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Number specification in L2 processing of Subject-Verb agreement: An ERP study

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Foreword

“...Last but not least

I wanna thank me

I wanna thank me for believin in me

I wanna thank me for doin all this hard work

I wanna thank me for having no days off

I wanna thank me for...for never quit

I wanna thank me for always being a giver and trying to give more than I receive

I wanna thank me for tryin to do more right than wrong

I wanna thank me for just being me all the time ...”

Snoop Dogg

1 Introduction

Do native speakers of a language (L1ers) and second language learners (L2ers) differ in how they process the language they have in common? There are two different approaches to investigating this topic. The first class of theories claims that compared to L1ers, L2ers' language processing is different due to the use of either different types of information (The Shallow Structure Hypothesis; Clahsen & Felser, 2017, 2006; Interface Hypothesis; Sorace, 2011) or different processing systems (The declarative/procedural model; Ullman, 2001, 2005). Despite fundamental differences, these hypotheses/models all have argued that with enough exposure to second language (L2) input, L2ers will be able to show native-like proficiency measured by offline tasks, however the difference will be reflected in online tasks. The second class of approaches on the first language (L1) vs L2 language processing claims that L1ers and L2ers use a similar processing system and any difference between the two groups can be explained in terms of working memory capacity (Cunnings, 2017). To investigate L1 vs L2 processing different linguistic dependencies are tested in language pairs where the target linguistic feature is absent in one of the languages (Alemán Bañón & Rothman, 2019; Alarcón, 2009; Belletti, Bennati, and Sorace, 2007).

The subject-verb agreement has been a topic of language processing research for a long time (Bock & Cutting, 1992; Franck et al., 2002; Solomon & Pearlmutter, 2004; Eberhard et al., 2005). Since the subject-verb agreement is not a universal linguistic feature and it is absent in some languages, it is used frequently to answer the question of whether L2ers can process morphosyntactic features absent in their L1 in a similar way to native speakers (Cheng et al., 2021; Lempert, 2016; Chen et al., 2007; Tokowicz and MacWhinney, 2005). In English, one of the most widely studied languages in this regard, verbs agree with their subject in person and number as in (Example 1a and 1b). The verb is overtly marked (inflected with –s) in the present tense for the third person singular form. In Norwegian, on the other hand, verbs are not overtly marked for person and number, as in (Example 2a and 2b). Some studies have shown that advanced Norwegian learners of English struggle with subject-verb agreement (Son, 2020; Garshol, 2019; Jensen et al., 2017; Jensen, 2016).

1.

- a. Mary drinks milk.
- b. Mary and Tom drink milk.

2.

a. Marie drikker melk

*Mary drink milk

"Mary drinks milk"

b. Marie og Tom drikker melk

Mary and Tom drink milk

"Mary and Tom drink milk"

Although the rules of English subject-verb agreement are simple, errors are observed in the production and comprehension of verb number marking by L2ers (Tanner & Bulkes, 2015). These errors are more likely to happen in a non-local agreement where the subject noun phrase (NP) of a sentence contains two nouns, as in (3), and the verb is not preceded immediately by the noun it checks agreement with. This linguistic phenomenon is called 'agreement attraction'. In agreement attraction, the verb fails to agree with the head noun of the subject phrase, and instead, it checks agreement with the local noun (attractor), the noun that intervenes between the verb and the head noun.

3. *The key to the cabinets are rusty.

Studies on agreement attraction error production (Wagers et al., 2009; Franck et al.2002) have shown that different factors affect the likelihood of agreement errors, like number feature, the structural distance (feature percolation theories; Wagers et al., 2009), and linear distance between the verb and the head noun and/or attractor (Gibson, 2000). One of the factors is how the number is marked on the head noun. Agreement attraction comprehension has been investigated using different offline and online methods. Research, using the Event Related Potential (ERP) technique, has shown that agreement violation elicits more sensitivity in L1ers and L2ers when the head noun is double-marked on the determiner (4b), relative to (4a), where the head noun is not double-marked (Tanner and Bulkes, 2015).

4.

- a. *The cookies tastes the best when dipped in milk.
- b. *Many cookies tastes the best when dipped in milk.

ERP experiment is a noninvasive method used in neurolinguistics to elicit unconscious responses which give insight into the cognitive processing of the learners (Luck, 2014). It provides high-resolution temporal information about the brain activity, i.e., it reflects ongoing brain activity with a millisecond precision. An ERP waveform consists of peaks that can be negative or positive and show the voltage change. Any consistent voltage changes that systematically vary in amplitude across time, condition, and individuals are called ERP components. There are many different ERP components and among them are the ones sensitive to linguistic variables. Syntactic violations are found to elicit different components mainly in the left inferior frontal lobe (Shen et.al, 2016). The P600 is a component elicited by the syntactic violations (Osterhout & Holcomb, 1992, 1995) between 500 and 800 ms, so around 600 ms and this is where the name comes from. For example, the word 'is' will elicit a larger P600 in (5a) than the word 'are' in (5b).

5.

- a. *The windows is really clean.
- b. The windows are really clean.

To our knowledge, there's only one ERPs study that has addressed the double-marking effect in L2 vs L1 processing when the L1 lacks the relevant number feature. Cheng, et al. (2021) manipulated number marking with unspecified-number determiners 'the' vs. number-specified determiner 'that'/these') to test the Chinese speakers of English whose L1 lacks the subject-verb agreement feature and it does not license double number-marking on the noun. With number specified sentences (6b and 6 d), the accuracy was increased in grammaticality judgment responses and there was a higher amplitude in the P600 for number-specified sentences with agreement violation (6d) compared to unspecified sentences with agreement violation (6c). They showed that both native and non-native speakers detect the non-local agreement violation indexed by a P600 effect. The sensitivity to agreement violation is also modulated by the double-markedness, suggesting that the underlying processing mechanisms are similar in L1 and L2 processing.

6.
 - a. The window of the house is clean
 - b. That window of the house is clean
 - c. *The windows of the house is clean
 - d. *Those windows of the house is clean.

This study is adapted from Cheng et al. (2021), to test the advanced Norwegian learners of English. Like Chinese, Norwegian lacks the overt subject-verb agreement, but unlike Chinese, it allows the double number-marking of the noun. Because of this mismatch between Norwegian and English that is different from the Chinese-English pair, Norwegian speakers of English are an interesting population to study because the findings will provide insight into L2 morphosyntactic processing where the linguistic feature is absent in L1 (subject-verb agreement) and where the target feature is formed similarly in the two languages (double marking on the noun). To our knowledge, no existing published study has tested the Norwegian-English language pair in an ERP experiment to investigate L2 morpho-syntax processing. The present study aims to fill this gap. We expected to see a P600 effect elicited by the syntactic violation in our L2ers and sensitivity to the number specification indexed by a P600 effect. Our participants detected the subject-verb agreement violation and our first prediction regarding P600 effect was confirmed. Sensitivity to number specification in our participants, however, was indexed by a positivity in N400 time window.

2 Literature Review

In this chapter, different models/hypotheses on L1/L2 language processing will be briefly presented in section 2.1. Secondly, agreement attraction theories will be discussed in section 2.2, followed by section 2.3 in which the differences between Norwegian and English concerning the subject-verb agreement and the potential linguistic transfer are discussed. ERP technique is discussed in section 2.4 followed by section 2.5 about the current study.

2.1 L2 vs L1 language processing

In this section, two different approaches to first and second language processing are presented. The first group (The Declarative/procedural Model: DP, Ullman, 2001, 2005; The Shallow structure Hypothesis: SSH, Clahsen and Felser, 2006, 2018 and, The Interface Hypothesis: IH, Sorace, 2011) argues that the first and the second language processing are different. The SSH and IH assume that L1 and L2 processing differ in terms of the information the speakers use to process the language, while the DP suggests different processing systems for L1ers and L2ers. The second group of approaches claims that L1ers and L2ers processing is similar, and any difference can be explained by the individual difference in working memory.

2.1.1 The Declarative/Procedural Model

The DP (Ullman, 2001, 2005) is a neurocognitive model that proposes two brain systems for language and nonlanguage functions: declarative memory and procedural memory. The declarative memory subserves the learning and use of facts and events. The knowledge acquired in declarative memory is explicit. The procedural memory system on the other hand is implicated in the learning of implicit knowledge, i.e., learning new habits and skills and in the control of cognitive skills (Ullman, 2005). According to the DP, unlike L1ers, L2 learners are dependent on declarative memory to learn grammar knowledge. While L1ers learn the grammatical knowledge implicitly by the procedural memory, L2ers learn explicit rules in declarative memory and use them to construct linguistic forms. This shift to declarative memory increases with increasing the age of exposure to L2 and with less experience with L2 (Ullman, 2001). Thus, the DP model predicts that acquiring grammatical knowledge is more difficult than acquiring lexical knowledge for adult learners because procedural memory is more active in adults while they are dependent on the declarative memory to acquire L2 grammar. Nevertheless, they claim that with enough exposure, L2 learners can become "L1-

like" in grammatical knowledge. This emphasizes the role of input in language acquisition (Ullman, 2001, 2005).

2.1.2 The Shallow Structure Hypothesis

The Shallow Structure Hypothesis (SSH; Clahsen & Felser, 2006, 2018) claims that L2 speakers have problems in building or using the syntactic representation in real-time. Both L1 and L2ers use surface-level information (semantic and pragmatic information) in sentence processing but L2ers rely more on it than the native speakers. L2ers underuse syntactic information and instead, they are more sensitive to non-grammatical information. SSH claims that age of acquisition is a crucial factor to distinguish between the native and non-native grammatical processing, but it does not determine how and when grammatical processing would become non-nativelike. According to SSH, adult L2ers may show native-like proficiency in behavioral tests that require linguistic knowledge, but the difference between L1ers and adult L2ers will be reflected in language processing tests. This means that even if adult L2ers have grammatical knowledge, they have difficulty putting that to use during real-time processing (Clahsen & Felser, 2006, 2018).

2.1.3 Interface Hypothesis

According to Interface Hypothesis (IH; Sorace, 2011), some structures require only syntactic domain computations (like objective pronoun use) and can be easily acquired by the second language learners. Parsing these structures requiring only syntactic constraints is faster and operates automatically at the very early stages of processing and highly advanced L2ers have no difficulty with these structures. Some structures, on the other hand, require an interface between an internal linguistic component (syntax) and cognitive domains (familiarity in the context and the interlocutor's perspective), like using an overt pronoun in null-subject languages requires the learner to integrate the contextual factors and cognitive domains. The IH claims that these structures are less likely to be acquired by L2ers, even at very advanced stages due to the integration cost (Sorace, 2011).

2.1.4 Working memory approaches

Despite the differences among the DP, the SSH and the IH, these approaches posit that L2ers can be as proficient as native speakers in offline/behavioral tests that require the linguistic knowledge of the participants, but they will show differences in online tests that capture the language processing. Other approaches argue that language processing in L1ers and L2ers is similar. These models assume that L1 vs L2 differences in language comprehension can be

explained by the working memory. Working memory is the system that keeps information in mind while performing complex tasks such as comprehension and learning. The concept of working memory evolved from the notion of short memory. Short memory is the temporary storage that keeps a small amount of information for a short time (Baddeley, 2010, 2003).

One of the influential models involving working memory is Baddeley's model, a capacity-based approach (Cunnings, 2017). In this model, individual differences in working memory affect the number of words or sentences that can be maintained. L1 vs L2 differences in language comprehension can be explained in terms of the amount of information that individuals can keep in mind (memory capacity) and the ability to retrieve the different types of syntactic or non-syntactic information (decoding) at a given point of time (McDonald, 2006). On the other hand, other models assume that the processes involved in encoding, storage and retrieval, and attention switching can result in individual differences in language comprehension. There are two different models in terms of information retrieval that differ regarding the items brought in and out of focal attention (active concentration on a particular item and excluding others): activation-based models (Gibson, 1998) and cue-based models (Van Dyke & Johns, 2012 as cited in Cunnings, 2017). These models are mainly evidenced with research on different linguistic dependencies with a growing body of research on subject-verb agreement processing in L1 and in L2 to see whether L2ers process this morphosyntactic feature in a native-like way.

The role of working memory in language processing has been evidenced in many studies. Cunnings (2017) claims that any difference observed between L1ers and L2ers can be explained in terms of the ability to retrieve information from memory during sentence processing. He also argues that when comprehension requires access to information from memory, L2ers are more sensitive than L1ers to retrieval interference. Hopp (2014) found out that L2ers have native-like preferences in judgments and processing of relative clauses, moderated by the individual differences in the capacity of working memory. In another study, Lempert (2016) found out that L2ers have more difficulty with subject-verb agreement than L1 speakers and a higher score in memory tasks was associated with higher accuracy.

The studies addressing the L1 vs L2 debate are mainly investigating the agreement (Alonso et al, 2020; Alemán Bañón & Rothman, 2019; Sorace and Filiaci, 2006) in different languages with a growing body of research on the subject-verb agreement (Bock & Cutting, 1992; Franck et al., 2002; Solomon & Pearlmutter, 2004; Eberhard et al., 2005). Since the subject-

verb agreement is not present in all the languages it can provide us with information on morphosyntactic acquisition/process in L1 and L2. In English, there are two types of subject-verb agreements in terms of the distance between the subject and the verb. The local subject-verb agreement, where the verb is preceded by the subject Noun Phrase (NP), as in ('The boy goes to school by bus') and the non-local subject-verb agreement where there is either a Prepositional Phrase (PP) or a Relative Clause (RC) between the subject NP and the verb as in ('The window of the house is really clean'). The non-local agreement has elicited errors in both native speakers and L2ers because the verb checks agreement with the intervening noun (attractor) in PP instead of the head NP. This is known as the agreement attraction effect. In the next section, theories explaining the agreement attraction effect are presented.

2.2 Agreement attraction theories

There are two classes of theories explaining the agreement attraction effect: one class (Feature Percolation Theories, Clause Packaging Hypothesis; Bock & Cuttings, 19992) claims that this effect arises due to the faulty representation of the number feature of the subject, while the other class (Incomplete Dependency Hypothesis, Lewis, 1996 and Stabler, 1994 ; Dependency Locality Theory, Gibson, 1998, 2002) suggests that attraction occurs during re-accessing the subject number feature at the verb.

2.2.1 Feature percolation theory

Based on this account, agreement attraction is a result of feature movement or '*percolation*' of the local noun (the attractor or the intervening noun) within the syntactic representation, i.e., the error derives from the syntactic encoding. In percolation, information from the structured representations is transmitted within the constituents through the structural links. Syntactic features on a constituent can be transferred to the other nearby constituent, but this movement proceeds in only one syntactic '*step*' at a time: features should first move to the immediately dominant syntactic node and then to the next (Wagers et al., 2009). Sentence (7) is a typical agreement attraction case with a subject with a PP modifier. The singular head noun followed by plural intervening nouns (attractor) is the ones that lead to more attraction errors (Eberhard et al, 2005).

7. *The key to the cabinets are rusty

In (7), the number feature of the noun phrase within PP, which is plural, percolates upward to the highest projection, i.e., the subject phrase noun. Thus, the subject head noun number feature is overwritten with number features of the attractor noun and the subject phrase will

get the plural number feature. The verb phrase is valued by the number on the subject phrase. In (7), the verb is inappropriately valued by the number of PP percolated to the subject phrase, so the plural form of the verb is used to finish the sentence. As Eberhard et al. (2005) noted, a singular head noun followed by plural leads into attraction error, not the other way around, and preambles like (8) generally lead to very few errors. This is explained by the 'markedness' effect, which is a part of the percolation account.

8. The keys to the cabinet

Agreement features (e.g., gender and number) are internally organized based on the markedness hierarchy. The masculine-feminine or singular-plural feature pairs are not symmetrical: only one of them is the default feature and considered unmarked. This means it carries no feature information and it is unspecified. The other one carries the information and is feature specified (Corbett, 2000). Singular is the default, unmarked, unspecified one in the singular-plural pair. It carries no number feature information. There is less agreement attraction error in (8) because there is no number feature on the attractor noun to be percolated to the head noun, whereas in (7) the number feature from the plural attractor moves upward to the head noun which is not specified. The verb will successfully check the plural feature present on the head noun, causing agreement attraction error.

However, there are two findings by Wagers et al. (2009) that the feature percolation theory fails to explain. First finding is the attraction in the relative clause (e.g., *The woman who John danced with yesterday is beautiful*). Although there is no direct structural relationship between the attractor (*John*) and the head noun, attraction errors still occur in this structure. Second, attraction effects are limited to the ungrammatical sentences and not the grammatical ones ('*grammatical asymmetry*'). If the above-mentioned theories were correct, there should also be an attraction effect in grammatical sentences because of the faulty representation of the subject number.

2.2.2 Clause Packaging Hypothesis

The clause packaging hypothesis does not determine how language processing is organized; it only defines the structural boundaries. It claims that the language processor focuses on individual clauses, so the materials within a clause have priority over the material outside the clause in processing. The consequence is that the information outside of the clause is less available in both comprehension and production. Bock and Cutting (1992) studied agreement attraction production. The participants were asked to finish two series of preambles in 3

experiments: the ones with relative clause (RC) or complement clause, as in (9), and the ones with a prepositional phrase modifier (PP), as in (10). They reported that there were significantly more errors in the sentences with PP modifiers.

9. The advisor who directed the students

10. The advisor for the chemistry students

They claimed that the errors in the agreement are due to the failure in resolving the interference between concurrent features of linguistic information. In one of the experiments, increasing the number of the words in the phrase did not result in an increase in the number of errors. They concluded that clause boundaries can explain the results.

The results suggested that in language production, errors in the agreement are more likely to represent a failure to resolve interference between concurrent features of linguistic information (Bock and Cutting, 1992). In other words, if a local noun is within the same clause as the head noun, they will be encoded simultaneously, and the local noun would be more likely to interfere with agreement computation. In sentence (9), there is less agreement error because the local noun and the head noun are in different clauses while in (10) both are within the same clause which would increase the probability of an agreement error (Bock and Cutting, 1992).

2.2.3 Incomplete dependency hypothesis

The incomplete dependency hypothesis was proposed by Lewis (1996) and Stabler (1994) to explain the nesting complexity theory. The sentences in (11) are increasingly complex. In (11a), there is no lexical item between the noun phrase (NP) on the subject head (*'the reporter'*) and the verb and it checks agreement with (*'dislike'*). In (11b) the relative clause (RC) intervenes between the NP and the verb. The RC (*'who the senator attacked'*) is *'nested'* within the main clause. In (11c) a second RC is nested within the first RC, between the NP (*the senator*) and the verb (*attacked*). The final double nested structure in (11c) is so complex that it is nearly impossible to comprehend.

11.

a. The reporter disliked the editor.

b. The reporter [who the senator attacked] disliked the editor.

- c. *The reporter [who the senator [who John met] attacked] disliked the editor.

The incomplete dependency hypothesis suggests that the complexity is indexed by the number of incomplete dependencies of the same kind. According to this hypothesis, if the incomplete syntactic dependencies present at a given point of time during processing are different, they will not interfere in the processing. However, Kac (1981) found out that the structures are much easier to process when the most embedded subject of nested RC structure is a pronoun, as in (12). Complexity theories fail to predict and explain the observed difference.

12. The reporter [who the senator [who I met] attacked] disliked the editor.

In (13a) the subject head noun phrase (NP) is dependent on the verb, and the dependency is satisfied immediately by processing the next word (*is*). According to the incomplete dependency hypothesis (Lewis, 1996; Stabler 1994), (13a) is easier than (13b) because in (13a) there is one incomplete dependency while in (13b) there are two incomplete dependencies at the time of processing the verb. In processing (13c) there are three incomplete dependencies, the NP ‘the poster’, the NP (*the door*) and the NP (*the toilet*), dependent on the following verb. Additionally, they are all simultaneously present at the verb processing stage which makes it difficult to keep track of them.

13.

- a. The poster is quite nice.
- b. The posters on the door is quite nice
- c. The posters on the door of the toilet is quite nice

2.2.4 The Dependency Locality Theory (DLT)

Gibson (1998, 2000) proposed the Dependency Locality Theory (DLT) to explain the complexity of sentences like (13b) and (13c). DLT is a theory of human computational resources in sentence comprehension, and it has two key insights. First, resources are required for two aspects of language comprehension: storage, and integration. The two aspects are integrated and there is a fixed amount of resources for them. Second, the complexity of a structure depends on the linear distance or locality between the two elements being integrated. Integration is connecting an incoming new word to its head or dependent on the current structure for the input. The difficulty of performing an integration depends on the local distance of the integration involved (Warren & Gibson, 2002).

DLT is an activation-based theory. It means that when an item is encoded in the memory, its activation level will decay when a new item is introduced. Thus, more recent items are easier to retrieve. To process the former items, they need to be retrieved and re-activated to the target of threshold activation (Lewis & Vasishth, 2005). In (13a), when the verb (*is*) is integrated with the noun phrase (*the poster*), some aspects of the NP have been decayed due to integration of the new input. Those decayed aspects should be retrieved from memory and it should be re-activated. In (13b), activation of the NP will break down as the intervening words are processed into the structure because the quantity of resources for activation is limited. Thus, (13c) is more difficult to process because there are more intervening words integrated into the structure increasing the local distance between the two dependent heads.

There is a number of components in integrating a new word, one of them is structural integration. The new syntactic category is expected to be matched with an existing syntactic structure. There is a storage cost associated with predicting syntactic heads. Since there is a fixed quantity of resources for integration and storage, more resources used in the storage means the slower integration occurs. There is also the possibility that the storage costs might not all require a fixed amount of resources. There is also the possibility that the storage capacity is fixed, and it will be divided, not necessarily equally, among the predictions (Gibson, 2000). In other words, the more predictions are stored, the fewer resources are available for each of them, and some predictions are stored less well. As a result, as more predictions are stored, it is less likely that all of them will be recalled as in (13c).

Franck et al. (2002) claim that the DLT fails to explain the results from Bock and Cutting (1992). They have argued that the preambles with relative clauses are syntactically more complex than the ones with PP modifiers then they should elicit more errors. As it was mentioned above, the DLT is based on the incomplete linguistic dependencies, and it claims that different incomplete syntactic dependencies will not interfere in the processing even if they are present at a given point of time. The preambles with RC modifier in (9) and PP modifier in (10) are the same length (six words), and in both there are two incomplete syntactic dependencies when the verb is introduced. According to DLT, what results in more attraction error in (10) than (9) is that the two syntactic dependencies that compete together to check agreement with the verb belong to the same syntactic category while in (10) the two linguistic dependencies are different.

In their study, Franck et al (2002) conducted two experiments in French and English. They asked the participant to add endings to the preambles where the subject phrase was modified by two stacked prepositional phrases (PP) like in (14).

14. The inscription(s) on the door(s) of the toilet(s)

They found out that it is the medial PP that led to more frequent attraction errors, suggesting that it is the structural distance (syntactic projection) between the head noun and the potential attractor that impacts the likelihood of the attraction and not the linear distance. They concluded that a more embedded local noun has no chance to affect the agreement process while the one higher in the tree can have interference in the process. Another interesting finding was a large number of errors with plural head nouns. They suggest that processing complexity may have an important role because the material used in these experiments was longer and more complex than the materials used previously in agreement studies (Franck et al, 2002).

Furthermore, both studies mentioned above (Bock and Cutting, 1992; Franck et al, 2002), tested production and not comprehension. To understand the relationship between agreement attraction and syntactic versus linear representation, we need evidence from agreement processing in comprehension as a complement to evidence from production. In production studies of agreement attraction, the proportion of agreement errors produced by the participants is the key measure while in comprehension studies either acceptability judgment tests or reading time difference or a pattern of event-related potential (ERP) is used. While production studies on agreement provide us with information about the ungrammatical sentences, comprehension studies enable us to analyze the responses to both grammatical and ungrammatical sentences.

2.3 Linguistic Transfer

Before moving to the ERP technique in 2.4, we will first cover the linguistic transfer as an important factor in L2 acquisition/processing. Learners in L1 acquisition have no linguistic experience while L2ers have a linguistic experience that may affect their L2 acquisition by linguistic transfer.

Language is parsed through the linguistic representation (grammar) in the mind of the speaker. This linguistic representation is changed and modified by the interactions happening in language processing when there is a mismatch between the input and the grammar, and by

other representations in the same or the other language even when there is not a mismatch between the grammar and the input. Crosslinguistic influence is the interaction between the languages present in the speakers' linguistic competence (Odlin, 2012; Rothman et al, 2019). According to Rothman et al. (2019, p 23-26), linguistic transfer is a representation that is formed by the reduplication from a previously acquired grammar while the cross-language effect (CLE, interference) is the influence on the processing of any given linguistic property. The linguistic transfer is consistent, it is not a slip of tongue, and it can co-occur with the processing-related crosslinguistic influence. Linguistic transfer affects both production and comprehension and it is motivated by '*underspecification*', that is the absence of the target linguistic representation to parse the target input that the learner is receiving. There are two kinds of underspecification: 1) the general underspecification in the initial stages of the exposure to the new language system and 2) when the linguistic property is absent in one of the languages, i.e. there is a mismatch between the languages (Rothman et.al, 2019). CLE affects processing the linguistic properties that have stable representation in the linguistic system. It does not concern the linguistic representations, but it is not independent of the linguistic transfer and it can have an indirect, long-term effect on linguistic representation irrespective of the linguistic competence. That is, we can observe CLE in advanced learners who have mastered the target system. For instance, in morphology production even among the proficient learners, CLE is observed in terms of errors of omission (lack of using obligatory morphology) or errors of commission (random use of the morphology) (Rothman et.al, 2019). Since the extent of CLE seems to be influenced by the other linguistic system, it has been studied in language pairs that contain mismatches in some structures. For example, there is a mismatch between Norwegian and English in subject-verb agreement in the present tense. In English, the 3rd person singular verb in the present tense is inflected with the suffix -(e)s, as in (15), but the bare form of the verb is used when the subject of the sentence is not 3rd person singular in the present tense.

15.

- a. I go to school every day.
- b. Tom goes to school every day.
- c. Tom and Mary go to school every day.

In Norwegian, the present tense is marked with the suffix –(e)r. Regarding the subject-verb agreement, Norwegian has no overt agreement morphology, and the verb does not change its form, regardless of the number and person of the subject, as in (16).

16.

a. Jeg bor i Tromsø

I - live - in - Tromsø

'I live in Tromsø'

b. Hannah bor i Tromsø

*Hannah – live – in - Tromsø

'Hannah lives in Tromsø'

c. Hannah og Ove bor i Tromsø

Hannah – and – Ove – live – in - Tromsø

'Hannah and Ove live in Tromsø'

There have been several studies focusing on the English subject-verb agreement acquisition by Norwegian native speakers. Jensen et al. (2017) and Jensen (2016) found that subject-verb agreement is more difficult for L2ers, even for advanced learners. Garshol (2019) found that young Norwegian learners of English overuse the third person singular –s inflection. In his master's thesis, Son (2020) has investigated Subject-verb agreement in written English by L1 Norwegian university students at a later stage of acquisition. He found that Norwegian university students have no difficulty with the local agreement, where the subject is immediately followed by the verb, but they show difficulty with the non-local agreement, where there is an intervening noun between the subject and the verb.

The crosslinguistic influence can be easily observed in L2ers with the structures that are absent in either L1 or L2. The question arises about the effect of the two language systems on each other where there is no mismatch in the two languages. In the case of Norwegian-English, one area of similarity is number marking on the noun. In English, numbers are marked on nouns by the suffix *-(e)s*, so in (11b) and (17d) the word ‘*cats*’ means we have more than one cats while in (17a) and (17c) we have one cat because the word ‘*cat*’ does not have the suffix *-s*. In English nouns can also be double marked by quantifiers (*many, some, all*) and demonstratives (*this, that, these, those*). In (17a) and (17b) the definite article ‘*the*’ does not have any number information, and the noun is realized as singular because it is not inflected (17a). On the other hand, in (17c) in addition to the non-inflected noun, the demonstrative pronoun ‘*this*’ indicates that the noun is singular (17c), so the noun is double marked.

17.

- a. The cat is hungry.
- b. The cats are hungry.
- c. This cat is hungry.
- d. These cats are hungry.

In Norwegian, nouns in their indefinite forms are marked plural with the suffix *-er*, as in (18a). Definiteness is also marked on the noun by the suffix *-en* as in (18b) for the singular nouns. Definite plural nouns in Norwegian are suffixed with *-ene*.

18.

- a. Katt (a cat), Katter (cats)
- b. Katten (the cat), kattene (the cats)

Like English, Norwegian allows double number marking on the nouns by singular demonstratives (*denne, dette, den, det*) and plural demonstratives (*disse, de*), as in (19 a-d). Nouns followed by the demonstratives take the definite forms, i.e., the definiteness is also double marked. This pronominal definiteness marker is acquired later than the suffixed definite article in Norwegian (Anderssen, 2007).

- 19.
- a. Katten er sulten
The cat - is - hungry

 - b. Kattene er sultne
The cats -are- hungry

 - c. Denne katten er sulten
This- cat- is- hungry

 - d. Disse kattene er sultne
These- cats- are- hungry

There have been many studies investigating the CLI in L2/L3 production (Son, 2020; Garshol, 2019) and comprehension (Jensen, 2016; Jensen et al., 2017) using the offline methods (Grammatical Judgment Test) that measure the explicit linguistic knowledge of the learners. Tokowicz and MacWhinney (2005) investigated the effect of L1 on L2 processing using the ERP technique that measures the implicit unconscious knowledge of the learners. They have studied native English speakers who were learning Spanish in classroom context using the experimental items in three different syntactic constructions: the one that is similar in L1 and L2, the one that is formed differently in L1 and L2, and the one that is unique to L2 and is absent in L1. They have found that the learners were sensitive to violations in L2 for structures that are similar in L1 and L2 and the structures unique to L2. This sensitivity was indexed by a P600 effect. For the syntactic structures that were different in the two languages, the participants did not show any sensitivity.

2.4 EEG/ERP

In the past few decades, the ERP technique has joined the list of methods used to examine language processing. ERP is a non-invasive method that provides high-resolution temporal information about the mind and the brain i.e., it reflects ongoing brain activity with minimal delay (Luck, 2014). Although the spatial resolution in ERP is low, each component has a distinctive scalp distribution and it reflects the location of the patch of cortex in which it was originally generated, so *Electroencephalogram (EEG)*, can be used to create models of the distribution of activity over the cortical surface (Luck, 2014).

ERPs are elicited from, electrical brain activity via EEG, which is measured by placing the electrodes on the scalp. The EEG is amplified and the changes in voltage over time are plotted. EEG cannot be used in its raw form because it represents a mix of neural activities that make it difficult to isolate any one specific neuro-cognitive process. However, it is possible to extract and isolate the neural responses associated with specific cognitive, sensory, and motor events with averaging techniques. ERP provides information from the beginning of the experiment (before the stimulus presentation) to the end, after the neural response. These responses are the electrical potentials related to specific events and they are called Event-Related Potentials (Luck, 2014).

Different ERP components have been found to correlate with specific processes during language comprehension. These components are defined in terms of their scalp distribution and their responses to experimental variables. One of the psycholinguistic models for language processing that considers the temporal structure of syntactic processes is Frazier's language processing model (Frazier 1987 as cited in Friederici, 1996,). There are two separate consecutive stages for syntactic processes. During the first stage, an initial structure is assigned to the input by the parser. This process is based on word category information, and it is reflected by early negativity around 200 ms prominent over the left anterior region. In this stage, all the information encoded in the lexical element is immediately available. This information includes semantic information, like the meaning of a word, and syntactic information, such as subcategorization information. Processing the semantic and syntactic information of a word are associated with a negative component around 400 ms, however, the distribution of N400 is different. Processing the semantic information is related to N400 in the parietotemporal part of both hemispheres while syntactic information processing is indexed by an N400 in the left anterior brain region (Friederici et al., 1996).

During the second stage, the thematic role is assigned to the input and syntactic and semantic analyses are mapped into each other. The second stage of processing is associated with a positive component around 600 ms distributed over the centroparietal region. The P600 is observed in relation to some syntactic and morphosyntactic violations (Osterhout & Holcomb, 1992, 1995). This model also assumes some principles for possible ambiguities that may lead to an initial analysis. If the initial analysis in the first stage is not confirmed by the thematic analysis in the second stage, the initial structure will be reanalyzed (Friederici et al., 1996). This is supported by the study by (Osterhout and Holcomb, 1993) showing that recovery from garden-path sentences elicits a P600 component. A similar positivity was found by

Mecklinger, Schriefers, Steinhauer, and Friederici (1995) peaking at 345 ms in correlation with a revision of an initial filler-gap relation during the processing of German relative clauses that were syntactically correct.

The P600 is sometimes preceded by the N400. Violation of expected word category and agreement information-carrying consequences for thematic assignment may trigger the biphasic response i.e., the P600 preceded by an N400 component, while recovery from garden-path sentences may elicit an isolated P600 component without an N400. In their study, Friederici et al. (1996) found out that N400 was present only in sentences with syntactic violations not in ambiguous sentences, while P600 was observed in both sentences. They have argued that the failure in building up the syntactic structure during the initial stage is reflected by an N400 component, and the assignment of the thematic role, reanalyzing, and repair are associated with a P600 component. Their findings support the language parsing model by Frazer (1987 via Friederici et al., 1996).

The P300 or Late Positive Component (LPC) is an ERP component that reflects the enhancement of the attentional focus to foster memory storage (Polich, 2012, Rushby et al., 2005). The P300 is comprised of a P3a and P3b, where P3a reflects the early attention-related process resulting from a representational change in the working memory, and P3b reflecting the transmission of the attention-driven stimulus signals to the temporal and parietal structures. Thus, the P300 reflects the neural inhibition when stimulus and task engage fundamental cognitive mechanisms. (Polich, 2012).

Context updating theory (Donchin, 1981) is one of the major theoretical accounts of P300 and it suggests that P300 reflects the brain activities underlying revision of the mental representation created by incoming stimuli. When the initial sensory input has been introduced, the representation of the previous event is evaluated by an attention-driven comparison. If no change is detected, the current mental model is maintained. If a new stimulus is detected, the neural stimulus representation is updated in working memory, and P300 is produced. P300 amplitude is sensitive to the amount of attention needed for task performance (Alonso et al., 2020; Kramer et al., 1985). More distinctive stimuli are more likely to be recalled and they elicit larger P300 (Fabiani et al., 1986). Unattended stimuli do not elicit a P300 (Nieuwenhuis, Aston-Jones, & Cohen, 2005).

Recall the debate within L2 acquisition and processing research where some claim that L2ers have difficulty in processing some syntactic structures because they tend to use different information compared to L1ers (The Shallow Structure Hypothesis; Clahsen & Felser, 2017, 2006; Interface Hypothesis; Sorace, 2011) or they use a different processing system (The declarative/procedural model; Ullman, 2001, 2005). On the other hand, other approaches claim that L1ers and L2ers use a similar syntactic representation and processing system and any difference between them can be explained in terms of working memory capacity (Gibson, 1998; Cunnings, 2017). Several studies have investigated the topic by studying subject-verb agreement processing in L1 and L2 using ERPs to see whether L2ers can acquire and process L2 morphosyntactic features in a similar way to L1ers (e.g., Alemán Bañón & Rothman, 2019; Ojima, 2005; Tanner and Bulkes, 2015; Osterhout & Mobley, 1995 among all). It has been shown that L1ers detect the local agreement violation as in (14) reflected by a P600 effect (Tanner and Bulkes, 2015).

20.

- a. The cookies taste the best when dipped in milk.
- b. *The cookies tastes the best when dipped in milk.
- c. Many cookies taste the best when dipped in milk.
- d. *Many cookies tastes the best when dipped in milk.

The results for L2ers whose native language lack morphological agreement are contradictory. Armstrong et al. (2018) has replicated the study by Tanner and Bulkes (2015) to study the L1 vs L2 agreement processing in Mandarin speakers of English. They found a P600 effect in L2ers suggesting that agreement violations elicit similar neural responses in L1ers and L2ers. On the other hand, studying agreement processing in Japanese speakers of English, Ojima et al. (2005) have found that the P600 effect was absent for L2ers with low proficiency. They have concluded that L2 processing approximates that of L1 as proficiency increases.

Chen et al. (2007) used the agreement attraction design, manipulating the verb and the attractor (the intervening noun in PP) to study the Chinese speakers of English and compare them with native speakers of English. L1ers showed a P600 component but the L2ers showed a late negative shift, suggesting that L2 processing is different from L1 processing when the processed feature is absent in L1. They argued that language-specific experience with L1 will affect the neural responses in L2 processing even when the behavioral pattern of L2ers is

similar to L1ers. Cheng et al. (2021) conducted an ERP study on L1 vs L2 non-local agreement processing on native English speakers and Chinese speakers of English. Both L1ers and L2ers detected non-local agreement violations indexed by a P600. They concluded that L1ers and L2ers use similar underlying mechanisms for processing non-local dependencies.

The role of double marking in agreement processing has been investigated in some L1 and L2 studies. In English, number is marked morphologically (e.g., *cat + s*) and lexically with quantifiers (e.g., *some, many*). The combination of the two results in double number marking (*many cats*). Tanner and Bulkes (2015) manipulated the double markedness with using quantifiers (*some, many*), as in (20) to investigate the effect of the double marking in L1 agreement processing. They reported a larger difference in the amplitude of the P600 effect when the NP was preceded by a number-specified quantifier, as in (20c) and (20d). They concluded that double marking with quantifiers facilitates sensitivity to agreement errors in L1 processing.

Armstrong et al. (2018) replicated the study by Tanner and Bulkes to see whether double marking has a facilitative effect on Chinese speakers of L2 whose L1 lacks the double marking on the noun. The results suggest that the L2ers fail to use the quantifiers as a facilitator, which is indexed by a reduced P600 effect for quantified sentences as in (20c) and (20d) compared to the unquantified ones (20a) and (20b). They argued that in (20c) and (20d) the L2ers will parse the number marked quantifier but they use the lexical cues rather than the morphological cues, because in their L1 the number is marked lexically. Thus, these L2ers paid less attention to the morphosyntactic cues on the noun.

Moreover, Cheng et al. (2021) pointed out a potential confound in the material by Armstrong et al. (2018). They argued that some of the quantifiers used in the material are number-ambiguous, like "*some*", because they can be used with singular nouns as well. To investigate the facilitative effect of double marking, Cheng et al. (2021) tested the Chinese L2ers living in the UK. They manipulated the NP in the subject head and the quantifier as in (21).

21.

- a. The window of the house is really clean.
- b. *The windows of the house is really clean.
- c. That/this window of the house is really clean.
- d. *Those/these windows of the house is really clean.

With number specified sentences (c and d), the accuracy was increased in the offline grammaticality judgment responses and there was a higher amplitude in the P600 for number-specified sentences with agreement violation (d). They showed that both native and non-native speakers detect the non-local agreement violation indexed by a P600 effect suggesting that the underlying processing mechanisms are similar in L1 and L2 processing.

2.5 Current Study

In this study, we adapted Cheng et al. (2021) to see the L1 vs L2 processing in the Norwegian speakers of English. Like Chinese, Norwegian does not allow over subject-verb agreement. The difference between Chinese-English and Norwegian-English language pairs is the double marking. In Chinese, Unlike English, nouns are not morphologically marked, and they are marked by quantifiers and demonstratives, so double marking is not licensed in Chinese and the two languages mismatch regarding the double marking on the noun. In Norwegian, however, double marking is allowed and the two languages i.e., English and Norwegian match in this syntactic structure. To our knowledge, there is no published ERP study on non-local agreement violations processing in Norwegian speakers of English. This study will help us to understand the underlying mechanism in L2 processing and specifically the how lexical and morphological cues can affect L2 processing. Additionally, this study can provide us with insight on L1 versus L2 processing when the feature is not present in L1 (subject-verb agreement). Moreover, it will provide us with information on L2 processing when the syntactic structure in L1 and L2 match (double marking on noun). The following research questions are addressed in this study:

Research Question 1. Will a P600 effect be elicited by non-local violations in native Norwegian L2 English speakers?

Research Question 2. Do number-specified sentences elicit a larger P600 than the unspecified sentences?

Based on the previous findings (Cheng et al., 2021; Armstrong et al, 2018) the research hypothesis is that L2ers can process non-local violations in a similar way to L1ers. We expect that our Norwegian speakers of L2 should exhibit a P600 effect, indicating that they detect the syntactic violation. According to Tokowicz and MacWhinney, 2005), L2ers will show sensitivity to the structures that are present in L1 and L2 and the two structures match. Since double marking is allowed in both Norwegian and English, we expect the double marking to have a facilitative effect in non-local violations in L2ers which would result in a larger P600 effect for double-marked sentences as observed in Cheng et.al (2021). The following predictions are based on the previous findings:

Prediction 1. A P600 effect will be elicited by non-local violations in native Norwegian L2 English speakers.

Prediction 2. Number-specified sentences elicit a larger P600 than the unspecified sentences.

To answer the research questions posed above, we used the event-related potential (ERP) technique.

3 Methodology

3.1 Participants

This study is a part of an ongoing research with 12 Norwegian L2 English speakers who learned English in school. One additional participant was removed from the cohort for analysis due to self-reported diagnosis of Tourette syndrome (Tourette's or TS). The final sample for analysis thus included 11 participants (mean age = 23, female = 7). All participants were undergraduate students from the Arctic University of Norway in Tromsø (UiT). They were compensated 250 NOK for participating. All the participants were born and raised in Norway and were living in Tromsø at the time of testing. They all started learning English at school at the age of 6, except for one participant who started learning English at the age of 7 (mean AoA = 6). Three participants reported living in other countries (South Korea, United States, and Iceland) where Norwegian is not the dominant language. Their length of experience ranged from 6 to 24 months (mean = 14 months). One out of the 11 participants was left-handed and all the participants had normal or corrected-to normal vision.

3.2 Experiment Items

3.2.1 EEG Sentences

The materials were adapted from Cheng et al (2021). We had four target conditions (grammatical unspecified, ungrammatical unspecified, grammatical specified, ungrammatical specified) in a 2x2 design with 32 trials per condition. The experiment involved EEG data collection during a Grammaticality Judgement test (GJT). We adapted 128 baseline sentences from the original 160 baseline sentences from Cheng et al. (2021). First half of the 160 sentences from Cheng et al. (2021) contained the verb “*to be*”. We used the same sentences in our experiment. The sentences in the other half, contained the verb “*to be*” in the present perfect tense or the verb “*to have*” in the present tense. We used 48 of those sentences so that all the sentences contained the verb “*to be*” and we inserted an adjective or adverb where necessary to make our sentences the same length. In total, we had 512 experimental sentences (critical items) that were distributed across four lists so that the participants saw each sentence in only one condition. Each list contained 128 critical items and 128 fillers.

The critical items contained the verb “*to be*” in the 3rd person singular form as the critical word. The head noun was either singular or plural, so half of the sentences were grammatical (conditions 1 and 3), and half of them were ungrammatical (conditions 2 and 4). The

intervening noun (the attractor) was not manipulated, and it was always singular to match with the number feature of the verb. We used demonstratives to manipulate number specifications on the determiner for the head noun. Head nouns in conditions 1 and 2 had a number-unspecified determiner "*The*", while in conditions 3 and 4, they had a demonstrative specifying number "*This/These*" in half of the items and "*That/Those*" for the other half of the items. One hundred twenty-eight sentences were added to each list as fillers. Half of the fillers were grammatical and half of them were ungrammatical. Some of the fillers had a similar structure to the critical items but with a plural verb.

1. The window of the house is really clean. (Grammatical, Number-unspecified)
2. *The windows of the house is really clean. (Ungrammatical, Number-Unspecified)
3. That window of the house is really clean. (Grammatical, Number-Specified)
4. *Those windows of the house is really clean. (Ungrammatical, Number-Specified)

3.2.2 Language Social Background Questionnaire (LSBQ)

To collect the demographic data and information about the language use of the participants we used LSBQ. It is a reliable test to measure the degree of bilingualism in young adults in communities where English is the official language. It describes bilingualism based on the extent of proficiency and use of a non-English language at home and socially (Anderson et al., 2018). LSBQ contains four sections. The questions of the first section gather demographic information. There are also some questions to measure Socioeconomic Status (SES) of the participants and some questions about the participants' neurological impairment or head injury or any psychoactive medications they are taking. The second section, Language Background, assesses the language(s) the participant can understand or speak, the age, and the place the languages were acquired or learned. In section three, Self-rated proficiency and use, participants are asked to self-rate their proficiency for speaking, understanding, reading, and writing the indicated languages on a scale from 0 to 10, where 0 indicates no ability and 10 indicates native fluency. The frequency of use of each language was assessed on a scale from "None" to "All" of the time. Section four, Community Language Use Behavior, is on Norwegian language use in different stages of life (infancy, preschool, primary school, and high school) and different contexts, with different people (family, friends, neighbors), in different situations (home, school, work) and for different activities (reading, social media,

watching TV). The section includes some questions about language-switching. The participants rated their language use on a scale from "All Norwegian" to "Only other language".

3.2.3 Oxford Quick Placement Test (QPT)

We used quick placement test (version 1, 2001) to assess the proficiency level of our participants. Proficiency level is an index of the grammatical knowledge of the target language, and it can tell us whether the participants have acquired the target grammatical structure in L2, in our case, the subject-verb agreement. QPT consists of three parts. In the first two parts, the participants saw 60 questions with multiple answers. For the first 5 questions, the participants have to match the picture they see to the correct context described in the sentences. For the rest of the questions, they have to choose the words and phrases that fit in a text (cloze test) or best complete a sentence. The questions test the grammar knowledge and vocabulary knowledge of the participants. Part three of the test is a writing section. We did not test the participants' writing skills. The score of the test can range from 0 to 60 where 60 reflects the highest proficiency level and 0 indicates beginner level. The standard error of measurement of this test is ± 4 , meaning that 68% of the time, a participant's score is within ± 4 points of the score they get. The results of QPT have been converted to the five levels from 0= beginner to 5 = very advanced. Seventy-three percent of our participants were advanced and very advanced speakers of English. The converted results are illustrated in Table 1. The mean proficiency score for all the participants is 48 that equals to level 4 (Advanced) of the proficiency test. It means we had a group of advanced Norwegian speakers of English.

Table 1. The distribution of the participants in the Oxford Language Placement Test

level	percentage
Elementary	9
Lower-Intermediate	9
Upper-Intermediate	9
Advanced	46
Very Advanced	27

3.3 Procedure

The study was conducted in one session. All participants were asked to sign a consent form for participating in the study. Subjects first completed the LSBQ and then underwent a resting state EEG recording, in which the brain activity is monitored in the absence of task performance. The data for the resting state will be used in another study. They were asked to look at a fixation mark on the screen for 5 minutes and for another 5 minutes they were asked to close their eyes and try not to sleep. The order of eyes-open and eyes-closed resting state recordings was counterbalanced among participants. The data from the resting state is going to be used in another study. Since we are not using the resting state data in our study, we will not discuss it further.

The main EEG experiment was run and presented in rapid serial visual presentation (RSVP). The participants were asked to look at the screen and read the sentences with minimum movement. They were asked to try not to blink or move their eyes as much as possible during the presentation. They could blink at the end of each sentence. We also asked them not to move their head during the experiment. Before starting the actual experiment, the participants did a practice with 5 sentences. The experiment was conducted in 8 blocks, followed by a short break. Before each sentence, a fixation cross appeared in the middle of the screen. Each word in the sentences was displayed for 450 ms with an inter-stimulus interval of 200ms.

After each sentence, participants had to indicate with the left- and right arrows of the keyboard whether or not the sentence was well-formed (left for grammatical sentences and right arrow for the ungrammatical sentences). The participants had a maximum 3 seconds to answer. If not, the next sentence would be presented on the screen. After the EEG task, all participants completed the oxford QPT. The project has been approved by the Norwegian Center of Research Data (NSD).

3.4 Pre-processing

The EEG activity was recorded with Brain Vision Recorder and BrainAmpDC amplifier system (Brain Products, Germany). We used a 32-channel active cap system. The data was recorded with a reference to FCz and was re-referenced offline to the average of mastoids. Eye movements were monitored by Fp1 and Fp2. Impedances were maintained below 5 Ω for all channels. The EEG signal was digitized at a sampling rate of 1000 Hz with a bandpass filter of 0.016 to 200 Hz.

The data were pre-processed in Brain Vision Analyzer (Brain Products, Germany). The data were filtered offline at 0.01-55 Hz. Epochs of 1500 ms were segmented around the critical word with 300 ms before the onset of the critical stimulus and 1200 ms post-onset. The baseline was corrected for all epochs (100 ms pre-stimulus). Independent Component Analysis (ICA, ref) was applied to remove any artifacts due to eye movement and short blinks, followed by semi-automatic artifact rejection that was applied to spot blinks or eye-movement that was not caught by ICA and/or any other noise in the data. We aimed for the trials with absolute amplitude lower than -130 mV or higher than 130 mV, or with the activity lower than 0.05 mV in the intervals of 100 ms, or with a voltage step higher than 50 mV/ms. Trials with blinks, eye movements, and noisy electrodes were removed. In our study on L2, we kept 84% of the trials in each condition and we excluded 16% before averaging the data. ERPs were time-locked to the onset of the critical word and were averaged offline for each condition at each electrode for each participant.

4 Results

We found a P600 effect and positivity in the N400 time window in our ERP data. The effect of grammaticality was significant resulting in a larger P600 for the ungrammatical sentences. Specificity was indexed by the positivity in the N400 time-window in the frontal lobe, with the most significant effect on the specified grammatical sentences. The behavioral data reflected grammatical asymmetry i.e., the grammatical sentences were judged more accurate than ungrammatical sentences. Specificity was not facilitative for the participants in judging the sentences in the behavioral GJT. Unspecified grammatical sentences had the highest rate of accuracy. The data is presented in detail in the following sections.

4.1 Behavioral Data

The descriptive results from the four conditions in the Grammatical Judgement Test (GJT) during EEG are shown in Figure 1. The Grammatical sentences (blue) were judged more accurately than the ungrammatical sentences (red). Unspecified grammatical sentences were judged more accurately (85%) than the specified grammatical sentences (73%). For ungrammatical sentences, however, specified sentences were judged more accurately (62%) than the unspecified sentences (52%).

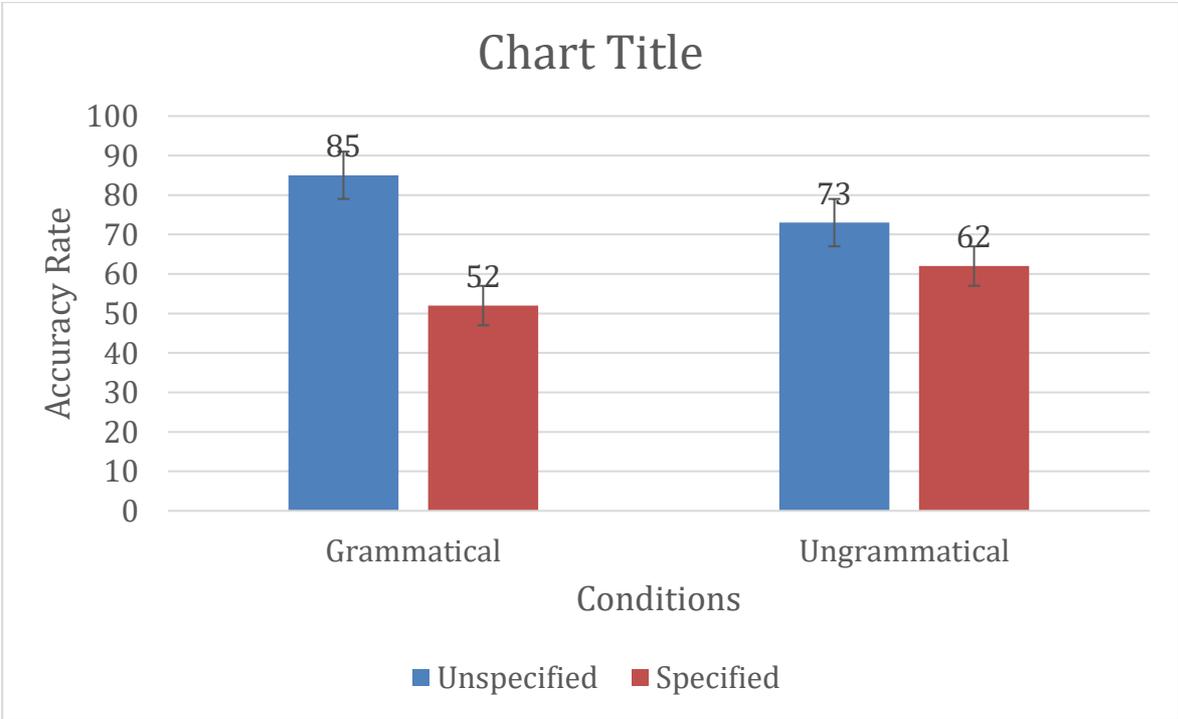


Figure 1. Accuracy rate of the Grammatical Judgement Test

The Grammatical Judgement test (GJT) from the EEG data were analyzed using mixed effect models. A generalized mixed effect model was conducted including fixed effects of grammaticality and number specification and their interactions. Random intercepts for subjects were included. There was a significant effect of specificity ($estimate = 0.8474$, $SD = 0.2014$, $z = 4.207$, $p = 2.59e-05$) and a significant effect of grammaticality ($estimate = -1.6919$, $SD = 0.1744$, $z = -9.702$, $p < 0.0001$) such that specificity decreased accuracy and grammaticality increased accuracy. The follow-up test (mean comparison with “Tukey” test) showed that the participants made better judgements on grammatical sentences compared to ungrammatical sentences for the specified sentences ($estimate = 1.692$, $SD = 0.174$, $z = 9.702$, $p < .0001$), as well as the unspecified sentences ($estimate = 2.074$, $SD = 0.196$, $z = 10.563$, $p < .0001$). The results suggest no effect of interaction of specificity and grammaticality ($z = -1.477$, $p = 0.14$).

Within the grammatical condition, unspecified sentences elicited more correct judgements than the specified sentences ($estimate = -0.847$, $SD = 0.201$, $z = -4.207$, $p = 0.0002$), indicating that the specificity was not facilitative. Within the ungrammatical sentences, however, the effect of specificity was not significant ($estimate = -0.466$, $SD = 0.163$, $z = -2.861$, $p = 0.0219$).

4.2 ERPs

4.2.1 P600 time window

Grand averaged ERP waveforms for the grammatical and ungrammatical sentences are illustrated in Figure 2 (unspecified sentences) and Figure 3 (specified sentences) at the two electrodes where the P600 effect is observed typically (CP1 and CP2). In both figures there is a difference in the amplitude of the grammatical and ungrammatical waveforms in the 500-900 time-window (the highlighted area).

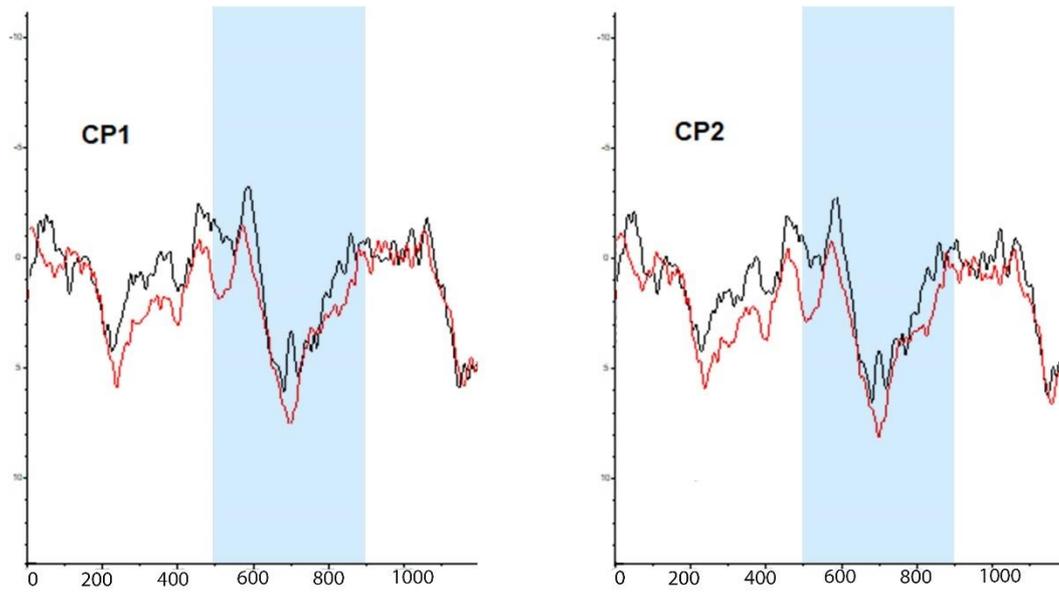


Figure 2. Grand average ERP waveforms for unspecified grammatical(black) and unspecified ungrammatical sentences at electrodes CP1 and CP2.

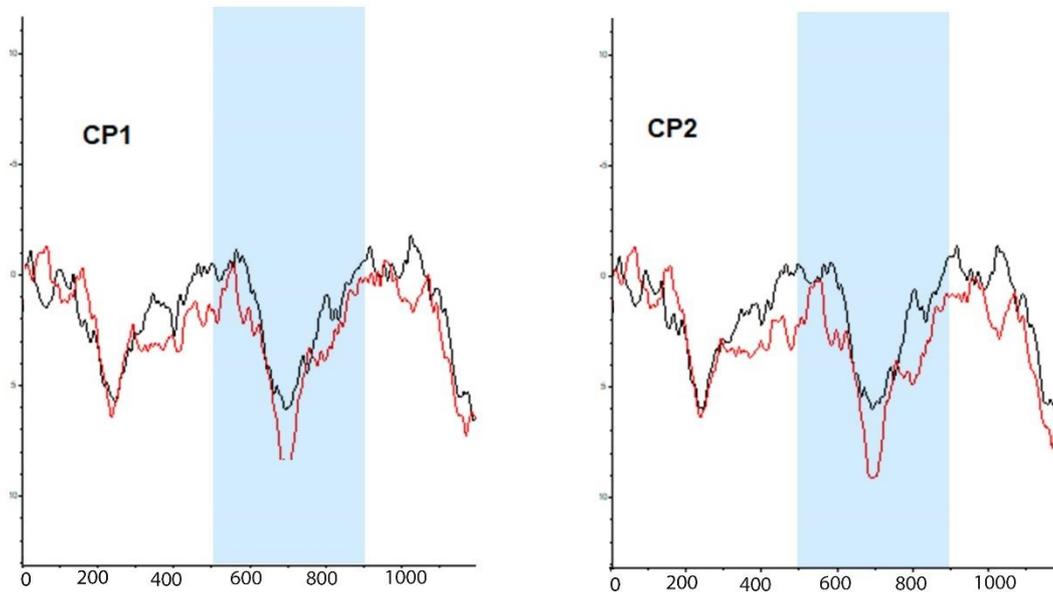


Figure 3. Grand average ERP waveforms for specified grammatical(black) and specified ungrammatical(red) sentences at electrodes CP1 and CP2.

We compared the grand average ERP waveforms for specified and unspecified sentences at the electrode CP1 (Figure 4). For the ungrammatical sentences, the two waveforms (specified and unspecified) are almost identical in the 500-900 time-window. While for grammatical sentences, there is a difference in the waveforms in the P600 time-window, the specified grammatical sentences have a higher amplitude.

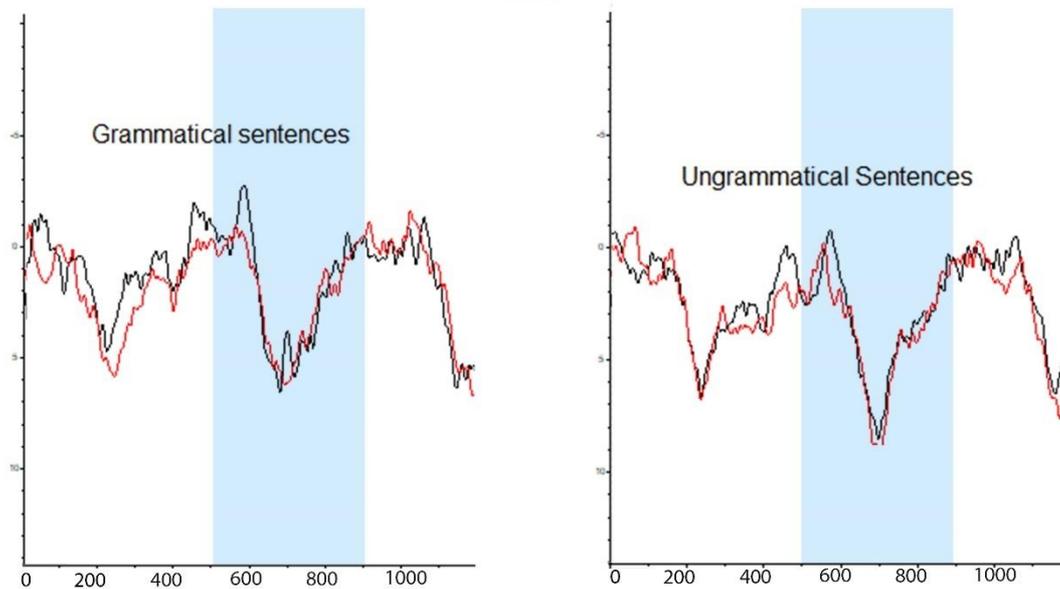


Figure 4. Grand averaged ERP waveforms for the unspecified (black) vs specified (red) sentences in Ungrammatical and Grammatical conditions at electrode CP1

We examined the mean voltage in the 500-900 ms time-window. The mean voltage for ungrammatical sentences is higher than the grammatical sentences (for both unspecified and specified sentences) across all the electrodes, while mean voltage for the specified sentences does not seem different from the unspecified sentences (Figure 5). This suggests that specificity should not affect the amplitude of P600 and the mean voltage for grammatical sentences and ungrammatical sentences. In other words, the mean amplitude for specified grammatical sentences and grammatical unspecified will not be different. This also applies for the specified and unspecified ungrammatical sentences.

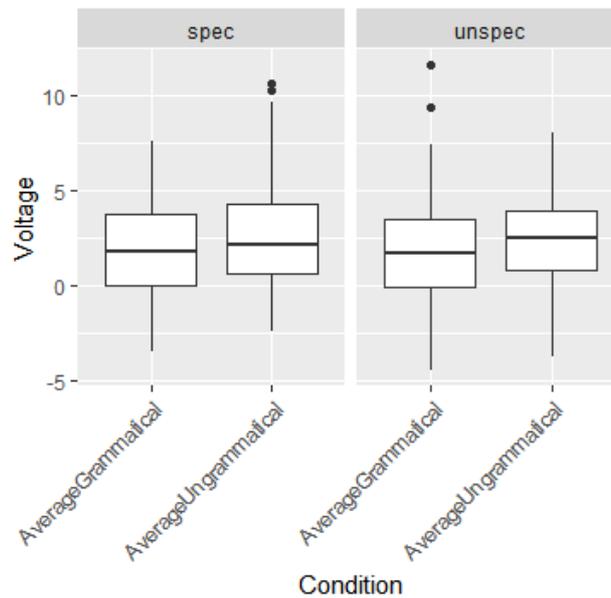


Figure 5. Mean voltage for interaction of grammaticality and specificity for all the electrodes in 500-900 ms time window

The repeated measures ANOVA was conducted to explore the effect of specificity, grammaticality, and caudality (anterior vs posterior region) on voltage. Five regions of interest were included in the analysis including the four lateral regions: left anterior (F3, F7, FC5, FC1), left posterior (P3, P7, CP5, CP1), right anterior (F4, F8, FC2, FC6), right posterior (P4, P8, CP6, CP2), and the midline region that includes: midline anterior (Fz), midline medial (Cz), and midline posterior (Pz, Oz). Due to the different number of electrodes at each region, the analysis for the midline and lateral region was done separately. For the midline region, the effect of specificity ($F = 0.15, p = 0.70$) and grammaticality ($F = 32.67, p = 0.048$) was not significant. The only significant effect, after sphericity correction, in the midline region was caudality ($F = 82.64, p = 0.009$). Post-hoc tests (multiple comparisons of means with 95% confidence level) showed that the mean voltage was higher significantly in the posterior than the anterior ($p = 0.009, diff = 1.60$) and median ($p = 0.004, diff = 1.74$) region. Since this effect did not interact with the grammaticality, we do not discuss it further.

The ANOVA results for the mean voltage measured at the lateral electrodes during the 500-900 ms time window showed a significant effect of caudality ($F = 8.65, p = 0.01$), and post-hoc tests indicated that the voltage was significantly more positive ($p < 0.0001, DF = 1$) for the posterior region. There is also a significant effect of grammaticality in interaction with caudality and hemisphere ($F = 14.52, p = 0.003$) in the ANOVA results. The data was subset

into four regions (left anterior, left posterior, right anterior, right posterior). Follow-up tests were done to detect the region in which the grammaticality effect is more significant. The results are shown in Table 2.

Table 2. ANOVA results for the effect of Condition on the lateral electrodes in 500-900 ms time window

Region	<i>F</i>	<i>P-value</i>	<i>DF</i>
Left Anterior	1.47	0.22	1
Left Posterior	4.01	0.046*	1
Right Anterior	8.72	0.003*	1
Right Posterior	9.13	0.002**	1

Post-hoc tests were done for the three lateral regions to compare the means of the two different conditions (grammatical vs. ungrammatical) on voltage, and the results showed that for the ungrammatical (specified and unspecified) sentences the mean amplitude is higher than the grammatical sentences and the difference is significant in all three regions. The results are illustrated in table 3.

Table 3. Multiple comparisons of means for Ungrammatical-Grammatical sentences for lateral regions in 500-900 ms time window

Region	<i>p-value</i>	<i>Difference</i>
Left Posterior	0.04*	0.76
Right Anterior	0.01*	0.79
Right Posterior	0.002**	1.11

While the results show that both number specified and number unspecified sentences demonstrate grammaticality effect with more positive responses to ungrammatical sentences compared to grammatical ones, no differences were observed between the specified and unspecified sentences in the P600 time window. This is visualized in Figure 6 for the three regions that the effect was observed, i.e., left posterior, right anterior, and right posterior. This effect was not significant in the left anterior.

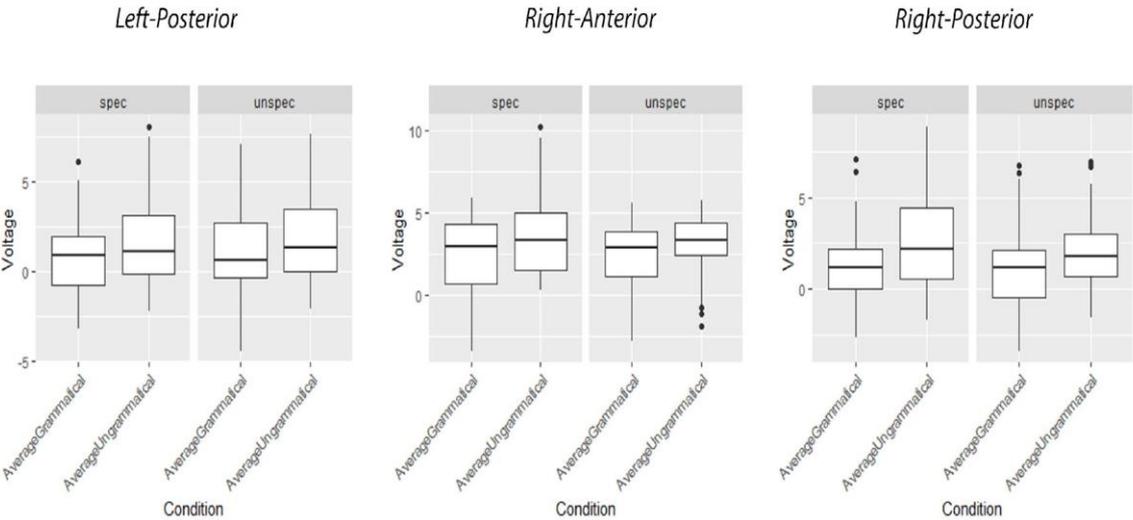


Figure 6. Mean voltage comparison for specified and unspecified sentences in different condition in 500-900 ms for the lateral region

4.2.2 N400 time window

A positivity in the grand average waveforms was observed in the 250-500 ms time window where the N400 effect is typically observed (Figures 2-4). To examine the effect of specificity, grammaticality, and caudality on voltage, a repeated-measures ANOVA was run for the midline and lateral regions separately. For the midline region, the effect was significant for caudality ($p = 0.001, DF = 2$), caudality in interaction with grammaticality ($p = 0.047, DF = 2$) and caudality in interaction with specificity ($p = 0.005, DF = 2$) as shown by Mauchly’s statistics. Post-hoc tests (multiple comparisons of means with 95% confidence level) revealed that there is more positivity in the posterior region than the median ($p = 0.01, diff = 1.41$). Brain responses for ungrammatical sentences were significantly more positive than the grammatical sentences ($p = 0.003, diff = 1.20$).

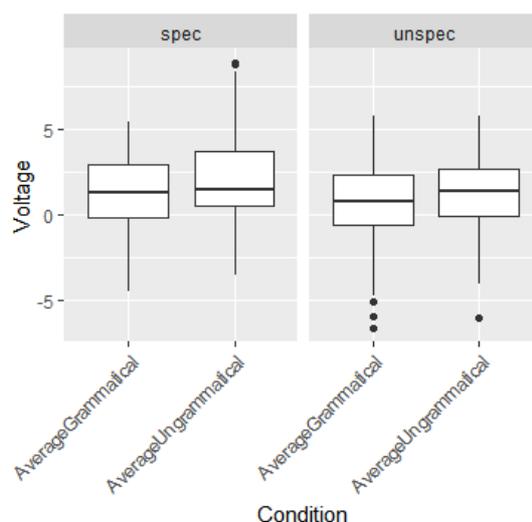


Figure 7. Mean voltage for grammaticality and specificity for all the electrodes in 200-500 ms time window

For the lateral region, the ANOVA results showed the significant effect of hemisphere ($F = 14.12, p = 0.003$), grammaticality in interaction with caudality ($F = 5.15, p = 0.046$), grammaticality in interaction with hemisphere and caudality ($F = 13.23, p = 0.004$), and the interaction of all the factors i.e., grammaticality, hemisphere, caudality and specificity ($F = 13.82, p = 0.003$).

Post-hoc tests (multiple comparisons of means with 95% confidence level) showed that the mean voltage in the right hemisphere is significantly higher than the left hemisphere ($p = 0.0007, diff = 0.56$) indicating that the brain response is more positive in the right hemisphere. To detect the region in which the positive effect of the grammaticality is more significant (interaction between grammaticality, caudality, and hemisphere), follow-up tests were done. As it is shown in Table 4, grammaticality elicited more positive responses in the right hemisphere and the left posterior region.

Table 4. ANOVA results for the effect of grammaticality in interaction with hemisphere and caudality in 250-500 ms time window

Region	<i>F</i>	<i>P-value</i>	<i>DF</i>
Left Anterior	0.067	0.79	1
Left Posterior	8.078	0.005**	1
Right Anterior	5.799	0.017*	1
Right Posterior	10.13	0.001**	1

Post-hoc tests were done to compare the means of the two different conditions (grammatical vs. ungrammatical) on voltage for the three lateral regions, and the results showed that for the ungrammatical sentences the mean amplitude is higher than the grammatical sentences and the difference is significant in all three regions but more significant in the posterior region, illustrated in Table 5.

Table 5. Multiple comparisons of means for Ungrammatical-Grammatical sentences for lateral region in 250-500 ms time window

Region	<i>P-value</i>	<i>difference</i>
Left Posterior	0.005**	0.95
Right Anterior	0.017*	0.79
Right Posterior	0.001**	1.08

The results suggest that sentences demonstrate a grammaticality effect with more positive responses to ungrammatical sentences compared to grammatical ones. This is visualized in Figure 8 for the three regions that the effect was observed (left posterior, right anterior, and right posterior). Since this effect was not significant in the left anterior, it is excluded in the visualization.

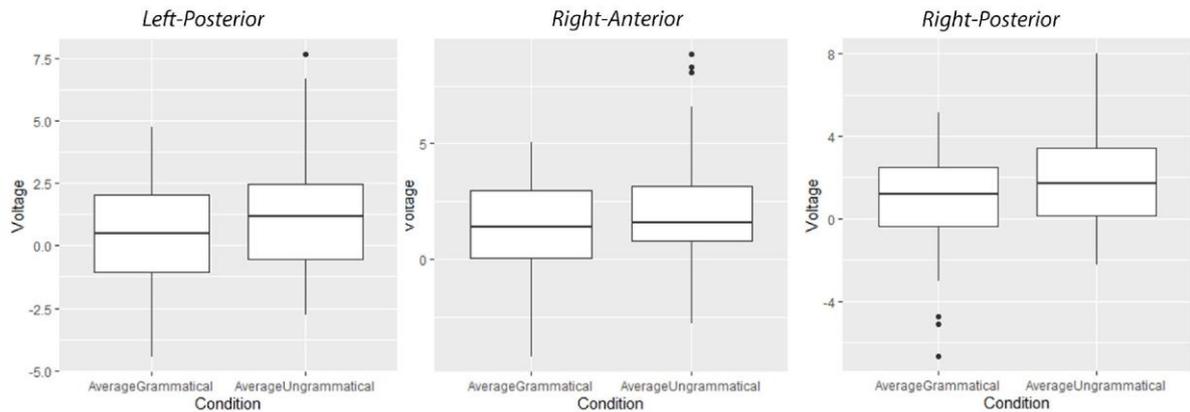


Figure 8. Mean voltage comparison for grammatical and ungrammatical sentences in 250-500 ms time window

To detect the effect of grammaticality in interaction with specificity, hemisphere, and caudality, the follow-up tests were done for all the four lateral regions separately, followed by a post-hoc test (multiple comparisons of means with 95% confidence level). For the left anterior, specificity was significant ($F = 12.91$, $p = 0.0004$, $DF = 1$) with a significant difference between the specified and unspecified sentences ($p = 0.0004$, $diff = 1.07$), with higher mean voltage for specified ungrammatical sentences than the unspecified ungrammatical sentences ($p = 0.0007$, $diff = 1.64$) in this region. In the left posterior region, however, specificity did not show any significant effect and the mean voltage in all four conditions was not significantly different. The interaction of grammaticality and specificity was not significant in the left hemisphere. The data for the left anterior and left posterior is visualized in Figure 9.

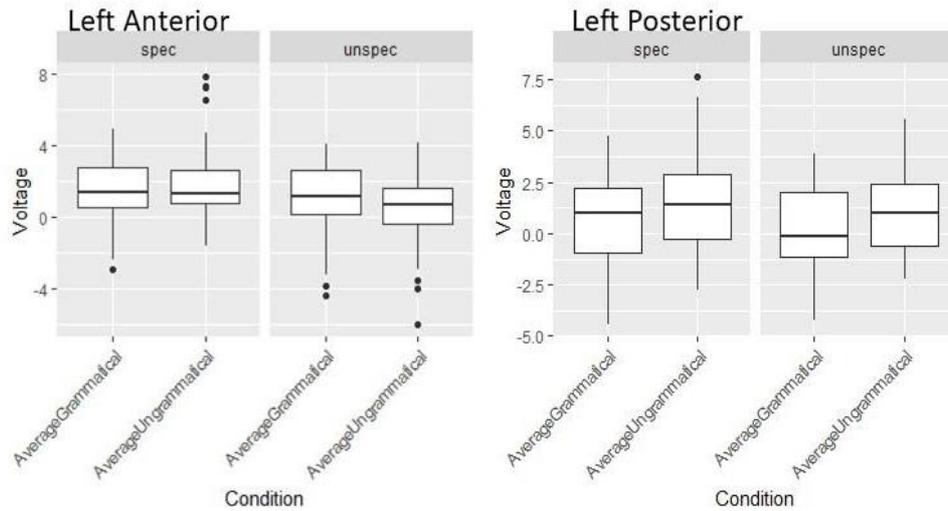


Figure 9. Mean voltage comparison for specified and unspecified sentences in interaction with grammaticality 250-500 ms time window for the left hemisphere

The effect of specificity was significant in the right anterior region such that specified sentences elicited more positive responses than unspecified sentences ($p = 0.0003$, $diff = 1.16$). The effect of specificity was significant for the grammatical sentences ($p = 0.044$, $diff = 1.18$), indicating that the specified grammatical sentences elicited more positive responses than the unspecified grammatical ones. Specificity did not have a significant effect on the neural responses elicited by ungrammatical sentences in this region. No significant effect of specificity was observed in the right posterior region. The interaction between condition and specificity was not significant in the right hemisphere. The effect of condition and specificity in the right anterior and right posterior region is visualized in Figure 10.

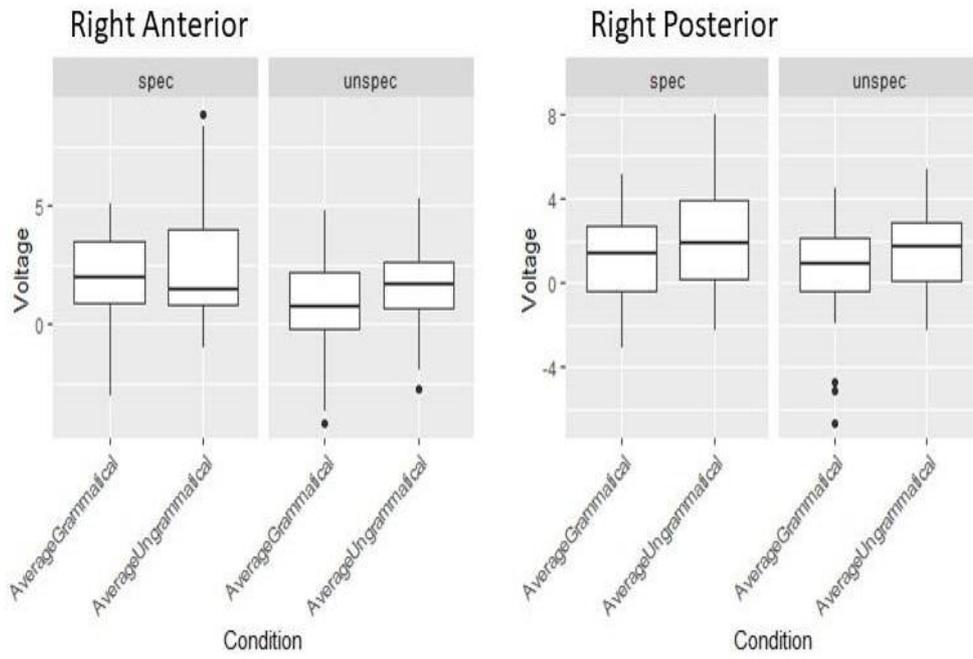


Figure 10. Mean voltage comparison for specified and unspecified sentences in different condition in 250-500 ms time window for the right hemisphere

5 Discussion

This study examined the processing of non-local violations in Norwegian speakers of English and tested whether this process was influenced by double marking from the determiner-number specification in four different conditions, i.e., grammatical unspecified, ungrammatical unspecified, grammatical specified, and ungrammatical specified. ERP/EEG studies have shown that L2ers detect subject-verb agreement violations indexed by a P600 effect (Alemán Bañón & Rothman, 2019; Ojima, 2005; Tanner and Bulkes, 2015). Number specification has shown to affect the amplitude of P600 in L2ers (Cheng et al, 2021; Armstrong et al, 2018; Tanner & Bulkes, 2015). Therefore, we came up with two hypotheses: 1) A P600 effect would be elicited by non-local violations in native Norwegian L2 English speakers. 2) Number-specified sentences would elicit a larger P600 than the unspecified sentences. The EEG data indicated that Norwegian speakers of English in our study detected the subject-verb agreement violation and exhibited a P600 during the processing of non-local violation. The effect of determiner-number specification on detecting the subject-verb agreement violation, however, was exhibited with positivity in the N400 time window. The results of our behavioral data indicated a better judgment performance on grammatical sentences. Determiner-number specification was not facilitative in the Grammatical Judgement Test (GJT) during EEG. The unspecified grammatical sentences were judged more accurate than all the other conditions. We will discuss our behavioral data (Grammatical Judgement Test during EEG) and EEG data below. We will also discuss the implications for theories of L2 sentence processing and agreement attraction theories.

Since we do not have the data for English native speakers to do the quantitative comparison between L1ers and L2ers, and we replicated Cheng et al. (2021), we will use the L1ers from their study for the qualitative comparison. Thus, in this section, by the native speakers, we mean the native speakers from Cheng et.al. (2021). It is also worth mentioning that we use ‘*our data*’ to imply the fact that the findings of our study should not be generalized because we have only 11 participants in our study. What we see and do not see in our data is at best preliminary and it should be interpreted cautiously.

5.1 GJT during EEG recording

Consistent with previous findings (Cheng et al., 2021; Armstrong et al., 2018), L2ers were able to detect the errors in sentences with non-local agreement violations (ungrammatical sentences). We saw more incorrect judgment on ungrammatical sentences than the

grammatical ones replicating the general finding in the literature that there is an asymmetry in agreement attraction error and ungrammatical sentences show significantly more attraction effect than the grammatical ones and grammatical sentences are judged more accurately (Wagers et al., 2009). Yet, another possible explanation for the higher rate of accuracy for the grammatical sentences in our data could be the fact that the intervening NP and the verb were always singular in all our conditions. We manipulated the head NP to make ungrammatical sentences. In other words, in our grammatical sentences, the head NP, the intervening NP, and the verb were all in the singular form. Since both the head NP and the intervening NP match with the verb in the grammatical sentences, any attraction effect from the intervening NP will lead to the correct judgment and will be in favor of accuracy. For the ungrammatical sentences, however, the intervening NP was always matched with the verb in the singular form and the head NP was always plural. As Cheng et al. (2021), Pearlmutter et al. (1992), and Shen et al. (2013) have suggested, this attraction may result in judgment errors because the intervening NP checks agreement with the verb instead of the head NP.

Number specification was not facilitative in judging the non-local agreement violation. Looking at our ungrammatical sentences in the GJT data, it seems that our participants did not pay attention to the number-specified determiners. One of the explanations could be that our participants did not consciously rely on the lexical cues at all to judge their L2 sentences. Even though they have the double marking in their L1, they do not need to rely on it to process subject-verb agreement in their L1 because in Norwegian the verb is not overtly marked for number. Therefore, there is a possibility that they do not rely on number-specification determiner in their L2 because double marking is not facilitative for them in their L1. Based on the previous studies on Norwegian speakers of English that indicated that even the high proficient ones, have difficulty in acquiring the subject-verb agreement (Jensen, et al, 2017; Garshol, 2019), and our data on ungrammatical sentences showing that the number-specified determiners did not have a significant effect, we argue that for our participants the attraction effect of the intervening noun was stronger than the facilitative effect of the determiners. In other words, they may have paid attention to the determiners, but they were attracted by the intervening noun when the verb was introduced.

For ungrammatical sentences, number specification did not have any effect. While for the grammatical sentences: our participants were more accurate in judging the unspecified sentences compared to the specified ones. In our EEG data, however, we observed more sensitivity for the specified grammatical sentences than the unspecified grammatical

sentences. This inconsistency between the behavioral result and EEG result was also observed by Cheng et al. (2021), who found grammatical number specified sentences were less accurate than the grammatical unspecified sentences. Since this result was not observed in their offline GJT and their EEG recording data, they argued that this result is not reliable. Unfortunately, we did not have an offline GJT, and this is one of the shortcomings of our study. In addition to the inconsistency that the GJT EEG indicates, another fact that adds up to the problem of reliability is the short time the participants had to judge the sentences (3 seconds). The participants were told that they had 3 seconds to respond and if they did not respond within 3 seconds, the new sentence would be displayed. Thus, there is the possibility that the results from the GJT EEG are subject to chance. The participants may have randomly responded to some sentences. To investigate this, further analysis is needed, which is beyond the scope of this masters' thesis. Thus, we do not discuss it further.

5.2 ERP

Our L2ers were sensitive to non-local subject-verb agreement violation indexed by a P600 effect, but unlike L1ers in Cheng et al.'s (2021) study the number cues in the specified sentences were not facilitative in the P600 time window for them, suggesting that the participants in our study do not process L2 in the same way as L1ers. The ERP results during the 500-900 ms time window from both lateral and midline electrodes showed a typical P600 effect and a positivity in the N400 time window elicited by sentences containing non-local agreement violations, suggesting that L2ers spotted the non-local violation during processing. P600 was distributed in the posterior area of the scalp, confirming that the P600 effect is largely displayed in the centro-parietal region. The number specified determiners had a facilitative effect. This facilitative effect was not reflected by P600, but by positivity in the N400 time window that was significant in the frontal lobe.

Our first hypothesis was that non-local subject-verb agreement will elicit a P600 effect in the Norwegian speakers of English. This hypothesis was confirmed. Our data is consistent with the previous literature (Armstrong et al., 2018; Cheng et al, 2021) suggesting that L2ers are able to detect the non-local subject-verb agreement even if their L1 lacks the syntactic feature. The L2ers in other discussed studies have shown sensitivity to the subject-verb agreement violation with a P600 effect, while our L2ers' sensitivity was reflected by a P600 and positivity in the N400 time window. Since we did not test L1ers until now, we are not able to make a quantitative comparison between our L2ers to L1ers. Norwegian speakers of English

demonstrated qualitatively different agreement processing which is distinct from L1ers by Cheng et al. (2021). Both L1ers and L2ers in Cheng et al. (2021) have shown a typical P600 in agreement processing, while our L2ers have shown a P600 and a positive peak in the N400 time window. Our findings show that despite the difficulty the Norwegian speakers of English have in acquiring subject-verb agreement in English (Jensen, et al. 2017), they are able to process the non-local agreement but the underlying mechanism for L2 processing is qualitatively different. One major difference between our L2ers and L2ers from Cheng et al. (2021), is the input the two groups received. As mentioned earlier, the L2ers from the Cheng et al. (2021) study were in the immersion context which means being exposed to the authentic input and having more opportunity to use the L2. As Cheng et al. (2021) pointed out, the immersion context can have a deterministic role in L2 language processing. This can also explain our result, L2ers from the current study were not in an immersion context and our findings are consistent with the studies suggesting that neural responses to the non-local agreement in L2ers are different from L1ers (Chen et al, 2007; Ojima et al, 2005).

Regarding our second hypothesis, the facilitative effect of specificity, as indexed by P600 modulation, our results are contrary to the findings by Cheng et al. (2021) and Armstrong et al. (2018). In Cheng et al. (2021), the sentences with number-specified determiners have elicited larger P600 compared to the unspecified sentences. Armstrong et al. (2018), however, reported a smaller P600 in sentences with the double marking for L2ers. In our study, specificity was reflected in positivity in the N400 time window or an LPC. Tanner and Bulkes (2015) suggest that readers predict the number of upcoming verbs based on the number features of the subject NP. The subject NP that is double marked by the number-specified determiner, will lead to stronger prediction. If LPC was an index of predictability, we should have observed even a larger LPC for the ungrammatical sentences. As stated by the Context Updating Theory (Donchin, 1981) the P300 reflects the brain activity for revision of the incoming stimuli. When a new input is introduced the representation of the previous event will be evaluated by the attention-driven comparison. If a change is detected, a P300 is produced. Since LPC for ungrammatical sentences was not significant we argue that LPC in our data is not an index of prediction. Instead, it reflects the enhancement of the attentional focus to foster memory (Polich, 2012). In our ERP results, the amplitude for the LPC was larger for the specified sentences while in the GJT data, the unspecified grammatical sentences were judged more accurate than the specified sentences. This difference can be explained by the function of LPC. In line with Alonzo et al. (2020), LPC in our data suggests

that the participants' attentional resources were differently allocated. We observed a larger LPC likely because the participants paid more attention to the sentences with number-specified determiners. According to Nieuwenhuis et al., (2005), unattended stimuli do not elicit LPC, and this can explain the smaller LPC for unspecified grammatical sentences in our EEG data. The absence of the P600 in the unspecified-specified sentences is consistent with the studies claiming that P600 is an index of syntactic violation and not a re-analysis. If P600 was elicited due to the complexity of the sentences, we should have observed a larger P600 for unspecified sentences than the specified ones, because we added the lexical cues to the specified sentences to make them easier to process. Instead, LPC was significant for grammatical vs ungrammatical sentences and unspecified vs specified sentences, implying the re-analysis function of LPC and syntactic violation detection of P600 in our data.

The results regarding the specificity in our study and the one by Cheng et al. (2021) are qualitatively different. This can be explained in terms of the two factors that are different in the two studies. The first one is the language pairs being studied. As mentioned earlier, double number-marking is absent in Chinese while in Norwegian it is licensed. According to Tockowicz and MacWhinny (2005), L2ers will show sensitivity in processing the structures that are absent in their L1 and the structures that are formed similarly in their L1 and L2. Thus, both Chinese speakers and Norwegian speakers should demonstrate sensitivity in processing the structures. Since the Chinese speakers do not have the double markedness of numbers, they showed sensitivity in the forms of a P600 effect like native English speakers. Norwegian speakers showed sensitivity with an LPC which is different from the English native speakers. This may be because of the cross-linguistic influence from their L1. But to what extent is this difference a result of the cross-linguistic influence? In other words, Is Norwegian speakers' neural response to the double-markedness in their L1 indexed by LPC? To answer these questions, we should see how Norwegian speakers process double-markedness in their L1 (Norwegian) to compare the two data. To our knowledge, no published study has investigated the processing of double markedness in native Norwegian speakers. This can be the line for further investigation.

The second factor that is different in the two studies is the quality and quantity of the input the two L2er groups (Chinese and Norwegian) received. Chinese L2ers were living in the UK at the time of testing, which means they have been exposed to authentic L1 input. Living in an immersion context means using L2 more frequently and having more chances to interact with native English speakers. Norwegian native speakers were living in Norway at the time of

testing. Other than one participant who had lived in the UK for eight months at some point in his life, our participants did not learn English in an immersion setting. We think that this can explain the different results we have for the specified sentences. There is some evidence in some neuroimaging and ERP/EEG studies that immersion context affects L2 processing (Deluca et al, 2020; Morgan-Short et al, 2012).

Herein, we have presented the Declarative/Procedural model (Ullman, 2001, 2005), Shallow Structure Hypothesis (Clahsen & Felser, 2017, 2006), Interface Hypothesis (Sorace, 2011), and working memory approaches to L1 vs L2 processing. The role of input is emphasized in the first three models/hypotheses and they all claim that L1 and L2 processing is different. The DP (Ullman, 2001, 2005), SSH, and IH claim that with enough exposure, L2ers gain the native-like knowledge that can be measured by offline tests, but when it comes to online processing tests, they (DP, SSH, IH) claim that L2ers' responses are different from L1ers'. Among them, the DP (Ullman, 2001, 2005) can to some extent account for our findings where they claim that L2ers are dependent on declarative memory and the acquisition of the grammatical knowledge of L2 is explicit via declarative memory while L1ers learn the grammatical knowledge implicitly by the procedural memory. In our participants, syntactic violation has elicited an LPC in addition to the P600 component while native speakers exhibited a P600. Recall that LPC is associated with attention (Polich, 2012). Since processing a stimulus explicitly entails paying attention to it, we claim that this syntactic structure was processed by the declarative memory which is explicit. The DP (Ullman, 2001, 2005) also claims that the shift to declarative memory increases with increasing the age of exposure to L2 and with less experience with L2. For our participants, the AoA is relatively low (mean AoA = 6 years), but the amount of exposure to L2 (English) is lower in our cohort than in immersive contexts because our participants were living in Norway where the official language is Norwegian. To see how AoA and experience with L2 affect L2 processing quantitatively and qualitatively, there needs to be a study with Norwegian L2ers who have acquired English later in their life (as an adult) and also another study to test Norwegian L2ers in an immersion context.

The SSH (Clahsen & Felser, 2017, 2006) claims that the difference observed in L1 vs L2 processing is due to the information available to L1ers and L2ers. L1ers use the syntactic information to process the language while L2ers underuse the syntactic information to process L2 and rely on the contextual information. Compared to the native speakers by Cheng et al. (2021), our Norwegian speakers of English processed agreement attraction differently

(qualitatively). The difference observed between the two groups is the different ERP component that was observed. The P600 was elicited by the non-local agreement violation in the native speakers, while in our L2ers the P600 and an LPC (index of attention) were elicited. Even though the two groups (L1ers and L2ers) have demonstrated different ERP components, we cannot conclude that they used different information to process L2. The SSH also claims that even if the L2ers have the grammatical knowledge of the syntactic structure, they cannot use it during real-time processing. It means that L2ers can gain native-like proficiency in the offline behavioral tasks but when it comes to the online tasks, they are different. Our participants are advanced English learners but since we do not have an offline grammatical test in our study, we cannot support nor reject this claim. Future research would also include an offline grammatical test to assess the claims of the SSH.

Our data supports the Interface Hypothesis (Sorace, 2011) regarding the processing of the different syntactic structures. According to the IH, there are two types of syntactic structures. The ones that L2ers have no difficulty with because parsing them requires only the syntactic computations. Processing these structures is fast at the very early stages of second language learning. There are other structures that even advanced L2ers have difficulty in acquiring because learning them requires integrating the contextual factors and cognitive domain. Our participants demonstrated a LPC along with a P600 in processing the non-local subject-verb agreement, as an index of attention focus that is a cognitive process. It means that non-local subject-verb agreement needs cognitive factors to be parsed. Some behavioral studies conclude that advanced Norwegian learners of English have difficulty in acquiring subject-verb agreement (Son, 2020; Garshol, 2019; Jensen et al., 2017; Jensen, 2016). Our data along with the data from these studies support the IH where it claims that L1 vs L2 processing is different and even advanced L2ers have difficulty in parsing the structures that need the cognitive constraints to be processed.

Working memory approaches claim that the underlying processes are the same in L1 and L2 processing. In non-local subject-verb agreement, a P600 effect has been elicited by L1ers (Tanner & Bulkes, 2015). With L2ers, however, the results are inconsistent. Some studies have reported a higher amplitude in sentences with agreement violations (Cheng et al., 2021) while others did not find such an effect (Armstrong et al., 2018). Regarding the P600 effect, our study is in line with the first group, that is, our participants showed sensitivity to non-local subject-verb agreement violations. But our L2ers data is qualitatively different from the findings by Cheng et.al (2021) for L1ers implying that L1 vs L2 processing is different. We

found an LPC in addition to a P600. Since LPC is associated with attention, one might take that as evidence in favor of working memory approaches and claim that any differences in L1 vs L2 can be explained in terms of the individual differences in the cognitive ability and working memory. If working memory could account for L1 vs L2 processing, we should have seen a non-linguistic component in other L2 studies. However, this was not detected in any other L2 studies. As a part of a future project, we will collect data through a working memory task from L1ers and L2ers for our experiment that will provide us with a better picture of L1 vs L2 processing.

The Dependency Locality Theory (Gibson, 1998, 2000) is an activation-based working memory approach that accounts for the agreement attraction phenomenon and it was introduced as a complement to the Incomplete Dependency Hypothesis (Lewis, 1996, Stabler, 1994). According to the Incomplete Dependency Hypothesis, agreement attraction errors occur when there are two words from the same syntactic category at the time of the verb being processed. In other words, the head NP and the intervening noun compete to check the agreement when the verb is introduced in the input. Integration of the two words will be more difficult when there is a local distance between them. Accordingly, agreement errors occur due to the linear distance between the two elements, the head noun and the verb, being integrated, and due to the presence of the two nouns competing to agree with the verb. If this assumption is correct, we will see the same rate of accuracy irrespective of the grammaticality and/or specificity in our behavioral data. That is, the participants should have judged (un)grammatical/(un)specified sentences equally accurately because the length of the sentences is the same in all four conditions. But as we have mentioned, our participants were more accurate in judging the grammatical sentences than the ungrammatical sentences. And so, our data cannot support the DLT or the Incomplete Dependency Hypothesis. Our results for specified vs unspecified, however, could support the DLT because specificity did not have a facilitative effect in the behavioral data during EEG. However, GJT during EEG is not reliable for us because of the short time the participants had during EEG. Furthermore, in the ERP data the effect of the specificity has shown to be significant. Our ERP data cannot adjudicate between the DLT and the Incomplete Dependency Hypothesis because we have seen the sensitivity to both grammaticality and specificity in our sentences while the length of all the sentences is the same and there were always two incomplete dependencies at the time of verb processing. The DLT can be more precisely investigated by either adding more linear distance to the experimental items or replacing the intervening PP with another syntactic

category (Relative Clause) to test the effect of the local distance without the attraction effect. We emphasize that the DLT is one of the working memory approaches that is activation-based, and it cannot account for our results, but this does not mean that we reject the other working memory approaches that are trying to investigate the agreement attraction. To investigate the working memory approaches there needs to be a specific working memory task/measure.

In contrast with the working memory approaches, feature percolation theory and the clause packaging theory claim that attraction errors derive from the syntactic encoding, where the information from the structured representations is transmitted within the constituent through the structural links. In other words, the syntactic distance between the head NP and the verb leads to attraction errors, not the linear distance. It has been observed in the agreement attraction studies that the sentences with the singular head NP and plural intervening noun lead to more errors than the sentences with plural head NP and singular intervening noun. 'Markedness' effect of the feature percolation theory explains the difference between the frequency of the errors observed by stating that the plural feature is marked in the singular-plural pair and it percolates upward, while the singular feature is empty. We did not manipulate the intervening noun and the verb, and they are always singular. We have two conditions in which we have manipulated the head NP. And this does not allow us to support nor reject the feature percolation theory where we manipulate the grammaticality. Because in our grammatical sentences, the head NP, the intervening NP, and the verb were singular, and we cannot investigate the feature movement. The specified/unspecified pairs, however, can provide us better insight into the feature percolation theory. Recall our unspecified grammatical sentences ('the window of the house is really clean') and specified grammatical sentences ('this window of the house is really clean'). The head NPs in both conditions are singular. According to the markedness effect, even though the specified NP is double-marked both sentences are considered unmarked. Because the singular feature is unmarked. If this assumption is correct, then specificity will not have any effects. But we have seen a significant effect of specificity in our ERP data where the specified grammatical sentences elicited a larger neural response compared to the unspecified grammatical sentences. In the GJT during EEG, the unspecified grammatical sentences were judged more accurate than the specified grammatical sentences. Within ungrammatical sentences (with plural NPs), however, the markedness effect seems to be validated. Because the ungrammatical specified sentences, that are double marked by the plural determiner, have elicited a larger neural

response than the ungrammatical unspecified sentences, with the indefinite article 'the'. To investigate the feature percolation theory further, we need to have a study in which both the head NP and the intervening NP be manipulated to enable us to make a better comparison regarding the feature movement. Furthermore, the feature percolation theory was built on the production studies. Thus, a production study in which the participants can finish the preambles with the double marked head NPs would be the best measure for testing the markedness effect of the feature percolation theory.

6 Conclusion

In this thesis, we have used ERP/EEG to investigate non-local subject-verb agreement processing in Norwegian L2ers of English. In order to examine this, we have tested two syntactic structures. The one that does not match across English and Norwegian: the non-local subject-verb agreement, and the one that matches across the two languages: double-markedness of the number on the noun. To briefly repeat from chapter two, unlike English, in Norwegian the verbs are not overtly marked for person and number. It has been evidenced that even advanced Norwegian English L2ers have difficulty acquiring the subject-verb agreement (Son, 2020; Garshol, 2019; Jensen et al., 2017; Jensen, 2016). Regarding the number-marking on the noun, both English and Norwegian allow double marking. Double number-marking on the noun has shown to be facilitative in the non-local subject-verb agreement for L2ers whose L1 lacks this structure (Tanner and Bulkes, 2015; Cheng et al, 2021). To our knowledge, there is no study testing the language pair that match the number double-marking, and this study aimed to fill this gap.

Previous ERP/EEG studies on subject-verb agreement studies have shown that L2ers detect non-local subject-verb agreement indexed by a P600 effect (Tanner and Bulkes, 2015; Cheng et al, 2021; Armstrong et al, 2018). Double number-marking has increased sensitivity to subject-verb agreement violations. Therefore, we had two research questions; 1) Will a P600 effect be elicited by non-local violations in native Norwegian L2 English speakers? 2) Do number-specified sentences elicit a larger P600 than the unspecified sentences? To answer the research questions, we had a non-local subject-verb agreement where we manipulated the head noun, and we kept the intervening noun and the verb in the singular form. In other words, we had the grammatical condition with the singular head noun and the ungrammatical condition with the plural head noun. Half of the grammatical and ungrammatical sentences were double-marked by the number-specified determiners.

The main finding of our study was that our participants were sensitive to the non-local agreement violation indexed by a P600 and positivity in the N400 time window (Late Positive Component, LPC). Thus, like L1ers, L2ers can detect subject-verb agreement violations even their L1 lacks this linguistic feature. We also observed the sensitivity to the number specification by our participants. However, this sensitivity was reflected by an LPC. The participants in our study did not process their L2 similar to the L1ers as reported in the literature (e.g., Cheng et al., 2020). Therefore, when the linguistic feature is formed similarly

in L1 and L2, L2ers' language processing is not similar to L1ers. In sum, although there are still remaining questions, the experiment presented here supports the view that underlying mechanisms in L1 vs L2 language processing are different. This may contribute to current knowledge about L2 processing. Furthermore, the results give implications for language teaching because it illustrates that even advanced learners struggle with subject-verb agreement processing which is absent in their L1. Even with the structures present in their L1, L2ers, compared to L1ers, use different information to process L2.

Limitation and future direction

The main limitation of this study is the small sample size (11 participants) and not testing English native speakers. Due to the global pandemic of coronavirus disease, the Psycholinguistic of Language Representation (PoLar) lab has been partially closed at some points during our data collection. We also had limitations in terms of the number of participants allowed in the lab per day. To meet the deadline for this master's thesis, we had to use the data from the 12 participants we had so far. We also had to exclude one of the participants due to Tourette Syndrome. Since we adopted the study by Cheng et al. (2021), we used L1ers from his study to do the qualitative comparison. Regarding the design of the study, one of the shortcomings is that we did not include any offline tasks to test the participants' behavioral response to non-local subject-verb agreement and to investigate the facilitative effect of number-specifications in detecting agreement violation. An Offline task could also help to test the L2 vs L1 processing theories claiming that L2ers can gain native-like proficiency in the offline behavioral tasks but when it comes to the online tasks, they are different. Adding a working memory task could help us to measure the working memory capacity and investigate the relationship between working memory and L2 language processing.

To further investigate L2 processing we recommend testing the Norwegian native speakers to see how they process number specifications in their L1. This will enable us to draw a better conclusion on the structures that are similarly formed in the two languages. To examine the role of input, one can test the subject-verb agreement and number specification in Norwegian speakers of English in an immersion context.

References

- Alarcón, I. (2009). The processing of gender agreement in L1 and L2 Spanish: Evidence from reaction time data. *Hispania*, 814-828.
- Alemán Bañón, J., & Rothman, J. (2019). Being a participant matters: Event-related potentials show that markedness modulates person agreement in Spanish. *Frontiers in psychology*, 10, 746.
- Alonso, J. G., Banón, J. A., DeLuca, V., Miller, D., Soares, S. M. P., Puig-Mayenco, E., ... & Rothman, J. (2020). Event related potentials at initial exposure in third language acquisition: Implications from an artificial mini-grammar study. *Journal of Neurolinguistics*, 56, 100939.
- Anderson, J. A., Mak, L., Chahi, A. K., & Bialystok, E. (2018). The language and social background questionnaire: Assessing degree of bilingualism in a diverse population. *Behavior research methods*, 50(1), 250-263.
- Anderssen, M. (2007). The acquisition of compositional definiteness in Norwegian.
- Armstrong, A., Bulkes, N., & Tanner, D. (2018). Quantificational cues modulate the processing of English subject-verb agreement by native Chinese speakers. *Studies in Second Language Acquisition*, 40(4), 731-754.
- Baddeley, A. (2003). Working memory and language: An overview. *Journal of communication disorders*, 36(3), 189-208.
- Baddeley, A. (2010). Working memory. *Current biology*, 20(4), R136-R140.
- Belletti, A., Bennati, E., & Sorace, A. (2007). Theoretical and developmental issues in the syntax of subjects: Evidence from near-native Italian. *Natural language & linguistic theory*, 25(4), 657.
- Bock, K., & Cutting, J. C. (1992). Regulating mental energy: Performance units in language production. *Journal of memory and language*, 31(1), 99-127.
- Chen, L., Shu, H. U. A., Liu, Y., Zhao, J., & Li, P. (2007). ERP signatures of subject-verb agreement in L2 learning. *Bilingualism*, 10(2), 161.

Cheng, Y., & Cunnings, I., Miller, D., Rothman, J. (2021). Determiner-number specification matters for both L1 and L2 processing of non-local agreement similarly: An ERP investigation. *Studies in Second Language Acquisition*.

Clahsen, H., & Felser, C. (2006). Grammatical processing in language learners. *Applied psycholinguistics*, 27(1), 3.

Clahsen, H., & Felser, C. (2018). Some notes on the shallow structure hypothesis. *Studies in Second Language Acquisition*, 40(3), 693-706.

Corbett, G. G., & Fraser, N. M. (2000). Gender assignment: a typology and a model.

Cunnings, I. (2017). Parsing and working memory in bilingual sentence processing. *Bilingualism: Language and Cognition*, 20(4), 659-678.

DeLuca, V., Rothman, J., Bialystok, E., & Pliatsikas, C. (2020). Duration and extent of bilingual experience modulate neurocognitive outcomes. *NeuroImage*, 204, 116222.

Donchin, E. (1981). Surprise!... surprise?. *Psychophysiology*, 18(5), 493-513.

Eberhard, K. M., Cutting, J. C., & Bock, K. (2005). Making syntax of sense: number agreement in sentence production. *Psychological review*, 112(3), 531.

Fabiani, M., Gratton, G., Karis, D., & Donchin, E. (1987). Definition, identification, and reliability of measurement of the P300 component of the event-related brain potential. *Advances in psychophysiology*, 2(S 1), 78.

Felser, C., & Cunnings, I. (2012). Processing reflexives in a second language: The timing of structural and discourse-level constraints. *Applied Psycholinguistics*, 33(3), 571-603.

Franck, J., Vigliocco, G., & Nicol, J. (2002). Subject-verb agreement errors in French and English: The role of syntactic hierarchy. *Language and cognitive processes*, 17(4), 371-404.

Friederici, A. D., Hahne, A., & Mecklinger, A. (1996). Temporal structure of syntactic parsing: early and late event-related brain potential effects. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22(5), 1219.

Garshol, L. (2019). I just doesn't know: Agreement Errors in English Texts by Norwegian L2 Learners: Causes and Remedies. *Doctoral dissertations at University of Agder*.

Gibson, E. (2000). The dependency locality theory: A distance-based theory of linguistic complexity. *Image, language, brain*, 2000, 95-126.

Gibson, E. (1998). Linguistic complexity: Locality of syntactic dependencies. *Cognition*, 68(1), 1-76.

Hopp, H. (2014). Working memory effects in the L2 processing of ambiguous relative clauses. *Language Acquisition*, 21(3), 250-278.

Jensen, I. N. (2016). *The Bottleneck Hypothesis in L2 acquisition: Norwegian L1 speakers' knowledge of syntax and morphology in English L2* (Master's thesis, UiT Norges arktiske universitet).

Jensen, I. N., Slabakova, R., Westergaard, M., & Lundquist, B. (2020). The Bottleneck Hypothesis in L2 acquisition: L1 Norwegian learners' knowledge of syntax and morphology in L2 English. *Second Language Research*, 36(1), 3-29.

Kac, M. B. (1981, August). Center-embedding revisited. In *Proceedings of the third annual conference of the Cognitive Science Society* (pp. 123-124). Lawrence Erlbaum Hillsdale, NJ.

Lempert, H. (2016). Late L2ers can acquire grammatical features that do not occur in their L1: Evidence from the effect of animacy on verb agreement in L1 Chinese. *Memory & cognition*, 44(4), 538-553.

Lewis, R. (1996). A theory of grammatical but unacceptable embeddings. *Journal of Psycholinguistic Research*, 25(93), 116.

Lewis, R., & Vasishth, S. (2005). An activation-based model of sentence processing as skilled memory retrieval. *Cognitive Science*, 29, 375-419.

Luck, S. J. (2014). *An introduction to the event-related potential technique*. MIT press.

McDonald, J. L. (2006). Beyond the critical period: Processing-based explanations for poor grammaticality judgment performance by late second language learners. *Journal of Memory and Language*, 55(3), 381-401.

- Mecklinger, A., Schriefers, H., Steinhauer, K., & Friederici, A. D. (1995). Processing relative clauses varying on syntactic and semantic dimensions: An analysis with event-related potentials. *Memory & Cognition*, 23(4), 477-494.
- Morgan-Short, K., Finger, I., Grey, S., & Ullman, M. T. (2012). Second language processing shows increased native-like neural responses after months of no exposure. *PLoS One*, 7(3), e32974.
- Nieuwenhuis, S., Aston-Jones, G., & Cohen, J. D. (2005). Decision making, the P3, and the locus coeruleus--norepinephrine system. *Psychological bulletin*, 131(4), 510.
- Odlin, T. (2012). Crosslinguistic influence in second language acquisition. *The encyclopedia of applied linguistics*.
- Ojima, S., Nakata, H., & Kakigi, R. (2005). An ERP study of second language learning after childhood: Effects of proficiency. *Journal of cognitive neuroscience*, 17(8), 1212-1228.
- Osterhout, L., & Holcomb, P. J. (1992). Event-related brain potentials elicited by syntactic anomaly. *Journal of memory and language*, 31(6), 785-806.
- Osterhout, L., & Holcomb, P. J. (1995). Event-related potentials and language comprehension. *Electrophysiology of mind*, 171-215.
- Osterhout, L., & Mobley, L. A. (1995). Event-related brain potentials elicited by failure to agree. *Journal of Memory and language*, 34(6), 739-773.
- Oxford University Press (2004). *Quick Placement Test: Version 1*. Oxford: OUP.
- Polich, J. (2012). Neuropsychology of P300.
- Rothman, J., Alonso, J. G., & Puig-Mayenco, E. (2019). *Third language acquisition and linguistic transfer* (Vol. 163). Cambridge University Press, 23-26.
- Rushby, J. A., Barry, R. J., & Doherty, R. J. (2005). Separation of the components of the late positive complex in an ERP dishabituation paradigm. *Clinical Neurophysiology*, 116(10), 2363-2380.

- Shen, W., Fiori-Duharcourt, N., & Isel, F. (2016). Functional significance of the semantic P600: evidence from the event-related brain potential source localization. *NeuroReport*, 27(7), 548-558.
- Solomon, E. S., & Pearlmutter, N. J. (2004). Semantic integration and syntactic planning in language production. *Cognitive psychology*, 49(1), 1-46.
- Son, M. (2020). *Subject-verb agreement in written English by LI Norwegian university students: Error patterns, causes, and implication for teaching* (Master's thesis, UiT Norges arktiske universitet).
- Sorace, A. (2011). Pinning down the concept of “interface” in bilingualism. *Linguistic approaches to bilingualism*, 1(1), 1-33.
- Sorace, A., & Filiaci, F. (2006). Anaphora resolution in near-native speakers of Italian. *Second language research*, 22(3), 339-368.
- Stabler, E.P., (1994). The finite connectivity of linguistic structures. In: Clifton, C., Jr., Frazier, L., Rayner, K. (Eds.), *Perspectives on Sentence Processing*. Erlbaum, Hillsdale, NJ, pp. 303–336
- Tanner, D., & Bulkes, N. Z. (2015). Cues, quantification, and agreement in language comprehension. *Psychonomic bulletin & review*, 22(6), 1753-1763.
- Tokowicz, N., & MacWhinney, B. (2005). Implicit and explicit measures of sensitivity to violations in second language grammar: An event-related potential investigation. *Studies in second language acquisition*, 173-204.
- Tsimpli, I., & Sorace, A. (2006). Differentiating interfaces: L2 performance in syntaxsemantics and syntax-discourse phenomena. In *BUCLD Proceedings 30*.
- Ullman, M. (2001). The neural basis of lexicon and grammar: The declarative/procedural model. *Bilingualism: Language and Cognition*, 4, 105–122.
- Ullman, M. T. (2001). A neurocognitive perspective on language: The declarative/procedural model. *Nature reviews neuroscience*, 2(10), 717-726.

Ullman, M. (2005). A cognitive neuroscience perspective on second language acquisition: The declarative/procedural model. In Sanz, C. (ed.), *Mind and Context in Adult Second Language Acquisition*, pp. 141–178. Washington, Georgetown University Press

Wagers, M. W., Lau, E. F., & Phillips, C. (2009). Agreement attraction in comprehension: Representations and processes. *Journal of Memory and Language*, *61*(2), 206-237.

Warren, T., & Gibson, E. (2002). The influence of referential processing on sentence complexity. *Cognition*, *85*(1), 79-112.

Appendix

EEG Material

List 1

Condition 1 = Unspecified Grammatical

1. The window of the house is very clean.
2. The picture of the lake is unbelievably beautiful.
3. The email from the company is really boring.
4. The cup on the table is very dirty.
5. The gift from the party is truly nice.
6. The book on the desk is very heavy.
7. The film about the scientist is quite long.
8. The colleague of the lady is always kind.
9. The patient of the doctor is very angry.
10. The apple on the table is very sweet.
11. The train to the city is quite fast.
12. The name on the post card is not clear.
13. The mistake in the article is quite obvious.
14. The picture on the wall is very funny.
15. The problem in the school is extremely serious.
16. The photo from the trip is very nice.
17. The building in the street is quite old.
18. The road in the mountain is not safe.
19. The door of the building is always open.
20. The notebook on the desk is quite new.
21. The key to the room is very big.
22. The guitar for the concert is quite old.
23. The entrance to the building is not obvious.
24. The student of the teacher is really smart.
25. The bridge to the island is not safe.
26. The guy with the actor is very rich.
27. The lawyer from the company is very professional.

28. The desk in the office is really small.
29. The bridge over the river is almost old.
30. The map of the city is very detailed.
31. The window in the kitchen is always closed.
32. The jacket on the chair is very dirty.

Condition 2 = Unspecified Ungrammatical

33. The exams for the course is really difficult.
34. The knives on the plate is not sharp.
35. The shops in the street is never busy.
36. The computers in the office is very new.
37. The waiters with the manager is very nice.
38. The stories about the city is available online.
39. The students in the class is very quiet.
40. The movies at the cinema is really interesting.
41. The handbags in the shop is not cheap.
42. The hotels near the station is really busy.
43. The friends of the girl is very helpful.
44. The answers to the question is really funny.
45. The songs by the singer is really beautiful.
46. The magazines on the sofa is very boring.
47. The customers of the designer is really rich.
48. The trains to the airport is always busy.
49. The rivers near the village is quite clear.
50. The documents in the folder is extremely important.
51. The cafés outside the mall is very popular.
52. The reports from the conference is really good.
53. The comments about the policy is quite stupid.
54. The elephants under the tree is very tired.
55. The emails about the meeting is not clear.
56. The posters for the concert is very creative.
57. The walls of the flat is not clean.
58. The markets at the festival is always busy.
59. The stories in the book is very interesting.

60. The airports outside the city is quite big.
61. The offices in the school is usually busy.
62. The houses near the park is really modern.
63. The models with the designer is very famous.
64. The dresses for the party is beautifully colorful.

Condition 3 = Specified Grammatical

65. This orange on the tree is really small.
66. This book for the course is so good.
67. This toy in the box is very dirty.
68. This monkey behind the tourist is very cute.
69. This secretary of the manager is so polite.
70. This book on the shelf is quite old.
71. This library in the city is always busy.
72. This doctor of the patient is very young.
73. This bus to the school is really convenient.
74. This farm near the forest is so big.
75. This task in the game is quite difficult.
76. This product of the company is still popular.
77. This lady behind the guy is very loud.
78. This dog behind the girl is very small.
79. This kid with the volunteer is very happy.
80. This assistant of the scientist is really excellent.
81. This boy with the teacher is highly educated.
82. This girl with the boy is willingly invited.
83. This computer in the office is weekly upgraded.
84. This thief with the policeman is strongly punished.
85. This spoon on the table is nicely washed.
86. This rule in the school is suddenly changed.
87. This cinema in the town is formally closed.
88. This restaurant by the sea is finally reopened.
89. This seminar of the course is not cancelled.
90. This nurse with the doctor is very helpful.
91. This requirement of the machine is clearly described.

92. This dancer with the trainer is kindly invited.
93. This bedroom of the flat is nicely decorated.
94. This bike in the garden is daily cleaned.
95. This boy with the teacher is very naughty.
96. That floor of the building is weekly cleaned.
97. Those babies of the lady is very beautiful.

Condition 4 = Specified Ungrammatical

98. Those employees with the manager is very friendly.
99. Those girls with the policeman is so quiet.
100. Those doors of the house is firmly locked.
101. Those hospitals of the city is really excellent.
102. Those emails about the conference is finally read.
103. Those toilets for the office is daily cleaned.
104. Those walls in the house is previously painted.
105. Those museums in the town is usually visited.
106. Those flats behind the park is hardly sold.
107. Those singers near the journalist is very popular.
108. Those lessons in the textbook is regularly taught.
109. Those books on the shelf is preferably read.
110. Those readers of the writer is always curious.
111. Those letters for the company is sent.
112. Those flats behind the park is suddenly sold.
113. Those movies about the war is finally downloaded.
114. Those hairdressers in the salon is not fired.
115. Those classrooms for the exam is previously cleaned.
116. Those essays for the course is completely written.
117. Those presentations for the meeting is nicely prepared.
118. Those websites about the singer is monthly updated.
119. Those magazines on the floor is popularly read.
120. Those museums near the school is very popular.
121. Those flowers behind the tree is regularly watered.
122. Those mirrors in the house is kindly wiped.
123. Those interviews with the officer is hardly arranged.

124. Those gyms near the mall is very popular.
125. Those cats of the neighbour is usually fed.
126. Those superstars with the policeman is not arrested.
127. Those paintings on the wall is finally sold.
128. Those projects about the research is now started.

List 2

Condition 1 = Unspecified Grammatical

1. The exam for the course is really difficult.
2. The knife on the plate is not sharp.
3. The shop in the street is never busy.
4. The computer in the office is very new.
5. The waiter with the manager is very nice.
6. The story about the city is available online.
7. The student in the class is very quiet.
8. The movie at the cinema is really interesting.
9. The handbag in the shop is not cheap.
10. The hotel near the station is really busy.
11. The friend of the girl is very helpful.
12. The answer to the question is really funny.
13. The song by the singer is really beautiful.
14. The magazine on the sofa is very boring.
15. The customer of the designer is really rich.
16. The train to the airport is always busy.
17. The river near the village is quite clear.
18. The document in the folder is extremely important.
19. The café outside the mall is very popular.
20. The report from the conference is really good.
21. The comment about the policy is quite stupid.
22. The elephant under the tree is very tired.
23. The email about the meeting is not clear.
24. The poster for the concert is very creative.

25. The wall of the flat is not clean.
26. The market at the festival is always busy.
27. The story in the book is very interesting.
28. The airport outside the city is quite big.
29. The office in the school is usually busy.
30. The house near the park is really modern.
31. The model with the designer is very famous.
32. The dress for the party is beautifully colorful.

Condition 2 = Unspecified Ungrammatical

33. The oranges on the tree is really small.
34. The books for the course is so good.
35. The toys in the box is very dirty.
36. The monkeys behind the tourist is very cute.
37. The secretaries of the manager is so polite.
38. The books on the shelf is quite old.
39. The libraries in the city is always busy.
40. The doctors of the patient is very young.
41. The buses to the school is really convenient.
42. The farms near the forest is so big.
43. The tasks in the game is quite difficult.
44. The products of the company is still popular.
45. The ladies behind the guy is very loud.
46. The dogs behind the girl is very small.
47. The kids with the volunteer is very happy.
48. The assistants of the scientist is really excellent.
49. The boys with the teacher is highly educated.
50. The girls with the boy is willingly invited.
51. The computers in the office is weekly upgraded.
52. The thieves with the policeman is strongly punished.
53. The spoons on the table is nicely washed.
54. The rules in the school is suddenly changed.
55. The cinemas in the town is formally closed.
56. The restaurants by the sea is finally reopened.

57. The seminars of the course is not cancelled.
58. The nurses with the doctor is very helpful.
59. The requirements of the machine is clearly described.
60. The dancers with the trainer is kindly invited.
61. The bedrooms of the flat is nicely decorated.
62. The bikes in the garden is daily cleaned.
63. The boys with the teacher is very naughty.
64. The floors of the building is weekly cleaned.

Condition 3 = Specified Grammatical

65. That baby of the lady is very beautiful.
66. That employee with the manager is very friendly.
67. That girl with the policeman is so quiet.
68. That door of the house is firmly locked.
69. That hospital of the city is really excellent.
70. That email about the conference is finally read.
71. That toilet for the office is daily cleaned.
72. That wall in the house is previously painted.
73. That museum in the town is usually visited.
74. That flat behind the park is hardly sold.
75. That singer near the journalist is very popular.
76. That lesson in the textbook is regularly taught.
77. That book on the shelf is preferably read.
78. That reader of the writer is always curious.
79. That letter for the company is sent.
80. That flat behind the park is suddenly sold.
81. That movie about the war is finally downloaded.
82. That hairdresser in the salon is not fired.
83. That classroom for the exam is previously cleaned.
84. That essay for the course is completely written.
85. That presentation for the meeting is nicely prepared.
86. That website about the singer is monthly updated.
87. That magazine on the floor is popularly read.
88. That museum near the school is very popular.

89. That flower behind the tree is regularly watered.
90. That mirror in the house is kindly wiped.
91. That interview with the officer is hardly arranged.
92. That gym near the mall is very popular.
93. That cat of the neighbour is usually fed.
94. That superstar with the policeman is not arrested.
95. That painting on the wall is finally sold.
96. That project about the research is now started.
97. These windows of the house is very clean.
98. These pictures of the lake is unbelievably beautiful.
99. These emails from the company is really boring.
100. These cup on the table is very dirty.
101. These gifts from the party is truly nice.
102. These books on the desk is very heavy.
103. These films about the scientist is quite long.
104. These colleagues of the lady is always kind.
105. These patients of the doctor is very angry.
106. These apples on the table is very sweet.
107. These trains to the city is quite fast.
108. Those names on the post card is not clear.
109. Those mistakes in the article is quite obvious.
110. Those pictures on the wall is very funny.
111. Those problems in the school is extremely serious.
112. Those photos from the trip is very nice.
113. Those buildings in the street is quite old.
114. Those roads in the mountain is not safe.
115. Those doors of the building is always open.
116. Those notebooks on the desk is quite new.
117. Those keys to the room is very big.
118. Those guitars for the concert is quite old.
119. Those entrances to the building is not obvious.
120. Those students of the teacher is really smart.
121. Those bridges to the island is not safe.
122. Those guys with the actor is very rich.

123. Those lawyers from the company is very professional.
124. Those desks in the office is really small.
125. Those bridges over the river is almost old.
126. Those maps of the city is very detailed.
127. Those windows in the kitchen is always closed.
128. Those jackets on the chair is very dirty.

List 3

Condition 1 = Unspecified Grammatical

1. The orange on the tree is really small.
2. The book for the course is so good.
3. The toy in the box is very dirty.
4. The monkey behind the tourist is very cute.
5. The secretary of the manager is so polite.
6. The book on the shelf is quite old.
7. The library in the city is always busy.
8. The doctor of the patient is very young.
9. The bus to the school is really convenient.
10. The farm near the forest is so big.
11. The task in the game is quite difficult.
12. The product of the company is still popular.
13. The lady behind the guy is very loud.
14. The dog behind the girl is very small.
15. The kid with the volunteer is very happy.
16. The assistant of the scientist is really excellent.
17. The boy with the teacher is highly educated.
18. The girl with the boy is willingly invited.
19. The computer in the office is weekly upgraded.
20. The thief with the policeman is strongly punished.
21. The spoon on the table is nicely washed.
22. The rule in the school is suddenly changed.
23. The cinema in the town is formally closed.

24. The restaurant by the sea is finally reopened.
25. The seminar of the course is not cancelled.
26. The nurse with the doctor is very helpful.
27. The requirement of the machine is clearly described.
28. The dancer with the trainer is kindly invited.
29. The bedroom of the flat is nicely decorated.
30. The bike in the garden is daily cleaned.
31. The boy with the teacher is very naughty.
32. The floor of the building is weekly cleaned.

Condition 2 = Unspecified Ungrammatical

33. The babies of the lady is very beautiful.
34. The employees with the manager is very friendly.
35. The girls with the policeman is so quiet.
36. The doors of the house is firmly locked.
37. The hospitals of the city is really excellent.
38. The emails about the conference is finally read.
39. The toilets for the office is daily cleaned.
40. The walls in the house is previously painted.
41. The museums in the town is usually visited.
42. The flats behind the park is hardly sold.
43. The singers near the journalist is very popular.
44. The lessons in the textbook is regularly taught.
45. The books on the shelf is preferably read.
46. The readers of the writer is always curious.
47. The letters for the company is sent.
48. The flats behind the park is suddenly sold.
49. The movies about the war is finally downloaded.
50. The hairdressers in the salon is not fired.
51. The classrooms for the exam is previously cleaned.
52. The essays for the course is completely written.
53. The presentations for the meeting is nicely prepared.
54. The websites about the singer is monthly updated.
55. The magazines on the floor is popularly read.

56. The museums near the school is very popular.
57. The flowers behind the tree is regularly watered.
58. The mirrors in the house is kindly wiped.
59. The interviews with the officer is hardly arranged.
60. The gyms near the mall is very popular.
61. The cats of the neighbour is usually fed.
62. The superstars with the policeman is not arrested.
63. The paintings on the wall is finally sold.
64. The projects about the research is now started.

Condition 3 = Specified Grammatical

65. This window of the house is very clean.
66. This picture of the lake is unbelievably beautiful.
67. This email from the company is really boring.
68. This cup on the table is very dirty.
69. This gift from the party is truly nice.
70. This book on the desk is very heavy.
71. This film about the scientist is quite long.
72. This colleague of the lady is always kind.
73. This patient of the doctor is very angry.
74. This apple on the table is very sweet.
75. This train to the city is quite fast.
76. That name on the post card is not clear.
77. That mistake in the article is quite obvious.
78. That picture on the wall is very funny.
79. That problem in the school is extremely serious.
80. That photo from the trip is very nice.
81. That building in the street is quite old.
82. That road in the mountain is not safe.
83. That door of the building is always open.
84. That notebook on the desk is quite new.
85. That key to the room is very big.
86. That guitar for the concert is quite old.
87. That entrance to the building is not obvious.

88. That student of the teacher is really smart.
89. That bridge to the island is not safe.
90. That guy with the actor is very rich.
91. That lawyer from the company is very professional.
92. That desk in the office is really small.
93. That bridge over the river is almost old.
94. That map of the city is very detailed.
95. That window in the kitchen is always closed.
96. That jacket on the chair is very dirty.
97. Those exams for the course is really difficult.

Condition 4 = Specified Ungrammatical

98. Those knives on the plate is not sharp.
99. Those shops in the street is never busy.
100. Those computers in the office is very new.
101. Those waiters with the manager is very nice.
102. Those stories about the city is available online.
103. Those students in the class is very quiet.
104. Those movies at the cinema is really interesting.
105. These handbags in the shop is not cheap.
106. These hotels near the station is really busy.
107. These friends of the girl is very helpful.
108. These answers to the question is really funny.
109. These songs by the singer is really beautiful.
110. These magazines on the sofa is very boring.
111. These customers of the designer is really rich.
112. These trains to the airport is always busy.
113. These rivers near the village is quite clear.
114. These documents in the folder is extremely important.
115. These cafés outside the mall is very popular.
116. These reports from the conference is really good.
117. These comments about the policy is quite stupid.
118. These elephants under the tree is very tired.
119. These emails about the meeting is not clear.

120. These posters for the concert is very creative.
121. These walls of the flat is not clean.
122. These markets at the festival is always busy.
123. These stories in the book is very interesting.
124. These airports outside the city is quite big.
125. These offices in the school is usually busy.
126. These houses near the park is really modern.
127. These models with the designer is very famous.
128. These dresses for the party is beautifully colorful.

List4

Condition 1 = Unspecified Grammatical

1. The baby of the lady is very beautiful.
2. The employee with the manager is very friendly.
3. The girl with the policeman is so quiet.
4. The door of the house is firmly locked.
5. The hospital of the city is really excellent.
6. The email about the conference is finally read.
7. The toilet for the office is daily cleaned.
8. The wall in the house is previously painted.
9. The museum in the town is usually visited.
10. The flat behind the park is hardly sold.
11. The singer near the journalist is very popular.
12. The lesson in the textbook is regularly taught.
13. The book on the shelf is preferably read.
14. The reader of the writer is always curious.
15. The letter for the company is sent.
16. The flat behind the park is suddenly sold.
17. The movie about the war is finally downloaded.
18. The hairdresser in the salon is not fired.
19. The classroom for the exam is previously cleaned.
20. The essay for the course is completely written.
21. The presentation for the meeting is nicely prepared.

22. The website about the singer is monthly updated.
23. The magazine on the floor is popularly read.
24. The museum near the school is very popular.
25. The flower behind the tree is regularly watered.
26. The mirror in the house is kindly wiped.
27. The interview with the officer is hardly arranged.
28. The gym near the mall is very popular.
29. The cat of the neighbour is usually fed.
30. The superstar with the policeman is not arrested.
31. The painting on the wall is finally sold.

Condition 2 = Unspecified Ungrammatical

32. The project about the research is now started.
33. The windows of the house is very clean.
34. The pictures of the lake is unbelievably beautiful.
35. The emails from the company is really boring.
36. The cups on the table is very dirty.
37. The gifts from the party is truly nice.
38. The books on the desk is very heavy.
39. The films about the scientist is quite long.
40. The colleagues of the lady is always kind.
41. The patients of the doctor is very angry.
42. The apples on the table is very sweet.
43. The trains to the city is quite fast.
44. The names on the post card is not clear.
45. The mistakes in the article is quite obvious.
46. The pictures on the wall is very funny.
47. The problems in the school is extremely serious.
48. The photos from the trip is very nice.
49. The buildings in the street is quite old.
50. The roads in the mountain is not safe.
51. The doors of the building is always open.
52. The notebooks on the desk is quite new."
53. The keys to the room is very big.

54. The guitars for the concert is quite old.
55. The entrances to the building is not obvious.
56. The students of the teacher is really smart.
57. The bridges to the island is not safe.
58. The guys with the actor is very rich.
59. The lawyers from the company is very professional.
60. The desks in the office is really small.
61. The bridges over the river is almost old.
62. The maps of the city is very detailed.
63. The windows in the kitchen is always closed.
64. The jackets on the chair is very dirty.

Condition 3 = Specified Grammatical

65. That exam for the course is really difficult.
66. That knife on the plate is not sharp.
67. That shop in the street is never busy.
68. That computer in the office is very new.
69. That waiter with the manager is very nice.
70. That story about the city is available online.
71. That student in the class is very quiet.
72. That movie at the cinema is really interesting.
73. This handbag in the shop is not cheap.
74. This hotel near the station is really busy.
75. This friend of the girl is very helpful.
76. This answer to the question is really funny.
77. This song by the singer is really beautiful.
78. This magazine on the sofa is very boring.
79. This customer of the designer is really rich.
80. This train to the airport is always busy.
81. This river near the village is quite clear.
82. This document in the folder is extremely important.
83. This café outside the mall is very popular.
84. This report from the conference is really good.
85. This comment about the policy is quite stupid.

86. This elephant under the tree is very tired.
87. This email about the meeting is not clear.
88. This poster for the concert is very creative.
89. This wall of the flat is not clean.
90. This market at the festival is always busy.
91. This story in the book is very interesting.
92. This airport outside the city is quite big.
93. This office in the school is usually busy.
94. This house near the park is really modern.
95. This model with the designer is very famous.
96. This dress for the party is beautifully colorful.
97. These oranges on the tree is really small.

Condition 4 = Specified Ungrammatical

98. These books for the course is so good.
99. These toys in the box is very dirty.
100. These monkeys behind the tourist is very cute.
101. These secretaries of the manager is so polite.
102. These books on the shelf is quite old.
103. These libraries in the city is always busy.
104. These doctors of the patient is very young.
105. These buses to the school is really convenient.
106. These farms near the forest is so big.
107. These tasks in the game is quite difficult.
108. These products of the company is still popular.
109. These ladies behind the guy is very loud.
110. These dogs behind the girl is very small.
111. These kids with the volunteer is very happy.
112. These assistants of the scientist is really excellent.
113. These boys with the teacher is highly educated.
114. These girls with the boy is willingly invited.
115. These computers in the office is weekly upgraded.
116. These thieves with the policeman is strongly punished.
117. These spoons on the table is nicely washed.

118. These rules in the school is suddenly changed.
119. These cinemas in the town is formally closed.
120. These restaurants by the sea is finally reopened.
121. These seminars of the course is not cancelled.
122. These nurses with the doctor is very helpful.
123. These requirements of the machine is clearly described.
124. These dancers with the trainer is kindly invited.
125. These bedrooms of the flat is nicely decorated.
126. These bikes in the garden is daily cleaned.
127. These boys with the teacher is very naughty.
128. Those floors of the building is weekly cleaned.

Fillers

Grammatical

1. The seats for the concert have been booked.
2. The students in the classroom have been studying.
3. The meetings during the week have been cancelled.
4. The animals in the zoo have been friendly.
5. These documents on the desk have been checked.
6. These machines in the factory have some problems.
7. Those researchers from the university have already left.
8. Those parcels from the company have been opened.
9. The motorbikes in the street are really cool.
10. The drinks in the bar are quite nice.
11. The ducks in the lake are washing themselves.
12. The questions on the blackboard are very easy.
13. These poems from the poet are very romantic.
14. These telephones in the office are not working.
15. Those pictures in the book are very beautiful.
16. Those models on the stage are so handsome.
17. The tigers in the zoo looked really scary.
18. The sons of the man went to bed.
19. The children of the lady cried very often.

20. The lawyers of the man left this morning.
21. The rooms of the hotel smelled very bad.
22. The desserts on the table tasted quite nice.
23. The children in the class sounded super excited.
24. The guests on the sofa laughed very loudly.
25. The cats of the lady disappeared last week.
26. The fridges in the kitchen produced some milk.
27. The biology students need to observe the insects.
28. The guy wants to date his new neighbor.
29. The bus driver always smiles at his passengers.
30. The girl said she was happy to help.
31. The policeman forced the man to leave immediately.
32. My neighbor asked me to go out tonight.
33. His best friend introduced him to the girl.
34. Her parents expected her to become a scientist.
35. The man believed his wife still loved him.
36. The man didn't allow his kid to shout.
37. The doctor told his patient to be careful.
38. He waited for his girlfriend for hours yesterday.
39. The girl argued with her parents last night.
40. The professor gave her some good suggestions last night.
41. The girl gave the boy a small gift.
42. The man bought himself a book yesterday afternoon.
43. The woman went to the mall last Friday.
44. Johnny bought a new car for his dad.
45. Melissa cooked some nice food for her mum.
46. Jake fell into the water and got wet.
47. James sang a romantic song for his girlfriend.
48. Mark played football with his classmates after school.
49. Emily participated in a psychology experiment this morning.
50. Harry wants to open a restaurant in Sydney.
51. Emma obtained her PhD in medicine last year.
52. Paul teaches music in a local secondary school.
53. Olivia learned Swedish in school for two years.

54. Sarah likes reading novels and watching horror movies.
55. Lucy asked her boyfriend to walk her home.
56. Adam studied very hard and received the scholarship.
57. Allen put the fruit cake into the fridge.
58. The young man played basketball with his friends.
59. Susan cried because she lost her new book.
60. Jasmine is going to marry her boyfriend tomorrow.
61. Josh saw a weird man at the station.
62. Tony said he was going to Italy soon.
63. Tom taught himself some Spanish two years ago.
64. She had a lovely evening with the man.
65. The watermelon in the fridge are very big.
66. The summer in the country are fairly short.
67. The phone in the pocket are very heavy.
68. The journey on the plane are quiet pleasant.

Ungrammatical

69. The test for the class have been finished.
70. The breakfast for the family have been prepared.
71. The church for the city have been built.
72. The cleaner from the company have been employed.
73. This program on the TV are very popular.
74. This game on the computer are so boring.
75. That lady on the chair have many bags.
76. That library behind the building have been rebuilt.
77. The plant in the garden needing some water.
78. The boy in the kitchen wanting some food.
79. The horse of the farmer running very fast.
80. The girl behind the boy drinking black tea.
81. The husband of the woman hating blue cheese.
82. The man by the door loving playing football.
83. The neighbor of the man singing every morning.
84. The brother of the man swimming every Sunday.
85. The meeting in the company starting at nine.

86. The baby in the photo looking very cute.
87. I think him will start his job soon.
88. She saw me to eat all the food.
89. The man went the pub with his wife.
90. The girl believed the young man a thief.
91. The lady sat the chair and drank tea.
92. The boys are interested to the new game.
93. He showed the boy to drive the car.
94. Her husband spoke her about the new job.
95. The exam made the students to study hard.
96. The mother asked her son clean the room.
97. My father wants me go home after school.
98. I was chatting the lady in the café.
99. William decided quit his job in the restaurant.
100. Amy said she needed go to the hospital.
101. Susan told her dad not stay home alone.
102. Lee argued to his friend about their travel.
103. Simon listened the song and danced along it.
104. The man talked the lady at the party.
105. The math teacher agreed me on the answer.
106. Jessica finally married to her boyfriend this summer.
107. The boss insisted his assistant to go home.
108. The little boy bought herself a new toy.
109. The woman made himself some salad for lunch.
110. The policewoman gave himself some time to rest.
111. The salesman accidentally hurt herself in the kitchen.
112. The girl's father cooked herself some tasty food.
113. Chris and his friends are go out tonight.
114. The young girl told himself to be strong.
115. The lady made himself some cake in the morning.
116. His brother forced herself to do more exercises.
117. Her father taught herself some French at home.
118. His sister educated himself by reading some books.
119. The man found herself in a big trouble.

120. The little cat are scratching the sofa.
121. There are a café by the bus stop.
122. The computer were fixed by the technician yesterday.
123. The Christmas gifts was bought by his mother.
124. The scientist don't want to stop his research.
125. The firefighter go to the gym every Sunday.
126. The children doesn't want to drink the milk.
127. The girls likes to discuss their secrets together.
128. We often comes to this pub for drinks.

Oxford Quick Placement Test

**Oxford
University
Press and**

**University of Cambridge Local Examinations
Syndicate**

Name:

Date:

quick placement test

**This test is divided into two
parts: Part One (Questions 1 –
40) – All students.**

**Part Two (Questions 41 – 60) – Do not start this part
unless told to do so by your test
supervisor.**

Time: 30 minutes

Questions 1 – 5

- Where can you see these notices?
- For questions 1 to 5, mark **one** letter **A**, **B** or **C** on your Answer Sheet.

1

**Please leave your room
key at Reception.**

- A** in a shop
- B** in a hotel
- C** in a taxi

2

**Foreign money
changed here**

- A** in a library
- B** in a bank
- C** in a police station

3

**AFTERNOON SHOW
BEGINS AT 2PM**

- A** outside a theatre
- B** outside a supermarket
- C** outside a restaurant

4

CLOSED FOR HOLIDAYS
Lessons start again on
the 8th January

- A** at a travel agent's
- B** at a music school
- C** at a restaurant

5

Price per night:
£10 a tent
£5 a person

- A** at a cinema
- B** in a hotel
- C** on a camp-site

Questions 6 – 10

- In this section you must choose the word which best fits each space in the text below.
- For questions **6** to **10**, mark **one** letter **A**, **B** or **C** on your Answer Sheet.

Scotland

Scotland is the north part of the island of Great Britain. The Atlantic Ocean is on the west and the North Sea on the east. Some people **(6)**..... Scotland speak a different language called Gaelic.

There are **(7)** five million people in Scotland, and Edinburgh is **(8)**..... most famous city.

Scotland has many mountains; the highest one is called 'Ben Nevis'. In the south of Scotland, there are a lot of sheep. A long time ago, there **(9)**many forests, but now there are only a **(10)**

6 **A** on

B in

C at

7 **A** about

B between

C among

8 **A** his

B your

C its

9 **A** is

B were

C was

10 **A** few

B little

C Lot

Questions 11 – 20

- In this section you must choose the word which best fits each space in the texts.
- For questions **11** to **20**, mark **one** letter **A**, **B**, **C** or **D** on your Answer Sheet.

Alice Guy Blaché

Alice Guy Blaché was the first female film director. She first became involved in cinema whilst working for the Gaumont Film Company in the late 1890s. This was a period of great change in the cinema and Alice was the first to use many new inventions, (11).....sound and colour.

In 1907 Alice (12)..... to New York where she started her own film company. She was (13)..... successful, but, when Hollywood became the centre of the film world, the best days of the independent New York film companies were (14)When Alice died in

11 A bringing B including C containing D supporting

12 A moved B ran C entered D transported

13 A next B once C immediately D recently

14 A after B down C behind D over

15 A remembered B realised C reminded D repeated

UFOs – do they exist?

UFO is short for ‘unidentified flying object’. UFOs are popularly known as flying saucers,

(16) that is often the (17) they are reported to be. The (18)

"flying saucers" were seen in 1947 by an American pilot, but experts who studied his claim decided it had been a trick of the light.

Even people experienced at watching the sky, (19)..... as pilots, report seeing UFOs. In

1978 a pilot reported a collection of UFOs off the coast of New Zealand. A television

(20)..... went up with the pilot and filmed the UFOs. Scientists studying this

- 16 A because B therefore C although D so
- 17 A look B shape C size D type
- 18 A last B next C first D oldest
- 19 A like B that C so D such
- 20 A cameraman B director C actor D announcer

Questions 21 – 40

- In this section you must choose the word or phrase which best completes each sentence.
- For questions 21 to 40, mark **one** letter **A, B, C** or **D** on your Answer Sheet.

21 The teacher encouraged her studentsto an English pen-friend.

- A should write B write C wrote D to write

22 They spent a lot of time..... at the pictures in the museum.

A looking B for looking C to look D to looking

23 Shirley enjoys science lessons, but all her experiments seem to wrong.

A turn B come C end D go

24 From Michael, all the group arrived on time.

A Except B Other C Besides D Apart

25 She..... her neighbour's children for the broken window.

A accused B complained C blamed D denied

26 As I had missed the history lesson, my friend went..... the homework with me.

A by B after C over D on

27 Whether she's a good actress or not is a of opinion.

A matter B subject C point D case

28 The decorated roof of the ancient palace was up by four thin columns.

A built B carried C held D supported

29 Would it..... you if we came on Thursday?

A agree B suit C like D fit

30 This form..... be handed in until the end of the week.

A doesn't need B doesn't have C needn't D hasn't got

31 If you make a mistake when you are writing, just..... it out with your pen.

A cross B clear C do D wipe

32 Although our opinions on many things, we're good friends.

A differ B oppose C disagree D divide

33 This product must be eatentwo days of purchase.

A by B before C within D under

34 The newspaper report containedimportant information.

A many B another C an D a lot of

- 35 Have you considered to London?
A move B to move C to be moving D moving
- 36 It can be a good idea for people who lead an active life to increase their
of vitamins.
A upturn B input C upkeep D intake
- 37 I thought there was a of jealousy in his reaction to my good fortune.
A piece B part C shadow D touch
- 38 Why didn't you that you were feeling ill?
A advise B mention C remark D tell
- 39 James was not sure exactly where his best interests
A stood B rested C lay D centred
- 40 He's still getting the shock of losing his job.
A across B by C over D Through

Part 2

Do not start this part unless told to do so by your test supervisor.

Questions 41 – 50

- In this section you must choose the word or phrase which best fits each space in the texts.
- For questions 41 to 50, mark **one** letter **A, B, C** or **D** on your Answer Sheet.

The tallest buildings - SKYSCRAPERS

Nowadays, skyscrapers can be found in most major cities of the world. A building which was many (41)..... high was first called a skyscraper in the United States at the end of the 19th century, and New York has perhaps the (42)skyscraper of them all, the Empire State Building. The (43).....beneath the streets of New York is rock, (44)..... enough to take the heaviest load without sinking, and is therefore well-suited

- 41 A stages B steps C storeys D levels
- 42 A first-rate B top-class C well-built D best-known
- 43 A dirt B field C ground D soil
- 44 A hard B stiff C forceful D powerful
- 45 A weight B height C size D Scale

SCRABBLE

Scrabble is the world's most popular word game. For its origins, we have to go back to the 1930s in the USA, when Alfred Butts, an architect, found himself out of (46)..... He decided that there was a (47) for a board game based on words and (48)..... to design one. Eventually he made a (49) from it, in spite of the fact that his original

- 46 A earning B work C income D job
- 47 A market B purchase C commerce D sale
- 48 A took up B set out C made for D got round
- 49 A wealth B fund C cash D fortune
- 50 A receipt B benefit C profit D Allowance

Questions 51 – 60

- In this section you must choose the word or phrase which best completes each sentence.
- For questions **51** to **60**, mark **one** letter **A**, **B**, **C** or **D** on your Answer Sheet.

- 51 Roger's managerto make him stay late if he hadn't finished the work.
- A insisted B warned C threatened D announced
- 52 By the time he has finished his week's work, John has hardly..... energy left for the weekend.
- A any B much C no D same
- 53 As the game..... to a close, disappointed spectators started to leave.
- A led B neared C approached D drew
- 54 I don't remember..... the front door when I left home this morning.
- A to lock B locking C locked D to have locked
- 55 Ito other people borrowing my books: they always forget to return them.
- A disagree B avoid C dislike D object
- 56 Andrew's attempts to get into the swimming team have not with much success.
- A associated B concluded C joined D met
- 57 Although Harry had obviously read the newspaper article carefully, he didn't seem

- to have
..... the main point.
- A** grasped **B** clutched **C** clasped **D** gripped
- 58** A lot of the views put forward in the documentary were open to
- A** enquiry **B** query **C** question **D** wonder
- 59** The new collegefor the needs of students with a variety of learning backgrounds.
- A** deals **B** supplies **C** furnishes **D** caters
- 60** I find the times of English meals very strange – I'm not used..... dinner at 6pm.
- A** to have **B** to having **C** having **D** have

Language Social Background Questionare

Here's the link for LSBQ:

https://docs.google.com/forms/d/e/1FAIpQLSfa_d919NaB2LH_hRg7CR7BdEaeMjtc1GRmNv3S6nUOoIC6kA/viewform?usp=sf_link

