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Differential Processing of Anaphors and Logophors in Self-Paced Reading

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Abstract

This paper presents a study of the processing differences found between anaphors and logophors. Previous research by Harris et al. (2000) has suggested that SELF anaphors (as described by Reinhart and Reuland (R&R) (1993) exhibit P600 effects when they do not meet the structural requirements to be bound by their antecedent. Reflexives that are not governed by R&R's version of binding (logophors), however, do not exhibit the same P600 effect when illicitly licensed. Harris et al. take this as evidence that R&R's theory of binding is correct, due to the lack of syntactic ERP effects for logophors (which they predict would be licensed by semantic/discourse considerations). I present evidence that this lack of effect is due to a different property that logophors have, which is a sensitivity to intrusive antecedents (Xiang et al. 2009, King et al. 2012), which is not shared by anaphors. In experiment 1, I reproduce a processing effect for anaphors and the lack of processing effect for mismatched logophors in a self-paced reading task. In experiment 2, I show that when intrusive antecedents are removed from those sentences, reading slowdowns are found in for both mismatched anaphors and logophors. While the results in experiment 1 and Harris et al.'s experiment provide compelling processing evidence for the conceptual distinction between anaphors and logophors, experiment 2 shows that concluding that this is due to the lack of syntactic processing is unwarranted.

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1 Introduction

Reflexive pronouns are frequently found in complementary distribution with pronouns, as we can see in (1).

- (1) a. John_i saw himself_i/*him_i.
- b. John_i saw him_j/*himself_j.
- c. The man_i told himself_i/*him_i not to trust the bookie.

This has led to theories of reflexives and their binding which try to account for this complementarity. This can be accomplished by having anaphors and pronouns require the same domains in which they must be free or bound. Thus we find in Lectures on Government and Binding (Chomsky 1981) a binding theory of the form in (2):

- (2) Principle A: Anaphors must be bound in their governing category.
- Principle B: Pronouns must be free in their governing category.

While the domain used to calculate satisfaction of the principles varies, the principles in (2) suggest that the domains should be the same, which implies a complementary distribution for anaphors and pronouns. This type of binding theory has trouble when confronted with data, like in (3).

- (3) a. John said that the picture of him_i/himself_i was appealing.
- b. John_i kept the gun near him_i/himself_i at all times.
- c. John_i knew no one liked Bill and him_i/himself_i after what had happened.
- d. The Queen invited Suzy and me/myself to tea.

Given the data in (3), any complete theory of the distribution on pronouns and reflexives must account for this overlap. There are two ways that are commonly used to deal with such overlaps. One is to allow for the local domains to be different from each other. This is the aim of most versions of the binding theory attempting to account for this data. One example is Chomsky (1986), which had pronouns require small domains in which to be free, while allowing anaphors to extend their domain to potential antecedents before incurring a violation. We also see a differentiation of the domains of pronouns and anaphors in more modern incarnations of this type of binding theories, such as Hornstein (2009).

Another option is to claim that the reflexives which overlap with pronouns are a different class of reflexives. The reflexives that are in complementary distribution with pronouns are anaphors, and other reflexives, logophors, are not subject to the same grammatical restrictions. This is the road taken by Zribi-Hertz (1989), Pollard and Sag (1992), and most notably Reinhart and Reuland (1993). These theories make the prediction that, since logophors are not subject to the same syntactic restrictions, then logophors are instead licensed by semantic or discourse restrictions.

Harris et al. (2000) examine the processing of anaphors and logophors through the lens of Electroencephalography (EEG), and come to the conclusion that the Event Related Potentials (ERPs) they find support the claim that logophors are not governed by the narrow syntax. They take this as support for i) the distinction the parser is making between anaphors and logophors, and ii) the reference of anaphors is processed syntactically, while the reference of logophors is not. In this paper, I will present results that suggest that the crucial lack of effect found for logophors in the Harris et al. study is best analyzed as a consequence of the experimental design affecting the resolution of logophor reference rather than indicating of the module in which logophors are processed.

2 Background

2.1 Reinhart and Reuland (1993)

Binding theory has long been concerned with the distribution of reflexives and pronouns. While often in complementary distribution, as noted above, there are environments where they overlap, such as the examples in (3). Reinhart and Reuland (R&R) (1993) present a theory that diverges strongly from more traditional binding theories (Chomsky 1981, Chomsky 1986, Hornstein 2009). They frame binding theory as a description of the relationship between a predicate and its arguments. Their version of the binding theory is seen in (4):

- (4) i. The syntactic predicate formed of (a head) P is P, all its syntactic arguments, and an external argument of P (subject). The syntactic arguments of P are the projections assigned θ -role or Case by P.
 ii. The semantic predicate formed of P is P and all its arguments at the relevant semantic level.
 iii. A predicate is reflexive iff two of its arguments are co indexed.
 iv. A predicate (formed of P) is reflexive-marked iff either P is lexically reflexive or one of P's arguments is a SELF anaphor.
 v. Condition A: A reflexive-marked syntactic predicate is reflexive.
 vi. Condition B: A reflexive semantic predicate is reflexive-marked.¹

We see in (4) that only arguments of predicates are subject to these binding rules. This accounts for sentences like those in (1), because the anaphors and pronouns in these sentences are arguments of the verb, and explicitly excludes reflexives like those in (3). For example, let's examine sentences like (1a) and (1b).

- (1) a. John_i saw himself_i/*him_i.
 b. John_i saw him_j/*himself_j.

In (1a), since the object and the subject of *saw* are both coindexed, then by (4iii), that predicate is reflexive. (4vi) states this syntactic predicate must be reflexive marked. (4iv) states that in order for a predicate to be reflexive marked, it must have a SELF anaphor, which *himself* is, but *him* is not. Thus, (1a) is grammatical with *himself*, but not with *him*. In (1b), we see that the subject and object are not co-indexed. Therefore, the predicate is not reflexive. This means that *him* should be allowed in (1b). *Himself* is not allowed in (1b) however. This is because the SELF anaphor reflexive-marks the predicate, and (4v) says that reflexive-marked predicates must be reflexive (which it is not).

As a counter-example, let's look at (3c).

- (3) c. John_i knew no one liked Bill and him_i/himself_i after what had happened.

In this example, we are interested in the predicate *like*, and its arguments, *no one*, as well as the constituent *Bill and him/himself*. (4vi) states that if a predicate is reflexive, it should be reflexive marked. However, this predicate is not reflexive, since *no one* is not co-indexed with the conjoined phrase *Bill and him/himself*, thus, *him* should be allowed, as there is no need for obligatory reflexive marking. Also, *himself* is allowed, as the predicate is not reflexive marked, since neither of its arguments is a SELF anaphor, but merely contains a SELF anaphor.

This is useful in describing the distribution of pronouns and reflexives because it provides a good reason for some reflexives to be exempt from binding conditions. Since these binding conditions are thought to be calculated syntactically, this implies that reflexives which are not subject to these conditions to be restricted in other ways. Since the reflexives in (3) still seem to be

¹R&R use the terminology *i-reflexive* instead of reflexive to mean that a predicate is reflexive iff at least two of its arguments are co-indexed. Similarly, predicates are *i-reflexive-marked* iff either the predicate is lexically reflexive with respect to an argument, or one of the arguments that is *i-coindexed* is reflexive.

somewhat restricted in their reference and licensing, R&R argue that they are accounted for by discourse and semantic restrictions. It is worth noting that traditional binding theories cannot avoid appealing to restrictions in other modules for certain reflexives, such as in (3d), where the reference can only be extra-sentential.

2.2 Osterhout and Mobley (1995)

An important tool used in studying sentence processing has been the ERPs that occur in the brain as a result of the processing of certain types of errors and syntactic reanalysis. A positive deflection in this signal between 500 and 800 ms after the error is referred to as a P600. This signal has been linked to the processing of many different syntactic errors, such as subject/verb agreement violations (Hagoort et al. 1993, Osterhout and Mobley 1995, Vos et al. 2001), verb inflection violations (Friederici et al. 1993, Gunter et al. 1997), and phrase structure violations (Neville et al. 1991, Hahne and Friederici 1999, Friederici et al. 1993).

There have been a number of studies of the processing of anaphor agreement (Osterhout et al. 1997, Stuart 2003, Osterhout and Mobley 1995, Xiang et al. 2009, Harris et al. 2000). I will examine two in detail. One is Osterhout and Mobley (1995) which establishes that anaphors elicit a P600 response when they do not agree with their antecedent. The second is Harris et al. (2000), which claims that the lack of a P600 response to mismatched logophors can be seen as evidence for R&R's version of binding, since licensing of logophors is extra-syntactic.

Osterhout and Mobley (1995) show that the P600 is sensitive to the processing of mismatched anaphors. Sentences like the ones in (5) were used to elicit ERPs, with the goal of showing that processing the agreement mismatch would elicit a P600 due to the syntactic nature of binding. In sentence (5a), the reflexive is plural in order to agree with the plural subject (*children*), whereas in (5b), the reflexive is singular to mismatch with the subject. Measurements of the ERPs are taken after the reflexives are presented in both conditions.

- (5) a. The persistent children ingratiated themselves with the train conductor.
 b. *The persistent children ingratiated himself with the train conductor.

In the first experiment, subjects were asked to give acceptability judgments after each of the sentences. The comparison between matched and mismatched anaphors showed that the disagreeing condition elicited a P600.

Osterhout and Mobley were concerned that the effect might be specifically related to the task given.² Since the task can be seen as responding to the question of grammaticality of the sentence, the concern was that when the reflexive did not agree with the subject, the participant knew at that point the answer to the task would be that the sentence was ungrammatical. In order to test for this in the second study, the subjects were told to read the sentences carefully, but no other task was assigned. In this case, no P600 was elicited from this task.

Osterhout and Mobley suggest that the structures in which the reflexive did not have proper agreement with the antecedent only elicit the P600 when the subject is paying sufficient attention to the structure as a result of the grammaticality judgment task. The lack of effect when there was no task suggests that the subjects simply were not as attentive to the error without the prompt of the task. We know that the P600 can be attenuated by task demands in other domains, as seen in Hahne and Friederici (2002) and Hasting and Kotz (2008). While this tells us that the P600 can be sensitive to the mismatch in agreement between reflexives and their antecedents, it is necessary that participants be actively considering the structure of the sentence when processing.

2.3 Harris et al. (2000)

Harris et al. (2000) test R&R's claim that reflexives that are arguments of reflexive predicates are processed by a different module (the syntax) than those that are not (extra-syntactically in either the

²Also, Osterhout and Mobley voice concern that the P600 effect is left over from a separate effect, known as the P300, which is reported to correspond to task-related stimuli (Donchin 1981, Donchin and Coles 1998).

semantics or discourse). They examine the ERPs of anaphors and logophors in mismatch contexts much like Osterhout and Mobley. If different types of reflexives are processed by different modules of the grammar, it would be reasonable to expect this would be reflected in the neurological reactions to stimuli with those reflexives. They have four conditions to see the effects of processing mismatched anaphors and mismatched logophors in (6).

- (6) a. The pilot's mechanics brow-beat themselves after the race.
- b. *The pilot's mechanics brow-beat himself after the race.
- c. The pilot's mechanics brow-beat Paxton and themselves after the race.
- d. *The pilot's mechanics brow-beat Paxton and himself after the race.

The sentences in (6a) and (6b) both contain anaphors. The reflexive in (6a) agrees with the subject *mechanics*, which is expected in any theory of binding. This is compared to the reflexive in (6b) that agrees with *pilot*, which is not a licit antecedent for the reflexive. The key feature in this experiment is the second potential antecedent, which is inside the subject DP but does not c-command the reflexive. Harris et al. use it to ensure that a reader will see a potential antecedent with matching phi-features in the sentence for (6b), but then realize that the syntactic relationship between them is not sufficient to satisfy the syntactic requirements of binding. The expectation is that when the error in binding is realized, a P600 effect will be elicited due to the syntactic nature of the violation. Specifically, under a R&R theory of anaphor binding, the violation is incurred because *pilot* and *himself* are not co-arguments of the predicate *brow-beat*. This contrasts with a traditional binding theory, where the explanation would be the lack of a c-command relationship between the illicit antecedent and reflexive.

(6c) and (6d) were compared to look for the same effect in logophors, since reflexives in conjoined DPs are not arguments of the predicates, and are therefore not subject to the same restrictions as anaphors in a reflexivity theory. In this case, a traditional binding theory would still predict that the error would be syntactic in nature, since the reflexive is still subject to Principle A, thus eliciting a P600 effect. On the other hand, R&R would suggest that since the reflexive is not a co-argument of the predicate (rather the conjunction, which the reflexive is a part of, is the co-argument), there would not be a P600 effect, since the licensing of the reflexive would be governed by non-syntactic considerations.

Harris et al. found that, when compared, we see a P600 effect for the anaphors, but no effect for logophors (P600 or otherwise). Much like the Osterhout and Mobley (1995) study, a positive deflection in the centroparietal region for disagreeing anaphors begins around 500ms and lasts for the remainder of the ERP window. This stands in contrast to the logophors where Harris et al. show that disagreeing and agreeing logophors show no significant difference over the course of their ERPs. While both R&R's theory and a traditional binding theory both predict a P600 for the anaphor condition, the lack of one in the logophor condition seems at first glance to be a point in the favor of R&R's binding theory.

However, there are experimental design issues with the Harris et al. (2000) study. For example, the position of the logophor in the Harris et al. sentences is problematic. The extra potential antecedent in the Harris et al. study could in fact be masking a would-be effect due to subjects mistaking it for a licit antecedent, or what can be called an intrusive antecedent. However, we do not see this effect in the anaphor condition. While some studies indicate that reflexives are immune to intrusive licensing effects (Xiang et al. 2005), King et al. (2012) suggests that the picture might be more complicated than that. King et al. specifically point out that reflexives immediately after the verb are less susceptible to intrusive antecedents than those that are more distant. This might mean that the Harris et al. results are simply the consequence of the position of the logophors and anaphors, or that they behave differently with respect to intrusive antecedents.

2.4 King et al. (2012)

While Harris et al. assume that a second potential antecedent is necessary to obtain the P600 effect, the King et al. (2012) study shows that this design choice could be problematic, given that the position of the reflexives seems to be sensitive to intrusive licensing effects.

When examining eye-movements for reading sentences like (7), King et al. note that there is a significant overall slowdown in the first fixation on the reflexive when the reflexive is separated from the verb, like in (7b), when compared to sentences in which the verb and reflexive are adjacent (7a). Also, there is a large effect of gaze duration when the separated reflexive disagrees with the subject, but agrees with the intrusive antecedent. In addition, regression from the reflexive was significantly more frequent in separated reflexives than adjacent reflexives.

- (7) a. The bricklayer who employed Gregory/Hellen shipped himself/herself sacks of mortar...
 b. The bricklayer who employed Gregory/Hellen shipped sacks of mortar to himself/herself
 ...

In King et al.'s self-paced reading study, they show an overall difference in the reading times for the word after separated reflexives (compared to adjacent reflexives). We also notice that while the slowdown for adjacent reflexives that do not agree with the subject is unaffected by the intrusive antecedent, we see a very large facilitation in reading times in the word after separated reflexives that do not agree with the subject, but do agree with the intrusive antecedent. This suggests post-verbal and non-post-verbal reflexives are processed differently in the presence of a non-licensing referent.

Since reflexives that are immediately post-verbal are resistant to the processing costs of intrusive antecedents in a way that reflexives removed from the verb are not, it might be that the Harris et al. results were not driven by a distinction between anaphors and logophors, but instead were driven by a difference in the position of reflexives. Looking again at their sentences (repeated here in (8)), we see that each of them has a possessor in the subject.

- (8) a. The pilot's mechanics brow-beat themselves after the race.
 b. *The pilot's mechanics brow-beat himself after the race.
 c. The pilot's mechanics brow-beat Paxton and themselves after the race.
 d. *The pilot's mechanics brow-beat Paxton and himself after the race.

Following King et al., it is reasonable to think that the possessor in the subject (*pilot's*) has no effect on the processing of the reflexive as a result of being a potential intrusive antecedent for (8a) and (8b) because the reflexive in those sentences is immediately after the verb. However, if the King et al. data is a reflection of reflexives generally (not just anaphors), then we would expect that the possessor in (8c) and (8d) might make a reader think it is a potential antecedent to the reflexive, since we know that reflexives that are not immediately post-verbal can be affected by intrusive antecedents. This would cause them not to notice the error in (8d) immediately, which might eliminate or attenuate a P600 effect, since the effect is contingent on noticing a lack of agreement. This leaves us with two possible explanations for the lack of a P600 effect for mismatched logophors in the Harris et al. study. Harris et al. suggest that the agreement of logophors is not processed by the syntax, but rather the semantics, and therefore we would not expect to see the syntactic P600. The other possibility is that the reader has not noticed the mismatch between the logophor and the subject due to the intrusive antecedent, and thus the P600 is not there or is delayed until the reader notices.

3 Self-Paced Reading

Self-paced reading studies provide online measures for sentence processing. As such, they provide a behavioral substitute for EEG which specifically looks at the online processing of events, and examine temporal aspects of processing most precisely. These experiments will look at sentences similar to those used by Harris et al. (2000) to determine whether the lack of a P600 effect can reasonably be attributed to logophor licensing being extra-syntactic, or whether the lack of result is from intrusive antecedents in the possessor.

3.1 Experiment 1

3.1.1 Methods

48 undergraduates participated in this study. All subjects were speakers of American English.

Two major changes have been made to the sentences used in Harris et al. The first is a change in the position of the reflexives. While the anaphors in Harris et al.'s sentences are immediately after the verb, the logophors occur two words later, with an intervening potential referent. In order to avoid this, I have reversed the order of the two conjuncts in the logophors sentences. This alone will garden path readers into thinking the reflexive is an anaphor. Therefore, the object of every sentence is given a quantifier to indicate which type of reflexives might follow. You can see in (9) that both reflexives are in the same position relative to the verb, and that the quantifier *only* implies that the following reflexive is an anaphor,³ while *both* signals a logophor will follow, since the object must be conjoined. Additionally, an extra referent was added after the reflexive, which will be used for the comprehension task after 1/3 of the trials.⁴ Lastly, sentence lengths were equalized by removing a modifier from the end of the sentence in the logophor conditions.

- (9) a. The diver's teammates congratulated only themselves on the trainers' new discovery earlier.
 b. The diver's teammates congratulated only himself on the trainers' new discovery earlier.
 c. The diver's teammates congratulated both themselves and Rick on the trainers' new discovery.
 d. The diver's teammates congratulated both himself and Rick on the trainers' new discovery.

There were 4 lists of stimuli, so that each participant only saw one of the four conditions from each set of test sentences. Each participant saw 15 sentences from each condition, for a total of 60 test sentences. Half of the sentences from each condition had plural subjects with singular possessors, while the other half had singular subjects with plural possessors. There were 120 filler sentences, of which 50% were meant to be grammatical. The ratio of fillers to test sentences was 2:1. Sentences were randomized per subject to minimize ordering effects.

3.1.2 Procedure

Subjects read sentences in a self-paced reading moving window paradigm. Each word was displayed separately, and time spent on each word was recorded. Subjects could anticipate the number of words in each sentence, as each word had an underline where it would appear.

After 1/3 of the trials, a question about the sentence was presented. Subjects were asked to identify the theme of the verb from two possible referents to choose from. Since the possessors will not be present in experiment 2, the post-verbal referent is used as the competitor. Subjects would respond with button presses corresponding to each answer.

3.1.3 Results

Reading times were taken from each word, and grouped by distance from the target reflexive (T in Figure 1). Reaction times are log transformed. T-tests were performed comparing agreeing and disagreeing reflexives at each word for both logophors and anaphors. Significant differences were found only in the anaphor condition, one and two words after the target reflexive. The reaction time for the first word after the disagreeing anaphor was significantly longer the agreeing anaphor [$t(47)=2.43, p=.02$]. This was also found two words after the target [$t(47)=3.16, p=.003$]. There was also an anomalous difference at three words before the target anaphor, but since all of the sentences were identical until this point, this result is uninterpretable.

³While a conjoined object with *only* would be grammatical, the minimal assumption at the reflexive is that it is the object of the verb and would be an anaphor under Reinhart and Reuland's (1993) analysis.

⁴This is done to ensure that readers are being attentive, in order to avoid the lack of effect found by Osterhout and Mobley (1995) when running a reflexive ERP experiment without a task.

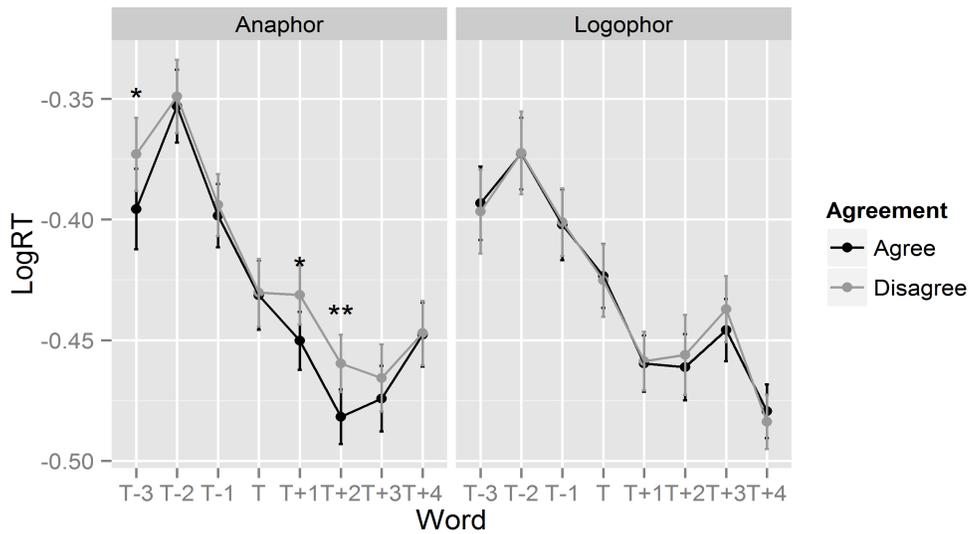


Figure 1: Experiment 1 self-paced reading results

3.1.4 Discussion

This experiment reproduces the results from Harris et al. (2000), as we see a clear separation between disagreeing and agreeing anaphors after the target, and no significant separation in the logophor condition. This shows that the difference between anaphors and logophors cannot be reduced to the position of the reflexive relative to the verb. With relative position ruled out, we can conclude that anaphors and logophors are processed differently. However, it remains a question as to whether this is a result of the module which they are governed by or how they interact with intrusive antecedents. It is the central claim of Harris et al. that the reason for differential processing effects is the separate licensing modules for anaphors and logophors. Differentiating these two claims will be the goal of the experiment 2.

3.2 Experiment 2

3.2.1 Methods

31 undergraduates participated in this study. All subjects were speakers of American English.

Since the goal of this experiment is to separate the processing of anaphors and logophors from the processing of intrusive antecedents, the subject possessors from experiment 1 are removed. The resulting sentences are in (10).

- (10) a. The teammates congratulated only themselves on the trainers' new discovery earlier.
- b. The teammates congratulated only himself on the trainers' new discovery earlier.
- c. The teammates congratulated both themselves and Rick on the trainers' new discovery.
- d. The teammates congratulated both himself and Rick on the trainers' new discovery.

These new sentences ensure that at the reflexive, the only potential referent is the subject. Then we can expect that any results will be due to the processing of the reflexives themselves, not any intrusive antecedents. All other aspects of the experiment remain the same as experiment 1.

3.2.2 Procedure

The procedure was the same as experiment 1, but with the altered sentences.

3.2.3 Results

Reading times were taken from each word, and grouped by distance from the target reflexive (*T* in Figure 2). Reaction times were log transformed. T-tests were performed comparing agreeing and disagreeing reflexives at each word for both logophors and anaphors. Significant results were found for both anaphors and logophors after the target reflexive. The reading time for the first word after the disagreeing anaphor was significantly longer than for the agreeing anaphor [$t(30)=2.37, p=.02$]. This was also true three words after the target anaphor [$t(30)=2.06, p=.05$]. Two words after anaphor, there was no significant difference, but the difference is the same direction. The reaction time for one word after the disagreeing logophor was significantly longer than for agreeing logophors [$t(30)=2.31, p=.03$]. This was also true for two words after the target logophors [$t(30)=2.15, p=.04$].

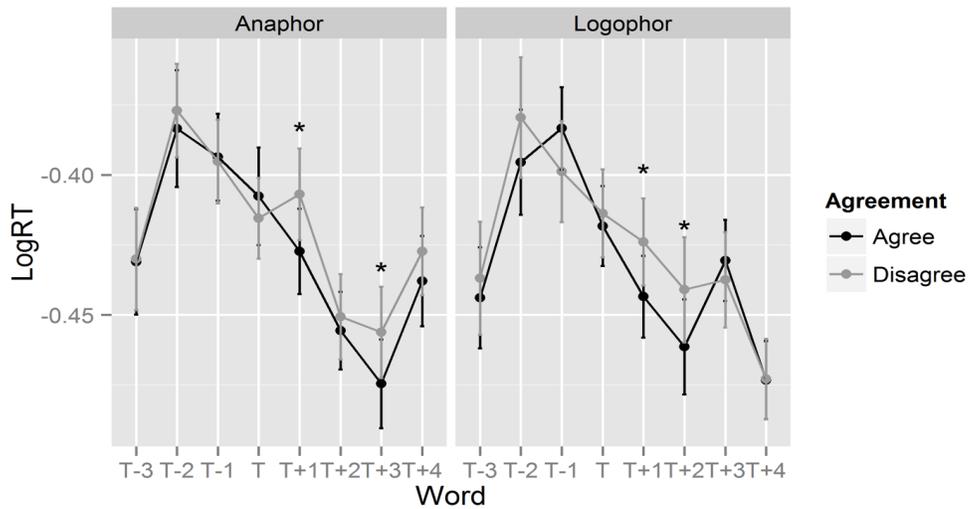


Figure 2: Experiment 2 self-paced reading results

3.2.4 Discussion

These results show that both anaphors and logophors incur reading slowdowns when they disagree with the subject of the sentence in the absence of other potential referents. This sheds light on the results in Harris et al. (2000). Harris et al. claim that the lack of a P600 is due to the module that governs anaphors being different from logophors. However, this study shows that such a claim is

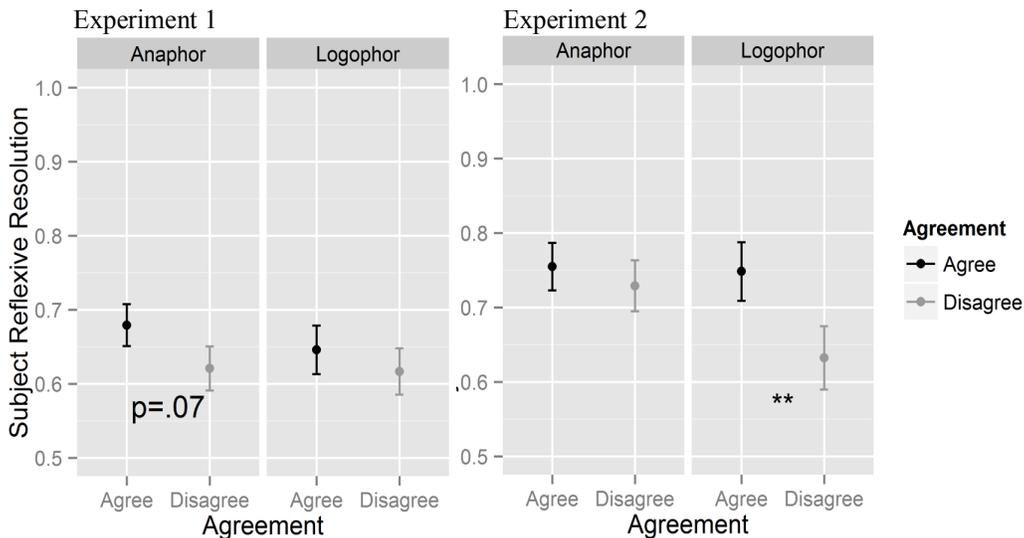


Figure 3: Frequency of resolving the subject as the antecedent of the reflexive in both experiments

too strong, as a similar missing effect in experiment 1 can be reintroduced by removing intrusive antecedents. Therefore, it is reasonable to believe that the lack of a P600 in the Harris et al. study was simply the result of how logophors are processed with intrusive antecedents.

While the conclusions of Harris et al. might have been premature, we see in Figure 3 that there is a difference in how subjects are resolving the antecedent of the anaphors and logophors. Recall that the task was a choice between the subject and a post reflexive referent as the antecedent for the reflexive. We see in experiment 1 that the level of choosing the subject as the antecedent is fairly low when compared to the anaphors and the agreeing logophors in experiment 2. When there are less discourse referents (experiment 2), we see that agreeing logophors are more frequently associated with subjects than disagreeing logophors [$t(30)=2.89, p=.007$]. This still conforms to the idea that the processing of anaphors and logophors differs. We see that when a logophors cannot be matched with a sentential antecedent, responses remain flexible, even though the post-reflexive referent is clearly not an available antecedent from the discourse. This similarity between agreeing logophors and anaphors more generally, however, might point to them using similar antecedent resolution mechanisms, which could suggest that they are both able to be calculated in terms of the narrow syntax, but logophors have other methods by which to obtain antecedents in the semantics/discourse.

3.3 General Discussion

The results from Harris et al. and these experiments provide ample evidence for the differential processing of anaphors and logophors. One of the relevant distinctions in their processing is their interaction with intrusive antecedents. When there are intrusive antecedents present, we can see that anaphors do not consider them as potential referents, and thus incur cost in the resolution of the antecedent. Logophors, on the other hand, seem to be satisfied by the intrusive antecedent, and thus there is no slowdown when the subject does not agree with a logophor.

The question of whether the difference in processing reflects the different grammatical modules that govern the licensing of these reflexives remains open. While R&R (1993) suggest that this should be the case, this is not a conclusion we can make from either the Harris et al. data or the experiments presented here. While these experiments confirm the differential processing of anaphors and logophors, that difference is predicted by both the R&R theory, as well as traditional binding theories, which assume non-syntactically licensed reflexives also.

Also, we know that not all logophors are treated the same. R&R predict that all of the reflexives in (3) are logophors, and should get antecedents from the discourse, but as we can see in (11) and (12), different logophors allow different types of antecedents, but their theory does not predict this.

- (11) Max_i said that Suzy invited Mary and himself_i to the ball.
- (12) *Max_i said that Suzy saw a picture of himself_i on the shelf.

Given that both traditional binding theories and reflexivity theories predict the presence of logophors that must be able to be licensed extra-syntactically, the lack of effect in Harris et al. is not evidence for a difference in governing module. Crucially, this study shows that when you remove intrusive antecedents, anaphors and logophors have similar reading times. The resistance of anaphors to the processing effects of intrusive antecedents is predicted by both King et al. (2012) and Xiang et al. (2009). This leaves open the possibility of both syntactically associated ERPs as well non-syntactically associated ERPs could occur in response to disagreeing logophors. Distinct ERPs from those seen in disagreeing anaphors might even be predicted by the difference in how disagreeing anaphors and logophors are resolved in experiment 2, as disagreeing logophors seem to be flexible in their reference during processing. Testing this distinction using ERPs without the confound of intrusive antecedents will be a topic I leave to further research.

4 Conclusion

This study examines the processing correlates of the anaphor/logophor distinction, and takes a critical look at previous findings that have done so. While neurolinguistic and psycholinguistic

research can be a useful testing ground for the predictions made by a theory, the processing data that results, much like any data, interacts with a wide variety of factors. Here we see the interaction of syntactic antecedent calculation, agreement, and the types and availability of discourse referents. We see that all of these interacting factors affect the processing of reflexives. Crucial to this type of study is a care in controlling for these interactions. The Harris et al. data provides a crucial look into the processing of these reflexives, and this study provides important clarification of those results and their implications for the modules of the grammar that govern reflexive licensing. Both the previous and present studies provide fertile ground for further neurolinguistic and behavioral inquiry into the nature of logophors and their processing.

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