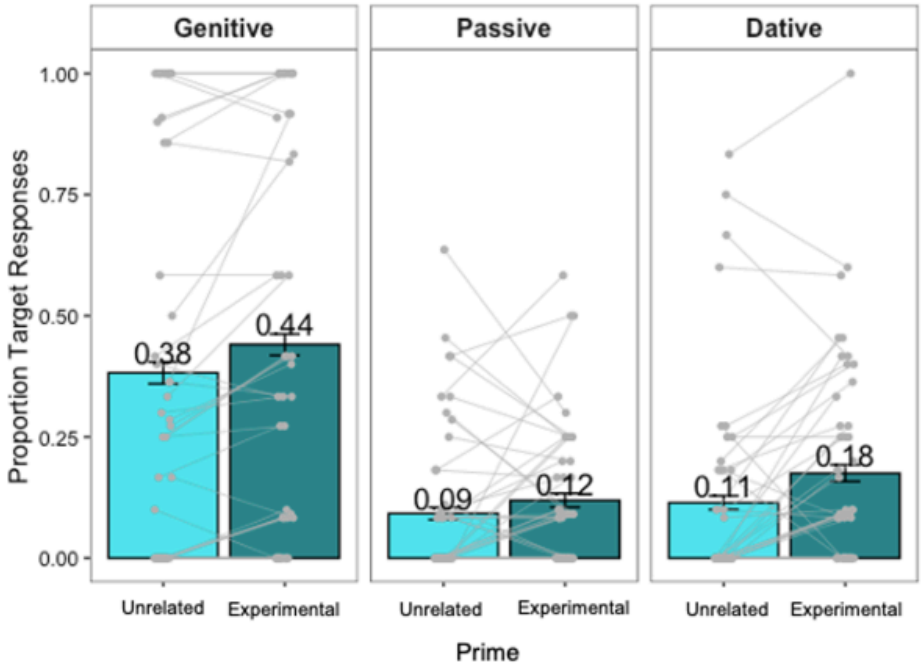
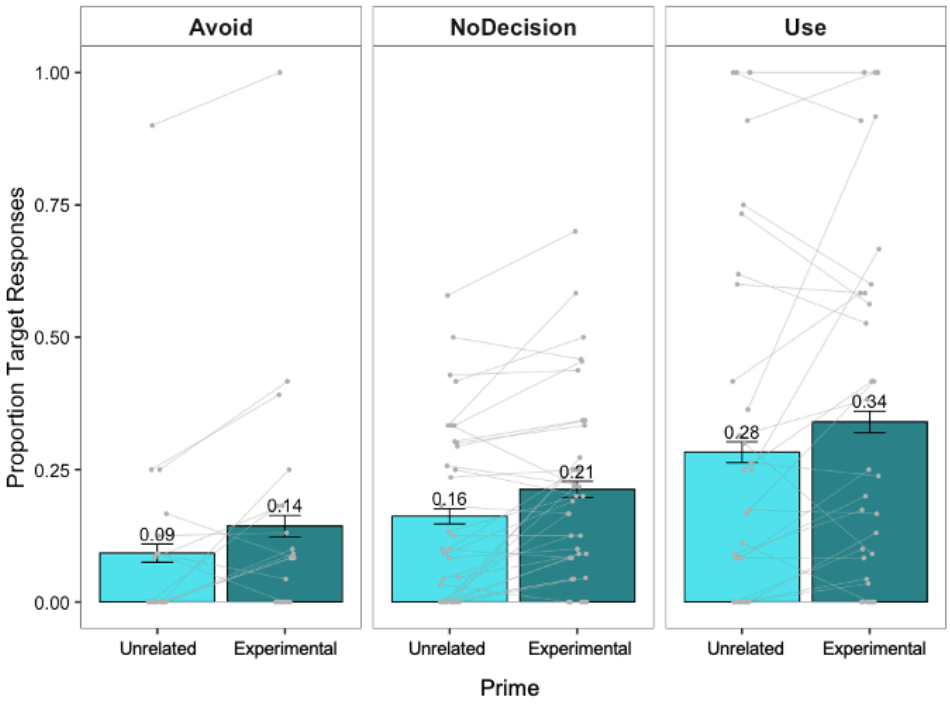


Figure 7.4 Target responses in the syntactic priming task. Mean proportion of target responses by Prime (and Structure) in the priming phase. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

a) Overall effect of Decision on priming



b) Effect of Decision on priming by structure

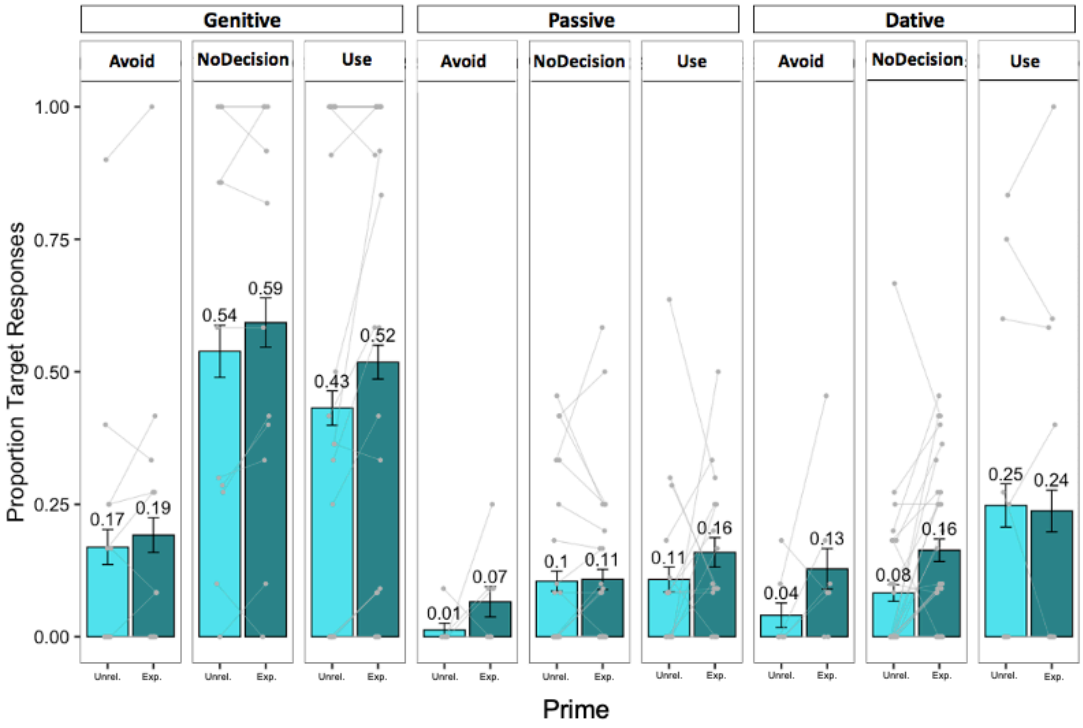


Figure 7.5 Effect of Decision in the syntactic priming task. Mean proportion of target responses by Prime, Decision (and Structure) in the priming phase. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

7.3.2 Learning effects

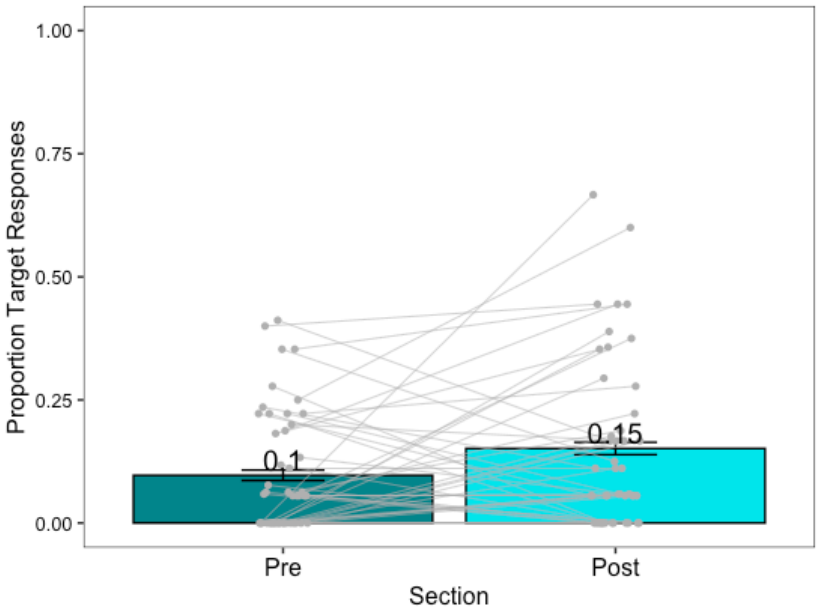
7.3.2.1 Language production

The best model for learning in terms of target structure production revealed significant main effects of Section, Structure 1 and Structure 2 (Table 7.7). Participants produced more target sentences in the post-test (*M*=0.15, *SD*=0.36) than in the pre-test (*M*=0.09, *SD*=0.29), with an overall learning effect of 5.5% (Cohen's *d*= 0.38, Figure 7.6a). Moreover, participants produced more 'of' genitives (*M*=0.16, *SD*=0.36) than passives (*M*=0.12, *SD*=0.32) and DO datives (*M*=0.09, *SD*=0.29; Figure 7.6b) across the whole experiment. Proficiency did not affect this type of learning and there was no significant interaction between Section and Structure (inverse BF=.003, i.e., "very strong" evidence in favour of the null hypothesis): learning did not vary by structure. The best model examining the effect of conscious decisions on learning showed main effects of Section and Decision 2 (Figure 7.7a). The Use group produced significantly more target structures (*M*=0.19, *SD*=0.39) than the No Decision group (*M*=.08, *SD*=0.27). There was no significant interaction between Section and Decision (inverse BF=.14, i.e., "positive" evidence in favour of the null hypothesis). When split by structure, there was no effect of Decision on learning for any structure (Figure 7.7b).

Table 7.7 Learning in language production model. Summaries of the best models for learning in terms of target structures production. *The best model included the main effects of Section and Structure and by-subject and by-item random intercepts. The best model for learning in language production per decision included the main effects of Section and Decision and by-subject and by-item random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Learning across structures				
Intercept	-2.34	.19	-12.62	**<.001**
Section	.52	.17	3.04	**<.001**
Structure 1	-.50	.20	-2.48	**<.05**
Structure 2	-.79	.21	-3.68	**<.001**
Learning per decision				
Intercept	-2.38	.18	-12.96	**<.001**
Section	.61	.19	3.28	**<.005**
Decision 1	.39	.24	1.66	.10
Decision 2	-1.00	.22	-4.48	**<.001**

a) Overall learning



b) Learning by structure

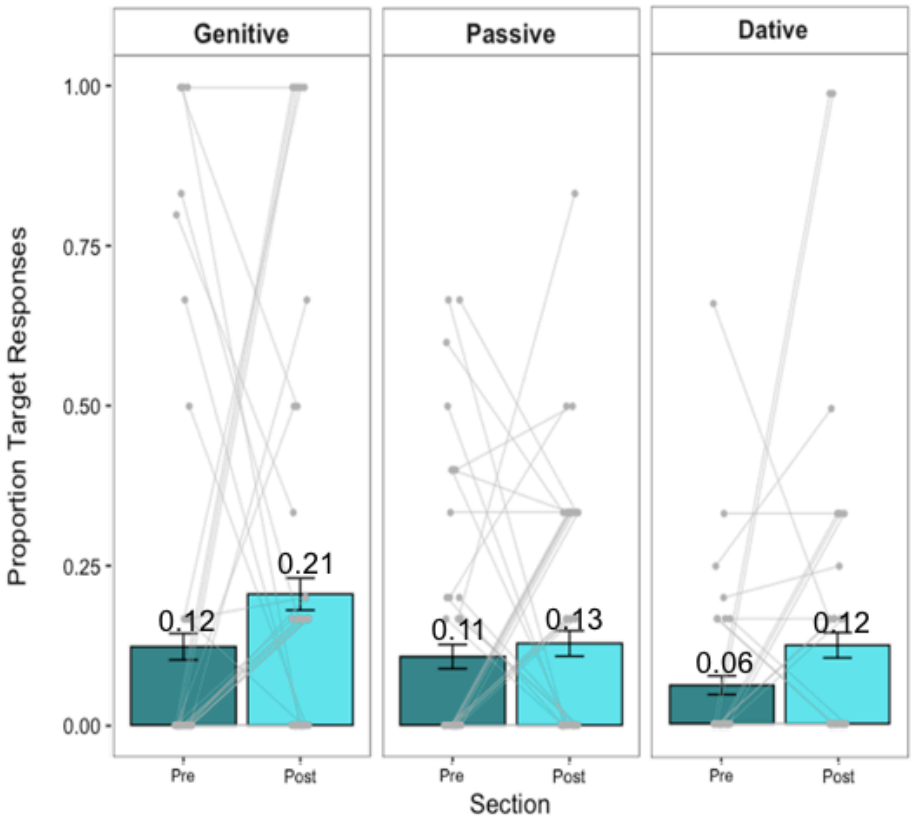
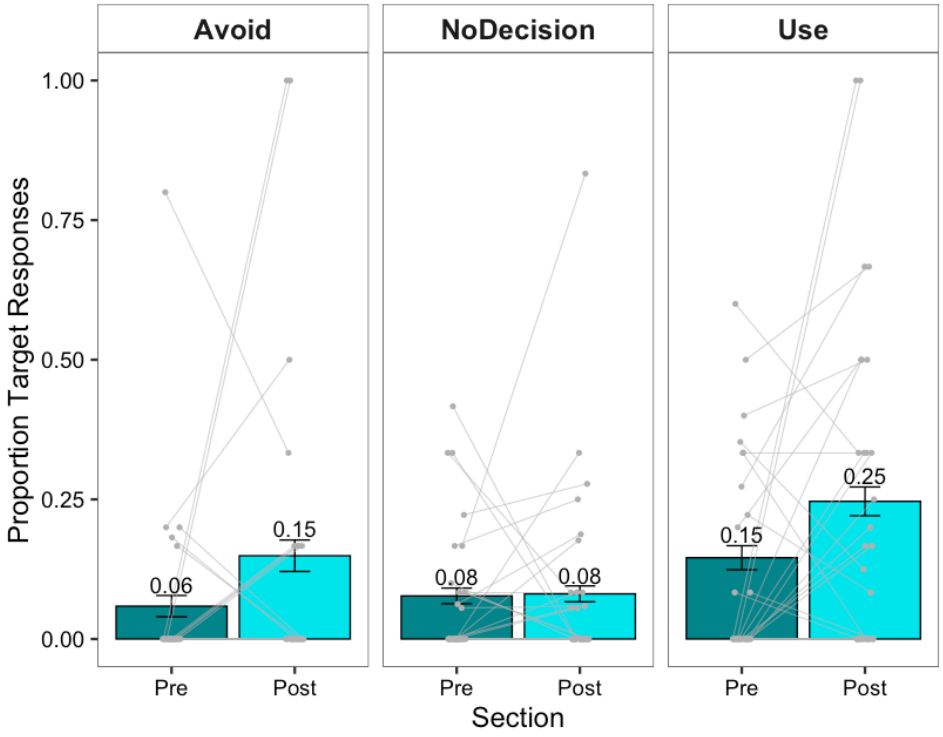


Figure 7.6 Target responses in the pre- and post-tests. Mean proportion of target responses by Section (and Structure) in the pre- and post-tests. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

a) Overall effect of Decision on learning



b) Effect of Decision on learning by structure

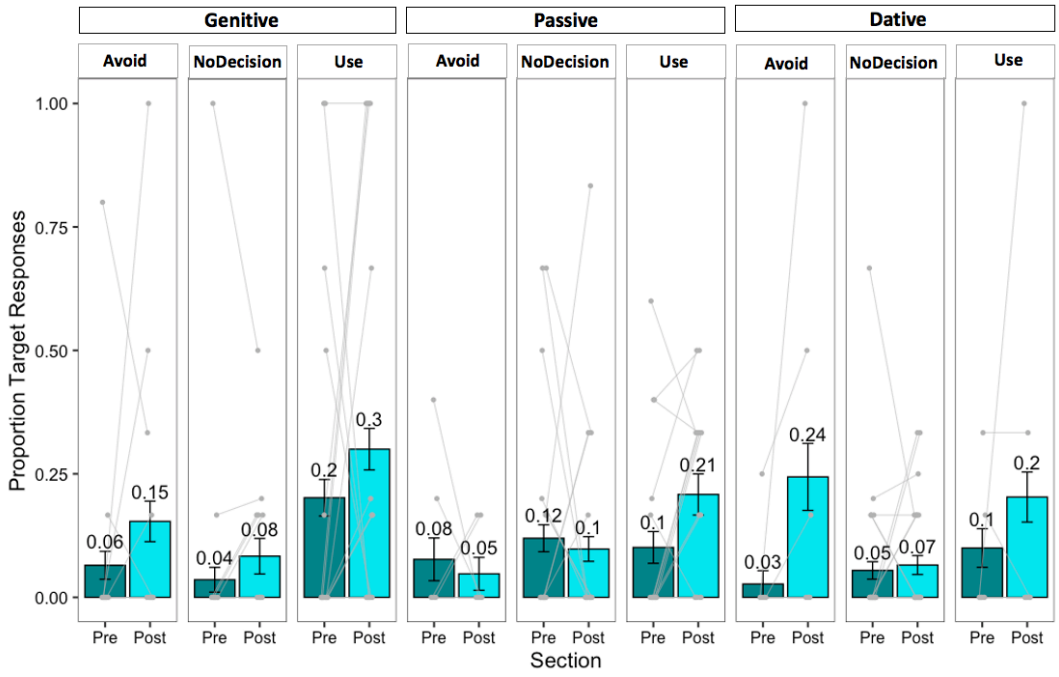


Figure 7.7 Effect of Decision on learning in language production. Mean proportion of target responses by Section, Decision (and Structure) in the pre- and post-tests. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual priming effects.

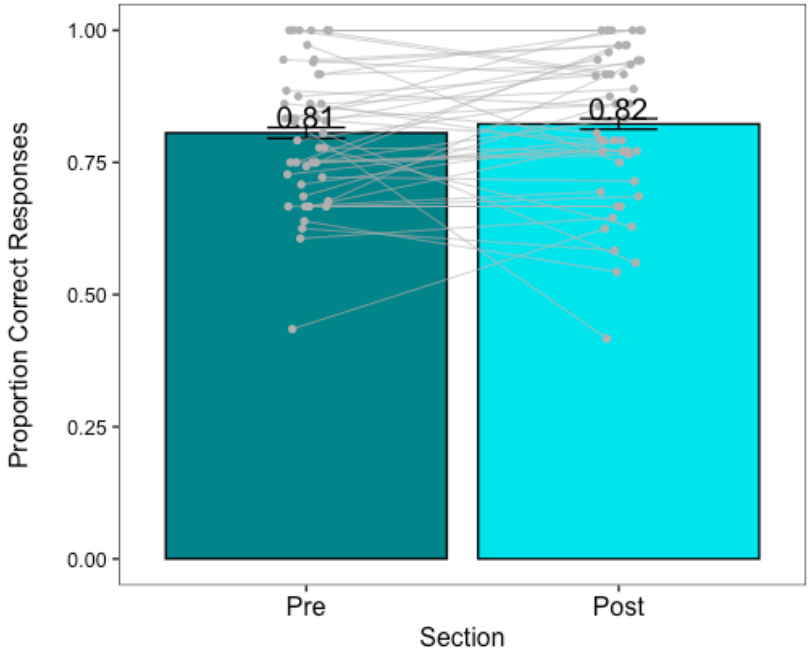
7.3.2.2 Explicit metalinguistic knowledge

The best model for learning in terms of explicit metalinguistic knowledge showed a main effect of Structure 2, whereby participants scored better on 'of' genitives (*M*=.86, *SD*=.35) than on DO datives (*M*=.71, *SD*=.45) (Table 7.8) overall. There was also a main effect of LexTALE, whereby participants scored higher on the GJT with increasing proficiency. Finally, there was a marginally significant interaction between Section and Structure 1 (inverse BF=.05, i.e., "strong" evidence in favour of the null hypothesis, Figure 7.8). However, there was no significant main effect of Section, which indicates that participants did not experience significant learning in terms of grammatical accuracy.

Table 7.8 Model for learning in the GJTs. Summaries of the best models for learning in terms of explicit metalinguistic knowledge. *The best model included the main effects of Section and Structure and their interaction, the main effect of LexTALE and by-subject and by-item random intercepts.*

Fixed effects	Estimate	Standard Error	z-value	*p*-value
Learning across structures				
Intercept	-1.06	1.11	-.96	.34
Section	.03	.14	.21	.84
Structure 1	.23	.19	1.22	.22
Structure 2	-1.05	.18	-5.99	**<.001**
LexTALE	.04	.02	2.76	**<.01**
Section x Structure 1	-.70	.37	-1.90	.06
Section x Structure 2	.11	.34	.33	.74

a) Overall learning



b) Learning per structure

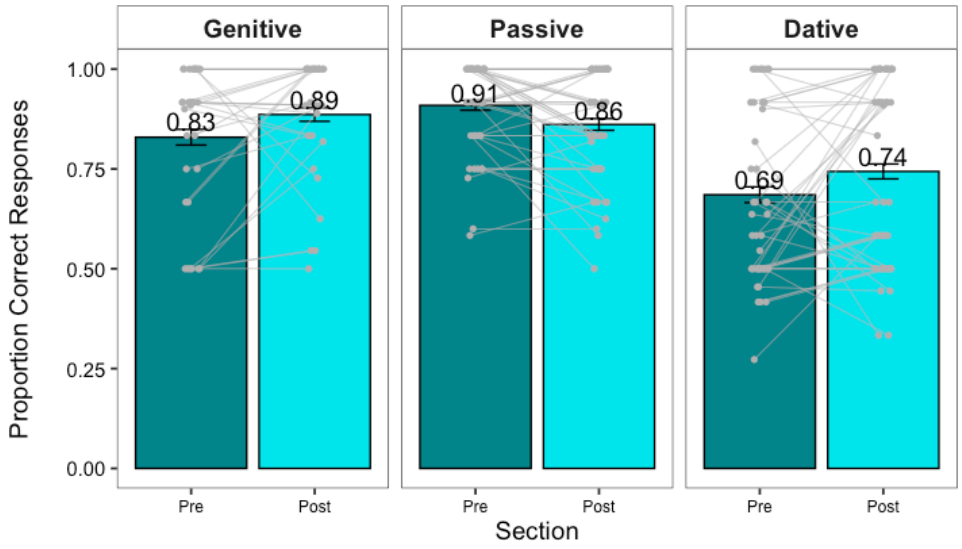


Figure 7.8 GJT scores in the pre- and post-tests. Mean proportion of accurate responses by Section (and Structure) in the pre- and post-tests. Error bars indicate the standard error of the mean, grey dots individual data points and grey lines individual learning effects.

7.4 Discussion

As expected, L2 learners experienced chat-based syntactic priming and learning in terms of target structure production in a task that included multiple structures, but they did not experience learning in terms of explicit metalinguistic knowledge. While prior knowledge and conscious decisions did influence target structure production, they did not significantly affect syntactic priming and learning. We review the implications of these findings for models of syntactic priming and for L2 learning and teaching.

7.4.1 Chat-based syntactic priming and learning

In line with previous research, L2 learners showed chat-based syntactic priming: they produced target structures more frequently following experimental primes than unrelated primes (e.g., Kim et al., 2019, 2020). Moreover, the effect of this immediate chat-based priming was long-lasting: learners produced more target structures in the post-test than in the pre-test as in previous chat-based (Kim et al., 2019, 2020) and oral syntactic priming studies (e.g., Chapters 2, 4, 5; Hurtado & Montrul, 2021a; Jackson & Ruf, 2018). Importantly, this syntactic priming and learning occurred even when multiple target structures were embedded in the same activity. The absence of significant effects of participants' LexTALE scores suggest that the task fostered priming and learning for L2 learners across proficiency levels, as opposed to previous research suggesting the existence of a proficiency "sweet spot" to benefit from priming activities (Grüter et al., 2021).

Participants showed only small (approximately 5%) increases in their production of the target structures on experimental relative to trials with unrelated primesbut this measurement may have actually masked larger effects of priming. Inspection of the graphs suggests that pre-test usage of the target structures was generally lower (accounting for 10% pre-test responses on average) than on trials with unrelated primes (on average 19% responses were target structures versus 24% on prime trials) in the syntactic priming phase. This suggests that once exposed to primes, participants' use of target structures increased across all trials, not just prime trials (see also Chapter 2). We ran an additional exploratory analysis which compared production of the target structures in the pre-test and in the syntactic

priming phase (collapsed across prime conditions). This showed that L2 learners were significantly more likely to produce target structures during the syntactic priming task than in the pre-test (p<.001). Thus, our study adds evidence that chat-based interactions with multiple structures are an appropriate medium to implement L2 grammar learning activities: syntactic priming via chat-based exposure supports increased and lasting target structure production. This is particularly relevant for language teachers who may have to resort more and more to online L2 teaching (Maican & Cocorada, 2021).

One route to learning may be that interacting in a chatting environment makes target structures particularly salient (Kim & Godfroid, 2019; Sauro, 2009). This may help learners notice target structures, which is thought to facilitate L2 learning (Doughty & Long, 2003; Long, 1996; Schmidt, 1990). In fact, 42 of the 47 learners reported noticing the 'of' genitives, 42 noticed passives and 37 noticed DO datives during the syntactic priming activities, which seem higher rates of noticing than in Chapters 3-5. Text-based chatting thus seems an ideal tool for L2 teaching as it fosters noticing of target structures in meaningful language input without explicit instructions. Such noticing may support learners' explicit memories of the prime sentence form used to formulate their own sentences (Kim et al., 2019, 2020). Since learners also experienced long-term learning effects in language production, this suggests that explicit memory processes may contribute to long-term learning via syntactic priming or that such learning benefits from implicit as well as explicit learning processes (see discussion of Chapter 2; Jackson & Ruf, 2018; Kim et al., 2020). However, the results of Chapters 3-4 rather suggest that self-reported noticing of the target structure does not foster larger long-term priming. Since our measure of noticing in this chapter differed from the way we measured it in Chapters 3-5, we refrained from running an additional analysis with this variable but this apparent discrepancy across chapters could indicate that noticing is more likely to support priming in written and interactive contexts. When noticing it, it might be easier for L2 speakers to copy a structure from written input or more relevant to do so to achieve understanding in an interaction (Pickering & Garrod, 2004; see Chapter 8 for further discussion).

Finally, the L2 learners did not show improvements in GJT performance following the syntactic priming task. Shin and Christianson (2012), who similarly only report marginal improvements in GJT scores after a priming task, propose two

explanations. This could be because, while GJT tasks assess knowledge in the comprehension modality, comprehension priming is less well demonstrated. It could be because priming and GJT tasks target different types of knowledge. GJT tasks could be measuring explicit metalinguistic knowledge while syntactic priming activities may trigger acquisition of rather implicit knowledge (e.g., Chang et al., 2006, 2012). Alternatively, while some of our ungrammatical sentences in the GJTs included morphosyntactic errors (see list of stimuli in the OSF), it is unclear whether syntactic priming relates to the acquisition not only of knowledge of word order but also of morphosyntactic knowledge. Finally, the learners of the present study scored highly on the pre-test GJTs for all structures (Figure 7.8) and may thus have simply experienced ceiling effects on this task. Overall, more research is needed to understand whether and how chat-based priming tasks could be improved to foster long-term language learning in terms of explicit metalinguistic knowledge.

7.4.2 Variation across structures

7.4.2.1 Prior knowledge

While we expected L2 learners to show the most syntactic priming on 'of genitives', followed by passives and DO datives, the syntactic priming and learning effects in terms of language production were equivalent across structures, regardless of learners' prior knowledge of them. However, the L2 speakers did produce significantly more 'of' genitives than passives and DO datives in the syntactic priming task which provides partial support for Costa et al. (2008)'s predictions (see Kim et al., 2020 for similar results). By contrast, our findings are not consistent with the inverse frequency effect predicted by theories defining syntactic priming as an implicit language learning mechanism (e.g., Chang et al., 2006, 2012), according to which participants should show more syntactic priming and learning with less familiar structures (see Reitter et al., 2011 and Malhotra et al., 2008 for similar predictions). Though the pre-test GJT scores reveal that the participants had overall high levels of explicit metalinguistic knowledge of all the target structures (Figure 7.8), they confirm that the L2 speakers were more familiar with 'of' genitives than with the other two structures. Hence, because of the similarity with the Spanish genitive, participants may have had higher prior knowledge of 'of' genitives, which made them more available for production (see Kim et al., 2020 for similar results).

These results imply that syntactic priming activities may be less well-suited to promote production of structures participants are less familiar with. Similarly, McDonough & Fulga (2015) observed that L2 learners needed to have some representation of the target syntactic structures to manifest significant priming (see also Jackson & Ruf, 2018). To clarify this for the pedagogical perspective, it would be interesting to assess whether increasing the number of experimental primes for less familiar structures, or working with them in isolation, would increase their production and resulting learning further.

7.4.2.2 Conscious decisions

While most L2 learners noticed the target structures in the present study, they did not necessarily choose to use them, as anticipated (see Jackson & Ruf, 2018). Rather, more prior knowledge of the target structure seems to result in an increased likeliness to choose to use it (Table 7.4): learners most often reported choosing to use 'of' genitives. This could be because these are easy to produce for Spanish speakers, whereas the most often-selected decision for passives and DO datives, which Spanish speakers would have less prior knowledge of, was "Neither". Nonetheless, learners reported choosing to *use* DO datives and passives more often than to *avoid* them. In line with this, a few participants explained that they decided to use a structure because their interlocutor had or because they had seen it in the task (see OSF for a list of the reasons why the L2 speakers chose to use or avoid the target structures). Thus, the modelling of structures provided by syntactic priming tasks appears to be a good way to motivate learners to produce structures (Costa et al., 2008).

We found indirect support for Costa et al.'s predictions (2008) regarding the effect of learners' decisions. Decisions did not significantly influence priming, but they did affect target structure production. Across structures, learners in the Use group were more likely to produce target structures in the syntactic priming task than in the No Decision and the Avoid groups. Within structures, learners in the No Decision and Use groups produced significantly more 'of' genitives than those in the Avoid group. The results for both DO datives and passives followed the same numerical trend though it did not reach significance. Given that splitting the data by decision group reduced sample sizes, understanding how exactly conscious decisions

affect syntactic priming and learning for various structures will require further research.

Overall, the absence of a significant interaction between priming and participants' conscious decisions reveals that, regardless of their decision, the L2 speakers showed the same magnitude of priming and thus experienced to some extent automatic and implicit priming that was insensitive to more top-down processes and strategies (see Ivanova et al., 2020 and Weatherholtz et al., 2014 for discussions of the relationship between top-down strategies and implicit syntactic priming). However, choosing to avoid a target structure inevitably led to reduced production in spite of exposure to prime structures and choosing to use the target structure increased target structure production, which indicates that the effect of prime sentences on subsequent sentence production is not purely implicit but may also depend on learners' decisions (Costa et al., 2008). Whether deciding to use the target structure led to more learning remains unclear. Learners of the Use group produced significantly more target structures than those in the No Decision group but only when considering the data of the pre- and post-tests together, which does not clearly reveal whether learners of the Use group experienced more learning. However, this may also reflect the lack of a relationship between immediate syntactic priming and decisions.

Taken together, these results imply that language teachers may need to explicitly ask learners to use the targeted structures (and not to avoid them) in order to increase their production rate in syntactic priming tasks. More research is needed to determine whether such explicit instructions are also beneficial for long-term learning.

7.5 Conclusion

This study shows that written chat-based collaborative syntactic priming activities support practice and learning of L2 syntactic structures even when multiple structures are presented simultaneously. We also found that L2 learners' production, and potentially learning, was influenced by their conscious decisions to use or avoid the targeted structures. Overall, the results suggest that both explicit and implicit processes determine syntactic structure production in this context. These findings

have important implications for instructors when considering how to adopt syntactic priming tasks for language teaching.

Chapter 8

General discussion

This thesis explored the mechanisms underlying and the factors affecting L2 learning via syntactic priming. In this chapter, I first report the main results of the thesis. I then discuss their theoretical and pedagogical implications and provide potential limitations and directions for future research.

8.1 Summary of findings

Chapter 2 compared immediate and long-term priming effects in English L2 speakers of French and French L1 speakers in an oral interactive task. I tested participants on French fronted temporal adverbial phrases and passive sentences and manipulated between-subjects the presence or absence of lexical overlap. Though both speaker groups experienced long-term priming for both structures without lexical overlap, they showed abstract immediate priming (i.e., without overlap) for fronted but not for passives sentences. The L2 speakers did not manifest larger abstract immediate priming than L1 speakers for either structure. With lexical overlap, the L2 speakers showed larger lexical boost effects and larger lexically-based priming than L1 speakers across both structures. Finally, both speaker groups experienced long-term priming even with lexical overlap and, for passives, participants produced more target structures in the post-test with than without overlap.

Chapter 3 further examined the datasets of Chapter 2 to assess whether individual differences in attention (L2 and L1 speakers) and language learning motivation (L2 speakers) would affect immediate and long-term priming. Neither attention nor motivation increased the magnitude of immediate and long-term priming for either structure across overlap conditions and speaker groups. However, high attention and motivation levels led to reduced long-term priming and impacted the production of fronted sentences, but not of passive sentences.

Chapter 4 compared the magnitude of immediate and long-term priming for written targets following exposure to written or spoken primes. This web-based study tested French L2 speakers of English and English L1 speakers and targeted

English passives. I also examined how self-reported attention and motivation related to priming and learning across modality conditions. Both speaker groups exhibited significant immediate and long-term priming in immediate and delayed post-tests, but the L2 speakers showed greater learning. Immediate priming was larger in the listening-to-writing condition in both groups, but modality did not influence long-term priming. Priming and learning were unrelated to individual differences in attention and motivation.

Chapter 5 included a direct manipulation of participants' attention in an oral interactive syntactic priming task. By means of a mistake searching task, French L2 speakers of English and English L1 speakers were instructed to pay attention to the syntax of the primes (syntax-focused condition) or to the experimental pictures (picture-focused condition). This study further explored immediate and long-term priming of English passives and evaluated how self-reported motivation would influence priming across conditions. The preliminary results suggest that both speaker groups primed more in the syntax-focused than in the picture-focused condition during the immediate priming phase. The L2 speakers also produced more passives overall than L1 speakers. Further data collection is however necessary to corroborate these results, and to determine how the attention manipulation affects long-term priming, as well as how motivation will relate to priming and learning across conditions.

Chapter 6 was designed to examine French L1 students' learning of English Wh-questions during and following classroom-based syntactic priming activities. Specifically, it aimed to assess whether priming and learning would vary across the following teaching settings: teacher-to-students priming conditions, where a teacher would pronounce primes with the target structure in front of the whole class; student-to-student conditions, where students would engage in a peer-to-peer priming activity; comprehension-to-production conditions, where students would listen to primes delivered to them by a classmate; and finally, production-to-production conditions, where students would read aloud the primes themselves. This study would also have examined the effect of self-reported attention and motivation on priming across all conditions. Based on the current data, it is unclear whether priming differs across teaching settings, but the preliminary results suggest that more than one priming session is necessary for students to produce Wh-questions more accurately. Collecting the entire dataset is needed to understand how L2 learning via

syntactic priming varies with teaching settings and individual differences in this context.

Chapter 7 tested Spanish L1 speakers' priming and learning of multiple simultaneously-targeted English L2 syntactic structures (genitives, passives and datives) in an interactive written chat-based activity. This study also examined whether priming depends on learners' prior knowledge of the targeted structures and their conscious decisions to use or avoid each structure. The learners experienced immediate and long-term priming across structures, but their performance on grammaticality judgment tasks did not improve following the priming activity. Participants' prior knowledge of the structures and their decisions did not influence syntactic priming and learning themselves. However, choosing to use a given structure increased its production rate, and the structure learners produced the most and chose to use the most was the one they were the most familiar with (i.e., genitives).

8.2. L2 learning via syntactic priming

8.2.1 Evidence for L2 learning

This thesis demonstrates that syntactic priming supports L2 learning in a multitude of contexts. Across chapters, in line with the predictions of the language learning models of priming (e.g., Chang et al., 2006; Reitter et al., 2011), the tested L2 speakers consistently experienced both immediate and long-term syntactic priming effects (as in e.g., Grüter et al., 2021; Jackson & Hopp, 2020; McDonough & Chaikitmongol, 2010). These learning effects occurred for a variety of structures (passives, fronted temporal adverbial phrases, 'of' genitives and Double Object (DO) datives), within different groups of speakers (English L1 speakers learning French, French and Spanish L1 speakers learning English), in various environments (interactive lab-based and chat-based tasks and non-interactive online tasks) and for L2 speakers of various proficiency levels, since I did not restrict participant recruitment to a specific proficiency range. Though most chapters measured long-term priming by comparing target structure production in a post-test immediately following the priming task relative to a pre-test, the influence of priming also persisted to a post-test delayed by one week (Chapter 4). These findings confirm that

priming activities, across settings and conditions, foster long-term changes in learners' L2 syntactic representations. Specifically, that syntactic priming tasks increased L2 speakers' production of structure(s) they spontaneously disprefer suggests that such activities foster changes in connection weights or predictions (Chang et al., 2006) or long-term increases in the base-level activation of structures (Reitter et al., 2011).

The classroom-based study was designed to assess whether such activities also help learners produce L2 structures more accurately. The incomplete study reveals that English Wh-questions are particularly difficult to produce for French students, although they experienced some minimal improvements in their production of this structure following priming. Analyses performed with the entire dataset confirming the latter result would corroborate that priming tasks also foster improvements in L2 syntactic accuracy (e.g., Kim et al., 2020; McDonough & Chaikitmongol, 2010).

L2 speakers seem however not to acquire new explicit metalinguistic knowledge of (morpho)syntactic rules via syntactic priming (Chapter 7). Their performance on the grammaticality judgment tasks (GJT) did not improve following the priming phase (see Shin & Christianson, 2012 for similar results). This could be because, while some of the ungrammatical sentences for DO datives and passives included in our GJTs contained morphosyntactic errors, priming may not lead to acquisition of morphosyntactic knowledge. Priming indeed seems to be insensitive to variation in morphosyntactic cues such as tense, aspect or case marking (e.g., Pickering & Branigan, 1998; Muylle, 2020; but see Michel & Stiefenhöfer, 2019). However, this could not explain the absence of improvements for genitives for which the GJT mistakes only related to word order. Alternatively, syntactic priming may support the acquisition of implicit knowledge, which L2 speakers could not retrieve when completing a GJT targeting explicit knowledge. Finally, the L2 speakers in that study may have been too proficient to experience improvements on the GJTs.

Overall, this thesis illustrates that we can use syntactic priming tasks to foster practice and long-term production of a wide variety of L2 syntactic structures which learners spontaneously produce infrequently, in a variety of languages and contexts. As such, in addition to informing our understanding of the psycholinguistic mechanisms of L2 learning, syntactic priming tasks constitute a useful tool to help learners acquire syntactic knowledge in the L2.

8.2.2 Task characteristics

This thesis provides useful evidence regarding which factors affect L2 learning via syntactic priming. Specifically, it is informative regarding whether priming and learning vary with the modality of primes or interactions and depending on which and how many structures a priming task targets.

8.2.2.1 The modality of priming

Chapter 4 revealed L2 (and L1) speakers experience larger immediate priming effects when listening to than when reading prime sentences, though I expected written input to facilitate language processing, particularly in L2 speakers (Gilabert et al., 2016; Kim & Godfroid, 2019). This contradicts previous L1 research reporting that priming strength does not vary across modalities (e.g., Hartsuiker et al., 2008; Mahowald et al., 2016). These results suggest that the participants were influenced by the frequency of passives in spoken vs. written language input during the immediate priming phase: since passives are more frequent in written than in spoken language (Roland et al., 2007), the participants seem to have experienced inverse frequency effects, as predicted by the language learning models of priming (Chang et al., 2006; Reitter et al., 2011). Future research examining the effect of input modality on priming will need to target structures with more similar frequencies across modalities in order to disentangle the specific effect of modality on priming, as opposed to the effect of structure frequency.

However, this study is the first to show that long-term learning from priming is equivalent across input modality conditions. The results indeed demonstrate that L2 speakers can re-use syntactic knowledge acquired via syntactic priming for language production, regardless of the language input modality and both within and between modalities (Kim & Godfroid, 2019). Furthermore, across chapters, I found evidence for significant L2 immediate and long-term priming in a variety of contexts involving various modalities: in face-to-face (Chapter 2) and in online interactions (Chapter 7), and when L2 speakers produced both oral (Chapter 2) and written target sentences (Chapters 4 and 7). This thesis therefore demonstrates that priming activities foster L2 learning via syntactic priming in multiple modalities.

8.2.2.2 Target structure(s)

This thesis shows that L2 speakers can manifest significant priming and learning for a wide variety of structures. First of all, Chapter 7 is the first priming study assessing speakers' priming on three different structures within one task and it reveals that a single syntactic priming activity can foster priming and learning of multiple simultaneously-targeted structures. From a pedagogical perspective, this indicates that language instructors can use syntactic priming to encourage learners to produce multiple structures and to foster their learning within one task. It also suggests that using authentic material (e.g., books or videos) which contains a multitude of structures for teaching purposes may successfully foster learning of multiple structures.

Additionally, Chapter 7 directly demonstrates that, although overall production varies across structures, priming and learning effects do not. The latter result stands in contradiction with the inverse frequency effects predicted by the language learning models (Chang et al., 2006; Reitter et al., 2011), according to which speakers should prime more with unfamiliar structures (e.g., Kaschak et al., 2011; McDonough & Fulga, 2015). Rather, both during the priming task and across the pre- and post-tests, the L2 speakers produced more frequently the structure of which they had the most prior knowledge. This (indirectly) supports the L2 frequency effects Costa et al. predict (2008; Hurtado & Montrul, 2021a). This finding also aligns with the results of Chapter 2 where L2 and L1 speakers showed significant abstract priming for fronted but not for passive sentences. The pre-test scores of each experiment clearly indicate that participants spontaneously produced more fronted than passive sentences and were thus more familiar with the former than with the latter form. This set of findings suggests that the syntactic representations of well-known structures may be more available and easier to access for L2 language production. From a methodological point of view, that priming patterns (see Chapter 2's combined analysis) or target structure production (Chapter 7) varied across structures within speakers reveals the importance of testing participants on multiple syntactic forms.

This thesis also reveals that L2 speakers can experience immediate and long-term priming for structures for which they exhibit varying degrees of familiarity. Nonetheless, the observed L2 frequency effects suggest that priming activities may be better suited to foster production and practice of structures learners are already

more familiar with. The significant lexically-based priming effects participants experienced for passives (Chapter 2) imply that including lexical overlap between primes and targets could encourage production of less familiar structures. However, whether doing so would foster long-term learning of these structures is unclear (e.g., Jackson & Ruf, 2018; McDonough, 2011; Ruf, 2011), although both L2 and L1 speakers manifested significant long-term priming following a priming task with lexical overlap (Chapter 2). Alternatively, increasing the number of prime sentences of lesser known structures or priming learners with one structure at a time may foster more production and learning for these structures. Indeed, the L2 speakers seem to have experienced more learning in immediate post-tests in priming tasks involving a larger number of primes per structure and targeting only one structure at a time than in Chapter 7: they experienced 21% long-term priming for fronted sentences and 27% for passives in Chapter 2, 14% learning for passives in Chapter 4 but only 2%, 6% and 8% learning for passives, DO datives and 'of' genitives respectively in Chapter 7.

8.2.3 Future directions

Investigating the effect of proficiency on L2 priming was not central to this thesis. As such, I recruited participants of various L2 proficiency levels in all studies, although they tended to be higher proficiency learners overall. Therefore, even if I found that some of the factors either did not affect priming or learning (e.g., prime modality), or only did so to a limited extent (e.g., attention, see section 8.3.2), such factors may play a larger role in language processing and learning at lower L2 proficiency levels. For instance, reading rather than listening to primes may facilitate learning better in less proficient learners who may have more difficulties understanding the L2 pronunciation. Future research should thus recruit beginner learners to better examine whether certain (task) characteristics impact their learning more than highly proficient L2 speakers'. Testing beginner learners would also allow us to assess whether priming can support acquisition of syntactic representations from the very earliest stages of learning.

To be fully relevant for L2 learners and L2 teaching, further priming research should be conducted in naturalistic contexts (e.g., L2 classrooms, written chat interactions) or with more authentic language input (e.g., videos or books). In

particular, since a single priming task supports learning of multiple simultaneously-targeted structures (Chapter 7) and while I presented the target structures in isolated sentences in that study, researchers could investigate whether perceiving several target forms in meaningful contexts such as videos fosters their priming and learning in L2 students. Furthermore, given that language teachers can use various teaching settings to support grammar instruction and practice (Chapter 6; Hedge, 2008), future studies could examine whether language learning experienced on one type of priming task transfers to other types (e.g., Kaschak et al., 2014).

8.3 Mechanisms of priming and language learning

8.3.1 Between-group differences

The results of this thesis do not clearly allow us to pick which of the error-based or hybrid mechanisms (Chang et al., 2006; Reitter et al., 2011) best accounts for patterns of syntactic priming across speaker groups (Chapter 2), but the findings across chapters do still inform our understanding of the mechanism of priming.

Both types of models predict that L2 speakers, due to their reduced experience with the target language, should exhibit more priming and consequently, learning, than L1 speakers. This thesis includes a substantial set of studies systematically comparing immediate and long-term priming between speaker groups which provide repeated evidence for this expected between-group difference. The L2 speakers experienced more long-term priming in immediate (Chapters 2 and 4) and delayed (Chapter 4) post-tests than L1 speakers. Moreover, several significant main effects of Group revealed that L2 speakers produced the target structures more overall than L1 speakers (Chapters 2-5). These findings together may confirm that the magnitude of priming across speaker groups relies on an error-based mechanism (Chang et al., 2006) or on the base-level activation of syntactic representations (Reitter et al., 2011). However, these between-group differences arose for (French and English) passives but not for fronted sentences (Chapter 2). While previous research also provides mixed findings regarding between-group differences (Abrahams et al., 2019; Flett, 2006; Jackson & Hopp, 2020; Ruf, 2011), this thesis suggests that whether they emerge may depend on the nature of the targeted structure. Unsurprisingly, L2 speakers seem more likely to experience larger prediction error (Chang et al., 2006) or larger changes in base-level activation

(Reitter et al. 2011) than L1 speakers with more syntactically complex and infrequent structures (i.e., passives) than with less complex and more frequent structures (i.e., fronted sentences).

That the L2 speakers only showed more significant long-term priming but not more immediate priming than L1 speakers (e.g., Chapters 2 and 4) is surprising, and not consistent with previous research (e.g., Flett, 2006, experiments 1 and 2; Jackson & Hopp, 2020), nor clearly predicted by the language learning models (Chang et al., 2006; Reitter et al., 2011). The between-group difference may however be more detectable once the changes triggered by priming in the language system have accumulated after multiple encounters with the target structure, i.e., once the L2 speakers have experienced the prediction errors (Chang et al., 2006) or changes in base-level activation (Reitter et al., 2011) multiple times.

Detecting a between-group difference might also be more likely when considering overall target production in a given experimental phase (i.e., when comparing target structure production in the priming phase or in a post-test overall relative to a pre-test, as in Hurtado & Montrul, 2021a) than when analysing priming on a trial-by-trial basis (i.e., when comparing the production of passives after passive vs. active primes). The results of Chapters 4 and 5 show significant main effects of Group in the priming phase, thereby revealing that, during that phase, L2 speakers produced significantly more passives, and were therefore more impacted by the priming manipulation than L1 speakers. In other words, in those cases, L2 speakers' production of the target structures increased not only immediately after exposure to a prime containing the target structure, but across both prime types. Though I did not observe significant interactions between priming condition and speaker group, it would therefore be premature to interpret this null effect as indicating that there was no between-group difference in the effect of immediate priming. I could not conduct such an analysis in the present thesis due to the imbalance in number of target sentences in the pre-tests and priming phases I designed. However, future L2 priming and learning studies could measure the effect of priming as overall increases in target structure production, across prime types, in the priming phase relative to the pre-test as such measurements would still reflect learning (see Hurtado & Montrul, 2021a).

To summarise, this thesis provides ample empirical support for the between-group differences in syntactic priming predicted by the language learning models

(Chang et al., 2006; Reitter et al., 2011), but whether this pattern of results arises seems to depend on the nature of the target structure and more likely to arise in post-tests.

8.3.2 The contribution of explicit processes

8.3.2.1 Syntactic priming with lexical overlap

In line with previous literature and with the predictions of the language learning models (e.g., Chang et al., 2006; Reitter et al., 2011), this thesis demonstrates that both L1 and L2 speakers experience lexical boost effects to priming, i.e. they show significantly more syntactic priming with than without lexical overlap (e.g., Branigan et al., 2000; Mahowald et al., 2016; Flett, 2006; Jackson & Ruf, 2017, 2018). While both models state that lexically-based priming primarily relies on short-lived explicit memories of prime sentences which increase speakers' likelihood to re-use a structure, according to them, language learning via the error-based mechanism (Chang et al., 2006) and via incremental adjustments of base-level activation (Reitter et al., 2011) is in contrast supported by implicit processes. Based on these models, the lexical boost to priming should thus be short-lived (see for instance, Branigan & McLean, 2016; Hartsuiker et al., 2008; Mahowald et al., 2016; Ruf, 2011).

The L2 and the L1 speakers of Chapter 2 experienced long-term priming even in the lexically-based priming condition (see e.g., Jackson & Ruf, 2018; Ruf, 2011 for opposite results in L2 speakers). This indicates that the participants were still experiencing priming and learning via prediction error (Chang et al., 2006) or increases in base-level activation (Reitter et al., 2011) in the priming phase despite the presence of lexical overlap. This finding could also reveal that the explicit memories of prime sentences forged by the repetition of lexical items across primes and targets contributed to long-term learning (see Ferreira & Bock's (2006) discussion of the contribution of explicit and implicit processes to syntactic priming). The latter interpretation fits perhaps better with the observation that the participants of Chapter 2 seem to have manifested larger long-term priming with than without lexical overlap. Experiencing lexical boost effects could have given speakers an additional opportunity to practice producing the target structure, which fostered larger learning. Although such an interpretation would not be consistent

with an error-based mechanism where language learning occurs via prediction errors experienced during *comprehension* (Chang et al., 2006), language production, like comprehension, could raise the base-level activation of syntactic nodes (Reitter et al., 2011). Moreover, some researchers do hypothesize that language production fosters deeper processing of syntactic structures and help encoding them in memory (see Hopman & Macdonald, 2018 for a discussion of the benefits of production for language learning).

A major finding of the thesis is that the L2 speakers appeared more sensitive to lexical overlap manipulations than the L1 speakers: they showed larger lexical boost effects and larger lexically-based priming than participants of the latter group. This could demonstrate that learners' syntactic representations are (more) item-specific (i.e., associated with specific lexical items) than L1 speakers' (Mahowald et al., 2016). Hartsuiker & Bernolet (2017) state that this should be particularly true for beginner learners who have not yet acquired L2 abstract syntactic representations (see Bernolet et al., 2013; Kim & McDonough, 2008). While this thesis did not specifically investigate the role of proficiency, comparing priming across L2 speakers of various proficiencies to L1 speakers could help to ascertain whether learners' syntactic representations are overall more lexicalized than L1 speakers', even at more advanced levels of L2 proficiency. If so, highly proficient L2 speakers should show larger lexical boost effects than L1 speakers. Alternatively, the L2 speakers may have been more likely to rely on explicit memory processes during the priming task than L1 speakers. Such a strategy may facilitate language production more in the former than in the latter group such as if, for example, re-using the verb form of a prime passive sentence boosts L2 speakers' confidence when formulating their own sentences with the same verb.

Through the lexical overlap manipulation, the results of Chapter 2 overall suggest that explicit processes may not necessarily prevent language learning via priming from arising and that L2 speakers' priming may be more sensitive to explicit processes than L1 speakers.

8.3.2.2 Attention, motivation and conscious decisions

To further explore the relationship between priming and explicit processes, this thesis was the first to directly measure participants' attention to the linguistic input

(cf. Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015), their language learning motivation and their conscious decisions to use or avoid the target structure to assess their effect on immediate and long-term priming.

8.3.2.2.1 Immediate priming

Previous priming literature indicates that attention to linguistic input can increase the magnitude of immediate priming in L1 and L2 speakers (e.g., Bock et al., 1992; Ivanova et al., 2020; McDonough & Fulga, 2015; Shin & Christianson, 2012). Furthermore, Costa et al. predict (2008) that L2 speakers' motivation to practice the language may determine whether they decide to copy their interlocutor's syntax, and therefore, show priming. Based on these, I expected high attention and motivation levels to increase the magnitude of immediate priming.

I found mixed support for these predictions. The incomplete study of Chapter 5 provides preliminary evidence that instructing participants to focus their attention on the syntax of stimuli rather than on experimental pictures may foster larger priming effects across speaker groups (cf. Bock et al., 1992). However, self-reported attention did not relate to immediate priming in Chapters 3-4. This discrepancy (if confirmed) may result from the fact that we only measured attention with self-report questionnaires in Chapters 3-4, whereas directly manipulating participants' attention in Chapter 5 was a more accurate and objective way to assess the effect of this factor on priming (e.g., Bock et al., 1992). Self-reports may indeed reflect participants' memory for the target structure or for aspects of the task for instance. Alternatively, this absence of an effect of attention could reveal that the degree of immediate priming in Chapters 3-4 was primarily determined by implicit processes, and unrelated to attentional focus. Michel and Smith (2018) similarly observed that English learners' overt visual attention assessed with eye-tracking techniques did not relate to their lexical priming behaviour (see Bock et al., 1992 and Ferreira & Bock, 2006 as well). Likewise, I found that L2 speakers' motivation in these two chapters and their conscious decisions in Chapter 7 did not affect immediate priming either. In other words, participants' priming behaviour was then not impacted by their willingness to practice the target language, their engagement in the task, nor by whether they decided to use the target structure or not.

If we hypothesize that immediate priming was more implicit in Chapters 3-4 and 7 than in Chapter 5, the discrepancy of results across chapters may demonstrate that the way we manipulated attention with the mistake searching task in Chapter 5 drew participants' attention to the immediate context across attention conditions and thereby made priming less implicit. In that case and if motivation makes participants rely on explicit (priming) strategies (Costa et al., 2008), motivation may be more likely to relate to priming in Chapter 5 than in the other chapters. Completing data collection in Chapter 5 is necessary to assess how motivation relates to immediate priming in this vs. the studies of Chapters 3-4.

8.3.2.2.2 Long-term priming

It was less clear whether to expect attention, motivation and conscious decisions to modulate long-term priming. High attention and motivation levels could increase speakers' likeliness to use explicit memories of primes when producing targets (but see Chapters 4-5 for additional explanations of how high attention and motivation could affect learning via the implicit learning mechanisms), while taking conscious decisions may lead participants to rely on explicit strategies to copy their interlocutor's syntax (e.g., Costa et al., 2008). If so, the language learning models of priming predict that these factors should not influence language learning via syntactic priming, which they define as being implicit (Chang et al., 2006; Reitter et al., 2011; but see Ferreira & Bock, 2006). However, SLA research has identified attention and motivation as modulators of L2 learning (e.g., Leow, 2019; Masgoret & Gardner 2003; Robinson et al., 2012), and choosing to use the target structure could have led speakers to practice it more and therefore to learn more (see section 8.3.2.1). In that case, I would have expected these factors to influence language learning via syntactic priming.

The results across chapters suggest that long-term priming is supported by largely implicit mechanisms, as per the predictions of Chang et al.'s (2006) and Reitter et al.'s (2011) models. Enhanced attention never increased long-term priming in L2 speakers. Evidently, as above, self-report questionnaires may not be sensitive enough to assess variation in attention and completing the study of Chapter 5 is necessary to find out whether biasing participants to pay attention to syntax increases long-term priming. The results concerning the effect of conscious decisions on

learning are unfortunately not clearly informative. The learners who chose to use the target structures produced them significantly more than those who took no specific decision (Chapter 7). However, this pattern was observed when considering the pre- and post-tests together, which does not tell us whether learners of the Use group experienced more long-term priming than the others.

Regarding motivation, a first potential explanation is that motivation may not relate to priming in Chapter 3 because the participants in that study were highly motivated to learn the language and complete the task: they were all students who had chosen to study French and who had volunteered to participate in the study. However, this interpretation is difficult to reconcile with the fact that motivation did not influence learning in Chapter 4 either, where the L2 speakers seemed overall at least less motivated to perform the priming task. Rather, the participants may have been too proficient across chapters or the targeted structures not challenging enough (see e.g., Takahashi, 2005) for the L2 speakers for individual differences in motivation to modulate language learning. A final possibility is that, while SLA studies have demonstrated that being motivated influences overall L2 abilities (Ushioda, 2016), this factor may in contrast not help learn specific linguistic features.

The investigation of how variation in attention to linguistic input, motivation and conscious decisions, or explicit processes in general, relate to priming and learning led to mixed results. On the one hand, including lexical overlap and manipulating participants' attention can increase priming. On the other hand, self-reported attention and motivation, and conscious decisions did not affect priming and learning in L2 speakers.

8.3.2.2.3 Target structure production

Attention and conscious decisions did not affect immediate and long-term priming themselves but they did sometimes modulate target structure production. Although noticing the target structure did not increase production of passives (Chapters 3-5), it led to more production of fronted sentences in L2 and L1 speakers (Chapter 3). This discrepancy potentially reflects the two choices participants face when noticing a structure. L2 speakers may decide to *use* the structures of their interlocutor (e.g., Grüter et al., 2021), if they wish to improve their L2 skills (Costa et al., 2008), want

to practice formulating the L2 structures (Ruf, 2011) or if producing the structure is easy for them (Chapter 7). They may in contrast choose to *avoid* using a structure (e.g., Jackson & Ruf, 2018), if it is too effortful to produce (Kim et al., 2020) or if they lack confidence regarding how to build it (Chapter 7; Costa et al., 2008).

Based on this previous literature, I hypothesize that, when noticing fronted sentences, participants chose to produce them, because these were easy to formulate as reflected in their baseline production rates of this structure. When noticing passives, a structure which participants spontaneously produced less or were less familiar with, they conversely decided to avoid them or neither to use nor to avoid them. Chapter 7 provides support for this interpretation. The pre-test production and GJT measurements reveal that participants were more familiar with 'of' genitives than with DO datives and passives. In line with the above interpretation, it is only for 'of' genitives that L2 speakers selected the conscious decision Use the most, while for the other two structures the most often selected option was neither to use nor to avoid them. Furthermore, deciding to use a target structure (at least numerically) increased structure production relative to deciding to avoid it or taking no specific decision. These results revealing that L2 speakers' conscious decisions can influence structure production during a priming task seem to corroborate the predictions of Costa et al. (2008).

Finally, this thesis indicates that syntactic priming tasks are an appropriate tool to foster noticing of target structures across a variety of contexts, especially in L2 speakers. In Chapters 3-5, on average, 52% (range 39-63%) of the L2 speakers noticed the target structure, as did 42% (range 24-58%) of the L1 speakers, while in Chapter 7, 89% of the learners noticed 'of' genitives and passives, and 79% noticed DO datives. This may be because syntactic priming tasks represent a form of input flooding (see Indrarathne & Kormos, 2017 for a review), a technique which consists of increasing the frequency of a target construction in the input to make it more salient. From a pedagogical point of view, L2 teachers may therefore use such tasks as a starting point to implement inductive pedagogical approaches, where learners are invited to discover grammatical rules by themselves in the language input (Hedge, 2008). Furthermore, even though, as discussed above, such noticing does not necessarily increase structure production for all structures, participants still selected the decision "use" more often than "avoid" for DO datives and passives

(Chapter 7). Hence, the modelling of structures in primes seems to make L2 speakers choose to use structures more overall.

Overall, this thesis shows that explicit processes can increase (L2) speakers' production of target structure(s) during a priming task. However, whether they do so depends on a multitude of factors such as participants' knowledge of or confidence with the target structure, or the amount of effort required to produce that syntactic form. Currently, the findings suggest that, to ensure that learners produce the structures they are the least familiar or confident with, language instructors may need to instruct them to use these structures or provide instructions about them, even if participants noticed the structures.

8.3.3 Future directions

Following previous research, I mainly used self-report questionnaires to assess individual differences in attention and motivation (e.g., Brooks & Kempe, 2013; McDonough & Fulga, 2015; Dörnyei & Taguchi, 2010). In the future, it may be more accurate to assess variation in attention with less subjective measurements such as eye-tracking methods. For instance, in a chat-based activity such as Chapter 7, one could analyse whether participants are more likely to exhibit priming when fixating more on, and hence when paying more attention to parts of the written sentences that are relevant to production of the target syntactic form (e.g., past participles for passives; see Michel & Smith, 2018; Michel & O'Rourke, 2019). Additionally, one could directly manipulate participants' motivation by comparing priming across conditions that are more or less likely to foster high levels of task-specific motivation for instance, such as by manipulating whether participants receive a reward or not following the task.

For our understanding of L2 learning and for the pedagogical perspective, it would be particularly relevant to examine the relationship between explicit grammar instructions about the target form or instructions to use the target form and L2 learning via syntactic priming. Such instructions should make learners rely on more explicit language processing and production strategies, and the results of Chapter 7 indicate that L2 speakers who rely on such strategies by choosing to use the target structure for example produce it more. However, how the two types of instructions

would relate to priming and long-term learning remains largely unexplored (Shin & Christianson, 2012).

Finally, though the psycholinguistic language learning models of priming make the prediction that L2 speakers acquire implicit knowledge via syntactic priming (Chang et al., 2006; Reitter et al., 2011), few studies have directly evaluated what type of knowledge learners acquire through priming tasks (e.g., Chapter 7; Shin & Christianson, 2012). This question is particularly relevant to the field of SLA (e.g., Kim & Godfroid, 2019; Pawlak, 2019) and, to answer that question, future experimental work could systematically compare acquisition of implicit vs. explicit syntactic knowledge (e.g., with timed vs. untimed GJTs, see Pawlak, 2019 for a review) via syntactic priming tasks.

8.4 Concluding words

This thesis constitutes a substantial set of L2 studies demonstrating that language learning effects from syntactic priming are ubiquitous: they arise for multiple structures, various language combinations, and across priming contexts. It examined the psycholinguistic mechanisms underlying L2 learning via syntactic priming and the factors potentially affecting this learning. As such this work has important theoretical and pedagogical implications. The results imply that a complex interplay of implicit and explicit processes underlie syntactic priming, language learning and target structure production in priming activities. From a pedagogical perspective, syntactic priming tasks seem well-suited to support L2 grammar teaching of various structures, across environments and in meaningful contexts. A promising avenue for future research would be studies that help us better understand the contribution of explicit language processing strategies to long-term L2 syntactic priming in L2 classrooms. This thesis provides the methodological and theoretical backdrop to such work.

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