

SYNTACTIC PREDICTION AS EVIDENCED BY ELIDED STRUCTURES AND WORD-  
CATEGORY VIOLATIONS

By

JOSEPH ANDREW KIRKHAM

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To my closest family and friends for their unflagging support

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## LIST OF ABBREVIATIONS

|              |  |
|--------------|--|
| ANOTHER WORD | Remember to use a tab between the abbreviations and the definitions                                |
| +ELLIPSIS    | Describes a condition in which an elided noun is licensed in the second clause of the sentence     |
| -ELLIPSIS    | Describes a condition in which an elided noun is not licensed in the second clause of the sentence |
| EEG          | Electroencephalography   |
| ERP          | Event-related potentials   |
| LEAP-Q       | Language Education and Proficiency Questionnaire   |

Abstract of Thesis Presented to the Graduate School  
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By

Joseph Andrew Kirkham

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There is ample evidence that readers anticipate upcoming information when processing sentences. Exactly how and when syntactic predictions affect the processing of incoming words is still under debate. According to Lau, Stroud, Plesch, and Phillips (2006), syntactic predictions can modulate the ELAN effect for ungrammatical continuations of a sentence. The aim of the current ERP study was to test the effect of structure-based predictions on the processing of word category violations. The current study replicated the experiment conducted by Lau et al. (2006). EEG was recorded from 20 native English speakers while they completed a grammaticality judgment task in which they read sentences that varied in degree of expectancy of the critical word by manipulating the licensing of an elided noun. In addition, measures of language proficiency, cognitive control, and working memory were correlated with ERP effects.

Contrary to Lau et al. (2006), there was no ELAN effect at the critical word. Instead, a significantly larger, right-lateralized centro-parietal component was found to be modulated by the possibility of ellipsis. This component may be interpreted as reflecting predictive processing. However, a non-prediction-based interpretation is also possible, especially considering potential experimental confounds. Measures of

language proficiency and cognitive control, but not working memory, were also found to correlate with the size of this ellipsis-modulated effect. Additional components, including a right-frontal negativity related to the attachment of an incongruent preposition to an elided structure, and posterior positivities for ungrammatical conditions relative to a grammatical condition were also elicited.

## CHAPTER 1 INTRODUCTION

### **Motivation for the Current Study**

The purpose of the study reported here is to investigate the nature of a theorized linguistic processing phenomenon known as syntactic prediction. As will be detailed below, there has been much evidence in support of semantic-based linguistic processing, but the reality of syntactic processing is less clear. Lau, Stroud, Plesch, and Phillips (2006) investigated syntactic prediction using an ERP methodology and interpreted their findings as evidence for syntactic prediction. The main purpose of the current study will be to attempt to replicate the findings of Lau et al. (2006). In addition, measures of cognitive factors, including cognitive control and working memory capacity, and language proficiency measures will be correlated with ERP effects in order to attempt to establish how predictive capabilities may related to more general cognitive abilities.

This thesis will assume the following structure: the rest of Chapter 1 will outline past research relevant to sentence processing and prediction in language. In particular, special attention will be given to the research study which is the object of the current study's replication, Lau et al. (2006). Chapter 2 will detail the procedures and methods used during experimental preparation and data gathering. Chapter 3 will detail the results of the online and offline measures and their associated statistical tests. Chapter 4 will discuss the implications of the current study's findings with an eye toward future research in this field.

## **State of the Literature**

There are two main areas of psycho and neurolinguistics research that are relevant to this study: syntactic processing and linguistic prediction.

### **Syntactic Processing**

Electroencephalography (EEG) has become a powerful tool in the field of cognitive neuroscience. Particularly for neurolinguistics, the application of event-related potentials (ERPs) has led to great strides in the quest to describe the details of language processing. Event-related potentials (ERPs) such as the N400 have been linked with processing of semantic information (Kutas and Hillyard, 1980; for a review, see Kutas and Federmeier, 2011), whereas components such as the early left anterior negativity (ELAN; Neville, Nicol, Barss, Forster, and Garrett, 1991), left anterior negativity (LAN; Kutas and Hillyard, 1983), and the P600 (Osterhout and Holcomb, 1992) and have been linked with various aspects of morphosyntactic processing.

Of particular relevance to this study are the components associated with syntactic processing. The ELAN has only been elicited in response to a very narrow range of syntactic anomalies, primarily word-category violations (Neville et al., 1991; Hahne and Friederici, 1999; Rossi, Gugler, Friederici and Hahne, 2006; for a review and discussion of ELAN controversy, see Steinhauer and Drury, 2012). The LAN component has been shown to appear in response to slightly more complex syntactic violations or anomalies, such as agreement violations (Kutas and Hillyard, 1983) and garden-pathing (Kaan and Swaab, 2003). The late positivity component has been implicated across a broad variety of linguistic anomalies, including explicit violations like word-category and subcategorization violations (Osterhout and Holcomb, 1992; Hagoort, Brown, and Groothusen, 1993; Hahne and Friederici, 1999; Friederici and Frisch, 2000), and other

anomalies like garden-pathing (Osterhout and Holcomb, 1992; Osterhout, Holcomb, and Swinney, 1994; Kaan and Swaab, 2003). These various components strongly suggest that there are separate cognitive mechanisms used in the construction and revision of different parts of linguistic information, even within the realm of a single theoretical field, such as syntax or morphosyntax.

Under the model of syntactic processing described by Hahne and Friederici (1999; also, Friederici, 1995), the initial ELAN and LAN components reflect automatic processes, due to the speed at which they occur. They are thought to only make use of very basic syntactic information, which explains the relatively narrow range of linguistic violations and anomalies that elicit these components. However, under Hahne and Friederici's (1999) model, later processes, like the P600, reflect more consciously-controlled processes, likely reanalysis and/or repair of the anomaly. Crucially, all three of these processes have been interpreted as reflecting processes of syntactic integration. From a strictly integrationist viewpoint of language comprehension, sentence processing is seen as no more than basic incremental sentence construction, where sentence structure is only built as portions of the sentence are heard and analyzed.

Consider the prototypical example of an ELAN-eliciting word-category violation from Hahne and Friederici (1999), as illustrated in (1b).

- (1) a. Die Kuh wurde im Stall gefüttert. (grammatical)  
the cow was in the barn fed  
"The cow was fed in the barn."  
b. \*Die Kuh wurde im gefüttert. (word category violation)

the cow was in the fed

\* "The cow was fed in the."

According to a strictly integrationist interpretation, upon encountering the verb *gefüttert* in (1b), the syntactic process responsible for the ELAN simply cannot successfully integrate the verb into the existing syntactic structure constructed from the rest of the sentence. In this view, the ELAN is seen as reflecting the effort that the underlying syntactic process is putting toward integration. Relating to integration and semantic processing, in studies that show smaller N400 effects for sentence completions with a higher cloze probability (Kutas, Lindamood, and Hillyard, 1984; Kutas and Hillyard, 1984; and several replications), this is taken as evidence of ease of integration based on the high degree of contextual overlap between the target word and the rest of the sentence (Van Petten and Luka, 2012).

However, there is a viewpoint counter to the integration viewpoint. Lau et al. (2006) contended that the amount of time available for syntactic integration to occur is very small after time has been allotted for perception and conversion into abstract linguistic representations (Sereno and Rayner, 2003). Using a clever design, Lau et al. (2006) investigated an alternative to the integration interpretation of the ELAN. This alternative is the idea that the underlying process is more akin to prediction.

### **Prediction in Language**

The concept of predictive processes in language comprehension is controversial and very difficult to define. Van Petten and Luka (2012) provide a very nice summary of the history of research on linguistic prediction. Linguistic prediction is supported by several neurolinguistic methodologies, including reaction-times (Forster 1981, Traxler and Foss 2000), eye-tracking (Altmann and Kamide 1999, Kamide et al. 2003, Hopp,

2012; Nakamura, Arai, Mazuka, 2012), and EEG (DeLong, Urbach, and Kutas 2005; Van Berkum, Brown, Zwisterlood, Kooijman, and Hagoort 2005; Wicha, Moreno, and Kutas 2004; Lau et al. 2006). Though reaction-time data can easily be interpreted as reflecting solely processes of integration, the high degree of temporal resolution inherent in eye-tracking and EEG lends stronger support to the prediction viewpoint. Visual world studies by Altmann and Kamide (1999) and Kamide et al. (2003) demonstrated in both English and Japanese that—even *before hearing the object of a sentence*—more looks were made to a corresponding object in the visual display when the object was highly congruent with the verb than when the object was less congruent with the verb (in a sense, highly congruent objects corresponded to the visual analogue of words with high cloze probability). Related to syntax, Hopp (2012) demonstrated in another visual-world paradigm study that even advanced second-language speakers could predict target objects based on gender information in preceding structure. In ERP studies, DeLong et al. (2003) showed a higher N400 effect on an indefinite article (*a/an*) that did not phonologically match a highly expected noun. For example, in the sentence “The day was breezy, so the boy went out to fly...”, the sentential context highly constrains the following noun phrase to contain *kite*. However, if *an*, which is phonologically incongruent with *kite*, heads the determiner phrase, there is a larger N400 effect than when *a* is presented. This effect has been reproduced cross-linguistically: Van Berkum et al. (2005) showed a similar effect with Dutch target noun-preceding adjectives marked with incongruent genders, while Wicha et al. (2004) showed a similar effect on incongruently gender-marked Spanish articles. These effects cannot be explained by integrative processes, as there is no difference in semantic meaning between *a/an* and

differentially gender-marked adjectives and articles, yet these effects are readily compatible with a model of sentence processing that contains (a) predictive mechanism(s). In an MEG study, Dikker and Pylkkänen (2012) found increased activation in the left mid-temporal cortex and the ventro-medial pre-frontal cortex in more predictive contexts than left predictive contexts; the activation occurred *prior* to the visual presentation of the target object.

However, these forms of linguistic prediction just under discussion are all entirely focused on prediction based on semantic context. There has been little work on whether upcoming syntactic information is anticipated based on analysis of earlier syntactic information. Consider again sentence (1b), from a perspective of syntactic prediction. Upon processing the word *im*, which is functioning as determiner (strictly speaking, it is a contracted form of a preposition plus a determiner *in dem* “in the”), a linguistic process recognizes that a determiner can only occur in the context of a noun, and predicts a structure containing a noun. Upon encountering the verb *gefüttert*, this causes dissonance between the expectation and the realization, because *gefüttert* does not match the anticipated word category (and also not another word, such as an adjective, that could feasibly fit into the structure between the determiner and the noun), and an ELAN is elicited. The predictive nature of the ELAN could explain its rapidity.

Lau et al. (2006) developed a novel paradigm for testing prediction of word categories. This study will use this paradigm as a foundation for continuing research. The authors manipulated predictability through the possibility of ellipsis. Sentences (2a) and (2b) are the critical conditions that the authors compared.

- (2) a. Although Erica kissed Mary's mother, she did not kiss Dana's \_\_\_\_ \*of the bride. (N or Ø possible in the blank)
- b. Although the bridesmaid kissed Mary, she did not kiss Dana's \*of the bride. (N only possible in the blank)

In both sentences, there is a word category violation following the possessive, as *of* cannot fit into the subcategorization frame of *Dana's*. As mentioned above, word category violations are known to elicit ELANs, so both of these sentences are expected to elicit an ELAN. The crucial difference between these sentences lies in the possibility of ellipsis. In both (2a) and (2b), the sentences are grammatical prior to the offending *of*. In sentence (2a), the phrase *Mary's mother* in the first clause allows for the possibility of ellipsis in the second clause, where the elided word would be interpreted as *mother*. Of course, it is not ungrammatical and even perfectly plausible to overtly include the noun *mother*, or even any other noun like *father*, *brother*, or *groom*. The crucial point being, either a noun or Ø are expected to follow *Dana's*. In sentence (2b), there is no possessive in the first clause to allow for the possibility of ellipsis in the second clause, so only a noun could be expected to follow the possessive *Dana's*. In effect, this means the position following *Dana's* is less predictable in sentence (2a) than in sentence (2b). The authors hypothesized that if the syntactic process marked by the ELAN has an anticipatory functionality, the ELAN elicited by the category violation in each condition would be modulated by the variable predictability. This is indeed what they found: the ELAN in the more predictive sentence (2b) had a larger amplitude than the ELAN elicited by the less predictive sentence (2a). The authors concluded that only the

difference in predictability could account for this modulation of the ELAN. However, there are some key issues with this study that will be addressed below.

**Prediction outside of neurolinguistics.** Prediction is not a concept limited to neuro/psycholinguistics. Research in the largely separate field of computational linguistics has also given rise to computational models—including the probabilistic expectation model (Levy, 2008)—of linguistic prediction. These models conceptualize linguistic prediction in terms of resource allocation, which is compatible with the view that the modulation of ERP components related to the degree with which a target word matches a constrained context is related to the effort required to integrate *based on a prediction* (for a discussion on the costs and benefits of predictions and associated ERP components, see Van Petten and Luka, 2012).

Outside of linguistics, Bar (2009) outlined a view of prediction on a much more general, non-linguistic level. He proposes a proactively predictive brain across cognitive domains, where lower-level analogies of simple situations/associations combine to form larger scripts that the brain uses in order to deal with daily life. Indeed, it is well-established that prior experience heavily influences virtually every aspect of human behavior. This inherently includes non-linguistic human perception of the world. This raises an interesting issue: to what extent is predictive processing specific to language? Certainly, the visual world paradigm studies by Altmann and Kamide (1999) and Kamide et al. (2003) arguably demonstrate the priming of non-linguistic information based on linguistic input. It may be more parsimonious to assume a single predictive mechanism (or set of smaller processes) at the conceptual level that is mediated by and modulates linguistic perception than to assume an extra (set of) process(es) specifically dedicated

to linguistic prediction. Further evidence that linguistic prediction is part of a more domain-general process is found in the concurrence of ventro-medial pre-frontal activation in predictive linguistic contexts shown by Dikker and Pykkänen (2012) and predictive non-linguistic contexts (Bar, 2007).

## **The Current Study**

### **Issues in Lau et al. (2006)**

As mentioned above, there are some methodological issues with Lau et al. (2006). The first issue concerns the fact that the paradigm could not confirm whether the components in question were in fact ELAN effects. In order to confirm that the components were the same as ELANs reported in previous studies, the authors would have had to directly compare grammatical to ungrammatical conditions. However, the nature of the grammatical conditions made a direct comparison impossible, as the grammatical sentences had a full DP (determiner + noun) prior to the critical position of *of*, which differed from the possessive proper noun in the ungrammatical sentences. Despite this flaw, the timing and polarity of the waves indicate that they were indeed ELANs. The most glaring issue in this study, though, regards the post-processing of the EEG data. The standard method of rereferencing is to rereference the signal to the mastoid signals. However, in order to avoid potentially omitting experimentally-relevant signals by using a mastoid reference, the authors instead rereferenced to the average of all of the signals. It was in this analysis that the ELAN was elicited. When analyzed with the standard rereferencing technique, there was no significant difference between the ungrammatical ellipsis and non-ellipsis conditions. These issues cast greater skepticism on the results and their interpretations. The current study sought to replicate

the Lau et al. (2006) paradigm with methodological changes to overcome these issues. These changes will be detailed in Chapter 2.

### **Objectives of the Current Study**

The main purpose of this study is to investigate the question: Do native speakers unconsciously and actively predict word category information during online sentence processing? It is predicted that ELAN effects will be modulated by predictability, with more predictable positions eliciting a larger ELAN (consistent with Lau et al. 2006).

A secondary purpose of this study is to investigate the potential effect of cognitive factors such as working memory and cognitive control on predictive effects and the processing of syntactic anomalies as measured by the ERP task. Cognitive control (January, Trueswell, Thompson-Schill, 2009; Moreno, Bialystok, Wodniecka, and Claude, 2010) and working memory (Vos, Gunter, Schiefers, and Friederici 2001) have been shown to modulate ERP amplitudes and latencies. Tests of these cognitive factors will be administered to participants, and the results will be compared with ERP differences and latencies.

There will also be several English-language proficiency measures administered to participants. The reported experiment is only a portion of a larger study including a group of highly-proficient second-language speakers of English; this was a large factor in the decision to include English proficiency measures with native English speakers.

## CHAPTER 2 EXPERIMENTAL METHODOLOGY

### **Participants**

Participants consisted of 25 native speakers of American English (17 females, 8 males). They were recruited from the student population of the University of Florida (UF) in Gainesville, Florida, USA. Most were recruited from the participant pool of undergraduate students required to participate in research as a course requirement. All participants in this group were pre-screened and reported as being native speakers of American English on the Language Education and Proficiency Questionnaire (Marian, Blumenfeld, and Kaushanskaya, 2007); more detailed results are reported in Chapter 2. Because of various ERP recording issues (detailed in Chapter 3), five subjects were dropped from ERP analysis. Only data from the remaining 20 subjects (13 females, 7 males) were retained for analyses of all reported results (behavioral and ERP). The participants ranged from 18 to 26 years of age (mean 20.5). These participants were compensated at a rate of \$10/hour for all time beyond the maximum 2 hours of course credit; a small number of participants were compensated entirely in monetary payment. All subjects reported no history of neurological disorder and were verified as right-handed by the Edinburgh Handedness Inventory (Oldfield, 1971). All participants gave informed consent.

### **Experimental Design**

#### **Language Proficiency Measures**

Participants completed two English proficiency measures: the Language Education and Proficiency Questionnaire (Marian et al., 2007) and the C-Test (Keijzer, 2007). The results of these studies were used for comparison with the results of the

ERP task, and as an extension will be used to compare with the English proficiency of a second-language group being tested in a larger version of this experiment.

**Language Education and Proficiency Questionnaire.** This standardized questionnaire, henceforth referred to as the LEAP-Q, asks participants to indicate age, demographics, education, language history and proficiency, and their parents' education and language history/proficiency. This task took participants approximately 10 minutes to complete.

**C-Test.** This task consisted of four brief passages with 20 incomplete words scattered throughout each passage. Participants were required to complete the incomplete words so that they made grammatical and semantic sense within both the sentence on a micro level and the passage on a macro level. Participants had a maximum of 5 minutes per passage, but many participants completed some passages within 2 or 3 minutes. This task usually took participants between 15-20 minutes. The original version of the C-Test from Keijzer (2007) consisted of five texts, however one particularly difficult passage (Text 3) was deemed unnecessary and dropped in order to decrease the total length of the experimental session.

### **Cognitive Measures**

As mentioned in the introduction/literature review, measures of working memory capacity and cognitive control have been shown to be correlated with linguistic knowledge/performance. To assess potential effects of these cognitive systems, two tests were administered: a digits forward and reversed task (a measure of working memory capacity), and the Stroop task (Stroop, 1935; a measure of cognitive control).

**Digits forward and backward.** In this measure of working memory capacity, participants were read sequences of numbers (1-9) by an experimenter. Sequences

grew progressively longer, with two sequences for each length between 2 and 9 number of digits. First, in the forward portion of the task, participants were asked to simply repeat the numbers in each sequence as they were read out to them. Second, in the backward portion, participants were required to repeat the sequence in the reverse order that it was read to them. Each response was scored simply as “correct” or “incorrect.” Only sequences repeated 100% correctly were counted as correct. If participants missed both sequences of the same length in either direction, the task was halted and the experiment proceeded to the next task. This task took five minutes or less, dependent on participant performance.

**Stroop task.** In this measure of cognitive control, participants were asked to read two lists. In the first, several columns of the string “XXX” were colored in red, blue, or green. Participants were instructed to read the color of the font down each column from left to right as quickly and accurately as possible. In the second list, the columns consisted of strings that read either “RED”, “BLUE”, or “GREEN”, and the strings were colored such that the font color never matched the semantic meaning of the text. Again, participants were asked to read the color of the font down each column as quickly and accurately as possible. Participants’ total reading times for each list were recorded. This task took no more than five minutes.

### **Edinburgh Handedness Inventory**

Although participants were screened for handedness during the recruitment process, participants completed the Edinburgh Handedness Inventory (Oldfield, 1971) to verify their dominant hand. In this questionnaire, participants indicated which hand they use when performing certain tasks or utilizing certain instruments (e.g., writing,

using a fork, etc.). This task was performed during the EEG setup process, and took less than five minutes.

## ERP Task

As indicated in the introduction, the design of the ERP portion of the current study draws heavily from Lau et al. (2006). Many of the design characteristics of their study (as described in Chapter 1) are applicable to the current study, with some key differences, which will be described at appropriate points throughout this section.

**Stimuli.** The majority of experimental stimuli were borrowed directly from Lau et al.'s (2006) study, though some conditions and sentence types were altered, eliminated, or added. Each participant was presented with 288 total sentences; 160 criticals (4 conditions of 40 trials each) and 128 fillers (4 types of 32 each).

### Critical stimuli.

Table 2-1. Critical conditions in Lau et al. (2006).

| Type      | Sentence      |  |
|-----------|---------------|--|
| +Ellipsis | Grammatical   | a. Although Erica kissed Mary's mother, she did not kiss the daughter <u>of</u> the bride  |
|           | Ungrammatical | b. Although Erica kissed Mary's mother she did not kiss Dana's <u>*of</u> the bride.       |
| -Ellipsis | Grammatical   | c. Although the bridesmaid kissed Mary, she did not kiss the daughter <u>of</u> the bride. |
|           | Ungrammatical | d. Although the bridesmaid kissed Mary, she did not kiss Dana's <u>*of</u> the bride.      |

Table 2-2. Critical conditions in the current study; the critical word is underlined

| Type      | Sentence      |  |
|-----------|---------------|--|
| +Ellipsis | Grammatical   | a. Although Peter met John's surgeon, he did not meet Max's <u>*of</u> the operation.        |
|           | Ungrammatical | b. Although Peter met John's surgeon, he did not meet Max's <u>before</u> the operation.     |
| -Ellipsis | Grammatical   | c. Although <u>the</u> surgeon met John, he did not meet Max's <u>*of</u> the operation.     |
|           | Ungrammatical | d. Although <u>the</u> surgeon met John, he did not meet Max's <u>*before</u> the operation. |

The complete set of critical stimuli is listed in Appendix A. Though the basic methodological design was retained for the current experiment (manipulation of ellipsis to vary predictability of the critical position), the critical conditions were altered for a few crucial reasons. Examples of the critical stimuli used in Lau et al. (2006) are in Table 2-1, and an example of the critical stimuli used in the current study are in Table 2-2. Conditions b. and d. in Lau et al. (2006) correspond exactly to conditions a. and c. in the current study; these constitute the +ellipsis/\*of condition and the -ellipsis/\*of condition, respectively (+ellipsis refers to a possessive followed by a noun in the first clause, hence the possibility of grammatical ellipsis following a possessive in the second clause; -ellipsis refers to a lack of such a construction in the first clause, precluding the possibility of grammatical ellipsis in the second clause). These two conditions will also be referred to collectively as the  $\pm$ ellipsis/\*of conditions, as they both carry a proper name possessive followed by the category-violating preposition *of*. In the current study, these conditions were not altered, save for the nature of the prepositional phrase at the end of each sentence (see below). The comparison of these two conditions is essential for replication of Lau et al. (2006). However, conditions a. and c. in Lau et al. (2006) were not retained for the current study. As Lau et al. (2006) admits, because of the large differences between the  $\pm$ ellipsis/\*of conditions and their other two critical conditions, it is impossible to do a direct comparison between a grammatical and an ungrammatical condition in order to confirm a classical ELAN (or other components). In the current study, condition b. (+ellipsis/other) was included in order to remedy this flaw, as the difference between +ellipsis/\*of and +ellipsis/other constitutes a classical category violation. In the current study's conditions b. and d. (+ellipsis/other and –

ellipsis/\*other, respectively; collectively referred to as the  $\pm$ ellipsis/(\*)other conditions), the *other* indicates that the position following the possessive (the critical position) is one of the three prepositions *before*, *after*, or *during*. In the +ellipsis/other condition, this yields the only grammatical variant of the four critical conditions. The –ellipsis/other condition, was useful a) to enable a direct comparison between a grammatical and an ungrammatical condition, b) to equalize the number of  $\pm$ ellipsis/\*of and  $\pm$ ellipsis/(\*)other conditions, and c) to act as a detector of a participant strategy by which participants would rely on the *of/other* distinction in the behavioral portion of the task. The sentences that form the basis of each variant of critical stimuli 1-32 were borrowed directly from Lau et al. (2006), whereas 33-40 were created by the experimenters. The post-possessive prepositional phrases (e.g., ...*Max's of/before the operation*) always contained an NP in reference to some time or event, so that the prepositional phrase would always be understood as temporal rather than locative. Though there were variants of the critical sentences for each of the four conditions, the Latin-square design allowed for the creation of four separate lists of stimuli, in which only one critical variant of each sentence was presented to any single participant.

In order to assess the validity of the experimental manipulation for this experiment, 43 native speakers of English from the student population of the University of Florida completed a questionnaire containing a sample of the critical conditions. A total of 120 sentences were used, with 12 of each of the 4 critical conditions. An additional 72 fillers were included. Participants were instructed to indicate the grammaticality of the sentence on a 1-7 Likert rating system, where a rating of 1 was described as “implausible” and 7 was described as “plausible.” A total of four lists were

used with each of the 4 variants of the sampled critical conditions. The lists were Latin-squared and organized such that there was no repetition of a sentence variant in any given list, and each variant of the sampled critical sentences were represented across the four lists. As expected, the sentences from the +ellipsis/other condition (average rating 5.19 (SD=0.95)) were rated as significantly more grammatical than the other three conditions (+ellipsis/\*of,  $T(42)=14.46$ ,  $p < .001$ ; -ellipsis/\*of,  $T(42)=15.09$ ,  $p < .001$ ; and -ellipsis/\*other,  $T(42)=11.94$ ,  $p < .001$ ). Additionally, the sentences in the -ellipsis/of condition (mean rating 2.04, SD=0.86) were rated as significantly less grammatical than the other three conditions (+ellipsis/\*of,  $T(42)=-4.47$ ,  $p < .001$ ; +ellipsis/other  $T(42)=-15.09$ ,  $p < .001$ ; and -ellipsis/\*other,  $T(42)=-4.72$ ,  $p < .001$ ). The results for the other two ungrammatical conditions were as follows: +ellipsis/\*of (mean rating 2.62, SD=0.93) and -ellipsis/other (mean rating 2.37, SD=1.03). This is presumably due to the fact that the -ellipsis/of condition has two noticeable errors, so its ungrammaticality is more salient than those of the other ungrammatical conditions. The +ellipsis/\*of and -ellipsis/other conditions did not differ from each other ( $p > .05$ ).

### Fillers.

Table 2-3. Filler conditions used in the current study; important aspects are underlined.

| Type                  | Sentence  |
|-----------------------|---|
| +Ellipsis, <u>ON</u>  | Although Leigh emailed Kate's assistant, she did not email Amy's <u>secretary</u> before the class.     |
| -Ellipsis, <u>ON</u>  | While Kimberly denied the criminal charges, she admitted that her lover's <u>allegations</u> were true. |
| Grammatical <u>of</u> | Although the nurse weighed Tristen, she forgot to take the temperature <u>of</u> the patient.           |
| Unrelated             | Because Chloe had no other food in her house, she ate some chips for dinner.                            |

The complete set of filler stimuli is listed in Appendix B. Four different types of fillers were used in this experiment. Each participant read 32 fillers from each of the four filler conditions. Many sentential elements were borrowed from the fillers of Lau et al. (2006), but in many cases were heavily altered to fit into the categories of fillers for the current experiment. An example of each of the four filler types are provided in Table 2-3. Filler types +ellipsis,ON (overt noun), and –ellipsis,ON, (collectively “Name’s noun”) were included to provide cases in which an overt noun followed a possessive. Because all of the critical stimuli involve an elided noun in the second clause, these fillers were included to prevent participants from always anticipating an elided noun in the second clause. In +ellipsis,ON, there is a possessive in the first clause (hence the possibility for ellipsis in the second clause), whereas in –ellipsis,ON there is no possessive in the first clause (precluding the possibility of grammatical ellipsis in the second clause). Sentences in filler type Grammatical *of* all contained grammatical uses of the word *of*. Sentences of this type were included to bias participants away from noticing the fact that all uses of the preposition *of* in the critical trials were ungrammatical. Filler type Unrelated contained no possessives or elided nouns. These were included to introduce extra variability into the sentence structures presented to participants. Because the ratio of grammatical to ungrammatical stimuli in the critical conditions was so biased (1:3), some fillers were made to be ungrammatical to equalize the overall number of grammatical to ungrammatical sentences across the entire task. One fourth of all filler types were ungrammatical. While the fillers Lau et al. (2006) contained only a single type of ungrammaticality (subject-verb agreement), the current study utilized two types of ungrammaticality: subject/verb agreement violations and word order violations. The

presence of these ungrammaticality types also helped to distract participants from the crucial types of ungrammaticality in the critical conditions and to ensure that participants would be forced to scan the entirety of critical sentences.

**ERP Recording.** Participants were fitted with a cap (ANT-Neuro) with 64 electrodes for scalp EEG recording. Signals were recorded from the following scalp locations (front to back): Fpz/1/2, AF3/4/7/8, Fz/1/2/3/4/5/6/7/8, FCz/1/2/3/4/5/6, FT7/8, Cz/1/2/3/4/5/6/, T7/8, CPz/1/2/3/4/5/6, TP7/8, Pz/1/2/3/4/5/6/7/8, POz/3/4/5/6/7/8, and Oz/1/2. An additional 6 electrodes were placed at the following locations: both mastoids, to the outside of each eye, above the left eye, and below the left eye. The left mastoid was used as a reference during recording. Eye electrodes were used for monitoring eye movements (to be removed during the analysis process). Conductive gel was injected into each electrode site. Impedance levels were generally kept below 5 k $\Omega$ , though in rare cases some electrodes could only be reduced to ~10 k $\Omega$ . The signal was amplified through an ANT-Neuro amplifier. Signals were sampled at a rate of 256 Hz. Stimuli were presented with the ANT-Neuro software eevolve, and EEG signals were recorded with ANT-Neuro software eemagine.

**ERP Procedure.** The ERP task consisted of a machine-guided presentation of sentences presented visually one word at-a-time on the center of a screen. Participants were seated centrally with respect to the screen, with eyes at a distance of 100 cm from the screen. Participants who required corrective lenses wore their lenses or glasses during this task. The experiment took place in a sound-attenuated, dimly-lit booth. Participants were instructed to silently read each sentence while keeping as still as possible during sentence presentation. The text was present in white 36-point Arial font

against a black background. In each trial, a fixation cross appeared for 700ms, followed by the words of the sentence. After the last word of each sentence, there was a 700-millisecond buffer before a question mark “?” was presented on the screen. This was the participants’ cue to indicate via a button press whether they judged the previous sentence to be a grammatical sentence of English or not as quickly and accurately as possible, without sacrificing speed for accuracy. After responding, the words “Press for next” appeared on the screen. This was the participants’ cue to press either response button to trigger the presentation of the next trial. During this period, participants were able to adjust themselves and blink, and encouraged to proceed to the next trial at their own pace. Each word was presented for a static period of 300ms, with 200ms of blank screen in between each word. The 288 trials were broken into 8 even blocks of 36 trials each, with 5 occurrences of each critical condition within each block. Instances of fillers were slightly more variable, with 3-5 of each filler type in each block. The order of trials was pseudorandomized so that no two critical trials of the same condition occurred in immediate succession. The order of blocks was randomized per participant. In between each block, the door was opened and participants were allowed to relax and rest for at least 1-2 minutes before indicating that they were ready to proceed to the next block. Participants were heavily encouraged throughout the entire experiment to indicate if they felt any discomfort during the entire task, and were assured that any discomfort would be remedied to the best of the experimenters’ abilities. At the conclusion of the ERP task, the cap and electrodes were removed and the participants were provided with shampoo and a towel with which they could clean the conductive gel out of their

hair. Including EEG setup, the entirety of the ERP task was approximately 2 hours, but varied dependent upon setup time, participant response speed, and trial pace.

### **Debriefing Tasks**

There was some concern that the participants would not be sensitive to the grammaticality of elided structures. To verify that the participants judged these sentences as intended, participants completed two offline language comprehension tasks, a written cloze task and a grammaticality judgment task, containing sentences from the critical conditions of the ERP task. The cloze task was only implemented beginning with the 11<sup>th</sup> subject; overall, only 10 retained subjects completed the cloze task. These tasks were completed after the ERP task, so as not to induce priming of the sentences and nature of the ungrammaticality during the ERP task. The same sentences were used for all participants. A final general debriefing questionnaire concluded the experimental session.

**Written cloze test.** In this task, participants were given 20 incomplete sentences and asked to complete the sentences so that they were grammatical. There were 4 sentences of each critical condition, where the blank appeared after the possessive in the second clause. Additionally, there were 4 fillers. The participants were given explicit instructions that they could write as little or as much as they felt was necessary, and that they could simply place a period if they felt that the sentence was grammatical without any extra words or phrases. This task took participants about 5 minutes.

**Written grammaticality judgment task.** In this task, participants were given 40 complete sentences, some of which were ungrammatical. Like the cloze test, some sentences from the critical conditions in the ERP experiment were included. Participants were instructed to judge each sentence for grammaticality and write a “G” or “U” under

the sentence to indicate their judgment. In addition, participants were told that for any sentence they judged to be ungrammatical, they were to correct the sentence by any means necessary to render it grammatical. This task took participants about 10 minutes.

**General debriefing questionnaire.** This questionnaire asked participants to indicate their general feeling during the experiment, how confident they felt in their grammaticality judgments, whether they used any particular strategies during the ERP experiment, if they noticed any patterns in the sentences, and whether they felt that fatigue affected their ability to respond. Participants' responses to these questions factored into any minor restructuring of the experimental procedure for future participants. This task took participants no more than 5 minutes.

### **Task Order**

All tasks were carried out within a single experimental session for each participant. Experimental sessions began with the informed consent process. Following informed consent, participants began the battery of language proficiency, working memory (digits), and cognitive control (Stroop) tasks. Tasks were completed in the following order: C-Test, working memory, and Stroop. Next, participants began preparations for the ERP task. During EEG setup, participants completed the Edinburgh Handedness Inventory and the LEAP-Q. After the ERP task, participants were given the opportunity to wash their hair before completing the debriefing tasks and questionnaire. Participants were then compensated and encouraged to ask any questions or make any additional comments before dismissal.

## CHAPTER 3 RESULTS

### **Behavioral Data**

#### **LEAP-Q**

Because of the sheer amount of data gathered on this questionnaire, discussion will only be kept to the most relevant details. Participants reported using English overall on average 90.9% of the time (SD=9.8%), reading in English 93.1% (SD=7.7%), and speaking in English 87.0% (SD=15.2%). On a scale from 1-10, participants reported their English speaking proficiency on average as 9.70 (SD=0.71), spoken comprehension as 9.75 (SD=0.43), reading as 9.70 (SD=0.64), and writing as 9.65 (SD=0.65). Because the self-ratings for English writing, reading, speaking, and comprehension proficiency were highly correlated, a composite of these scores was created by averaging these ratings within each participant. The average composite English proficiency score was 9.70 (SD=0.55). As mentioned before, these measures will primarily be used for later comparison with second-language learners of English.

#### **C-Test**

In scoring the C-Test, answers not intended by the authors yet considered appropriate by the experimenter (a native English speaker), in concert with consultations with other native English speakers, were also graded as correct. One participant, who completed the C-Test incorrectly by treating some blanks as new words instead of a continuation of the immediately preceding string, was dropped from all analyses regarding the C-Test. This left data from 19 participants. In general, participants performed well on the C-Test, with an average accuracy rate across all four passages of 89.0% (SD=7.3%). Text 5 proved the most difficult (mean accuracy 83.0%,

SD=13.5%), whereas Text 1 was responded to most accurately (mean 93.4%, SD=8.1%).

### **Working Memory**

On the digits-forward task, participants demonstrated a working memory capacity toward the higher end of the traditional  $7 \pm 2$  item capacity, with an average of 9.05 (SD=1.83). Scores on the digits-reversed task were slightly lower with an average of 7.95 (SD=2.96).

### **Stroop**

One participant who read both lists at a very slow and deliberate pace was dropped from analyses involving the Stroop task. The remaining 19 participants had an average Stroop effect (time on the color list minus time on the XXX list) of 24.89 seconds (SD=8.26).

### **ERP Grammaticality Judgment Task**

On the grammaticality judgment task, accuracy rates for only the critical conditions were quantified. On the rare occasions of a presentation error of a critical sentence, these were omitted from consideration of accuracy rates. Overall, participants performed accurately on the critical conditions with an average accuracy rate of 86.3% (SD=11.5%). The average accuracy rates for the individual conditions were as follows: +ellipsis/\*of 86.8% (SD=13.9%), +ellipsis/other 92.0% (SD=8.6%), -ellipsis/\*of 98.5% (SD=3.0%), and -ellipsis/other 87.8% (SD=7.3%). When subjected to a repeated-measures ANOVA, the -ellipsis/of condition was found to be the easiest of all conditions, as this condition was responded to significantly more accurately than +ellipsis/\*of ( $p < .01$ ), -ellipsis/\*other ( $p < .001$ ), and marginally significantly more accurately than the +ellipsis/other ( $p = .055$ ).

## ERP Data

Of the 25 participants, the ERP results from one participant were discarded due to high rejection rates (artefacts), four were rejected due to unacceptable accuracy rates (below 55% accuracy in any critical condition) and/or poor performance on the debriefing grammaticality judgment task. In total, the data from 20 subjects were analyzed. The ERP data were processed in the ANT-Neuro analysis software eeprobe. Artefacts were rejected in two steps: the first step consisted of pre-programmed rejection of data that varied 30 standard deviations from the average at Fp1 and Fp2. This accounted for the majority of artefacts caused by eye blinks or other sources. The second rejection step involved manual visual inspection of the area surrounding the onset of the critical words. The experimenter rejected very noisy or artefact-contaminated trials not rejected in the auto-rejection process, and also judged the validity of automated rejections. Of the retained subjects, an average of 17.1% of trials were rejected due to artefacts. Per critical condition, the rejection rates were as follows: +ellipsis/\*of 11.1%, +ellipsis/other 11.7%, -ellipsis/\*of 16.2%, -ellipsis/\*other 16.1%. After rejection, the signals from each cap electrode were rereferenced to the average of the two mastoid references in order to remove potential hemispheric asymmetry induced by the referencing process. Note that this is crucially different from the rereferencing technique used by Lau et al. (2006) in the analysis that found an ELAN between the ungrammatical ellipsis conditions. In their study, the signal was rereferenced to the average of all scalp electrodes. Finally, the signals were filtered with a 0.01-30 hz. bandpass filter in order to further reduce noise in the signals.

The four critical conditions did not differ in the five words prior to the critical word (the preposition in the second clause). Despite this, it was believed that ±ellipsis

experimental manipulation in the first clause could feasibly affect signals prior to the critical word. In order to compensate for this, the baseline was established 100ms before the word *preceding the critical word* (i.e., the possessive), which corresponds to 600ms before the onset of the critical word. This allowed for the testing of differences between conditions prior to the critical word and allowed for the assessment of whether ERP differences occurring after the critical word were due to processing of the critical word or were related to the differential processing of earlier sentential material. The full range of epochs ran from 600ms before the onset of the critical word to 1000ms after the onset of the critical word. Data were analyzed in SPSS statistical software.

Data from seven different time windows were analyzed (0ms is equivalent to the onset of the pre-critical possessive): 300ms-500ms from the onset of the possessive (to investigate the potentiality of differences prior to presentation of the critical word), 500ms-700ms (to investigate the potentiality of later effects not related to the critical word), 600ms-800ms (to investigate the potentiality of an ELAN effect in the typical ELAN region), 800ms-1000ms (to investigate the potentiality of a LAN effect in the typical LAN region), and 900ms-1100ms (based on visual inspection), 1000ms-1200ms (to investigate the potentiality of a P600 effect in the typical P600 region), and 1300ms-1500ms (based on visual inspection).

All results within this section were subjected to Generalized Linear Model (GLM) tests. For the midline analyses, the location factors anteriority consisted of 6 levels (Fpz, Fz, FCz, Cz, CPz, and Pz). For lateral analyses, the location factors included anteriority (5 levels: frontal- F1/2/3/4/5/6/7/8, fronto-central- FC1/2/3/4/5/6 and FT7/8, central C1/2/3/4/5/6 and T7/8, central-parietal- CP1/2/3/4/5/6 and TP7/8, and parietal

P1/2/3/4/5/6) and hemisphere (2 levels: left and right). The condition factors as relevant for each test included preposition (2 levels: *of* and *other*), ellipsis (2 levels: +ellipsis and –ellipsis). Other tests involved direct comparisons between individual conditions, where the factor will be referred to as condition, ellipsis, or preposition where appropriate. For the planned left-frontal analyses, an additional three-level electrode factor (3 levels, F3, F5, and F7) was used. In tests of other individual anterior regions in individual hemispheres, a four-level electrode factor was used (4 levels, X1/2, X3/4, X5/6, and X7/8; e.g., F1, F3..., or PC2, PC4..., etc.). All tests involving factors with more than one degree of freedom are reported with Greenhouse-Geisser-corrected values (Greenhouse and Geisser, 1959) to correct for non-sphericity.

Several significant results were found related to main effects of location factors (i.e., anteriority, hemisphere, and electrode effects), however because these are of little interest in this study, these will be omitted from discussion.

In addition, because of the crucial experimental manipulation regarding ±ellipsis, a pair of planned comparisons (+ellipsis/\*of and –ellipsis/of, and +ellipsis/other and –ellipsis/other) in each time window for the ERP data were performed regardless of the finding (or lack thereof) of a main ellipsis effect or an interaction of ellipsis and preposition across all conditions. Additionally, in order to investigate grammaticality effects, there were planned comparisons of the +ellipsis/other and +ellipsis/\*of conditions (also necessary to check for the ELAN effect, as Lau et al. (2006) was unable to do), and planned comparisons of the ±ellipsis/(\*)other conditions. Results within each time window will be reported in separate subsections below. It should also be noted that because these analyses have lower power (one fourth of the number of

trials compared to the main ERP analyses), any results/interpretations based on these analyses should be treated with caution.

Finally, there was concern that trials in which participants gave an incorrect response would yield errant ERP signals. The rationale was that if they responded incorrectly, they did not process the sentence completely due to attention deficit or confusion. Separate plots were made for correct-only trials. However, upon close visual inspection, they were virtually identical to the plots containing both correct and incorrect trials. This is likely due to the high overall accuracy of the participants in the ERP task. From this visual inspection, any ill effect from inaccurate trials was deemed negligible, and no statistical analyses on ERP data were made regarding the accuracy of trials.

### **Summary of Major ERP Findings**

A general overview of the ERP results of all four critical conditions are in Figure 3-1. Importantly, there were no effects found pre-critical word and no effects found in the ELAN or LAN regions. An overview of the main statistical results can be found at the end of the ERP result section in Table 3-1. In summary, there are four significant areas with ERP findings that will be reported below:

- 1) The component marked by a difference between +ellipsis and -ellipsis conditions occurring between 500ms-700ms (i.e., onset of the critical word to 200ms after presentation of the critical word), statistically strongest in centro-posterior and posterior regions. Figure 3-2 shows the main ellipsis effect, Figure 3-3 shows the  $\pm$ ellipsis/\*of comparison, and Figure 3-4 shows the  $\pm$ ellipsis/\*other comparison.
- 2) The negativity for +ellipsis/\*of from approximately 900ms-1100ms (i.e., 400ms-600ms after the onset of the critical word) right-frontally. This is shown in Figure 3-5.
- 3) A late left-frontal negativity for -ellipsis/\*of relative to all other critical conditions was found after 1300ms (i.e., 800ms after presentation of the critical word). This is shown in Figure 3-6.
- 4) A collection of posterior components for all ungrammatical conditions (i.e., +ellipsis/\*of, -ellipsis/\*of, and -ellipsis/\*other) relative to +ellipsis/other, to be dissected and discussed more thoroughly. This is shown in Figure 3-7.

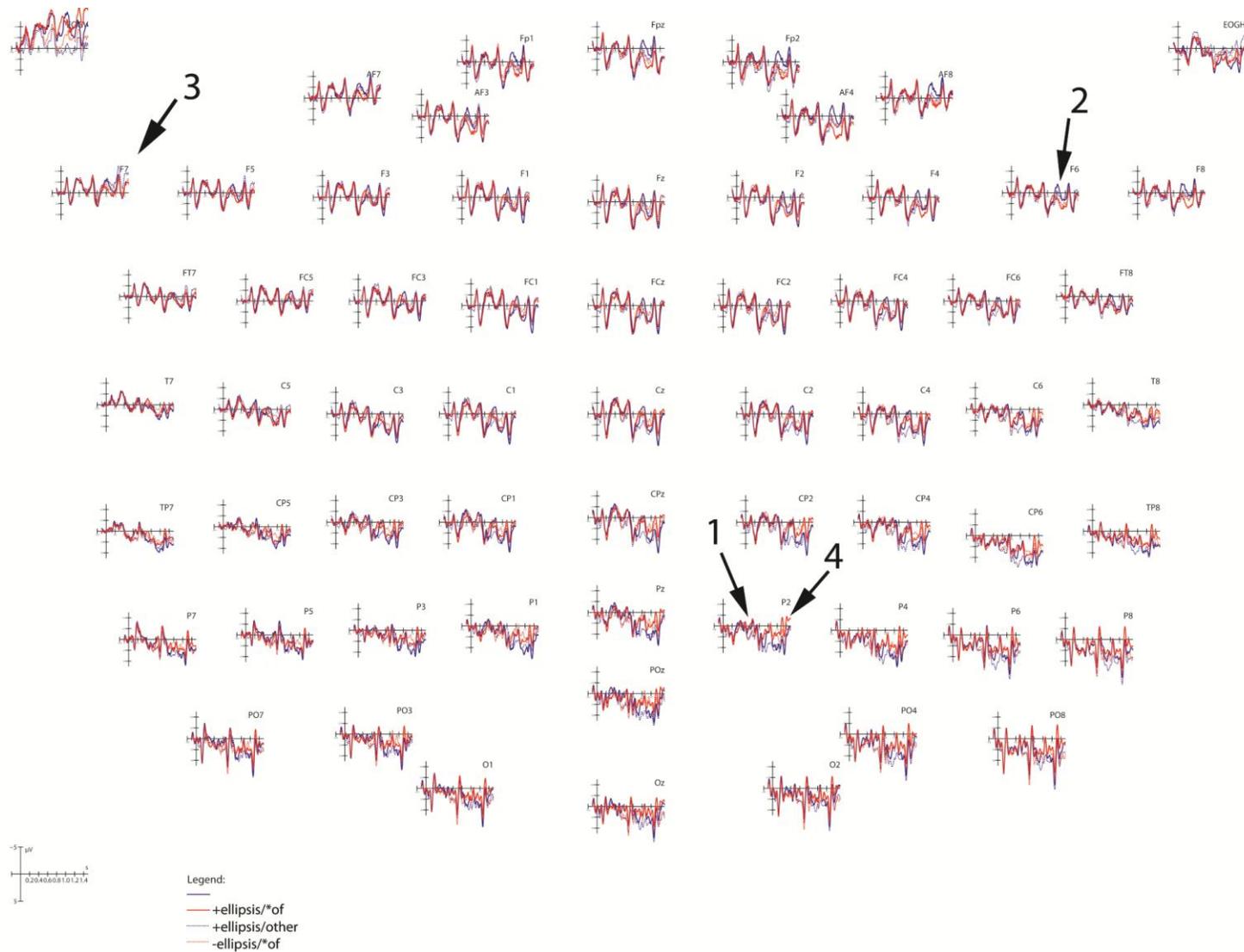


Figure 3-1. Overview of the grand averages of all four critical conditions across electrodes. Negative is up. Arrows indicate significant effects as reported directly above.

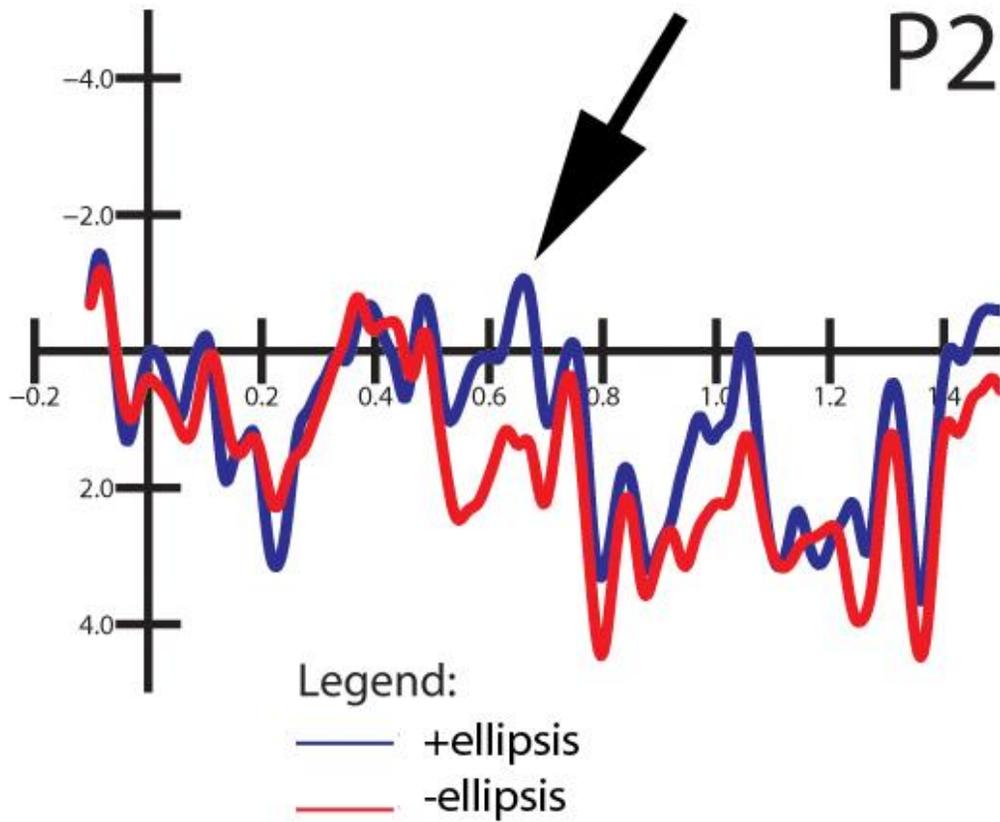


Figure 3-2. Grand averages of +ellipsis and –ellipsis conditions at electrode P2, collapsed over both levels of preposition. Negativity is plotted up. Arrow indicates significant negativity of +ellipsis conditions relative to –ellipsis conditions.

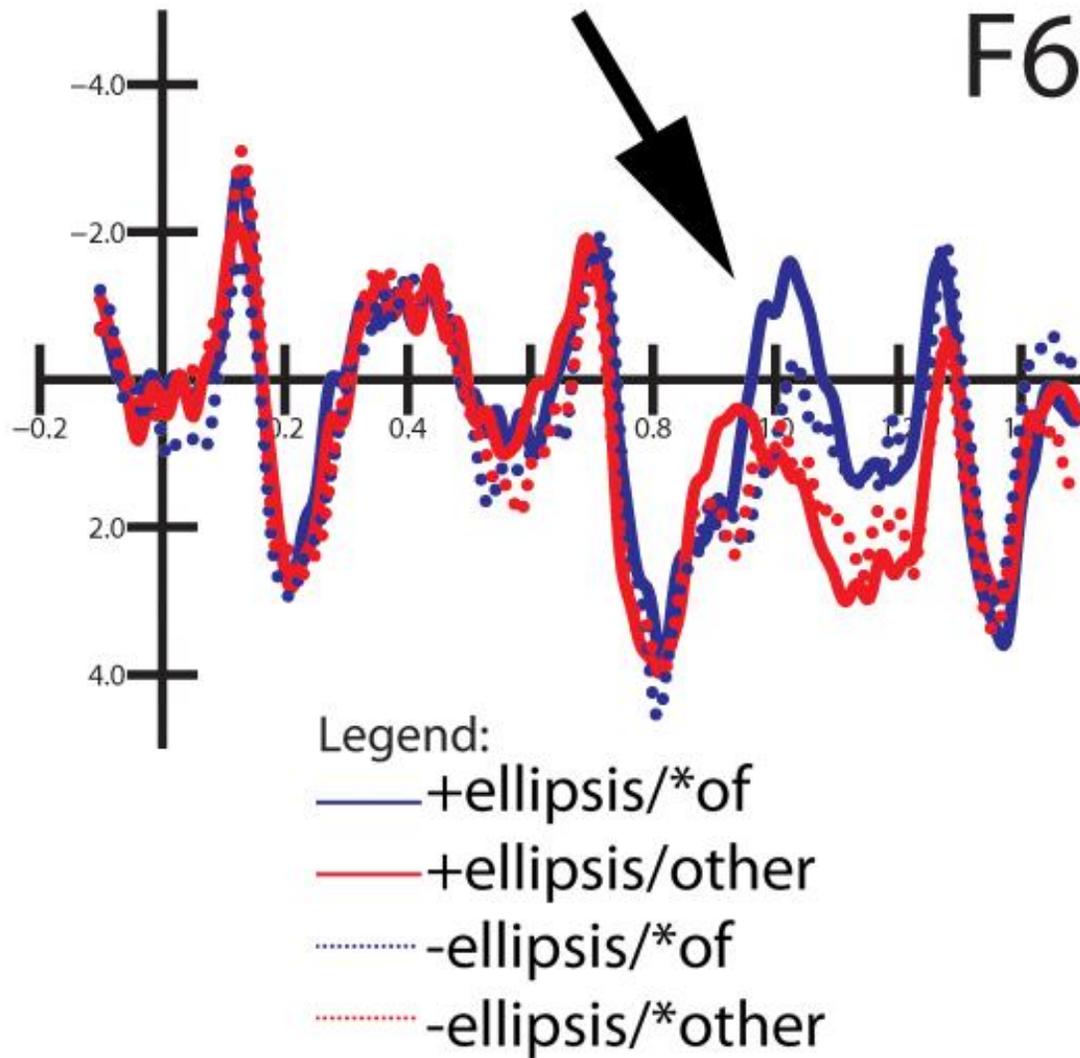


Figure 3-3. Grand averages of all four critical conditions at electrode F6. Negativity is plotted up. Arrow indicates significant negativity of +ellipsis/\*of relative to -ellipsis/\*of and -ellipsis/\*other.

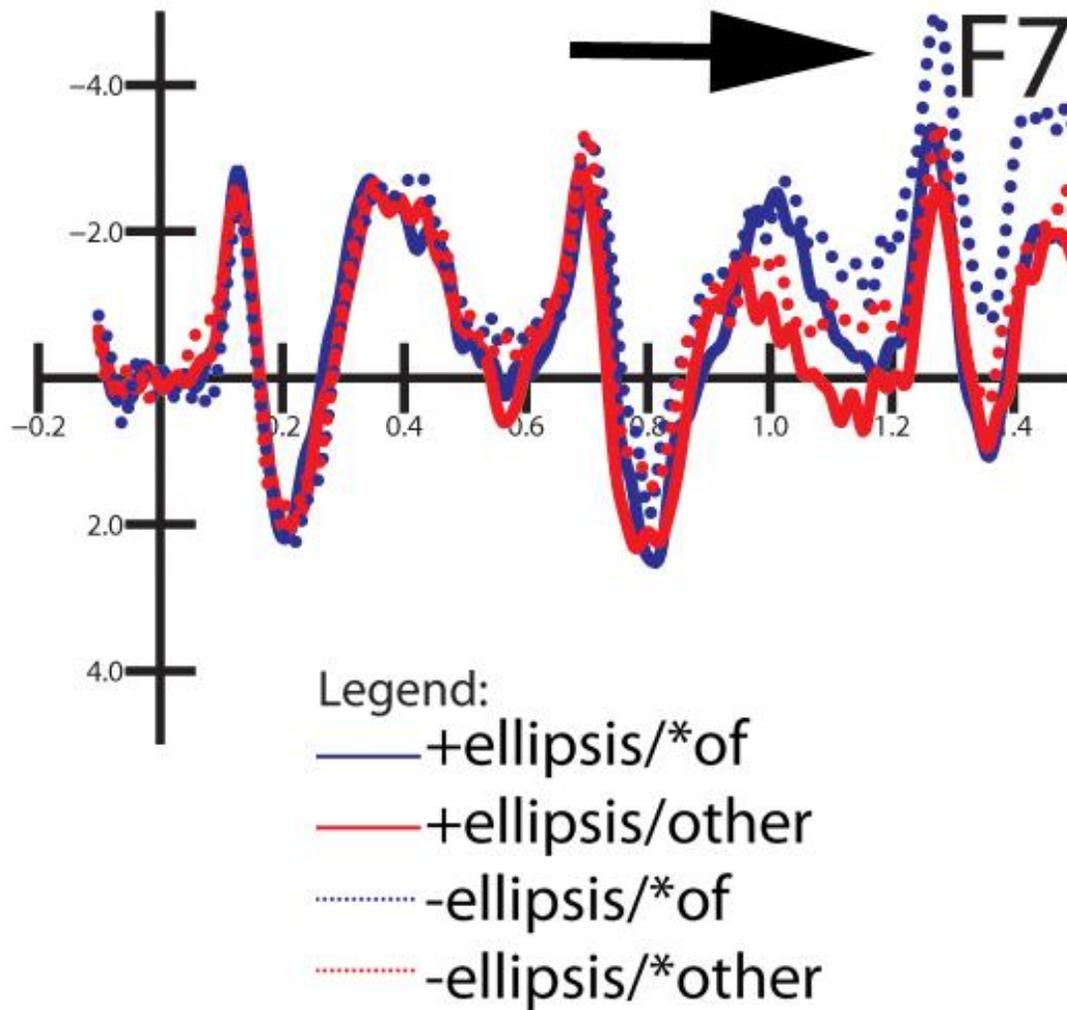


Figure 3-4. Grand averages of all four critical conditions at electrode F7. Negativity is up. Arrow indicates negativity of – ellipsis/\*of relative to all other critical conditions.

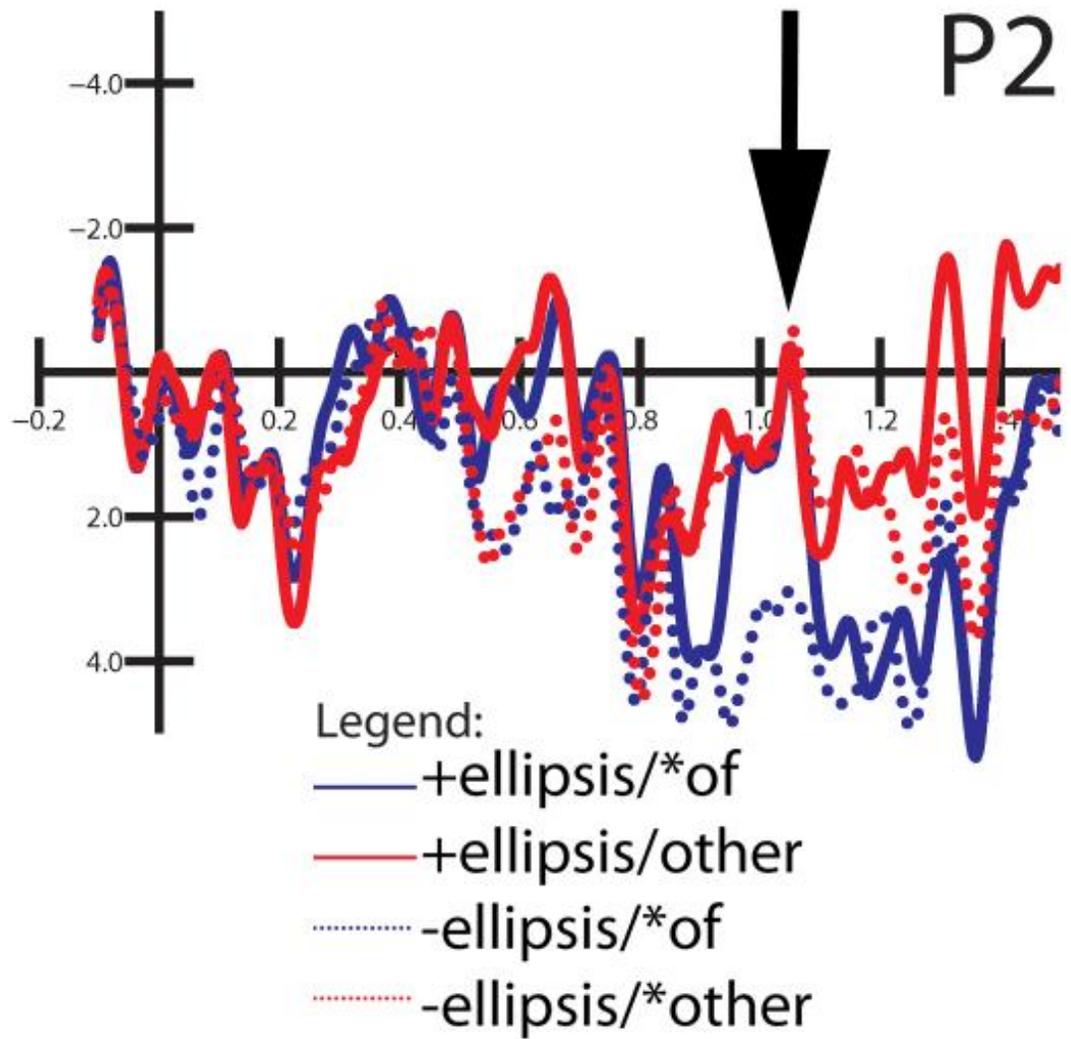


Figure 3-5. Grand averages of all conditions at electrode P2. Negativity is up. Arrow indicates positivity of all conditions relative to the grammatical condition +ellipsis/other.

### **300ms-500ms Time Window**

This time region is equivalent to the period from 200ms prior to the onset of the critical word to the onset of the critical word. As previously mentioned, analysis in this time window would shed light on whether ERP effects occurred prior to the critical word. A midline analysis of all conditions with factors six-level anteriority X preposition X ellipsis revealed no main effect of ellipsis  $F < 1$ , N.S. A lateral analysis of all conditions with factors five-level anteriority X hemisphere X preposition X ellipsis also found no main effect of ellipsis  $F < 1$ , N.S. The planned midline and lateral comparisons of the  $\pm$ ellipsis/\*of and the  $\pm$ ellipsis/(\*)other conditions revealed neither any main effect of ellipsis, nor any ellipsis interaction effects (all  $p$ s  $> .05$ ). Based on these results, there is no suspected difference between conditions prior to presentation of the critical word.

### **500ms-700ms Time Window**

This time region corresponds to the period from the onset of the critical word to 200ms after the onset of the critical word. The +ellipsis conditions elicited more negative ERPs, demonstrated by a main effect of ellipsis (midline  $F(1,19)=6.72$ ,  $p < .05$ , lateral  $F(1,19)=5.72$ ,  $p < .05$ ). This effect was strongest at parietal sites: the interaction of ellipsis X anteriority was significant at lateral sites  $F(4,19)=7.34$ ,  $p < .01$ . Because of special interest in this effect, separate analyses were conducted at each anterior region in each hemisphere. In the left hemisphere, there was a significant interaction of ellipsis X anteriority  $F(4,19)=6.18$ ,  $p < .001$ ; at individual anteriority regions in the left hemisphere, there was a significant effect of ellipsis centro-parietally  $F(1,19)=5.80$ ,  $p < .05$  and parietally  $F(1,19)=6.17$ ,  $p < .05$ . In the right hemisphere, there was a main effect of ellipsis  $F(1,19)=7.41$ ,  $p < .05$  and a significant interaction of ellipsis X anteriority  $F(4,19)=6.37$ ,  $p < .001$ ; at individual anteriority regions in the right hemisphere, there

was a significant effect of ellipsis fronto-centrally  $F(1,19)=4.68$ ,  $p < .05$ , centrally  $F(1,19)=7.15$ ,  $p < .05$ , centro-parietally  $F(1,19)=7.49$ ,  $p < .05$ , and parietally  $F(1,19)=10.25$ ,  $p < .01$ .

The planned midline and lateral comparisons of the  $\pm$ ellipsis/\*of conditions revealed a main effect of ellipsis that approached significance in the midline comparison  $F(1,19)=3.62$ ,  $p = .07$ , and no interactions involving ellipsis (all  $p$ s  $> .05$ ). The same effect of ellipsis was found for planned midline and lateral comparisons of the  $\pm$ ellipsis/\*other conditions  $F(5,19)=4.25$ ,  $p < .05$  and  $F(4,19)=7.13$ ,  $p < .01$ , respectively (strongest at parietal sites). Separate hemisphere analyses were also performed on the effect of ellipsis at each level of preposition. In the left hemisphere, analysis of the  $\pm$ ellipsis/\*other conditions revealed an interaction of ellipsis X anteriority  $F(4,19)=4.92$ ,  $p = .001$ ; there was no significant effect of ellipsis within  $\pm$ ellipsis/\*other at any individual level anteriority in the left hemisphere. In the right hemisphere, analysis of the  $\pm$ ellipsis/\*of conditions revealed a marginally significant effect of ellipsis  $F(1,19)=4.27$ ,  $p = .053$ . In the  $\pm$ ellipsis/\*other conditions, there was a significant interaction of ellipsis X anteriority  $F(4,19)=5.28$ ,  $p = .01$ ; at individual anterior regions in the right hemisphere, there was a significant effect of ellipsis parietally  $F(4,19)=6.71$ ,  $p < .05$ .

In sum, a strong effect of ellipsis was found, strongest at parietal sites and descriptively right-lateralized (note: no interaction of ellipsis X hemisphere was found). The effect was numerically stronger within the  $\pm$ ellipsis/\*of conditions. The significant findings regarding ellipsis in this window are the most relevant to the purpose of the study, and will be interpreted as the only effect unique to the ellipsis manipulation.

**Separate analyses by first two and last two blocks.** In the debriefing questionnaire, most participants reported noticing very early in the experiment (within the first two blocks) the regularity of grammaticality errors related to possessives and/or prepositions in the second clause. Additionally, some participants reported that fatigue may have affected their attention and performance, particularly in later blocks. To investigate potential effects of practice and/or fatigue effects as participants progressed through the ERP task, separate analyses were conducted on the first two blocks and the last two blocks. Because of the tenuous nature of other effects in this report, it was decided to only investigate the relevance of the first two and last two blocks in as they pertained to the ellipsis effect reported above. Note that because the analyses of first and last blocks only carry 25% of the number of trials per participant as the main analyses, they carry much less power and their results should be treated with heightened caution.

In the first two blocks, +ellipsis sentences elicited more negative ERPs than – ellipsis sentences, showing an interaction of ellipsis X anteriority along the midline  $F(4,19)=4.18$ ,  $p < .05$ . Within the preposition *of* (i.e., ±ellipsis/\*of), a main effect of ellipsis was found along the midline  $F(1,19)=4.25$ ,  $p = .053$  (marginal) and laterally  $F(1,19)=4.25$ ,  $p < .05$  (this WAS NOT significant in the analysis of all blocks). In addition, a significant interaction of ellipsis X anteriority was also found along the midline  $F(5,19)=3.93$ ,  $p < .05$  (this was NOT significant in the analysis of all blocks) and laterally  $F(4,19)=10.37$ ,  $p = .001$  (this was NOT significant in the analysis of all blocks).

Based on these analyses, it appears that in the first two blocks the overall effect of ellipsis roughly the same, based on test results that were significant even with low

power. However, it appears this effect was stronger in the  $\pm$ ellipsis/\*of conditions in the first two blocks than in all blocks, as this comparison was found to be significant in the first two blocks whereas it was not found to be a significant factor in the analyses of all blocks.

In the last two blocks, there were no effects or interactions of ellipsis (all  $p$ s > .05), neither across all conditions or within individual levels of preposition. Based on these results, it appears that the ellipsis effect overall and within prepositions was entirely missing from the final two blocks.

### **600ms-800ms Time Window (ELAN Region)**

This time window corresponds to the period from 100ms-300ms after the onset of the critical word to 500ms after the onset of the critical word. This time window is where ELAN effects are typically found. The +ellipsis sentences elicited more negative ERPs than –ellipsis sentences, as demonstrated by a significant interaction of ellipsis X anteriority along the midline  $F(5,19)=3.04$ ,  $p < .05$  and along lateral sites  $F(4,19)=8.49$ ,  $p < .001$ . Because these findings were related to the ellipsis effect discussed in-depth in the previous window, no further investigations were made into these interactions.

Because there was also interest in the possibility of an ELAN effect, the left-frontal region (F3, F5, and F7) was probed in planned comparisons. There were no interesting effects or interactions of ellipsis overall or in separate comparisons restricted to either the  $\pm$ ellipsis/\*of conditions or the  $\pm$ ellipsis/(\*)other conditions (all  $p$ s > .05). Additionally, no ELAN effect was found in the comparison between the +ellipsis/\*of and +ellipsis/other conditions ( $F$ s < 1, NS) where word category violations have been found to elicit ELANs (Hahne and Friederici, 1999).

### 800ms-1000ms Time Window (LAN Region)

This time window corresponds to the period from 300ms after the onset of the critical word to 500ms after the onset of the critical word. This region is of particular interest because the ELAN effect reported by Lau et al. (2006) occurred in this window. A midline analysis of all conditions revealed only an effect of preposition  $F(1,19)=4.81$ ,  $p < .05$  (*of* more positive than *other*), but no effect of ellipsis  $F < 1$ , N.S. A lateral analysis also found an effect of preposition  $F(1,19)=4.38$ ,  $p = .05$ , but again no effect of ellipsis  $F < 1$ , N.S. However, an interaction of ellipsis X hemisphere was found  $F(1,19)=6.01$ ,  $p < .05$  (+ellipsis more negative over the right hemisphere). The planned midline analysis of the ±ellipsis/\*of conditions found no main effect of ellipsis  $F < 1$ , N.S, but the lateral analysis of these conditions revealed an interaction of ellipsis X hemisphere  $F(1,19)=8.07$ ,  $p = .01$  (again, +ellipsis more negative over the right hemisphere).

The preposition finding warranted further investigation, so two additional analyses were performed: the +ellipsis/\*of condition vs. the +ellipsis/other condition, and the -ellipsis/\*of condition vs. the -ellipsis/\*other condition. The +ellipsis prepositional midline and lateral analyses revealed no significant findings (all  $ps > .05$ ). In the –ellipsis prepositional analyses, -ellipsis/\*of elicited more positive ERPs than –ellipsis/\*other over the right hemisphere, as a significant preposition X hemisphere interaction was found  $F(1,19)=5.66$ ,  $p < .05$ . Notably, upon visual inspection of the right-hemisphere central-parietal and parietal regions, the –ellipsis/of condition appeared to be more positive than all other conditions (the tests confirming that it is significantly more positive than +ellipsis/\*of and –ellipsis/other have already been mentioned). To investigate the –ellipsis/of relation to +ellipsis/other, separate midline and lateral analyses were performed restricted to these two conditions; a condition X hemisphere interaction was

found in the lateral analysis  $F(1,19)=13.26$ ,  $p < .01$  (*-ellipsis/\*of* more positive than *+ellipsis/other*, strongest at centro-parietal sites).

Because Lau et al. (2006) found a significant difference in the  $\pm$ ellipsis/\*of conditions left-frontally, data from the left-frontal region were also probed in planned comparisons. An analysis of the F3, F5, and F7 region revealed no significant effects or interactions involving ellipsis (all  $ps < .05$ ). The planned comparison of the  $\pm$ ellipsis/\*of conditions found no significant effect or interaction involving ellipsis, and neither did a comparison of the  $\pm$ ellipsis/(\*)other conditions (all  $ps > .05$ ). From these results, there was no evidence of a negativity effect in the LAN time region.

### **900ms-1100ms Time Window**

This time window corresponds to the period from 400ms after the onset of the critical word to 600ms after the onset of the critical word. This window was chosen because of a perceived negativity for *+ellipsis/\*of* over *-ellipsis* conditions located right-centrally/frontally in this window. More specifically, the *+ellipsis/\*of* condition appeared to be more negative than other conditions right-fronto-centrally. A significant preposition X anteriority interaction was found along the midline  $F(5,19)=7.69$ ,  $p < .01$  and laterally  $F(4,19)=13.19$ ,  $p < .001$  (a polarity dichotomy was present here: *of* more positive than *other*, strongest at parietal sites, and related to an effect investigated more thoroughly in the 1000ms-1200ms section below; however, *of* more negative than *other*, strongest at frontal sites, relevant for the visually-inspect effect right-centrally/frontally). Relevant for the visually-inspected effect that inspired investigation of this time window, the lateral analysis across conditions also showed an interaction of ellipsis X hemisphere  $F(1,19)=7.85$ ,  $p < .05$  (*+ellipsis* more negative than *-ellipsis*, strongest at central-parietal

sites) and a three-way interaction of ellipsis X anteriority X hemisphere  $F(4,19)=3.61$ ,  $p < .05$ .

To further investigate this three-way interaction, each hemisphere was tested separately by anterior regions for ellipsis effects. No significant differences involving ellipsis were found over either hemisphere (all  $p$ s  $> .05$ ). However, given the grammaticality confound present in the comparisons, separate analyses were conducted in each hemisphere for the  $\pm$ ellipsis/\*of conditions and the  $\pm$ ellipsis/(\*)other conditions. The only significant finding in these tests was a right-hemisphere main effect of ellipsis  $F(1,19)=8.25$ ,  $p = .01$  (+ellipsis/\*of more negative than -ellipsis/\*of) in the  $\pm$ ellipsis/\*of comparison. This finding is related to a negativity of -ellipsis/\*of parietally, which will be investigated more thoroughly in the next time window. To further investigate the visually-inspected frontal positivity of +ellipsis/\*of, further comparisons were made between the  $\pm$ ellipsis/(\*)other conditions. In the +ellipsis/\*of vs. +ellipsis/other analysis a highly significant interaction of condition X anteriority was found  $F(1,19)=16.98$ ,  $p < .001$  (+ellipsis/\*of more negative than +ellipsis/other, strongest at F8). At individual levels of anteriority, there was a significant effect of condition right-frontally  $F(1,19)=5.42$ ,  $p < .05$  (+ellipsis/\*of more negative than +ellipsis/other, strongest at frontal regions). In the +ellipsis/\*of vs. -ellipsis/other comparison, a marginally significant interaction of condition X anteriority was found was found  $F(4,19)=3.58$ ,  $p = .054$  (+ellipsis/\*of more negative than -ellipsis/\*other, strongest at frontal sites). At individual levels of anteriority in the right hemisphere, a significant interaction of condition X electrode was found frontally  $F(3,19)=3.19$ ,  $p < .05$ ; a significant effect of condition was found at F6  $F(1,19)=5.59$ ,  $p < .05$ . In sum, +ellipsis/\*of was found to be

more negative than all other three critical conditions over the right hemisphere, particularly frontally (though this effect is not statistically as strong between +ellipsis/\*of vs. –ellipsis/other).

### **1000ms-1200ms Time Window (P600 Region)**

This time window corresponds to the period from 500ms after the onset of the critical word to 700ms after the onset of the critical word. This is the typical time window for the P600 effect. A significant preposition X anteriority interaction was found in both the overall midline analysis  $F(5,19)=11.84$ ,  $p < .001$  and the lateral analysis  $F(4,19)=18.15$ ,  $p < .001$  (a polarity dichotomy is present here: *of* more positive than *other*, strongest at parietal sites; and *of* more negative than *other*, strongest at right frontal sites). In addition, a significant ellipsis X hemisphere interaction  $F(4,19)=5.14$ ,  $p < .05$  (+ellipsis more positive than –ellipsis, strongest at right frontal sites), and a significant three way prepositional X hemisphere X anteriority interaction  $F(4,19)=6.84$ ,  $p = .001$  were found in the lateral analyses.

The three-way preposition interaction merited follow-up tests. Each hemisphere was tested separately by anterior regions for preposition effects. In the left hemisphere, there was a significant interaction of preposition X anteriority  $F(4,19)=5.80$ ,  $p < .05$  (*of* more positive than *other*). Separate analyses of each anteriority level were conducted in the left hemisphere. Only the analysis of the left parietal region (electrodes P1, P3, P5, and P7) yielded any interesting result, a marginally significant interaction of preposition X electrode  $F(3,19)=3.18$ ,  $p = .06$  (*of* more positive than *other*, strongest at P1). By individual electrodes in this region, the effect of preposition was significant at P1  $F(1,19)=4.70$ ,  $p < .05$ . Because of the grammaticality confound, separate analyses were also conducted by region between the +ellipsis/\*of and +ellipsis/other and –ellipsis/of

and –ellipsis/other conditions. In the frontal region, the –ellipsis/of/other comparison showed a significant effect of preposition X electrode  $F(3,19)=3.92$ ,  $p < .05$  (-ellipsis/\*of more negative than –ellipsis/\*other), but preposition was not significant at any individual electrode site in this region (all  $ps > .05$ ). There were no other significant findings in the left hemisphere. In the right hemisphere, an analysis of all conditions again revealed a highly significant preposition X anteriority interaction  $F(4,19)=35.68$ ,  $p < .001$  (a polar dichotomy was present here: *of* more positive than other, strongest at P2; *of* more negative than other, strongest at F6). Separate analyses of each anteriority level were conducted in the right hemisphere. Right-frontally, there was a significant effect of preposition  $F(1,19)=4.80$ ,  $p < .05$  (*of* more negative than other, strongest at F6). Right-centrally, there was a significant three-way interaction of preposition X ellipsis X electrode  $F(3,19)=3.74$ ,  $p < .05$ . Based on visual inspection, the ellipsis effect was deemed to be related to the negativity in the same region investigated in the last window, so for simplicity any effects related to ellipsis were ignored. Centro-parietally, there was a significant effect of preposition  $F(1,19)=6.73$ ,  $p < .05$  (*of* more negative than other, strongest at CP2). The same effect of preposition was found parietally  $F(1,19)=7.85$ ,  $p < .05$  (*of* more negative than other, strongest at P2). Again owing to the grammaticality confound, separate analyses within this hemisphere were conducted between preposition conditions within each level of ellipsis. In the +ellipsis/\*of/other comparisons, a significant interaction of preposition X anteriority was found  $F(4,19)=29.80$ ,  $p < .001$ . In analyses separated by region, a significant effect of preposition was found only frontally  $F(1,19)=5.42$ ,  $p < .05$  (+ellipsis/\*of more negative than +ellipsis/other, strongest at F8). In the –ellipsis/of/other comparison across the

entire right hemisphere, a marginally significant effect of preposition was found  $F(1,19)=3.93$ ,  $p = .06$  (with –ellipsis/of more positive than +ellipsis/other, strongest at CP2), and an interaction of preposition X anteriority  $F(4,19)=16.01$ ,  $p < .001$  was also found. In individual anterior regions, a main effect of preposition was found right-centrally  $F(1,19)=4.79$ ,  $p < .05$  (-ellipsis/\*of more positive than -ellipsis/\*other, strongest at C2), centro-parietally  $F(1,19)=8.96$ ,  $p < .01$  (-ellipsis/\*of more positive than –ellipsis/other, strongest at CP2), and parietally  $F(1,19)=5.91$ ,  $p < .05$  (-ellipsis/\*of more positive than –ellipsis/other, strongest at P2). Additionally, significant interactions of preposition X electrode were found central-parietally  $F(3,19)=4.95$ ,  $p < .05$  and parietally  $F(3,19)=5.52$ ,  $p < .01$ . At individual electrodes in these regions, -ellipsis/\*of was significantly more positive than –ellipsis/other at CP2  $F(1,19)=9.86$ ,  $p < .01$ , CP4  $F(1,19)=8.67$ ,  $p < .01$ , CP6  $F(1,19)=8.45$ ,  $p < .01$ , TP8  $F(1,19)=5.73$ ,  $p < .05$ , P2  $F(1,19)=7.97$ ,  $p < .05$ , (marginally) P4  $F(1,19)=4.35$ ,  $p = .051$ , P6  $F(1,19)=9.01$ ,  $p < .01$ , and P8  $F(1,19)=6.69$ ,  $p < .01$ .

In the planned midline and lateral analyses of the ±ellipsis/\*of and ±ellipsis/(\*)other conditions, the only significant finding was an interaction of ellipsis X hemisphere  $F(1,19)=6.65$ ,  $p < .05$  (+ellipsis/\*of more negative than +ellipsis/other, strongest at C2) in the lateral ±ellipsis/\*of analysis. Based on visual inspection, this effect was deemed related to the effect investigated with more intensity in the previous time window.

### **1300ms-1500ms Time Window**

This window corresponds to the period from 800ms after the onset of the critical word to 1000ms after the onset of the critical word. This time window was analyzed for two apparent effects based on visual inspection: apparent posterior positivities for all

conditions relative to +ellipsis/other, and left-frontal negativities for all conditions relative to -ellipsis/\*of. An interaction of preposition X anteriority was marginally significant along midline sites  $F(5,19)=3.26$ ,  $p = .053$  and was significant at lateral sites  $F(4,19)=4.56$ ,  $p < .05$  (*of* more positive than *other*, strongest at centro-parietal sites). A significant interaction of ellipsis X anteriority that approached significance in the midline analysis  $F(5,19)=2.64$ ,  $p = .067$  and was significant in the lateral analysis  $F(4,19)=6.03$ ,  $p < .05$  (a polar dichotomy is present here: -ellipsis more positive than +ellipsis, strongest at parietal sites, but -ellipsis more negative than +ellipsis, strongest at frontal sites). There was also an additional interaction of ellipsis X hemisphere  $F(1,19)=7.66$ ,  $p < .05$ .

Because of the inherent grammaticality confound, separate analyses were conducted on the component individual condition comparisons of the ellipsis and preposition factors (i.e., within ellipsis:  $\pm$ ellipsis/\*of and  $\pm$ ellipsis/(\*)other; within preposition: +ellipsis/\*of vs. +ellipsis other and -ellipsis/of vs. -ellipsis/other). In the ellipsis comparisons,  $\pm$ ellipsis/\*of analyses found an interaction of ellipsis X hemisphere that approached significance  $F(1,19)=3.95$ ,  $p = .062$  (+ellipsis/\*of more positive than -ellipsis of, strongest at F7) in the lateral analysis. In the  $\pm$ ellipsis/(\*)other analyses, there was a significant interaction of ellipsis X anteriority in the midline analysis  $F(5,19)=3.68$ ,  $p < .05$  (a polar dichotomy was present here: -ellipsis/\*other more positive than +ellipsis/other, strongest at P6; but +ellipsis/other more positive than -ellipsis/other, strongest at Fz), and the same interaction was found in the lateral analysis  $F(4,19)=5.99$ ,  $p = .01$ . In the preposition comparisons, the +ellipsis/\*of vs. +ellipsis/other midline and lateral comparisons found an interaction of preposition X anteriority  $F(5,19)=5.01$ ,  $p < .01$  and  $F(4,19)=4.50$ ,  $p < .05$ , respectively (+ellipsis/\*of more positive

than +ellipsis/other, strongest at P2). The –ellipsis/of vs. –ellipsis/other analyses found no significant effects (all  $p$ s > .05).

These initial analyses confirmed the suspected effects, but in order to establish whether the components were indeed specific to the specified conditions, further relevant analyses were made between conditions. Significant differences were already reported between all (relevant) conditions except the relationship between +ellipsis/other and –ellipsis/of has not yet been established. Both midline and lateral analyses showed significant effects of condition X anteriority  $F(5,19)=6.18$ ,  $p < .01$  and  $F(4,19)=11.04$ ,  $p = .001$  (a polar dichotomy was present here: -ellipsis/\*of more positive than +ellipsis/other, strongest at P2, relevant for the posterior positivity; -ellipsis/\*of more negative than +ellipsis/other, strongest at F7, relevant for the frontal negativity). The lateral analysis also showed an interaction of condition X hemisphere  $F(1,19)=15.58$ ,  $p = .001$  and a three-way interaction of condition X anteriority X hemisphere  $F(4,19)=4.16$ ,  $p < .05$ . This interaction merited follow-up analyses within each hemisphere.

The reported left-hemisphere effects in this paragraph are relevant for the suspected left-frontal negativity. In the left hemisphere, a significant interaction of condition X anteriority was found  $F(4,19)=5.08$  (-ellipsis/\*of more negative than +ellipsis/other, strongest at F7). At individual levels of anteriority, there was a marginally significant interaction of condition X electrode left-frontally  $F(1,19)=2.94$ ,  $p = .057$  (-ellipsis/\*of more negative than +ellipsis/other, strongest at F7). Within this region, -ellipsis/\*of was found to be more negative than +ellipsis/other at F7, but this effect only

approached significance  $F(1,19)=3.85$ ,  $p = .065$ . This tenuously confirms the negativity of –ellipsis/of relative to all other conditions left-frontally.

In the right hemisphere, a highly significant interaction of condition X anteriority was found  $F(4,19)=16.00$ ,  $p < .001$  (strongest at parietal sites). At individual levels of anteriority, a significant effect of condition was found centro-parietally  $F(1,19)=5.34$ ,  $p < .05$  (-ellipsis/\*of more positive than +ellipsis/other, strongest at CP2) and parietally  $F(1,19)=6.01$ ,  $p < .05$  (strongest at P2). This confirms the posterior positivity of all conditions relative to +ellipsis/other, biased slightly to the right hemisphere.

Table 3-1. Summary of major ERP results. For simplicity, only lateral analyses are included. Values indicate p-values; NS=not significant, MS=marginally significant, AS=approaches significance, X=test not applicable.

| Test Parameters                | Ellipsis  | Preposition | Prep. X Ant. | Ell. X Hemi. | Ell. X Ant.  | Prep. X Hemi. X Ant. |
|--------------------------------|-----------|-------------|--------------|--------------|--------------|----------------------|
| 300-500 (all conditions)       | NS        | NS          | NS           | NS           | NS           | NS                   |
| 500-700 (all conditions)       | <.05      | NS          | NS           | NS           | <.01         | NS                   |
| 500-700 ( $\pm$ Ell/*of)       | NS        | X           | X            | NS           | NS           | X                    |
| 500-700 ( $\pm$ Ell/*)other)   | NS        | X           | X            | NS           | <.01         | X                    |
| 600-800 (all conditions)       | MS (0.56) | NS          | NS           | NS           | <.01         | NS                   |
| 600-800 ( $\pm$ Ell/*of)       | NS        | X           | X            | NS           | AS (GG .066) | X                    |
| 600-800 ( $\pm$ Ell/*)other)   | NS        | X           | X            | NS           | <.01         | X                    |
| 800-1000 (all conditions)      | NS        | 0.05        | NS           | <.05         | NS           | NS                   |
| 800-1000 ( $\pm$ Ell/*of)      | NS        | X           | X            | 0.01         | NS           | X                    |
| 800-1000 ( $\pm$ Ell/*)other)  | NS        | X           | X            | NS           | NS           | X                    |
| 900-1100 (all conditions)      | NS        | NS          | <.001        | <.05         | NS           | <.05                 |
| 900-1100 ( $\pm$ Ell/*of)      | MS (.055) | X           | X            | <.005        | NS           | X                    |
| 900-1100 ( $\pm$ Ell/*)other)  | NS        | X           | X            | NS           | NS           | X                    |
| 1000-1200 (all conditions)     | NS        | NS          | <.001        | <.05         | NS           | 0.001                |
| 1000-1200 ( $\pm$ Ell/*of)     | NS        | X           | X            | <.05         | NS           | X                    |
| 1000-1200 ( $\pm$ Ell/*)other) | NS        | X           | X            | NS           | NS           | X                    |

## **Ellipsis-Related ERP Correlations with Behavioral Data**

Because of the tenuous nature of later effects in the main analyses, it was decided to only investigate the correlations in this window as they pertained to the ellipsis effect found in the 500ms-700ms time window. Recall that an ellipsis main effect and an ellipsis X anteriority interaction were found across all conditions and that the greatest difference was found, numerically, at P6. For this reason, P6 was chosen as the electrode to correlate with several behavioral measures. Correlations were made with the differences between the average amplitude means of the differences +ellipsis minus –ellipsis, +ellipsis/\*of minus –ellipsis/\*of, and +ellipsis/other minus –ellipsis/other. The behavioral measures included the measures from the LEAP-Q, C-Test, working memory reversed-digit-span task, Stroop task, and ERP grammaticality judgment task (as reported in the Behavioral Results section of this chapter). As mentioned earlier, one participant was excluded from Stroop analyses and one participant was excluded from C-Test analyses. Because there were specific predictions regarding the directionality of correlations, all correlations were calculated using one-tailed tests. Notably, reversed-digits scores did not significantly correlate with any ellipsis effect at any electrode. It can only be ascertained that the working memory-related cognitive factors measured by the reversed-digits task are not related to the linguistic processes responsible for the ellipsis component.

### **Correlations with ±ellipsis Effect**

The findings at the P6 electrode were: a strong negative correlation with the composite English self-rating score  $r = -.521$ ,  $p < .01$  (Figure 3-6), and a positive correlation with +ellipsis/other accuracy  $r = .471$ ,  $p < .05$  (Figure 3-7).

### **Correlations with $\pm$ ellipsis/\*of Effect**

The findings at the P6 electrode were: a strong negative correlation with the composite English self-rating score  $r = -.590$ ,  $p < .01$  (Figure 3-8), a strong negative correlation with +ellipsis/\*of accuracy,  $r = -.543$ ,  $p < .01$  (Figure 3-9), a strong positive correlation with +ellipsis/other accuracy  $r = .552$ ,  $p < .01$  (Figure 3-10), and a strong positive correlation with Stroop effect  $r = .515$ ,  $p < .05$  (Figure 3-11).

### **Correlations with $\pm$ ellipsis/(\*)other Effect**

There were no significant correlations at this electrode (all  $ps > .05$ ).

### **Summary of ERP Correlations**

Self-ratings of English proficiency correlated strongly with the ellipsis effect 500ms-700ms after the onset of the pre-critical word. The nature of the correlation is such that the ellipsis component is larger for people who rated themselves as more proficient in English proficiency. Though overall accuracy on the grammaticality judgment task did not correlate with the ellipsis component, the accuracy in the +ellipsis/\*of and +ellipsis/other conditions did correlate with the ellipsis effect. The more accurate participants were in the +ellipsis/\*of condition, the stronger the ellipsis effect. Accuracy in the +ellipsis/other condition showed the opposite pattern: the less accurate subjects were in the +ellipsis/other condition, the stronger the ellipsis effect. Finally, performance on the Stroop task correlated with the ellipsis effect; the smaller the Stroop effect, the stronger the ellipsis effect.

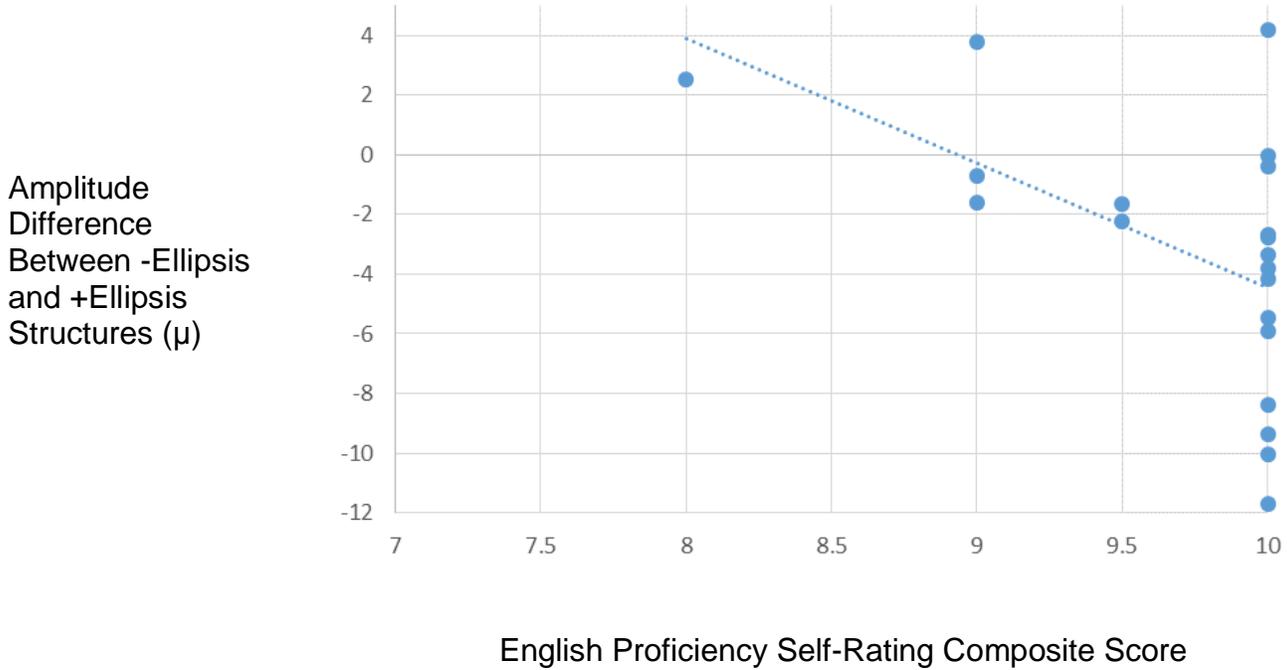


Figure 3-6. Correlation between participant English proficiency self-rating composite score and ellipsis effect across conditions;  $r = -.521$  ( $n=20$ ).

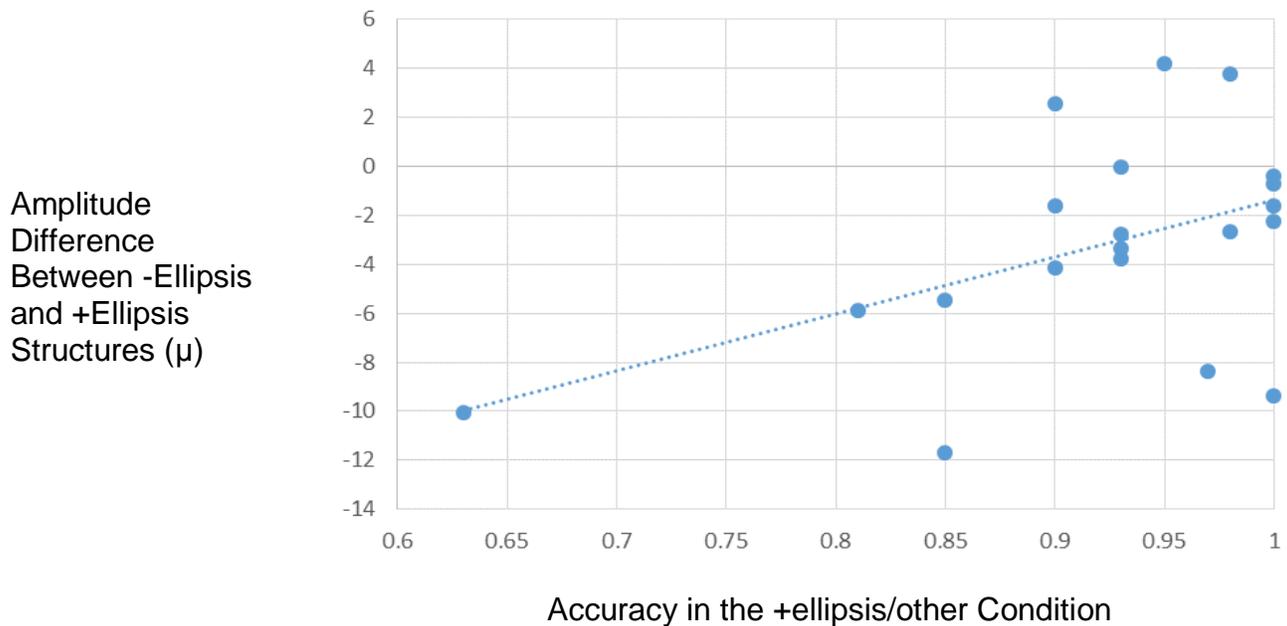


Figure 3-7. Correlation between accuracy in the +ellipsis/other condition in the grammaticality judgment task and ellipsis effect across conditions;  $r = .471$  ( $n=20$ ).

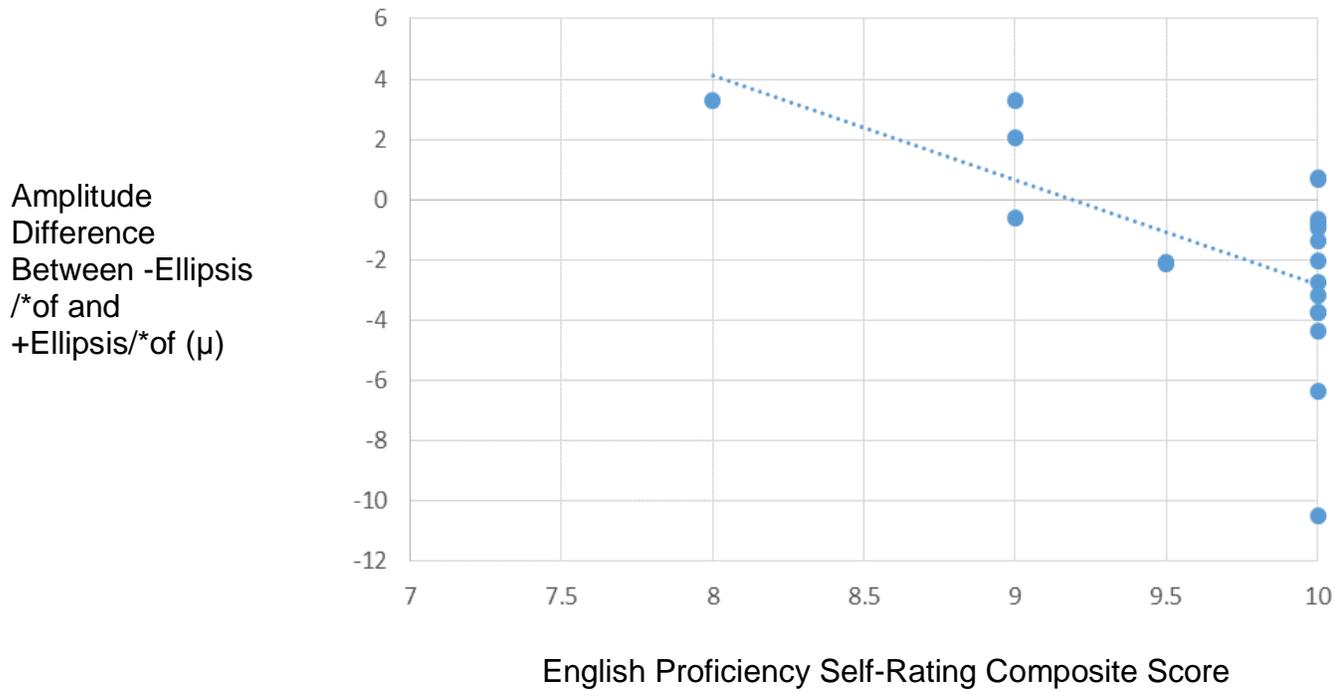


Figure 3-8. Correlation between participant English proficiency self-rating composite score and ellipsis effect within the preposition of,  $r = -.590$  ( $n=20$ ).

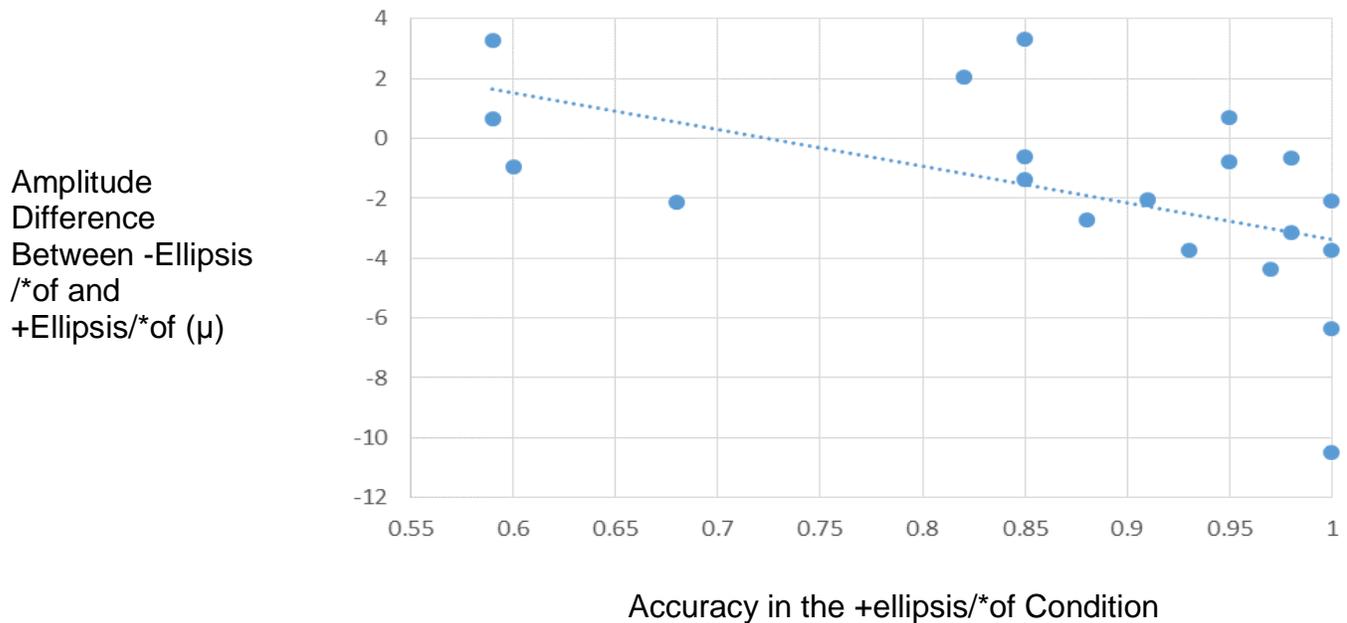
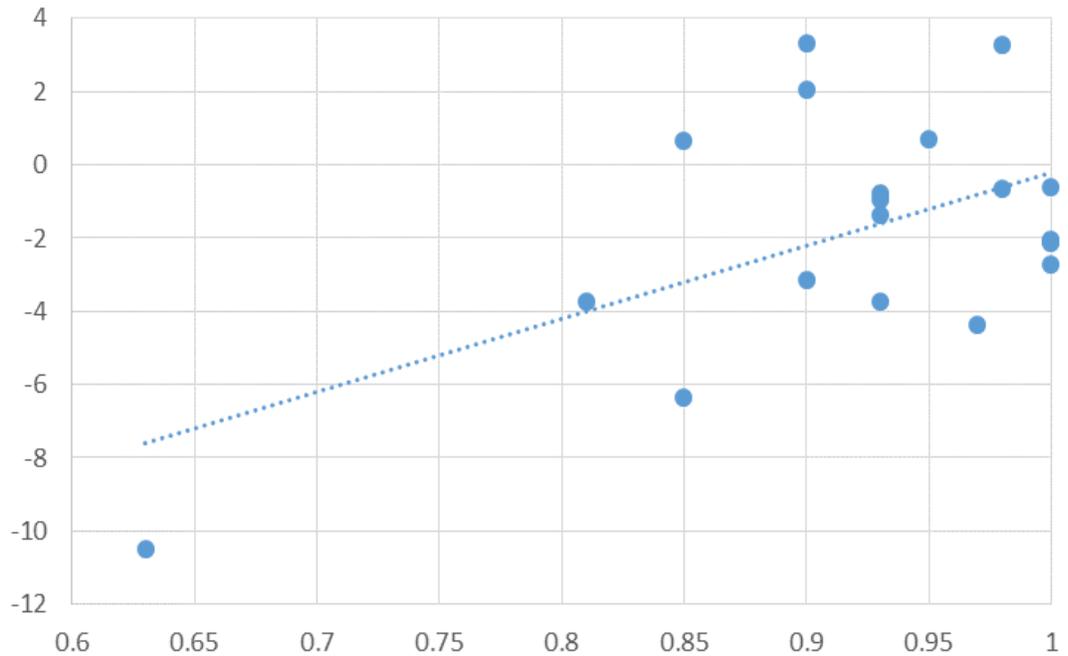


Figure 3-9. Correlation between accuracy in the +ellipsis /\*of condition in the grammaticality judgment task and ellipsis effect across conditions;  $r = -.543$  ( $n=20$ ).

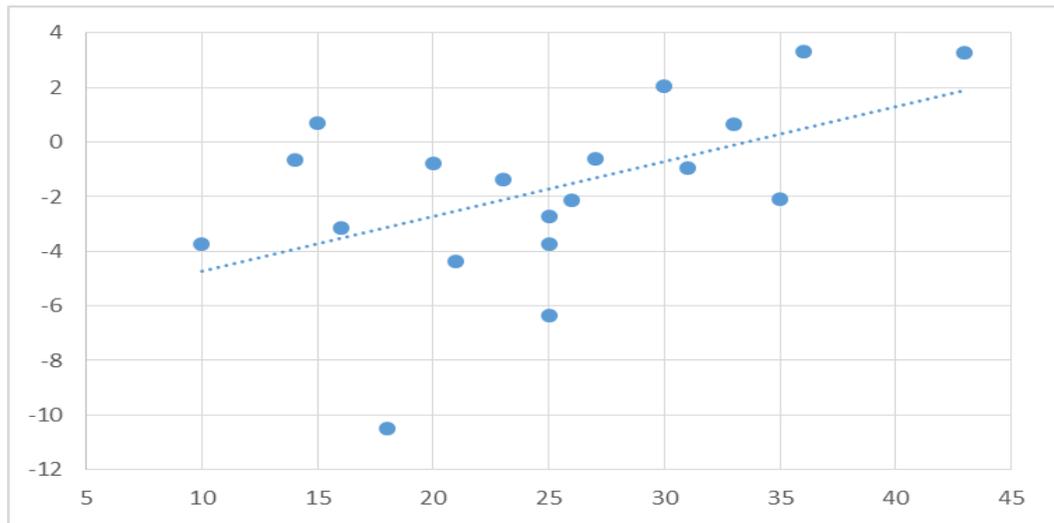
Amplitude  
Difference  
Between -Ellipsis  
/\*of and  
+Ellipsis/\*of ( $\mu$ )



Accuracy in the +ellipsis/other Condition

Figure 3-10. Correlation between accuracy in the +ellipsis/\*of condition in the grammaticality judgment task and ellipsis effect across conditions;  $r = .552$  ( $n=20$ ).

Amplitude  
Difference  
Between -Ellipsis  
/\*of and  
+Ellipsis/\*of ( $\mu$ )



Stroop Effect (seconds)

Figure 3-11. Correlation between the Stroop effect and ellipsis effect across conditions;  $r = .515$  ( $n=19$ ).

## CHAPTER 4 DISCUSSION AND CONCLUSIONS

Recall that the objectives of the current study were: a) To investigate a predictive language process using ERPs b) To investigate any prediction-related effect's relation with language proficiency c) To investigate any prediction-related effect's relation with cognitive factors.

### **ERP Findings**

Discussion of the ERP findings will be divided into sections regarding each of the four main areas of interest mentioned at the beginning of the ERP Results section in Chapter 3.

#### **Lack of (E)LAN**

Contrary to Lau et al. (2006), there was no significant finding regarding a LAN effect modulated by ellipsis. Hence, the experimental prediction for a significant LAN effect was not borne out. This is not very surprising, however, given the aforementioned atypical ERP post-processing procedures used in Lau et al. (2006) that elicited the LAN effect. The current study's lack of a LAN effect is consistent with the findings of Lau et al. (2006) using typical post-processing procedures. Given these findings, it appears that the (E)LAN component found in other studies is not sensitive to the crucial differences between the critical conditions. Any future investigations of syntactic prediction should not utilize this ellipsis- and word-category violation-based experimental paradigm with the intention of testing for a LAN component.

#### **Centro-Parietal Ellipsis Effect at the Presentation of the Critical Word**

Despite the lack of an ellipsis-based LAN effect, there was indeed a component modulated by ellipsis. This effect occurred 500ms-700ms after the onset of the word

prior to the critical word, which corresponds to the period from onset of the critical word to 200ms after the onset of the critical word (Figures 3-2, 3-3, and 3-4). An overall effect of ellipsis was found, focused in central-parietal and parietal regions, with a bias toward the right hemisphere. Because this is an effect related to the crucial ellipsis manipulation (intended to alter predictability of the target position), it could be interpreted as a component that indexes prediction. It occurs extremely rapidly, peaking about 50ms-100ms after the presentation of the critical word. The extreme rapidity of this component is potentially explicable as an effect of a prediction incongruous with a word-category violation: in the –ellipsis structures, after encountering the pre-critical possessive, a noun (or, at least, a DP structure) is heavily predicted. Upon encountering the preposition \*of, the realized word is compared with the predicted word, and the mismatch results in a positivity in the –ellipsis conditions. In a garden-pathing study of temporarily syntactically-ambiguous structures by Osterhout et al. (1994), a similar ambiguous word. In this study, the authors manipulated the scope of subcategorization frames by including or omitting the complementizer. For example, participants were presented sentences such as “The lawyer charged (that) the defendant was guilty”, where *that* was included in half of the sentences but not the other half. The rationale was that the inclusion of *that* narrowed the potential interpretation of *the defendant* to the subject of an embedded clause, whereas the omission of *that* rendered the interpretation of *the defendant* more ambiguous because it could either be interpreted as the subject of an embedded clause or the object of the matrix verb. A positivity strikingly similar to the ellipsis component in the current study was seen in the more ambiguous condition at the presentation of the ambiguous word. A prediction

interpretation is possible here: because the chosen verbs were biased toward transitivity, *the defendant* is initially biased toward an object interpretation; this conflicted with the grammatical interpretation of *the defendant* as an embedded subject, and the elicited component indexed the mismatch between the predicted structure and the realized structure. However, this interpretation of the effect seems unlikely, since this assumes that the appropriateness of the realized word's object role could be assessed and then compared within this extremely quick time period. Semantic effects are typically not seen until 400ms, where the N400 is a reliable index of semantic incongruity. Similarly, the explanation of the rapidity of analysis of *\*of* with regard to the component under discussion also seems dubious because it is unlikely that the relevant lexical information of the realized *\*of* could be extracted and then compared to the predicted lexical information so quickly. There is, however, another interpretation involving prediction that seems more plausible: the positivity in Osterhout et al. (1994)'s more ambiguous condition could reflect *extra pre-emptive effort* toward resolving the ambiguity not undertaken in the unambiguous condition. The allocation of this extra effort could be based on a prediction aided by analysis of *that*, which rendered the necessity for extra parsing effort unnecessary. In the analogous component in the current study, the positivity in the –ellipsis conditions could reflect an initial extra pre-emptive allocation of resources toward interpreting (and adjoining) the upcoming anticipated noun. In the +ellipsis condition, this allocation of resources is unnecessary because the noun is already interpretable during the processing of the possessive.

There is yet another explanation for this component. In a study of anaphor processing by Streb, Hennighausen, and Roesler (2004), participants were presented

with sentences (in German) with elided verbs. For example, “Werner gave Lisa a ring of shining gold and Joseph \_\_\_\_ Anna a necklace,” where the blank corresponds to the elided verb *gave*. Approximately 600ms after *Joseph* and 100ms after *Anna* (the same presentation rate as the current study, 500ms between words), a left-frontal negativity appeared for the elided structures relative to control sentences with overt nouns. This component is interpreted by the authors as extra effort toward resolution of the elided structure. Though the distribution and nature of the ellipsis is different than the component found in the current study, the possibility cannot be ignored that the component under discussion reflects late, extra effort toward resolution of the ellipsis rather than an index of a predictive process. Contrary to the prediction interpretations, this interpretation could describe a conscious, controlled process.

Practice and/or fatigue effects must be taken into consideration as well. Analyses of the first two blocks still revealed an effect of ellipsis (weaker, but this is possibly related to lack of statistical power). However, the ellipsis effect is missing entirely in analyses of the final two blocks. This suggests participant adoption of task strategies or possibly habituation over the course of the experiment that may have affected and confounded participant performance in the analyses of all blocks (likely by weakening the strength of the effect). Habituation effects may have been caused by biases in the stimuli. In fillers with possessives + overt nouns in the second clause, the possessed noun in the second clause was always identical to the possessed noun in the first clause. Because of this, upon seeing a second-clause possessive, participants may have been heavily biased toward anticipating the object of a second-clause possessive as identical to the possessed object in the first clause, without even waiting for a

possible overt noun (which would always confirm the biased interpretation). Of course, this was only possible when ellipsis was possible in the +ellipsis conditions. It is unclear how this may have influenced the signal in +ellipsis conditions; based on the results of the last two blocks (which, again, may have only have yielded null results due to low power), this confound could have modulated the component under discussion in such a way that attenuated the significance of the difference from the analogous component in the –ellipsis conditions. Because of the predictability of the semantic nature of the elided noun, this strengthens the ellipsis resolution interpretation of the ellipsis-modulated component.

Another habituation effect could have arisen from the fact that both –ellipsis conditions were always ungrammatical; if participants noticed this, they could have observed the lack of a possessive in the first clause and then safely ignored the rest of the sentence and still been able to accurately judge the grammaticality of the sentence. The first clauses in the unrelated filler condition (75% of which are grammatical) bore some similarities to the critical –ellipsis first clauses, however the –ellipsis criticals were consistent and unique enough (“Although the <noun> met <name>...” was the pattern in all –ellipsis criticals, and did not occur at all in the fillers). In this case, perhaps the –ellipsis conditions may have been modulated by an attentional confound in later blocks. However, this habituation effect is not highly suspected, though, because if participants truly ignored the second clauses of –ellipsis structures, then these two conditions would be expected to pattern together across the entire epoch in the second clause; this was not found (see the Posterior Positivities subsection below for differences between the –ellipsis conditions).

In sum, there are three proposed interpretations of this effect. The first involves rapid analysis of the offending preposition compared against a predicted noun category; in this interpretation, the component is viewed as a positivity in the –ellipsis conditions, indexing some neural effort or response related to the false prediction. This interpretation is tenuous because of the extreme rapidity of the component. The second proposed interpretation also involves a predictive mechanism operating during the processing of the pre-critical word that causes a pre-emptive allocation of extra resources (indexed as a positivity in the –ellipsis conditions) toward preparing for the attachment of the anticipated noun. The third proposed interpretation involves no predictive mechanism, but rather interprets the component as a negativity in the +ellipsis conditions related to anaphor resolution after the possessive, irrespective of the critical word itself. All of these interpretations are rendered tenuous by potential practice, habituation, or fatigue effects developed over the course of the experiment.

### **Right-Central Negativity of +ellipsis/\*of**

From approximately 950ms-1100ms after the onset of pre-critical word (450ms-600ms after the onset of the critical word), a negativity of +ellipsis/\*of relative to +ellipsis/other –ellipsis/\*other was detected (Figure 3-5). The +ellipsis/\*of condition is marked because it is the only condition in which the only grammaticality violation is the offending *\*of*. The +ellipsis/other condition is grammatical, and the –ellipsis conditions are both ungrammatical because of the unlicensed anaphora of the noun. One interpretation is that this is a delayed N400 effect. N400s in response to linguistic stimuli are typically not found in anterior regions, but a review of N400 research by Kutas and Federmeier (2011) shows a wide neural distribution of N400 effects in the literature, including right fronto-central effects related to semantic memory and mismatch. If

related to semantic memory, the effect in the current study could be related to effort in attaching the offending *\*of* to the antecedent noun from the first clause stored in memory. The component then may reflect effort toward retrieval or integration of the stored object.

Another possibility for this component relates to the effort of attaching *\*of* to the elided structure. Contrary to an assertion by Lau et al. (2006), *of* is not necessarily always ungrammatical following a possessive; this can occur when the so-called ‘possessed’ noun preceding *of* is static across clauses/discourse, but the so-called ‘possessor’ noun following *of* changes across clauses/discourse. For example, “FC Utrecht’s player of the year was Van der Hoorn, whereas FC Groningen’s \_\_\_\_ of the match was Kwakman” (note that a contrastive pitch is also necessary at *match*). From the native intuitions of the author, this type of elision is infrequent enough that it could require extra effort for analysis of attachment feasibility, possibly indexed by this negativity. In the experiment, an entire filler category was dedicated to presenting grammatical uses of the preposition *of* in a <noun> *of* <noun> format (though, it was unequal: a total of 32 of these fillers were presented, whereas 80 prepositional + *\*of* combinations were presented in the ±ellipsis/*\*of* conditions, yielding a grammatical to ungrammatical *of* ratio of 2:5). The inclusion of these fillers may have kept participants from assuming consistent ungrammaticality of *of*, even in the +ellipsis/*\*of* condition.

Another possibility relates to the yet-to-be-discussed extended posterior positivity of -ellipsis/*\*of* from approximately 800ms onward. It is possible that the fronto-central negativity of +ellipsis/*\*of* was related to a solely prepositional effect, and that the effect responsible for the central-posterior positive deflection may have superceded a negative

deflection frontally. However, if this were the case, then the same posterior positive deflection might be expected in –ellipsis/\*other, which is not found. This makes any speculation about the possibility of a confounded *of* negativity dubious at best.

In sum, the proposed interpretation of the right-frontal/fronto-central negativity of +ellipsis/\*of relates to the effort toward attaching *of* to an elided noun.

### **Late Left-Frontal Negativity of –ellipsis/\*of**

Though an expected early left-frontal negativity was not found, a negativity of –ellipsis/\*of restricted visually to virtually one electrode (F7) was detected in the 1300ms-1500ms time window (800ms-1000ms after critical word onset; Figure 3-6). As with the +ellipsis/\*of negativity, the factors unique to –ellipsis/\*of were most highly suspected to be the cause of this negativity. This is the only condition with two grammatical violations: an unlicensed anaphoric noun and the inappropriate preposition *\*of*. This condition was unique in offline measures, as it was rated as significantly less plausible on the stimuli questionnaire (as reported in the critical stimuli subsection in Chapter 2). In the grammaticality judgment task, it was also responded to most accurately of all the critical conditions. This is supposedly due to the high saliency of the ungrammaticality in this condition. This component could reflect extra effort regarding the compounded ungrammaticality; little or no research is done on such compounded ungrammaticality because of the huge potential for complex interacting processes. Visually, this condition may only differ in this late window as the result of an earlier negative deflection around 1000ms. This resembles a LAN effect relative to the grammatical +ellipsis/other condition, which would be expected as an index of the syntactic anomalies inherent in the –ellipsis/\*of condition, but is neither statistically found nor visually present in the rest

of the left-anterior region. Because of the complexity and weakness of this effect, it will not be discussed further.

### **Posterior Positivities**

Posteriorly, particularly right-lateralized, there were some interesting effects beginning around 800ms after onset of the pre-critical word (300ms after critical word onset; Figure 3-7). Visually, -ellipsis/\*of begins to deviate from the other conditions around 800ms-900ms. This positivity is not surprising, as this condition is highly ungrammatical (as discussed in the above section on the weak left-frontal negativity of this condition). A positivity such as a P600 is expected, but not as early as this effect begins. The aforementioned complexity of the highly salient, compounded ungrammaticality in this condition could be responsible for its early onset. Another possibility is that the earlier onset of this component could be explained by experimentally-induced anticipation of ungrammaticality: because of the high frequency of the offending \*of, participants may have been expecting the offending \*of, which may have catalyzed reanalysis and repair efforts more quickly than typically indexed by P600 effects.

As mentioned earlier, this effect overlapped over the entirety of the +ellipsis/\*of right-frontal/central negativity. Though it was deemed unlikely that the full effect of the +ellipsis/\*of negativity was confounded by the current positivity under discussion, it seems plausible that the reverse is true: the posterior positivity may actually index a prepositional effect confounded by the +ellipsis/\*of negativity. Indeed, visually the +ellipsis/\*of condition appears to pattern with the posterior positivity before the onset of the negativity unique to this condition. After the negativity, +ellipsis/\*of visually drops sharply (i.e., becomes sharply more positive), and patterns very closely with -ellipsis/\*of

through the positivity and on through the rest of the epoch. If the positivity truly reflects a confounded prepositional effect, then it cannot simply be attributed to a word category violation, as the category-violating –ellipsis/\*other condition would be expected to follow the same pattern. Because there is no statistical evidence for such a preposition effect, no further attempt at discussion of this possibility will be made here.

Finally, a late posterior positivity for all conditions relative to the +ellipsis/\*other condition was found in the 1300ms-1500ms window (though visually only began shortly before 1400ms). This corresponds to 800ms-1000ms after the onset of the critical word. Again, this relationship is unsurprising, given that +ellipsis/\*other is the only grammatical condition and later, posterior positivities are typical of ungrammatical sentences. The timing, however, is later than typical. The effect occurs for the \*of conditions rather early, though the discrepancy between *of* conditions is noted in the previous paragraph. A visual difference between +ellipsis/other and –ellipsis/\*other seems to begin around 1200ms (700ms after the onset of the critical word), which is an acceptable time range for a P600 effect. The delay relative to the \*of conditions may be related to two experimental confounds: first, the aforementioned frequency and consistency of sentences with the offending \*of may have caused this effect to occur earlier, and second, because the *other* conditions were actually comprised of the three separate prepositions *before*, *after*, and *during*, participants may have been less habituated to the individual word forms and meanings, rendering a slightly longer latency to this effect. In addition, the prepositions *before*, *during*, and *after* are all orthographically and phonologically more complex than *of*, which may have also contributed to the latency of processing.

## Offline Correlates with Ellipsis ERP Effect

As mentioned earlier, only correlations with the centro-parietal ellipsis ERP component will be reported here. All correlations are discussed with the maxim “correlation does not equal causation” and the third variable problem in mind, though some speculations may violate these to some degree.

### Correlations with Language Proficiency Measures

The composite English proficiency self-rating correlated strongly with the size of the ellipsis component; the higher the self-rating, the larger the ellipsis effect (Figures 3-6 and 3-8). These findings are consistent with research that shows that more proficient speakers have been shown to have larger components related to linguistic anomalies (Rossi, Gugler, Friederici, and Hahne, 2006; though, this is a study investigating effect of proficiency in second-language speakers, whose second-language processing may differ from native patterns). The nature of this correlation is explicable as an increased sensitivity of more proficient speakers to linguistic anomalies. Notably, there was no significant correlation with the effect restricted to the  $\pm$ ellipsis/(\*)other conditions. This finding is surprising, given that there were significant ellipsis differences in the  $\pm$ ellipsis/(\*)other comparison. It is suspected that either the grammaticality confound or other discussed experimentally-induced confounds may be responsible for this finding. Interestingly, the C-Test scores did not correlate at all with the ellipsis effect. Only scores on the first text of the C-Test correlated with the English proficiency self-rating composite  $r = .383$ ,  $p < .05$ , but neither any other individual text accuracy nor overall C-Test accuracy correlated with the self-rating composite. It can only be ascertained that the specific native-language skills that are measured by the C-Test are not related to

the specific language skills that caused this effect (assuming that the effect was not a confound).

### **Correlations with Grammaticality Judgment Accuracy**

Accuracy on sentences in the +ellipsis/\*of condition correlated positively with the size of the ellipsis effect (Figure 3-9). This means that the more accurate people were at identifying the ungrammaticality of +ellipsis/\*of, the larger the ellipsis effect. Intuitively, this correlation is best explained by the notion that more sensitive participants are to the ungrammaticality of the +ellipsis/\*of condition (indexed by accuracy in this condition), the stronger the ellipsis effect. Interestingly, accuracy on the grammatical condition +ellipsis/other showed the opposite pattern; the less accurate participants were in this condition, the larger the ellipsis effect (Figures 3-7 and 3-10). Because lower accuracy rates in this condition indicate more frequent responses of “ungrammatical” to sentences in this condition, it seems plausible that participants who responded to these sentences as ungrammatical simply processed more of these sentences as ungrammatical than other participants (who more often judged the sentences to be accurate). The processing of the perceived ungrammaticality is thus indexed by the ellipsis component.

### **Correlation with Stroop Effect**

The size of the Stroop effect negatively correlated with the size of the ellipsis effect. This means that the better that participants were at suppressing irrelevant information, the larger the ellipsis effect. There are several possible interpretations of this finding: cognitive control may influence language proficiency, which in turn influences the ellipsis effect (indeed, Stroop effect correlated with several language proficiency measures and grammaticality judgment accuracy), cognitive control may be

directly involved in the process indexed by the ellipsis component, a third variable may influence some or all of these factors, or cognitive control is enhanced by language proficiency. January, Trueswell, Thompson-Schill (2009), and many others, have demonstrated the positive effect of cognitive control on language proficiency. A future portion of this study that will investigate this effect in second-language speakers will shed more light on this finding, as cognitive control is heavily associated with second-language proficiency/performance.

### **Conclusions and Future Directions**

The intention of this experiment was to attempt to replicate the ELAN modulated by ellipsis (i.e., prediction) in Lau et al. (2006). This experiment failed to find such an effect. This is not particularly surprising, since the effect was only found using an atypical signal rereferencing technique. Indeed, when the data from the current study were also averaged using the same atypical rereference technique, there was still no visually-present ELAN effect. The findings of this study cast even further doubt on the accuracy of the findings of Lau et al. (2006), and the failure of the replication of this paradigm indicates that the intended combinatory effect ellipsis and word-category violations, at least in this format, is not a useful design for investigating evidence for prediction of syntactic structures. In particular, there may be several confounds related to participant habituation and fatigue effects. These could be attenuated by increasing the ratio of fillers to criticals and reducing the overall number of trials. Regardless, it would be inadvisable for future research teams to investigate the effect of predictability on LAN effects using the current study's experimental paradigm.

An alternative component was discovered that may be evidence for prediction of upcoming syntactic structure. A central-parietal, slightly right-lateralized component

occurring 500ms-700ms after a word differed depending on whether or not the upcoming context had a highly constrained syntactic frame. It is not clear from this study whether or not this is related to analysis of a word incongruent with the anaphora (licensed or not), where the component corresponds almost exactly with the temporal period from the word's onset to approximately 200ms after the onset of the word. This is regarded as unlikely given the rapidity of the effect. However, an alternative prediction interpretation is proposed where the component is a positivity of –ellipsis conditions reflecting an anticipatory allocation of resources toward integration of a highly anticipated upcoming noun. Another possible interpretation that does not assume a predictive process views the component as a negativity related to the interpretation of the object of the possessive, which is suspected because of an experimentally-induced bias toward extremely predictable objects inherent in the experimental data. Regardless of the interpretation, significant correlations with language proficiency and cognitive control measures suggest the process(es) underlying this component are related to language proficiency and cognitive control. Future studies of syntactic prediction may benefit from designs that vary in the degree to which a target syntactic context is constrained (a continuum of constraint, rather than a dichotomy, would be even more desirable).

Another component was detected that was unique to the condition with a licensed anaphoric object of a possessive and the attachment of an ungrammatical *\*of*. It is unclear from the results of this study whether the component reflects retrieval and integration of the elided object from memory, or whether the component reflects effort toward attachment of the preposition *of*, which may be difficult because of the

infrequency yet plausibility of possessive + *of* structures. Future studies investigating this component should focus on finding ways to tease these two possibilities apart into distinct structures where only one of these two interpretations is possible.

Posterior positivities of the ungrammatical conditions relative to the only grammatical critical condition are entirely unsurprising, though their latency and polarity differences require some investigation. Future studies focusing on these phenomena should again seek to isolate the potential factors and test them independently.

## APPENDIX A CRITICAL STIMULI

This appendix contains the list of all critical stimuli used in the experiment. These sentences were adapted from the critical stimuli used in Lau et al. (2006). There are four variants—a, b, c, and d—of each sentence. The sentence variants correspond to the critical conditions as follows: a = +ellipsis/\*of, b = +ellipsis/other, c = -ellipsis/\*of, and d = -ellipsis/\*other.

- 1a. Although Peter met John's surgeon, he did not meet Max's of the operation.
- 1b. Although Peter met John's surgeon, he did not meet Max's before the operation.
- 1c. Although the surgeon met John, he did not meet Max's of the operation.
- 1d. Although the surgeon met John, he did not meet Max's before the operation.
- 2a. Although Scott interrogated Chris's suspect, he did not interrogate Max's of the robbery.
- 2b. Although Scott interrogated Chris's suspect, he did not interrogate Max's after the robbery.
- 2c. Although the prosecutor interrogated Chris, he did not interrogate Max's of the robbery.
- 2d. Although the prosecutor interrogated Chris, he did not interrogate Max's after the robbery.
- 3a. Although Paul saw Mike's guitarist, he did not see David's of the concert.
- 3b. Although Paul saw Mike's guitarist, he did not see David's during the concert.
- 3c. Although the guitarist saw Mike, he did not see David's of the concert.
- 3d. Although the guitarist saw Mike, he did not see David's during the concert.
- 4a. Although Andrew admired Matt's priest, he did not admire Richard's of the sermon.
- 4b. Although Andrew admired Matt's priest, he did not admire Richard's after the sermon.
- 4c. Although the priest admired Matt, he did not admire Richard's of the sermon.
- 4d. Although the priest admired Matt, he did not admire Richard's after the sermon.
- 5a. Although Joe disliked Steve's chiropractor, he did not dislike Jerry's of the treatment.
- 5b. Although Joe disliked Steve's chiropractor, he did not dislike Jerry's during the treatment.
- 5c. Although the chiropractor disliked Steve, he did not dislike Jerry's of the treatment.
- 5d. Although the chiropractor disliked Steve, he did not dislike Jerry's during the treatment.
- 6a. Although Adam congratulated Tim's agent, he did not congratulate Daniel's of the deal.
- 6b. Although Adam congratulated Tim's agent, he did not congratulate Daniel's after the deal.

- 6c. Although the agent congratulated Tim, he did not congratulate Daniel's of the deal.
- 6d. Although the agent congratulated Tim, he did not congratulate Daniel's after the deal.
- 7a. Although Nathan acknowledged Martin's teammate, he did not acknowledge Stuart's of the ceremony.
- 7b. Although Nathan acknowledged Martin's teammate, he did not acknowledge Stuart's during the ceremony.
- 7c. Although the executive acknowledged Martin, he did not acknowledge Stuart's of the ceremony.
- 7d. Although the executive acknowledged Martin, he did not acknowledge Stuart's during the ceremony.
- 8a. Although Gary respected Arthur's representative, he did not respect Harry's of the symposium.
- 8b. Although Gary respected Arthur's representative, he did not respect Harry's during the symposium.
- 8c. Although the trainee respected Arthur, he did not respect Harry's of the symposium.
- 8d. Although the trainee respected Arthur, he did not respect Harry's during the symposium.
- 9a. Although Justin supported Edward's candidate, he did not support Howard's of the rally.
- 9b. Although Justin supported Edward's candidate, he did not support Howard's during the rally.
- 9c. Although the mayor supported Edward, he did not support Howard's of the rally.
- 9d. Although the mayor supported Edward, he did not support Howard's during the rally.
- 10a. Although Craig praised Philip's conductor, he did not praise Nick's of the concert.
- 10b. Although Craig praised Philip's conductor, he did not praise Nick's after the concert.
- 10c. Although the conductor praised Philip, he did not praise Nick's of the concert.
- 10d. Although the conductor praised Philip, he did not praise Nick's after the concert.
- 11a. Although Samantha hated Jane's sister, she did not hate Billy's of the reunion.
- 11b. Although Samantha hated Jane's sister, she did not hate Billy's before the reunion.
- 11c. Although the nanny hated Jane, she did not hate Billy's of the reunion.
- 11d. Although the nanny hated Jane, she did not hate Billy's before the reunion.
- 12a. Although Kyle heard Josh's saxophonist, he did not hear Tony's of the recording.
- 12b. Although Kyle heard Josh's saxophonist, he did not hear Tony's before the recording.
- 12c. Although the saxophonist heard Josh, he did not hear Tony's of the recording.
- 12d. Although the saxophonist heard Josh, he did not hear Tony's before the recording.
- 13a. Although Jeff despised Wesley's financier, he did not despise Derrick's of the reconciliation.

- 13b. Although Jeff despised Wesley's financier, he did not despise Derrick's before the reconciliation.
- 13c. Although the financier despised Wesley, he did not despise Derrick's of the reconciliation.
- 13d. Although the financier despised Wesley, he did not despise Derrick's before the reconciliation.
- 14a. Although Daniel liked Sean's employer, he did not like Walter's of the firing.
- 14b. Although Daniel liked Sean's employer, he did not like Walter's after the firing.
- 14c. Although the customer liked Sean, he did not like Walter's of the firing.
- 14d. Although the customer liked Sean, he did not like Walter's after the firing.
- 15a. Although Evan reprimanded Patrick's editor, he did not reprimand Sheldon's of the event.
- 15b. Although Evan reprimanded Patrick's editor, he did not reprimand Sheldon's during the event.
- 15c. Although the editor reprimanded Patrick, he did not reprimand Sheldon's of the event.
- 15d. Although the editor reprimanded Patrick, he did not reprimand Sheldon's during the event.
- 16a. Although James identified Ray's killer, he did not identify Doug's of the interview.
- 16b. Although James identified Ray's killer, he did not identify Doug's during the interview.
- 16c. Although the witness identified Ray, he did not identify Doug's of the interview.
- 16d. Although the witness identified Ray, he did not identify Doug's during the interview.
- 17a. Although Russell called Charlie's dentist, he did not call Aaron's of the appointment.
- 17b. Although Russell called Charlie's dentist, he did not call Aaron's before the appointment.
- 17c. Although the dentist called Charlie, he did not call Aaron's of the appointment.
- 17d. Although the dentist called Charlie, he did not call Aaron's before the appointment.
- 18a. Although Stanley spotted Jeremy's caddy, he did not spot Fred's of the tournament.
- 18b. Although Stanley spotted Jeremy's caddy, he did not spot Fred's during the tournament.
- 18c. Although the caddy spotted Jeremy, he did not spot Fred's of the tournament.
- 18d. Although the caddy spotted Jeremy, he did not spot Fred's during the tournament.
- 19a. Although Kevin saluted Tom's captain, he did not salute Brendan's of the ceremony.
- 19b. Although Kevin saluted Tom's captain, he did not salute Brendan's after the ceremony.
- 19c. Although the captain saluted Tom, he did not salute Brendan's of the ceremony.
- 19d. Although the captain saluted Tom, he did not salute Brendan's after the ceremony.

- 20a. Although William honored Bob's rescuer, he did not honor Henry's of the memorial.
- 20b. Although William honored Bob's rescuer, he did not honor Henry's during the memorial.
- 20c. Although the president honored Bob, he did not honor Henry's of the memorial.
- 20d. Although the president honored Bob, he did not honor Henry's during the memorial.
- 21a. Although Tyler answered Seth's detective, he did not answer Keith's of the interrogation.
- 21b. Although Tyler answered Seth's detective, he did not answer Keith's during the interrogation.
- 21c. Although the celebrity answered Seth, he did not answer Keith's of the interrogation.
- 21d. Although the celebrity answered Seth, he did not answer Keith's during the interrogation.
- 22a. Although Jonathan paid Joe's contractor, he did not pay Bruce's of the service.
- 22b. Although Jonathan paid Joe's contractor, he did not pay Bruce's before the service.
- 22c. Although the owner paid Joe, he did not pay Bruce's of the service.
- 22d. Although the owner paid Joe, he did not pay Bruce's before the service.
- 23a. Although Ronald employed Johnny's uncle, he did not employ Rick's of the summer.
- 23b. Although Ronald employed Johnny's uncle, he did not employ Rick's during the summer.
- 23c. Although the manager employed Johnny, he did not employ Rick's of the summer.
- 23d. Although the manager employed Johnny, he did not employ Rick's during the summer.
- 24a. Although Ethan punished Scott's son, he did not punish Mark's of the incident.
- 24b. Although Ethan punished Scott's son, he did not punish Mark's after the incident.
- 24c. Although the teacher punished Scott, he did not punish Mark's of the incident.
- 24d. Although the teacher punished Scott, he did not punish Mark's after the incident.
- 25a. Although Victor contacted Cliff's attorney, he did not contact Jerome's of the negotiation.
- 25b. Although Victor contacted Cliff's attorney, he did not contact Jerome's before the negotiation.
- 25c. Although the attorney contacted Cliff, he did not contact Jerome's of the negotiation.
- 25d. Although the attorney contacted Cliff, he did not contact Jerome's before the negotiation.
- 26a. Although Felix befriended Roger's gardener, he did not befriend Glenn's of the outing.
- 26b. Although Felix befriended Roger's gardener, he did not befriend Glenn's before the outing.
- 26c. Although the gardener befriended Roger, he did not befriend Glenn's of the outing.

- 26d. Although the gardener befriended Roger, he did not befriend Glenn's before the outing.
- 27a. Although Steve frightened Greg's toddler, he did not frighten Jerry's of the trip.
- 27b. Although Steve frightened Greg's toddler, he did not frighten Jerry's before the trip.
- 27c. Although the clown frightened Greg, he did not frighten Jerry's of the trip.
- 27d. Although the clown frightened Greg, he did not frighten Jerry's before the trip.
- 28a. Although Sebastian impressed Phil's coach, he did not impress Bobby's of the competition.
- 28b. Although Sebastian impressed Phil's coach, he did not impress Bobby's during the competition.
- 28c. Although the coach impressed Phil, he did not impress Bobby's of the competition.
- 28d. Although the coach impressed Phil, he did not impress Bobby's during the competition.
- 29a. Although Zachary threatened Brian's enemy, he did not threaten Jesse's of the attack.
- 29b. Although Zachary threatened Brian's enemy, he did not threaten Jesse's before the attack.
- 29c. Although the bully threatened Brian, he did not threaten Jesse's of the attack.
- 29d. Although the bully threatened Brian, he did not threaten Jesse's before the attack.
- 30a. Although Ed scolded Oliver's student, he did not scold Robert's of the procession.
- 30b. Although Ed scolded Oliver's student, he did not scold Robert's during the procession.
- 30c. Although the teacher scolded Oliver, he did not scold Robert's of the procession.
- 30d. Although the teacher scolded Oliver, he did not scold Robert's during the procession.
- 31a. Although Eric criticized Ian's teammate, he did not criticize David's of the practice.
- 31b. Although Eric criticized Ian's teammate, he did not criticize David's after the practice.
- 31c. Although the goalie criticized Ian, he did not criticize David's of the practice.
- 31d. Although the goalie criticized Ian, he did not criticize David's after the practice.
- 32a. Although Anthony surprised Neil's assistant, he did not surprise Carol's of the flight.
- 32b. Although Anthony surprised Neil's assistant, he did not surprise Carol's before the flight.
- 32c. Although the boss surprised Neil, he did not surprise Carol's of the flight.
- 32d. Although the boss surprised Neil, he did not surprise Carol's before the flight.
- 33a. Although Ryan scared Jacob's cousin, he did not scare Janet's of the movie.
- 33b. Although Ryan scared Jacob's cousin, he did not scare Janet's during the movie.
- 33c. Although the clown scared Jacob, he did not scare Janet's of the movie.
- 33d. Although the clown scared Jacob, he did not scare Janet's during the movie.

- 34a. Although Justin reprimanded Elliot's supervisor, he did not reprimand Alice's of the presentation.
- 34b. Although Justin reprimanded Elliot's supervisor, he did not reprimand Alice's before the presentation.
- 34c. Although the supervisor reprimanded Elliot, he did not reprimand Alice's of the presentation.
- 34d. Although the supervisor reprimanded Elliot, he did not reprimand Alice's before the presentation.
- 35a. Although Vincent amused Brett's dad, he did not amuse Mark's of the show.
- 35b. Although Vincent amused Brett's dad, he did not amuse Mark's during the show.
- 35c. Although the comedian amused Brett, he did not amuse Mark's of the show.
- 35d. Although the comedian amused Brett, he did not amuse Mark's during the show.
- 36a. Although Barry fascinated Austin's therapist, he did not fascinate Beverly's of the session.
- 36b. Although Barry fascinated Austin's therapist, he did not fascinate Beverly's during the session.
- 36c. Although the therapist fascinated Austin, he did not fascinate Beverly's of the session.
- 36d. Although the therapist fascinated Austin, he did not fascinate Beverly's during the session.
- 37a. Although Ben reassured Andy's trainer, he did not reassure Tony's of the workout.
- 37b. Although Ben reassured Andy's trainer, he did not reassure Tony's before the workout.
- 37c. Although the trainer reassured Andy, he did not reassure Tony's of the workout.
- 37d. Although the trainer reassured Andy, he did not reassure Tony's before the workout.
- 38a. Although Damian consulted Noah's lawyer, he did not consult Nancy's of the trial.
- 38b. Although Damian consulted Noah's lawyer, he did not consult Nancy's before the trial.
- 38c. Although the lawyer consulted Noah, he did not consult Nancy's of the trial.
- 38d. Although the lawyer consulted Noah, he did not consult Nancy's before the trial.
- 39a. Although Pierre complimented James' predecessor, he did not compliment Ellen's of the speech.
- 39b. Although Pierre complimented James' predecessor, he did not compliment Ellen's during the speech.
- 39c. Although the biologist complimented James, he did not compliment Ellen's of the speech.
- 39d. Although the biologist complimented James, he did not compliment Ellen's during the speech.
- 40a. Although Jay thanked Theodore's butler, he did not thank Heather's of the meal.
- 40b. Although Jay thanked Theodore's butler, he did not thank Heather's after the meal.
- 40c. Although the butler thanked Theodore, he did not thank Heather's of the meal.
- 40d. Although the butler thanked Theodore, he did not thank Heathers after the meal.

- 41a. Although Marcus welcomed Owen's houseguest, he did not welcome Julie's of the reception.
- 41b. Although Marcus welcomed Owen's houseguest, he did not welcome Julie's before the reception.
- 41c. Although the host welcomed Owen, he did not welcome Julie's of the reception.
- 41d. Although the host welcomed Owen, he did not welcome Julie's before the reception.
- 42a. Although Leonard hit Jack's director, he did not hit Hannah's of the brawl.
- 42b. Although Leonard hit Jack's director, he did not hit Hannah's during the brawl.
- 42c. Although the director hit Jack, he did not impress Hannah's of the brawl.
- 42d. Although the director hit Jack, he did not impress Hannah's during the brawl.
- 43a. Although Charlie met Shane's roommate, he did not meet Patricia's of the play.
- 43b. Although Charlie met Shane's roommate, he did not meet Patricia's before the play.
- 43c. Although the landlord met Shane, he did not meet Patricia's of the play.
- 43d. Although the landlord met Shane, he did not meet Patricia's before the play.
- 44a. Although Wayne tutored Luke's classmate, he did not tutor Christine's of the exam.
- 44b. Although Wayne tutored Luke's classmate, he did not tutor Christine's before the exam.
- 44c. Although the upperclassman tutored Luke, he did not tutor Christine's of the exam.
- 44d. Although the upperclassman tutored Luke, he did not tutor Christine's before the exam.
- 45a. Although Kenny insulted Brad's roommate, he did not insult Shannon's of the party.
- 45b. Although Kenny insulted Brad's roommate, he did not insult Shannon's after the party.
- 45c. Although the bully insulted Brad, he did not insult Shannon's of the party.
- 45d. Although the bully insulted Brad, he did not insult Shannon's after the party.
- 46a. Although Todd trained Trevor's teacher, he did not train Anne's of the lecture.
- 46b. Although Todd trained Trevor's teacher, he did not train Anne's during the lecture.
- 46c. Although the teacher trained Trevor, he did not train Anne's of the lecture.
- 46d. Although the teacher trained Trevor, he did not train Anne's during the lecture.
- 47a. Although Patrick hired Albert's scriptwriter, he did not hire Diane's of the interview.
- 47b. Although Patrick hired Albert's scriptwriter, he did not hire Diane's after the interview.
- 47c. Although the scriptwriter hired Albert, he did not hire Diane's of the interview.
- 47d. Although the scriptwriter hired Albert, he did not hire Diane's after the interview.
- 48a. Although Norman confused Carl's accountant, he did not confuse Martha's of the conference.
- 48b. Although Norman confused Carl's accountant, he did not confuse Martha's during the conference.

- 48c. Although the accountant confused Carl, he did not confuse Martha's of the conference.
- 48d. Although the accountant confused Carl, he did not confuse Martha's during the conference.
- 49a. Although Bob baffled Troy's professor, he did not baffle Emily's of the exam.
- 49b. Although Bob baffled Troy's professor, he did not baffle Emily's after the exam.
- 49c. Although the professor baffled Troy, he did not baffle Emily's of the exam.
- 49d. Although the professor baffled Troy, he did not baffle Emily's after the exam.
- 50a. Although Norbert seated Alex's nephew, he did not seat Irene's of the wedding.
- 50b. Although Norbert seated Alex's nephew, he did not seat Irene's before the wedding.
- 50c. Although the babysitter seated Alex, he did not seat Irene's of the wedding.
- 50d. Although the babysitter seated Alex, he did not reprimand Irene's before the wedding.
- 51a. Although Jeremy disappointed Howie's rabbi, he did not disappoint Bonnie's of the blessing.
- 51b. Although Jeremy disappointed Howie's rabbi, he did not disappoint Bonnie's during the blessing.
- 51c. Although the rabbi disappointed Howie, he did not disappoint Bonnie's of the blessing.
- 51d. Although the rabbi disappointed Howie, he did not disappoint Bonnie's during the blessing.
- 52a. Although Carlos surprised Juan's producer, he did not surprise Jane's of the premiere.
- 52b. Although Carlos surprised Juan's producer, he did not surprise Jane's after the premiere.
- 52c. Although the producer surprised Juan, he did not surprise Jane's of the premiere.
- 52d. Although the producer surprised Juan, he did not surprise Jane's after the premiere.
- 53a. Although Frank captured Benjamin's murderer, he did not capture Annette's of the mugging.
- 53b. Although Frank captured Benjamin's murderer, he did not capture Annette's after the mugging.
- 53c. Although the detective captured Benjamin, he did not capture Annette's of the mugging.
- 53d. Although the detective captured Benjamin, he did not capture Annette's after the mugging.
- 54a. Although Warren sentenced Darryl's accomplice, he did not sentence Natasha's of the conviction.
- 54b. Although Warren sentenced Darryl's accomplice, he did not sentence Natasha's after the conviction.
- 54c. Although the judge sentenced Darryl, he did not sentence Natasha's of the conviction.
- 54d. Although the judge sentenced Darryl, he did not sentence Natasha's after the conviction.

- 55a. Although Chris worried Roy's neurologist, he did not worry Betty's of the consultation.
- 55b. Although Chris worried Roy's neurologist, he did not worry Betty's during the consultation.
- 55c. Although the neurologist worried Roy, he did not worry Betty's of the consultation.
- 55d. Although the neurologist worried Roy, he did not worry Betty's during the consultation.
- 56a. Although Ira convinced Cameron's boss, he did not convince Leslie's of the sale.
- 56b. Although Ira convinced Cameron's boss, he did not convince Leslie's during the sale.
- 56c. Although the boss convinced Cameron, he did not convince Leslie's of the sale.
- 56d. Although the boss convinced Cameron, he did not convince Leslie's during the sale.
- 57a. Although Curtis implicated Greg's servant, he did not implicate Abigail's of the arrest.
- 57b. Although Curtis implicated Greg's servant, he did not implicate Abigail's after the arrest.
- 57c. Although the servant implicated Greg, he did not implicate Abigail's of the arrest.
- 57d. Although the servant implicated Greg, he did not implicate Abigail's after the arrest.
- 58a. Although Lawrence pestered Colin's waiter, he did not pester Cynthia's of the luncheon.
- 58b. Although Lawrence pestered Colin's waiter, he did not pester Cynthia's during the luncheon.
- 58c. Although the waiter pestered Colin, he did not pester Cynthia's of the luncheon.
- 58d. Although the waiter pestered Colin, he did not pester Cynthia's during the luncheon.
- 59a. Although Louis inconvenienced Archie's chauffeur, he did not inconvenience Isabelle's of the event.
- 59b. Although Louis inconvenienced Archie's chauffeur, he did not inconvenience Isabelle's before the event.
- 59c. Although the chauffeur inconvenienced Archie, he did not inconvenience Isabelle's of the event.
- 59d. Although the chauffeur inconvenienced Archie, he did not inconvenience Isabelle's before the event.
- 60a. Although Ross disturbed Kenneth's boss, he did not disturb Margaret's of the inspection.
- 60b. Although Ross disturbed Kenneth's boss, he did not disturb Margaret's during the inspection.
- 60c. Although the boss disturbed Kenneth, he did not disturb Margaret's of the inspection.
- 60d. Although the boss disturbed Kenneth, he did not disturb Margaret's during the inspection.
- 61a. Although Joey fed Danny's grandson, he did not feed Arthur's of the trip.
- 61b. Although Joey fed Danny's grandson, he did not feed Arthur's before the trip.
- 61c. Although the grandfather fed Danny, he did not feed Arthur's of the trip.

- 61d. Although the grandfather fed Danny, he did not feed Arthur's before the trip.
- 62a. Although Jake shoved Harry's stepson, he did not shove Pat's of the altercation.
- 62b. Although Jake shoved Harry's stepson, he did not shove Pat's during the altercation.
- 62c. Although the guard shoved Harry, he did not shove Pat's of the altercation.
- 62d. Although the guard shoved Harry, he did not shove Pat's during the altercation.
- 63a. Although Jim shot Drew's bodyguard, he did not shoot Sadie's of the assassination.
- 63b. Although Jim shot Drew's bodyguard, he did not shoot Sadie's during the assassination.
- 63c. Although the bodyguard shot Drew, he did not shoot Sadie's of the assassination.
- 63d. Although the bodyguard shot Drew, he did not shoot Sadie's during the assassination.
- 64a. Although Gene dethroned Marty's heir, he did not dethrone Rose's of the revolution.
- 64b. Although Gene dethroned Marty's heir, he did not dethrone Rose's before the revolution.
- 64c. Although the assassin dethroned Marty, he did not dethrone Rose's of the revolution.
- 64d. Although the assassin dethroned Marty, he did not dethrone Rose's before the revolution.
- 65a. Although Erica kissed Mary's mother, she did not kiss Dana's of the reception.
- 65b. Although Erica kissed Mary's mother, she did not kiss Dana's before the reception.
- 65c. Although the bridesmaid kissed Mary, she did not kiss Dana's of the reception.
- 65d. Although the bridesmaid kissed Mary, she did not kiss Dana's before the reception.
- 66a. Although Danielle hugged Sarah's aunt, she did not hug Jenny's of the departure.
- 66b. Although Danielle hugged Sarah's aunt, she did not hug Jenny's before the departure.
- 66c. Although the grandmother hugged Sarah, she did not hug Jenny's of the departure.
- 66d. Although the grandmother hugged Sarah, she did not hug Jenny's before the departure.
- 67a. Although Katie understood Melissa's translation, she did not understand Catherine's of the speech.
- 67b. Although Katie understood Melissa's translation, she did not understand Catherine's after the speech.
- 67c. Although the politician understood Melissa, she did not understand Catherine's of the speech.
- 67d. Although the politician understood Melissa, she did not understand Catherine's after the speech.
- 68a. Although Allison misunderstood Rachel's grandmother, she did not misunderstand Theresa's of the discussion.
- 68b. Although Allison misunderstood Rachel's grandmother, she did not misunderstand Theresa's during the discussion.

- 68c. Although the secretary misunderstood Rachel, she did not misunderstand Theresa's of the discussion.
- 68d. Although the secretary misunderstood Rachel, she did not misunderstand Theresa's during the discussion.
- 69a. Although Wendy introduced Becky's sister, she did not introduce Laura's of the festival.
- 69b. Although Wendy introduced Becky's sister, she did not introduce Laura's before the festival.
- 69c. Although the hostess introduced Becky, she did not introduce Laura's of the festival.
- 69d. Although the hostess introduced Becky, she did not introduce Laura's before the festival.
- 70a. Although Mandy greeted Candice's publicist, she did not greet Brooke's of the commencement.
- 70b. Although Mandy greeted Candice's publicist, she did not greet Brooke's after the commencement.
- 70c. Although the publicist greeted Candice, she did not greet Brooke's of the commencement.
- 70d. Although the publicist greeted Candice, she did not greet Brooke's after the commencement.
- 71a. Although Amanda annoyed Monica's counselor, she did not annoy Sheryl's of the hike.
- 71b. Although Amanda annoyed Monica's counselor, she did not annoy Sheryl's before the hike.
- 71c. Although the counselor annoyed Monica, she did not annoy Sheryl's of the hike.
- 71d. Although the counselor annoyed Monica, she did not annoy Sheryl's before the hike.
- 72a. Although Leigh emailed Kate's assistant, she did not email Amy's of the class.
- 72b. Although Leigh emailed Kate's assistant, she did not email Amy's before the class.
- 72c. Although the assistant emailed Kate, she did not email Amy's of the class.
- 72d. Although the assistant emailed Kate, she did not email Amy's before the class.
- 73a. Although Maria commended Jennifer's teammate, she did not commend Holly's of the match.
- 73b. Although Maria commended Jennifer's teammate, she did not commend Holly's after the match.
- 73c. Although the cheerleader commended Jennifer, she did not commend Holly's of the match.
- 73d. Although the cheerleader commended Jennifer, she did not commend Holly's after the match.
- 74a. Although Alyssa saw Grace's instructor, she did not see Stephanie's of the gathering.
- 74b. Although Alyssa saw Grace's instructor, she did not see Stephanie's during the gathering.
- 74c. Although the instructor saw Grace, she did not see Stephanie's of the gathering.

- 74d. Although the instructor saw Grace, she did not see Stephanie's during the gathering.
- 75a. Although Sabrina recognized Kristin's twin, she did not recognize Heidi's of the accident.
- 75b. Although Sabrina recognized Kristin's twin, she did not recognize Heidi's after the accident.
- 75c. Although the babysitter recognized Kristin, she did not recognize Heidi's of the accident.
- 75d. Although the babysitter recognized Kristin, she did not recognize Heidi's after the accident.
- 76a. Although Tiffany feared Johanna's tenant, she did not fear Kelly's of the party.
- 76b. Although Tiffany feared Johanna's tenant, she did not fear Kelly's after the party.
- 76c. Although the tenant feared Johanna, she did not fear Kelly's of the party.
- 76d. Although the tenant feared Johanna, she did not fear Kelly's after the party.
- 77a. Although Veronica loathed Jacqueline's receptionist, she did not loathe Tracy's of the argument.
- 77b. Although Veronica loathed Jacqueline's receptionist, she did not loathe Tracy's after the argument.
- 77c. Although the receptionist loathed Jacqueline, she did not loathe Tracy's of the argument.
- 77d. Although the receptionist loathed Jacqueline, she did not loathe Tracy's after the argument.
- 78a. Although Evelyn overlooked Joanne's associate, she did not overlook Maria's of the conference.
- 78b. Although Evelyn overlooked Joanne's associate, she did not overlook Maria's before the conference.
- 78c. Although the associate overlooked Joanne, she did not overlook Maria's of the conference.
- 78d. Although the associate overlooked Joanne, she did not overlook Maria's before the conference.
- 79a. Although Janice encountered Kendra's teacher, she did not encounter Erin's of the class.
- 79b. Although Janice encountered Kendra's teacher, she did not encounter Erin's before the class.
- 79c. Although the teacher encountered Kendra, she did not encounter Erin's of the class.
- 79d. Although the teacher encountered Kendra, she did not encounter Erin's before the class.
- 80a. Although Robyn consulted Claire's principal, she did not consult Toby's of the discussion.
- 80b. Although Robyn consulted Claire's principal, she did not consult Toby's before the discussion.
- 80c. Although the therapist consulted Claire, she did not consult Toby's of the discussion.
- 80d. Although the therapist consulted Claire, she did not consult Toby's before the discussion.

- 81a. Although Julia fired Sally's assistant, she did not fire Fran's of the misbehavior.
- 81b. Although Julia fired Sally's assistant, she did not fire Fran's after the misbehavior.
- 81c. Although the manager fired Sally, she did not fire Fran's of the misbehavior.
- 81d. Although the manager fired Sally, she did not fire Fran's after the misbehavior.
- 82a. Although Sylvia angered Lisa's secretary, she did not anger Jennifer's of the conversation.
- 82b. Although Sylvia angered Lisa's secretary, she did not anger Jennifer's during the conversation.
- 82c. Although the secretary angered Lisa, she did not anger Jennifer's of the conversation.
- 82d. Although the secretary angered Lisa, she did not anger Jennifer's during the conversation.
- 83a. Although Elise teased Valerie's classmate, she did not tease Michelle's of the embarrassment.
- 83b. Although Elise teased Valerie's classmate, she did not tease Michelle's after the embarrassment.
- 83c. Although the student teased Valerie, she did not tease Michelle's of the embarrassment.
- 83d. Although the student teased Valerie, she did not tease Michelle's after the embarrassment.
- 84a. Although Stella visited Anne's doctor, she did not visit Vivian's of the mistake.
- 84b. Although Stella visited Anne's doctor, she did not visit Vivian's after the mistake.
- 84c. Although the caretaker visited Anne, she did not visit Vivian's of the mistake.
- 84d. Although the caretaker visited Anne, she did not visit Vivian's after the mistake.
- 85a. Although Ashley intimidated Karen's neighbor, she did not intimidate Stacey's of the storm.
- 85b. Although Ashley intimidated Karen's neighbor, she did not intimidate Stacey's during the storm.
- 85c. Although the neighbor intimidated Karen, she did not intimidate Stacey's of the storm.
- 85d. Although the neighbor intimidated Karen, she did not intimidate Stacey's during the storm.
- 86a. Although Allison comforted Barbara's infant, she did not comfort Courtney's of the wreck.
- 86b. Although Allison comforted Barbara's infant, she did not comfort Courtney's after the wreck.
- 86c. Although the caretaker comforted Barbara, she did not comfort Courtney's of the wreck.
- 86d. Although the caretaker comforted Barbara, she did not comfort Courtney's after the wreck.
- 87a. Although Monique helped Colleen's customer, she did not help Sharon's of the closure.
- 87b. Although Monique helped Colleen's customer, she did not help Sharon's before the closure.
- 87c. Although the storekeeper helped Colleen, she did not help Sharon's of the closure.

- 87d. Although the storekeeper helped Colleen, she did not help Sharon's before the closure.
- 88a. Although Dana bothered Lindsay's supervisor, she did not bother Carrie's of the intermission.
- 88b. Although Dana bothered Lindsay's supervisor, she did not bother Carrie's during the intermission.
- 88c. Although the supervisor bothered Lindsay, she did not bother Carrie's of the intermission.
- 88d. Although the supervisor bothered Lindsay, she did not bother Carrie's during the intermission.
- 89a. Although Natalie aided Amelia's maid, she did not aid Megan's of the checkout.
- 89b. Although Natalie aided Amelia's maid, she did not aid Megan's after the checkout.
- 89c. Although the maid aided Amelia, she did not aid Megan's of the checkout.
- 89d. Although the maid aided Amelia, she did not aid Megan's after the checkout.
- 90a. Although Meredith complimented Angela's employee, she did not compliment Corinne's of the presentation.
- 90b. Although Meredith complimented Angela's employee, she did not compliment Corinne's after the presentation.
- 90c. Although the employee complimented Angela, she did not compliment Corinne's of the presentation.
- 90d. Although the employee complimented Angela, she did not compliment Corinne's after the presentation.
- 91a. Although Amy encouraged Gina's pupil, she did not encourage Kim's of the lesson.
- 91b. Although Amy encouraged Gina's pupil, she did not encourage Kim's before the lesson.
- 91c. Although the schoolteacher encouraged Gina, she did not encourage Kim's of the lesson.
- 91d. Although the schoolteacher encouraged Gina, she did not encourage Kim's before the lesson.
- 92a. Although Cassandra photographed Nicole's friend, she did not photograph Renee's of the pageant.
- 92b. Although Cassandra photographed Nicole's friend, she did not photograph Renee's during the pageant.
- 92c. Although the reporter photographed Nicole, she did not photograph Renee's of the pageant.
- 92d. Although the reporter photographed Nicole, she did not photograph Renee's during the pageant.
- 93a. Although Linda ignored Marilyn's advisor, she did not ignore Leah's of the graduation.
- 93b. Although Linda ignored Marilyn's advisor, she did not ignore Leah's after the graduation.
- 93c. Although the professor ignored Marilyn, she did not ignore Leah's of the graduation.

- 93d. Although the professor ignored Marilyn, she did not ignore Leah's after the graduation.
- 94a. Although Susie questioned Laurie's valet, she did not question Elaine's of the collision.
- 94b. Although Susie questioned Laurie's valet, she did not question Elaine's after the collision.
- 94c. Although the driver questioned Laurie, she did not question Elaine's of the collision.
- 94d. Although the driver questioned Laurie, she did not question Elaine's after the collision.
- 95a. Although Alexis offended Claudia's director, she did not offend Alfred's of the filming.
- 95b. Although Alexis offended Claudia's director, she did not offend Alfred's during the filming.
- 95c. Although the director offended Claudia, she did not offend Alfred's of the filming.
- 95d. Although the director offended Claudia, she did not offend Alfred's during the filming.
- 96a. Although Jocelyn convinced Kathy's priest, she did not convince Jake's of the mass.
- 96b. Although Jocelyn convinced Kathy's priest, she did not convince Jake's during the mass.
- 96c. Although the priest convinced Kathy, he did not convince Jake's of the mass.
- 96d. Although the priest convinced Kathy, he did not convince Jake's during the mass.
- 97a. Although Samantha bored Alicia's mom, she did not bore Ted's of the reception.
- 97b. Although Samantha bored Alicia's mom, she did not bore Ted's before the reception.
- 97c. Although the botanist bored Alicia, she did not bore Ted's of the reception.
- 97d. Although the botanist bored Alicia, she did not bore Ted's before the reception.
- 98a. Although Vicki splashed Gayle's child, she did not splash Thomas's of the outing.
- 98b. Although Vicki splashed Gayle's child, she did not splash Thomas's during the outing.
- 98c. Although the child splashed Gayle, she did not splash Thomas's of the outing.
- 98d. Although the child splashed Gayle, she did not splash Thomas's during the outing.
- 99a. Although Emma liked Zoe's hairdresser, she did not like Rachel's of the session.
- 99b. Although Emma liked Zoe's hairdresser, she did not like Rachel's after the session.
- 99c. Although the hairdresser liked Zoe, she did not like Rachel's of the session.
- 99d. Although the hairdresser liked Zoe, she did not like Rachel's after the session.
- 100a. Although Eleanor infuriated Jill's editor, she did not infuriate Lance's of the argument.
- 100b. Although Eleanor infuriated Jill's editor, she did not infuriate Lance's during the argument.
- 100c. Although the editor infuriated Jill, she did not infuriate Lance's of the argument.
- 100d. Although the editor infuriated Jill, she did not infuriate Lance's during the argument.

- 101a. Although Molly found Lydia's cabinmate, she did not find Jack's of the collision.
- 101b. Although Molly found Lydia's cabinmate, she did not find Jack's after the collision.
- 101c. Although the attendant found Lydia, she did not find Jack's of the collision.
- 101d. Although the attendant found Lydia, she did not find Jack's after the collision.
- 102a. Although Faith recognized Brianna's acquaintance, she did not recognize Stephen's of the introduction.
- 102b. Although Faith recognized Brianna's acquaintance, she did not recognize Stephen's before the introduction.
- 102c. Although the diplomat recognized Brianna, she did not recognize Stephen's of the introduction.
- 102d. Although the diplomat recognized Brianna, she did not recognize Stephen's before the introduction.
- 103a. Although Laura overburdened Daphne's maid, she did not overburden Robert's of the banquet.
- 103b. Although Laura overburdened Daphne's maid, she did not overburden Robert's before the banquet.
- 103c. Although the queen overburdened Daphne, she did not overburden Robert's of the banquet.
- 103d. Although the queen overburdened Daphne, she did not overburden Robert's before the banquet.
- 104a. Although Jessica irritated Charlotte's tutor, she did not irritate Robbie's of the lecture.
- 104b. Although Jessica irritated Charlotte's tutor, she did not irritate Robbie's after the lecture.
- 104c. Although the tutor irritated Charlotte, she did not irritate Robbie's of the lecture.
- 104d. Although the tutor irritated Charlotte, she did not irritate Robbie's after the lecture.
- 105a. Although Elizabeth charmed Alana's nanny, she did not charm Ricky's of the visit.
- 105b. Although Elizabeth charmed Alana's nanny, she did not charm Ricky's during the visit.
- 105c. Although the nanny charmed Alana, she did not charm Ricky's of the visit.
- 105d. Although the nanny charmed Alana, she did not charm Ricky's during the visit.
- 106a. Although Dorothy fascinated Marie's biographer, she did not fascinate Darren's of the interview.
- 106b. Although Dorothy fascinated Marie's biographer, she did not fascinate Darren's during the interview.
- 106c. Although the biographer fascinated Marie, she did not fascinate Darren's of the interview.
- 106d. Although the biographer fascinated Marie, she did not fascinate Darren's during the interview.
- 107a. Although Nadia entertained Shirley's godmother, she did not entertain Bert's of the game.
- 107b. Although Nadia entertained Shirley's godmother, she did not entertain Bert's before the game.

- 107c. Although the cheerleader entertained Shirley, she did not entertain Bert's of the game.
- 107d. Although the cheerleader entertained Shirley, she did not entertain Bert's before the game.
- 108a. Although Daisy mocked Gretchen's teacher, she did not mock Kurt's of the class.
- 108b. Although Daisy mocked Gretchen's teacher, she did not mock Kurt's after the class.
- 108c. Although the teacher mocked Gretchen, she did not mock Kurt's of the class.
- 108d. Although the teacher mocked Gretchen, she did not mock Kurt's after the class.
- 109a. Although Abby excited Diana's daughter, she did not excite Kyle's of the vacation.
- 109b. Although Abby excited Diana's daughter, she did not excite Kyle's before the vacation.
- 109c. Although the daughter excited Diana, she did not excite Kyle's of the vacation.
- 109d. Although the daughter excited Diana, she did not excite Kyle's before the vacation.
- 110a. Although Pamela believed Olivia's client, she did not believe Casey's of the hearing.
- 110b. Although Pamela believed Olivia's client, she did not believe Casey's during the hearing.
- 110c. Although the attorney believed Olivia, she did not believe Casey's of the hearing.
- 110d. Although the attorney believed Olivia, she did not believe Casey's during the hearing.
- 111a. Although Donna lectured Shelley's niece, she did not lecture Evan's of the dinner.
- 111b. Although Donna lectured Shelley's niece, she did not lecture Evan's after the dinner.
- 111c. Although the aunt lectured Shelley, she did not lecture Evan's of the dinner.
- 111d. Although the aunt lectured Shelley, she did not lecture Evan's after the dinner.
- 112a. Although Nora assisted Denise's nurse, she did not assist Kent's of the surgery.
- 112b. Although Nora assisted Denise's nurse, she did not assist Kent's before the surgery.
- 112c. Although the nurse assisted Denise, she did not assist Kent's of the surgery.
- 112d. Although the nurse assisted Denise, she did not assist Kent's before the surgery.
- 113a. Although Shirley chased Darlene's assailant, she did not chase Calvin's of the assault.
- 113b. Although Shirley chased Darlene's assailant, she did not chase Calvin's after the assault.
- 113c. Although the assailant chased Darlene, she did not chase Calvin's of the assault.
- 113d. Although the assailant chased Darlene, she did not chase Calvin's after the assault.
- 114a. Although Catherine missed Rebecca's grandmother, she did not miss Todd's of the departure.
- 114b. Although Catherine missed Rebecca's grandmother, she did not miss Todd's after the departure.

- 114c. Although the grandmother missed Rebecca, she did not miss Todd's of the departure.
- 114d. Although the grandmother missed Rebecca, she did not miss Todd's after the departure.
- 115a. Although Tamara questioned Larissa's witness, she did not question Ted's of the trial.
- 115b. Although Tamara questioned Larissa's witness, she did not question Ted's during the trial.
- 115c. Although the judge questioned Larissa, she did not question Ted's of the trial.
- 115d. Although the judge questioned Larissa, she did not question Ted's during the trial.
- 116a. Although Anna dressed Joan's baby, she did not dress Sally's of the dance.
- 116b. Although Anna dressed Joan's baby, she did not dress Sally's before the dance.
- 116c. Although the babysitter dressed Joan, she did not dress Sally's of the dance.
- 116d. Although the babysitter dressed Joan, she did not dress Sally's before the dance.
- 117a. Although Victoria tickled Sophie's newborn, she did not tickle Alexander's of the birth.
- 117b. Although Victoria tickled Sophie's newborn, she did not tickle Alexander's after the birth.
- 117c. Although the godmother tickled Sophie, she did not tickle Alexander's of the birth.
- 117d. Although the godmother tickled Sophie, she did not tickle Alexander's after the birth.
- 118a. Although Carolyn praised Lynne's singer, she did not praise Thomas's of the performance.
- 118b. Although Carolyn praised Lynne's singer, she did not praise Thomas's after the performance.
- 118c. Although the pianist praised Lynne, she did not praise Thomas's of the performance.
- 118d. Although the pianist praised Lynne, she did not praise Thomas's after the performance.
- 119a. Although Louise startled Beth's babysitter, she did not startle Betty's of the evening.
- 119b. Although Louise startled Beth's babysitter, she did not startle Betty's before the evening.
- 119c. Although the babysitter startled Beth, she did not startle Betty's of the evening.
- 119d. Although the babysitter startled Beth, she did not startle Betty's before the evening.
- 120a. Although Hank treated Ryan's patient, he did not treat Bradley's of the accident.
- 120b. Although Hank treated Ryan's patient, he did not treat Bradley's after the accident.
- 120c. Although the dentist treated Ryan, he did not treat Bradley's of the accident.
- 120d. Although the dentist treated Ryan, he did not treat Bradley's after the accident.
- 121a. Although Miriam distracted Maya's waiter, she did not distract Morris's of the lunch.
- 121b. Although Miriam distracted Maya's waiter, she did not distract Morris's during the lunch.

- 121c. Although the waiter distracted Maya, she did not distract Morris's of the lunch.
- 121d. Although the waiter distracted Maya, she did not distract Morris's during the lunch.
- 122a. Although Tanya trusted Jackie's physician, she did not trust Samuel's of the appointment.
- 122b. Although Tanya trusted Jackie's physician, she did not trust Samuel's before the appointment.
- 122c. Although the physician trusted Jackie, she did not trust Samuel's of the appointment.
- 122d. Although the physician trusted Jackie, she did not trust Samuel's before the appointment.
- 123a. Although Fiona interrupted Jessie's lecturer, she did not interrupt Ivan's of the session.
- 123b. Although Fiona interrupted Jessie's lecturer, she did not interrupt Ivan's during the session.
- 123c. Although the lecturer interrupted Jessie, she did not interrupt Ivan's of the session.
- 123d. Although the lecturer interrupted Jessie, she did not interrupt Ivan's during the session.
- 124a. Although Rochelle welcomed Madeline's visitor, she did not welcome Eddie's of the arrival.
- 124b. Although Rochelle welcomed Madeline's visitor, she did not welcome Eddie's after the arrival.
- 124c. Although the representative welcomed Madeline, she did not welcome Eddie's of the arrival.
- 124d. Although the representative welcomed Madeline, she did not welcome Eddie's after the arrival.
- 125a. Although Jeannie saved Thelma's granddaughter, she did not hold Kimberly's of the bombing.
- 125b. Although Jeannie saved Thelma's granddaughter, she did not hold Kimberly's before the bombing.
- 125c. Although the grandmother saved Thelma, she did not hold Kimberly's of the bombing.
- 125d. Although the grandmother saved Thelma, she did not hold Kimberly's before the bombing.
- 126a. Although Maureen interviewed Sonia's architect, she did not interview Miriam's of the decision.
- 126b. Although Maureen interviewed Sonia's architect, she did not interview Miriam's before the decision.
- 126c. Although the reporter interviewed Sonia, she did not interview Miriam's of the decision.
- 126d. Although the reporter interviewed Sonia, she did not interview Miriam's before the decision.
- 127a. Although Sandy sued Melanie's stepdaughter, she did not sue Gavin's of the error.

- 127b. Although Sandy sued Melanie's stepdaughter, she did not sue Galvin's after the error.
- 127c. Although the stepdaughter sued Melanie, she did not sue Gavin's of the error.
- 127d. Although the stepdaughter sued Melanie, she did not sue Gavin's after the error.
- 128a. Although Clara distrusted Penny's paramedic, she did not distrust Michael's of the treatment.
- 128b. Although Clara distrusted Penny's paramedic, she did not distrust Michael's after the treatment.
- 128c. Although the paramedic distrusted Penny, she did not distrust Michael's of the treatment.
- 128d. Although the paramedic distrusted Penny, she did not distrust Michael's after the treatment.
- 129a. Although Allen promoted Spencer's manager, he did not promote Janelle's of the holiday.
- 129b. Although Allen promoted Spencer's manager, he did not promote Janelle's before the holiday.
- 129c. Although the manager promoted Spencer, he did not promote Janelle's of the holiday.
- 129d. Although the manager promoted Spencer, he did not promote Janelle's before the holiday.
- 130a. Although Travis demoted Dylan's boss, he did not demote Allie's of the meeting.
- 130b. Although Travis demoted Dylan's boss, he did not demote Allie's during the meeting.
- 130c. Although the boss demoted Dylan, he did not demote Allie's of the meeting.
- 130d. Although the boss demoted Dylan, he did not demote Allie's during the meeting.
- 131a. Although Jules congratulated Dean's contractor, he did not congratulate Lianne's of the construction.
- 131b. Although Jules congratulated Dean's contractor, he did not congratulate Lianne's after the construction.
- 131c. Although the contractor congratulated Dean, he did not congratulate Lianne's of the construction.
- 131d. Although the contractor congratulated Dean, he did not congratulate Lianne's after the construction.
- 132a. Although Joel startled Randy's brother, he did not startle Judy's of the night.
- 132b. Although Joel startled Randy's brother, he did not startle Judy's during the night.
- 132c. Although the policeman startled Randy, he did not startle Judy's of the night.
- 132d. Although the policeman startled Randy, he did not startle Judy's during the night.
- 133a. Although Brennan educated Ronney's roommate, he did not educate Natalia's of the semester.
- 133b. Although Brennan educated Ronney's roommate, he did not educate Natalia's during the semester.
- 133c. Although the roommate educated Ronney, he did not educate Natalia's of the semester.
- 133d. Although the roommate educated Ronney, he did not educate Natalia's during the semester.
- 134a. Although Richie warned Brandon's nurse, he did not warn Cary's of the mishap.

- 134b. Although Richie warned Brandon's nurse, he did not warn Cary's before the mishap.
- 134c. Although the nurse warned Brandon, he did not warn Cary's of the mishap.
- 134d. Although the nurse warned Brandon, he did not warn Cary's before the mishap.
- 135a. Although Clarence persuaded Shawn's lawyer, he did not persuade Hillary's of the trial.
- 135b. Although Clarence persuaded Shawn's lawyer, he did not persuade Hillary's before the trial.
- 135c. Although the lawyer persuaded Shawn, he did not persuade Hillary's of the trial.
- 135d. Although the lawyer persuaded Shawn, he did not persuade Hillary's before the trial.
- 136a. Although Harrison teased Wade's stepfather, he did not tease Kaitlin's of the meal.
- 136b. Although Harrison teased Wade's stepfather, he did not tease Kaitlin's before the meal.
- 136c. Although the driver teased Wade, he did not tease Kaitlin's of the meal.
- 136d. Although the driver teased Wade, he did not tease Kaitlin's before the meal.
- 137a. Although Kaley dressed Mallory's daughter, she did not dress Dave's of the wedding.
- 137b. Although Kaley dressed Mallory's daughter, she did not dress Dave's before the wedding.
- 137c. Although the designer dressed Mallory, she did not dress Dave's of the wedding.
- 137d. Although the designer dressed Mallory, she did not dress Dave's before the wedding.
- 138a. Although Brittany named Chelsea's kid, she did not name Rob's of the birth.
- 138b. Although Brittany named Chelsea's kid, she did not name Rob's after the birth.
- 138c. Although the nun named Chelsea, she did not name Rob's of the birth.
- 138d. Although the nun named Chelsea, she did not name Rob's after the birth.
- 139a. Although Kayla heard Jamie's drummer, she did not hear Alfredo's of the rehearsal.
- 139b. Although Kayla heard Jamie's drummer, she did not hear Alfredo's after the rehearsal.
- 139c. Although the drummer heard Jamie, she did not hear Alfredo's of the rehearsal.
- 139d. Although the drummer heard Jamie, she did not hear Alfredo's after the rehearsal.
- 140a. Although Jean watched Naomi's baby, she did not watch Blake's of the honeymoon.
- 140b. Although Jean watched Naomi's baby, she did not watch Blake's during the honeymoon.
- 140c. Although the baby watched Naomi, she did not watch Blake's of the honeymoon.
- 140d. Although the baby watched Naomi, she did not watch Blake's during the honeymoon.
- 141a. Although Suzy guided Laney's grandmother, she did not guide George's of the operation.
- 141b. Although Suzy guided Laney's grandmother, she did not guide George's after the operation.

- 141c. Although the associate guided Laney, she did not guide George's of the operation.
- 141d. Although the associate guided Laney, she did not guide George's after the operation.
- 142a. Although Katrina called Lillie's plumber, she did not call Nate's of the flood.
- 142b. Although Katrina called Lillie's plumber, she did not call Nate's after the flood.
- 142c. Although the plumber called Lillie, she did not call Nate's of the flood.
- 142d. Although the plumber called Lillie, she did not call Nate's after the flood.
- 143a. Although Katya messaged Theresa's priest, she did not message Brice's of the sermon.
- 143b. Although Katya messaged Theresa's priest, she did not message Brice's after the sermon.
- 143c. Although the priest messaged Theresa, she did not message Brice's of the sermon.
- 143d. Although the priest messaged Theresa, she did not message Brice's after the sermon.
- 144a. Although Kelsie consulted Lauren's gardener, she did not consult Theo's of the yardwork.
- 144b. Although Kelsie consulted Lauren's gardener, she did not consult Theo's during the yardwork.
- 144c. Although the gardener consulted Lauren, she did not consult Theo's of the yardwork.
- 144d. Although the gardener consulted Lauren, she did not consult Theo's during the yardwork.
- 145a. Although Cody pinched Nicholas's nephew, he did not pinch Duncan's of the trip.
- 145b. Although Cody pinched Nicholas's nephew, he did not pinch Duncan's during the trip.
- 145c. Although the toddler pinched Nicholas, he did not pinch Duncan's of the trip.
- 145d. Although the toddler pinched Nicholas, he did not pinch Duncan's during the trip.
- 146a. Although Logan confronted Stephen's bully, he did not confront Jason's of the class.
- 146b. Although Logan confronted Stephen's bully, he did not confront Jason's before the class.
- 146c. Although the bully confronted Stephen, he did not confront Jason's of the class.
- 146d. Although the bully confronted Stephen, he did not confront Jason's before the class.
- 147a. Although Alton served Fabian's grandfather, he did not serve Jimmy's of the gala.
- 147b. Although Alton served Fabian's grandfather, he did not serve Jimmy's during the gala.
- 147c. Although the grandfather served Fabian, he did not serve Jimmy's of the gala.
- 147d. Although the grandfather served Fabian, he did not serve Jimmy's during the gala.
- 148a. Although Lucas shoved Parker's attacker, he did not shove Christian's of the fight.
- 148b. Although Lucas shoved Parker's attacker, he did not shove Christian's before the fight.

- 148c. Although the attacker shoved Parker, he did not shove Christian's of the fight.
- 148d. Although the attacker shoved Parker, he did not shove Christian's before the fight.
- 149a. Although Joshua pushed Julian's bodyguard, he did not push Timothy's of the altercation.
- 149b. Although Joshua pushed Julian's bodyguard, he did not push Timothy's during the altercation.
- 149c. Although the bodyguard pushed Julian, he did not push Timothy's of the altercation.
- 149d. Although the bodyguard pushed Julian, he did not push Timothy's during the altercation.
- 150a. Although Dwight slapped Brent's neighbor, he did not slap Christopher's of the party.
- 150b. Although Dwight slapped Brent's neighbor, he did not slap Christopher's after the party.
- 150c. Although the neighbor slapped Brent, he did not slap Christopher's of the party.
- 150d. Although the neighbor slapped Brent, he did not slap Christopher's after the party.
- 151a. Although Derek trusted Lee's agent, he did not trust Oscar's of the negotiation.
- 151b. Although Derek trusted Lee's agent, he did not trust Oscar's during the negotiation.
- 151c. Although the agent trusted Lee, he did not trust Oscar's of the negotiation.
- 151d. Although the agent trusted Lee, he did not trust Oscar's during the negotiation.
- 152a. Although Will misled Drake's investigator, he did not mislead Elijah's of the investigation.
- 152b. Although Will misled Drake's investigator, he did not mislead Elijah's during the investigation.
- 152c. Although the investigator misled Drake, he did not mislead Elijah's of the investigation.
- 152d. Although the investigator misled Drake, he did not mislead Elijah's during the investigation.
- 153a. Although Amber photographed Cindy's teammate, she did not photograph Connie's of the victory.
- 153b. Although Amber photographed Cindy's teammate, she did not photograph Connie's after the victory.
- 153c. Although the teammate photographed Cindy, she did not photograph Connie's of the victory.
- 153d. Although the teammate photographed Cindy, she did not photograph Connie's after the victory.
- 154a. Although Crystal taunted Dori's competitor, she did not taunt Suzanne's of the brawl.
- 154b. Although Crystal taunted Dori's competitor, she did not taunt Suzanne's before the brawl.
- 154c. Although the competitor taunted Dori, she did not taunt Suzanne's of the brawl.
- 154d. Although the competitor taunted Dori, she did not taunt Suzanne's before the brawl.

- 155a. Although Caroline fed Kay's child, she did not feed Brenda's of the sunrise.
- 155b. Although Caroline fed Kay's child, she did not feed Brenda's before the sunrise.
- 155c. Although the child fed Kay, she did not feed Brenda's of the sunrise.
- 155d. Although the child fed Kay, she did not feed Brenda's before the sunrise.
- 156a. Although Morgan massaged Alexa's trainer, she did not massage Arian's of the match.
- 156b. Although Morgan massaged Alexa's trainer, she did not massage Arian's before the match.
- 156c. Although the trainer massaged Alexa, she did not massage Arian's of the match.
- 156d. Although the trainer massaged Alexa, she did not massage Arian's before the match.
- 157a. Although Blanche filmed Christina's stepdaughter, she did not film Deborah's of the race.
- 157b. Although Blanche filmed Christina's stepdaughter, she did not film Deborah's during the race.
- 157c. Although the stepdaughter filmed Christina, she did not film Deborah's of the race.
- 157d. Although the stepdaughter filmed Christina, she did not film Deborah's during the race.
- 158a. Although Carlie raised Justina's niece, she did not raise Sam's of the recovery.
- 158b. Although Carlie raised Justina's niece, she did not raise Sam's during the recovery.
- 158c. Although the caretaker raised Justina, she did not raise Sam's of the recovery.
- 158d. Although the caretaker raised Justina, she did not raise Sam's during the recovery.
- 159a. Although Taylor consoled Jordan's doctor, she did not console Giselle's of the funeral.
- 159b. Although Taylor consoled Jordan's doctor, she did not console Giselle's after the funeral.
- 159c. Although the doctor consoled Jordan, she did not console Giselle's of the funeral.
- 159d. Although the doctor consoled Jordan, she did not console Giselle's after the funeral.
- 160a. Although Beatrice summoned Jean's pharmacist, she did not summon Olga's of the surgery.
- 160b. Although Beatrice summoned Jean's pharmacist, she did not summon Olga's before the surgery.
- 160c. Although the pharmacist summoned Jean, she did not summon Olga's of the surgery.
- 160d. Although the pharmacist summoned Jean, she did not summon Olga's before the surgery.

## APPENDIX B FILLER STIMULI

This appendix contains the list of all filler stimuli used in the current study. As with the critical stimuli, these sentences were adapted from the materials used in Lau et al. (2006). As outlined in Chapter 2, there are four types of fillers: +Parallel, ON; - Parallel, ON; Grammatical *of*; and Unrelated. If sentences are preceded by (WO), this indicates that they are ungrammatical because of a word order violation; if they are preceded by a (VC), this indicates that they are ungrammatical because of a verb conjugation violation.

### **+Parallel, ON**

- 1(WO).Although Mary Michael's teacher emailed, she did not email Petra's teacher.
- 2(WO).Although Jasmine studied Jason's author, she did not study author Liara's.
- 3(WO).Although Donald Mark's accountant contacted, he did not contact Luis's accountant.
4. Although Alec talked to Lane's grandmother, he did not talk to Gail's grandmother.
- 5(VC).Although Ruth congratulate Nick's sister, she did not congratulate Tamera's sister.
- 6(VC).Although Emanuel trained Sophia's intern, he did not trains Gretta's intern.
- 7(VC).Although Craig charge Tyrome's customer, he did not sketch Janett's customer.
8. Although Holly grabbed Marcie's niece, he did not see Natalie's niece.
9. Although Yolanda scolded Tammy's maid every morning, she did not reprimand Carrie's maid.
10. Although Miriam directed Jared's assistant yesterday afternoon, she did not oversee Tabatha's assistant
11. Although Lois hired Ruthie's gardener last week, she did not hire Dean's gardener.
12. Although Whitney did not like Francine's father, she did like Janette's father.
13. Although Brent did not remember Florence's last client, he did remember Christine's last client.
14. Although Marcus argued with Nancy's friend, he did not disagree with Valentina's friend.
15. Although Susanna did not pay Lisa's optometrist, she did pay Ronnie's optometrist.
16. Although Marvin did not meet Tori's mentor, he did see Brandon's mentor.
17. Although Naomi played with Alejandra's son on the playground, she did not entertain Manfred's son.

18. Although Gilbert tutored Francine's cousin on Mondays, he did not meet with Chester's cousin.
19. Although Janine knitted Sheldon's brother a new scarf, she did not make one for Kevin's brother.
20. Although Cassie missed Sean's family, she did not miss Conrad's family.
21. Although Harriet did not listen to Janine's boss, she did follow Alejandro's boss.
22. Although Brent did not ask Michelle's parents, he did ask Jacqueline's parents.
23. Although Joel did not commend Donald's trainer, he did compliment Kaitlyn's trainer.
24. Although Rhonda ate with Trish's supervisor yesterday, she did not eat with Mercedes' supervisor.
25. While Sandra did not give Damien's mom a gift, she did buy Sanjay's mom a gift.
26. While George did not cook chicken for Kimberly's tenant, he did fry chicken for Lacey's tenant.
- 27(WO).When Helen spoke to Dianna's agent, she also met with agent Simon's.
28. When Winnie tried to cook dinner for Don's friend, she did not make dinner for Chloe's friend.
29. Since Jacque called Kyleen's dentist to make an appointment, he did not need to call Noah's dentist.
30. Since Ethan joined Blair's brother for lunch, he could not accompany Olivia's brother.
31. Because Jayden worked for Daria's family, he could not work for Alexander's family.
- 32(VC).Because Curtis needed to teach Felicia's son, he could not tutoring Jasmine's son on Monday.

**-Parallel, ON**

- 1(WO).Although the professional pianist performed Petra contacted, he did not contact Nathan's publicist.
- 2(WO).Although the captain dismissed Brandon, she did not Raymond's dismiss partner.
- 3(WO).Although the fired manager Denise, she did not fire Marley's new waitress.
- 4(VC).Although the salesman listen to Aaron, he did not listen to Fernando's contact.
- 5(VC).Although the plumber helped Max, he did not helped Ronald's family.
- 6(VC).Although the hairdresser schedule Reginald, she did not schedule Audrey's nephew.
7. Although the conductor directed Eric, he did not properly direct Olivia's friend.
8. Although the athlete met Sammy, she did not meet Marco's assistant after the game.
9. Although Eugene made an appointment with Bernard, he did not make an appointment with Abigail's secretary.
10. Although Ursula bought lunch for Gary last Wednesday, she did not buy lunch for Mason's friend.
11. Although Delores looked for Will in the phone book, she did not look for Isabella's cousin.

12. Although Jenna recommended Emma, she did not recommend Shirley's husband for the job.
13. Although Thelma never saved her receipts from stores, she went back to return Karl's book.
14. Although Doreen baked cakes quite often, they never were as good as grandma's brownies.
15. Although Dominique saw the baby crying, she could not see Becca's daughter.
16. Although Sarah had her own sleeping bag, she used Amanda's blanket during the camping trip.
17. Although Joyce had a laptop, she used Alexa's computer to write.
18. Although the CD sold very well, the country star's CD did even better that week.
19. Although Gerald received a ticket once, he was surprised Mimi's ticket was so expensive.
- 20(VC). Since Herbert knew Jacob was a vegetarian, he making his grandmother's special vegetarian bacon for breakfast.
21. Although Lisa turned down the marriage proposal politely, she accepted Juan's the following week.
22. Although the burglar stole the jewels, he decided to leave the prince's money in the vault.
23. Although Maurice failed to steal the protected files, he decided to take the researcher's data.
24. Although the inexperienced traveler had no suitcases of her own, she borrowed Harold's suitcase for her trip.
25. While Gwendolyn worked diligently on her homework, Sophia's study habits were much worse.
26. While Cynthia would not share things with Oscar, she sometimes shared her sister's toys.
27. Although Talia didn't like Mexican food very much, she ate Randy's enchiladas.
28. Since Cliff went on vacation with June, he took Liam's picnic basket with him.
29. When Garrett distrusted his new employee, he started to distrust Kayden's assistant too.
30. When the famous actor starred in many films, he never appeared on any of Fox's television shows.
- 31(WO). Because Mona had to chauffeur Sierra for a week, she decided to chauffer sister Tristan's too.
32. Because Doug did not work with Bryce, he felt awkward visiting Bryce's family.

### **Grammatical of**

1. Although Kacy texted Paula's sorority sister, she failed to text the president of the fraternity.
2. Although Chloe followed Tina's car, she did not follow the driver of the other car during the chase.
- 3(VC). While the interviewer chastise Ringo's hair, she did not mention the shirt of the interviewee.

4. When Theodore noticed Bradley's shoes, he also noticed the socks of the runner during the marathon.
5. After the judge fined Misty's friend, he additionally fined the defendant of the other trial.
6. Since Jorge earned a good grade, he will also earn the respect of his peers at the university.
7. Although the nurse weighed Tristen, she forgot to take the temperature of the patient.
8. Although Quincy found the weapon, he could not seize the suspect of the crime after the incident.
- 9(WO).While Sophia consoled the victim, she did not console the witness the of attack.
10. Since Curtis irked the waitress, he irked the patrons of the restaurant.
11. Though Nathaniel sang to the cute girl, he did not sing to the friend of the girl at the bar.
- 12(WO).When mailman the delivered Brent's package, he delivered the letter of the boss.
13. Because Rafael finished his homework, he had no time to finish the chapter of the book on his desk.
14. After Paula spilled the milk, she got a towel to clean the floor of the apartment.
15. When the student visited the teacher, she closed the door of the office after she entered.
- 16(VC).When Jackson mugged Richard, he was catch by the camera of the gas station.
17. The clinician measured Richard's height, though he did not analyze the rate of the growth.
18. Maggie erased the student's work, but she did not erase the comments of the teacher in the margins.
- 19(VC). Angela discourage Freddie's son, but she did not discourage the creativity of the child.
20. Franklin invigorated the company's workers, so he impressed the owner of the business.
21. The student passed Cameron, and she also passed the teacher of the class.
- 22(WO).Stan conned the wife electrician's, and he eluded the detectives of the police.
23. Susan accepted Elijah, but she did not like the man of the foreign country.
24. The magician hypnotized Jacqueline, but he did not entertain the members of the audience.
- 25(WO).The stylist shampooed the customer, though she did not cut the of hair the customer.
26. The dictator traumatized the citizens, so he angered the leaders of the world.
27. Jebediah exposed the priest, so he forced the members of the congregation from the church.
- 28(VC).The editor checked the article, but she did not finds the mistake of the writer.
29. Seline threw away the old papers, and she threw away the spoiled contents of the fridge.
30. The TV host introduced the band, and they pleased the audience of the show.
31. Ricardo programmed the computer, but he did not program the software of the robot.

32. The athlete swam very fast, but she did not defeat her rivals of the foreign nations.

### **Unrelated**

1(WO).Although Suzanne exercised after work day every, she did not exercise on the weekends or on holidays.

2. Although the amateur actress auditioned for many theatrical plays, she did not audition for any movies.

3. Although Edwin moved to a new apartment, he did not move to the big city.

4. Although the author liked to write short stories, he did not write novels.

5. Although Maureen read many books in school, she did not read books about wars.

6. Although Ruth bought a new bookshelf, she did not buy the matching dresser.

7(VC).Although the artist sketch the statue, he did not sketch the ugly building behind it.

8. Although the muscular man could lift the box of books, he could not lift the piano.

9(VC).Although Lillian did not want to have children, she did wants to get married one day.

10. Although the defendant did not confess to the murder, he did confess to the various robberies.

11(WO).Although David did not work during summer vacation, he took classes three at the university.

12(VC).After Betsy returning the socks that her grandmother gave her, she bought a new pair of sneakers.

13. Before Roxanne went to the grocery store, she made a shopping list of everything she needed.

14. Although Margie liked to listen to country music at work, she did not play it too loudly.

15. After Bobby tediously climbed up the hill, he quickly rolled back down.

16(WO).Before ate she dinner, Vanessa set the plates and silverware out on the table.

17. Since Jeremiah had no roommates, he became friends with his neighbors.

18. Although the exchange student could not understand French when she arrived in France, she learned the language quickly.

19. While Sammy often listened to jazz music, he also enjoyed rap occasionally.

20. Because he had stayed up too late the night before, the college student fell asleep during class.

21. Although the pizza delivery man accidentally gave Lenny the wrong pizza, he ate it anyway.

22. Because she loved to work with little kids, Christina wanted to become an elementary school teacher.

23. Although the cheap light bulb had only been on for five hours, it burned out.

24(VC).Although Rob was scared to ride on roller coasters, he deciding to try it out.

25. Although Sabine argued with Geoffrey, she did not argue with the family.

26. After she spilled cracker crumbs on the floor, Jasmine vacuumed the new white carpet immediately.

27(WO).While she was away on vacation in Jamaica, Cheryl some bought souvenirs to take home.

28. After the brave lifeguard rescued the little girl, the onlookers applauded him profusely.

29. After traveling around Europe for six months, Maria was happy to come home and see familiar places.

30. Because Samantha was doing laundry anyway, she decided to wash the bedsheets.

31. Because it was chilly outside, Diana wore a jacket from the parking lot to the building.

32. Since Genevieve was a photographer, she often enjoyed looking at pictures.

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## BIOGRAPHICAL SKETCH

Joe Kirkham was born in Atlanta, GA on January 21, 1989 to John and Melissa Kirkham. Before he was a year old, he and his parents moved to Central Florida, where he has spent the majority of the rest of his life. He graduated from Lake Brantley High School in 2007.

Joe spent his four undergraduate years at the University of Florida. He was a member of the Florida Drumline for three years. He took part in the Linguistics Society and was eventually elected as Ombudsman. Beginning in January of 2010, he joined Dr. Edith Kaan's Brain and Language Lab as a volunteer research assistant. After earning an undergraduate research scholarship, he worked with a fellow lab member, graduate student Shuang Lu, on a research project investigating the relationship between language and music processing. He went on to win the award for Best Quantitative Research Paper among the 2011 submissions to the Journal of Undergraduate Research. In May of 2011, he graduated with degrees in linguistics and psychology.

After a summer spent traveling Europe, Joe re-enrolled as a master's student in the University of Florida's Linguistics Department. He remained a research assistant in Dr. Kaan's lab, where he began a new ERP-based project focusing on syntactic prediction. The current paper is based on the work conducted on this project.

In the spring and summer of 2013, Joe, along with Dr. Kaan, was invited to continue the syntactic prediction project at the University of Utrecht Institute of Linguistics OTS. Based on his experiences at the University of Utrecht, he has ambitions to stay abroad and expand his experimental research repertoire before continuing on to doctoral study.