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How to Make a Pronoun Resumptive

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1. Introduction

In order to process a sentence like (1-a), the filler ('a zoo') must be interpreted in a later gap position. To do this, shortly after encountering the filler, the comprehender actively commits to a gap site (Crain & Fodor, 1985; Stowe, 1986; Traxler & Pickering, 1996). This can be demonstrated with the filled-gap effect. In a sentence like (1-b), processing difficulty occurs at the object 'the otter', implying that comprehenders had initially attempted to interpret 'a zoo' as the object of 'saw', and thus had to reanalyze the sentence upon detecting conflicting bottom-up input. Importantly, this process of active dependency formation is suppressed in syntactic island contexts. This suggests that grammatical principles faithfully and rapidly constrain active dependency formation processes (Phillips, 2006; Yoshida et al., 2014).

- (1) a. St. Louis has a zoo that I went to __
b. St. Louis has a zoo that I saw an otter at __

However, fillers can be associated with 'resumptive pronouns' in island contexts (Ross, 1967), as demonstrated in (2-a)¹. Resumptive dependencies are thought to be ungrammatical in English. Resumptive dependencies do not exhibit the syntactic and semantic characteristics of well-formed A'-chains (Chao & Sells, 1983). Additionally, they are assigned low ratings in formal judgment studies (Alexopoulou & Keller, 2007; Heestand et al., 2011). Instead, resumption in English is thought to be a repair strategy employed by the producer to fix a planned ungrammatical sentence (Kroch, 1981; Ferreira & Swets, 2005).

- (2) a. St. Louis has a zoo that [the first time I went to it] I saw an otter exhibit
b. *St. Louis has a zoo that [the first time I went to __] I saw an otter exhibit.

Although resumption in English is ungrammatical, it facilitates comprehension. For instance, comprehenders assign higher ratings to resumption when directly asked about the comprehensibility of the sentence (Beltrama & Xiang, 2016). Similarly, sentences with resumption are accepted when explicitly contrasted against the equivalent sentence with an island violation (Ackerman et al., 2018). Additionally, processing time is reduced after a resumptive pronoun for long filler dependencies (Hofmeister & Norcliffe, 2013). This suggests that the comprehender is capable of constructing an (ungrammatical) resumptive dependency in real-time. Taken together, these results present a paradox for the theory of filler-gap dependency processing: If active gap formation processes are faithful to grammatical constraints, then how are ungrammatical resumptive dependencies entertained in real-time?

In this paper, I argue that comprehenders do not actively construct resumptive dependencies. Instead, resumption is an anaphoric dependency that is constructed when the

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¹ Example produced by Griffin McElroy on the podcast Cool Games Inc., Episode 51: 'The Prestige Goose'.

comprehender has failed to maintain an expectation of a gap. To support this proposal, I show that resumption becomes more acceptable when working memory capacity is strained, either by making a sentence longer or introducing an language-external constraints on working memory.

2. A Previous Account

Chacón (2015) presents an account for how the English-speaking comprehender constructs resumptive dependencies on-line. His account builds on previous work, which argues that resumption in English is ultimately an anaphoric dependency that resolves the filler dependency (Erteschik-Shir, 1992). On his proposal, shortly after encountering the filler, the comprehender actively constructs a representation of the gap, in which the thematic role of the filler is grammatically discharged (Pritchett, 1991; Aoshima et al., 2004). However, if the comprehender encounters a pronoun in a syntactic island before reaching the anticipated gap, and if the pronoun and filler corefer, then the filler’s thematic role is identified with the thematic role of the pronoun instead. In a sentence like (2-a), the comprehender first commits to an analysis in which ‘the zoo’ binds a thematic role in the upcoming predicate. However, upon encountering ‘it’, the comprehender reanalyzes sentence such that ‘the zoo’ is understood as the object of the preposition ‘to’. Chacón proposes that the gap is therefore no longer necessary for constructing a coherent interpretation of the sentence, and thus the expectation for the gap is abandoned, even if it results in a syntactically ill-formed sentence. This process is sketched in (3).

- (3)
- a. Step 1: Build gap at filler
St. Louis has a zoo ...([_{VP} _])
 - b. Step 2: Resolve anaphoric dependency of pronoun
St. Louis has a zoo_i that the first time I went to it_i ...([_{VP} _])
 - c. Step 3: Abandon gap
St. Louis has a zoo_i that the first time I went to it_i ...([_{VP}])

In a sentence completion task, Chacón found that sentences containing an unresolved filler dependency and a pronoun were completed with gaps less often than controls. For instance, a sentence like (4) was more likely to be completed with a gap-less completion (e.g., ‘would offend the bride’) than a gapped completion (e.g., ‘would offend _ ’), in which the filler ‘which groomsman’ is understood as the object of the verb. However, the error rates were quite high (over 20%), and this result was not robust in judgments or reading-time data (Chacón, 2015; Lakhani & Chacón, 2016). Thus, the status of this interaction between pronoun interpretation and active gap formation is questionable.

- (4) The bridesmaid wondered which groomsman [_{NP} the speech that he prepared] ...

Furthermore, these results are challenged by studies on the processing of ATB configurations. In these structures, a filler must be associated with multiple gaps, each in a different conjunct. Wagers & Phillips (2009) and Parker (2017) found that, after encountering the first gap, comprehenders continued actively constructing gaps in later conjuncts. This demonstrates that comprehenders do not ‘turn off’ expectations for a gap after identifying a thematic role for the filler, in contrast to Chacón’s proposal.

3. The Revised Account

As discussed above, on the account given by Chacón (2015), active dependency formation processes are constrained by grammatical principles. However, revision processes are not – comprehenders abandon a grammatically sanctioned filler-gap dependency in favor of an ungrammatical resumptive dependency. Like this previous account, I argue that resumption ultimately relies on an anaphoric dependency built between the pronoun and the unresolved filler. However, I argue that resumption is only considered when comprehenders had already forgotten the gap.

Upon encountering a filler, the comprehender builds a representation of the predicate

containing a gap. This is necessary in order to assign a grammatically-licensed thematic role to the filler. This representation must be maintained over time in working memory². However, this representation is susceptible to decay over time (Van Dyke & Lewis, 2003; Lewis & Vasishth, 2005), and may be hindered by other linguistic material that must be stored in working memory during processing. While processing long dependencies or syntactically complex constructions, such as island constructions (Kluender, 2004; Hofmeister & Sag, 2010), the comprehender may not successfully maintain the representation of the gapped predicate. This results in decreased sensitivity to ungrammatical continuations of the sentence, i.e., comprehenders are less likely to notice if the filler successfully binds a gap. However, failing to maintain the gap also results in an incoherent interpretation, since the filler no longer is assigned a thematic role, and thus has no semantic relation to the rest of the sentence. When the comprehender encounters a pronoun, the comprehender normally searches for an antecedent. If the filler is identified as the pronoun’s antecedent, then the filler can be related to the sentence. Thus, sentences like (2-a) or (5-a) are ungrammatical, because the filler does not bind a gap. But, the anaphoric relation allows recovering a coherent interpretation for the ungrammatical sentence. Conversely, a sentence like (5-b) is both ungrammatical and incoherent, because the the filler cannot be related to the sentence, due to the lack of a possible anaphoric relation between the filler and pronoun. This process is sketched in (6).

- (5) a. * This is the maid that the butler said that her friend doesn’t like kids.
 b. */# This is the maid that the butler said that his friend doesn’t like kids.
- (6) a. Step 1: Build gap at filler
 St. Louis has a zoo ...([_{VP} _])
 b. Step 2: In syntactically complex contexts, gap is lost
 St. Louis has a zoo that the first time I ...
 c. Step 3: Resolve anaphoric dependency of pronoun
 St. Louis has a zoo_i that the first time I went to it_i

On this account, resumption “helps” by permitting an ungrammatical-but-coherent analysis. Importantly, this happens only when the comprehender has failed to maintain a representation of the gap (or gapped predicate). This may explain the distributional differences between resumption and gaps, since typically comprehenders prioritize constructing filler-gap dependencies, and resumption only is considered when this process breaks down. Additionally, this may explain why Chacón (2015) only found the ‘resumptive effect’ in studies with complex materials and high error rates. In this paper, I test three predictions of this proposal: (1) increased processing difficulty leads to a higher acceptance rates for “gapless” fillers, (2) coreference between pronoun and filler increases acceptability, but (3) only when strain on working memory is increased. In the next section, I show four experiments that support these predictions.

4. Experiments

4.1. Experiment 1

The goal of Experiment 1 was to demonstrate that resumption is generally rejected in English. For this, we used a speeded acceptability judgment task. In this experiment, sentences were displayed centered on the screen one word at a time, at a presentation rate of 300ms. After the entire sentence was presented, participants were asked to rate it as acceptable or unacceptable. There were 53 participants recruited from Amazon’s Mechanical Turk, and the study was conducted on IbexFarm. Participants were compensated \$1.50 for 15–20 minutes.

Each sentence contained a cleft dependency and a pronoun that may be interpreted as resumptive. I manipulated whether the final predicate of the sentence contained a grammatically licensed gap for the cleft dependency to resolve with (\pm Gap). The +Gap sentences contained a strongly transitive verb missing an argument, and the –Gap sentences contained a strongly

² The comprehender also likely maintains some representation of the filler (Wanner & Maratsos, 1978; Wagers & Phillips, 2014).

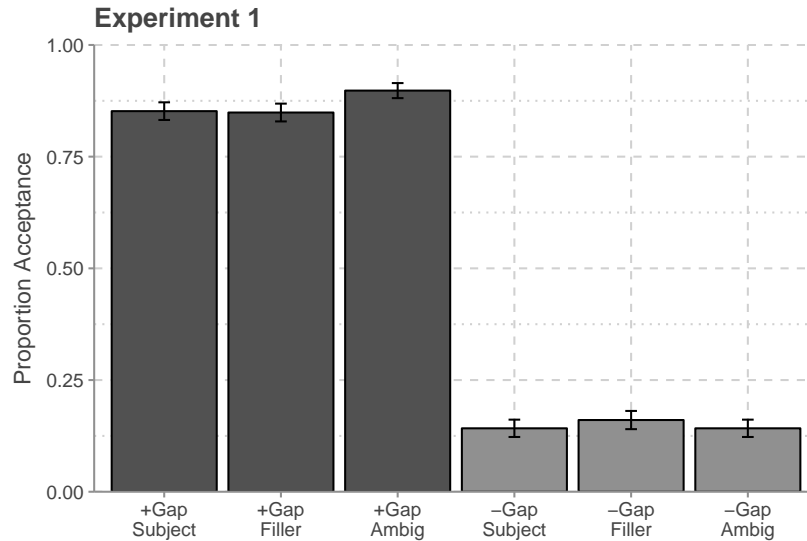


Figure 1: Mean acceptance rates by condition from Experiment 1, with error bars representing one standard error from the mean.

intransitive verb, or a verb with an NP object. The potentially resumptive pronoun was a possessor of a subject NP. Subject NPs are islands, but are also arguably not overly syntactically complex, and therefore less likely to overburden working memory. The stereotypical genders of the filler NP and a distractor subject NP were manipulated, to control the interpretation of the pronoun. This factor (Reference) had three levels: Filler, Subject, Ambiguous. The items are exemplified in (7). There were 36 items, and 32 complexity-matched fillers (50% ungrammatical). The target items and fillers were presented in random order, and the target items were distributed across four lists in a Latin Square design.

- (7) a. Subject, {+Gap / -Gap}
 The maid said that this is the butler that her friend
 { really highly recommended __ / doesn't like kids }
- b. Filler, {+Gap / -Gap}
 The butler said that this is the babysitter that her friend
 { really highly recommended __ / doesn't like kids }
- c. Ambiguous, {+Gap / -Gap}
 The maid said that this is the babysitter that her friend
 { really highly recommended __ / doesn't like kids }

The +Gap conditions are predicted to be accepted, and the -Gap conditions rejected. If resumption is grammatical in English, then in the -Gap, Filler condition, coreference between the filler ('the babysitter') and the pronoun should increase acceptance rates, compared to the -Gap, Subject condition, in which the pronoun cannot refer to the filler. Similar predictions are made for the -Gap, Ambiguous condition. Conversely, if resumptive dependencies are only considered when the representation of the gap has been lost, then there is no predicted effect of Reference. This is because the dependency is short – the only word separating the filler and the pronoun is the complementizer 'that'. Thus, the comprehender is sure to maintain the filler by the time the pronoun is encountered.

The mean acceptance rates by condition are shown in Figure 1. For analysis, the results were analyzed using a logit mixed effects model, with acceptance rates as the dependent variable, with \pm Gap, Reference, and their interaction term as fixed effects, and with random slopes by participant and item for Gap, Reference and their interaction term. The Reference factor was sum-coded. We also conducted pairwise comparisons between the three Reference conditions

within +Gap and within -Gap with Tukey HSD adjustments for multiple comparisons.

Most notably, there was a main effect of \pm Gap ($\hat{\beta} = 2.69 \pm 0.23, z = 11.73, p < 0.01$), with the +Gap conditions overwhelmingly accepted, and the -Gap conditions overwhelmingly rejected. However, there was no main effect of Reference nor any significant interaction (all $ps > 0.05$). Similarly, all planned pairwise comparisons were not significant (all $ps > 0.05$).

Thus, the results from Experiment 1 show that, in general, comprehenders only accept sentences in which fillers bind gaps, even if there is a potentially resumptive pronoun embedded in a syntactic island. This is reflected in the similar ratings across all three conditions within the -Gap level. If resumption is a strategy that only occurs when a representation of the gap has been lost, then this result is expected. The materials in Experiment 1 were purposefully constructed to avoid overburdening working memory. In Experiment 2, we increase strain on working memory by increasing the length between the filler and the pronoun. This allows more time for the representation of the gap to decay, and also increases the amount of linguistic material that must be processed between the filler and the pronoun, increasing the likelihood that the gap is lost.

4.2. Experiment 2

The goal of Experiment 2 was to determine whether resumption improves the acceptance rates of sentences that contain a longer cleft dependency than in Experiment 1. The task in Experiment 2 was identical to the task in Experiment 1. There were 60 participants in Experiment 2, recruited from Amazon’s Mechanical Turk.

The materials for Experiment 2 were similar to the materials in Experiment 1. However, the cleft dependency was located in the main clause in the target items, and the non-filler subject NP came after the filler. The materials are exemplified in (8).

- (8) a. Subject, {+Gap / -Gap}
This is the butler that the maid said that her friend
{ really highly recommended __ / doesn’t like kids }
- b. Filler, {+Gap / -Gap}
This is the babysitter that the butler said that her friend
{ really highly recommended __ / doesn’t like kids }
- c. Ambiguous, {+Gap / -Gap}
This is the babysitter that the maid said that her friend
{ really highly recommended __ / doesn’t like kids }

The re-ordering of sentence means that there is increased distance between the filler and pronoun. On my proposal, resumption should be more acceptable in this experiment, because there is an increased chance that comprehenders lose the representation of the gap. For the same reason, the -Gap conditions should be rated more highly overall compared to Experiment 1.

The mean acceptance rates are given in Figure 2. To analyze the results, we constructed a logit mixed effects model with the same parameters as in Experiment 1. As before, there was a main effect of \pm Gap ($\hat{\beta} = 1.07 \pm 0.12, z = 9.25, p < 0.01$), reflected in the higher acceptance rates for the +Gap sentences and the lower rates for -Gap. There was also a significant interaction for \pm Gap and one of the Reference coefficients ($\hat{\beta} = -0.34 \pm 0.11, z = -2.97, p < 0.01$). Additionally, planned pairwise comparisons revealed that the -Gap, Filler condition was accepted more frequently than the -Gap, Subject condition ($\hat{\beta} = 0.63 \pm 0.26, z\text{-ratio} = 2.47, p = 0.04$). Although it was accepted more frequently, a one-tailed binomial test revealed that -Gap, Filler conditions were not accepted more than chance ($p = 0.32$).

The increased acceptance rates in the -Gap conditions overall in Experiment 2 suggest that comprehenders were generally failing to maintain the expectation for a gap due to the increased dependency length. Additionally, the contrast between -Gap, Filler and -Gap, Subject in Experiment 2 demonstrates that the availability of an anaphoric relation between the unresolved filler and the pronoun mitigates the unacceptability of gaplessness. Finally, the fact that this effect was only detectable in Experiment 2, but not Experiment 1, suggests that the anaphoric

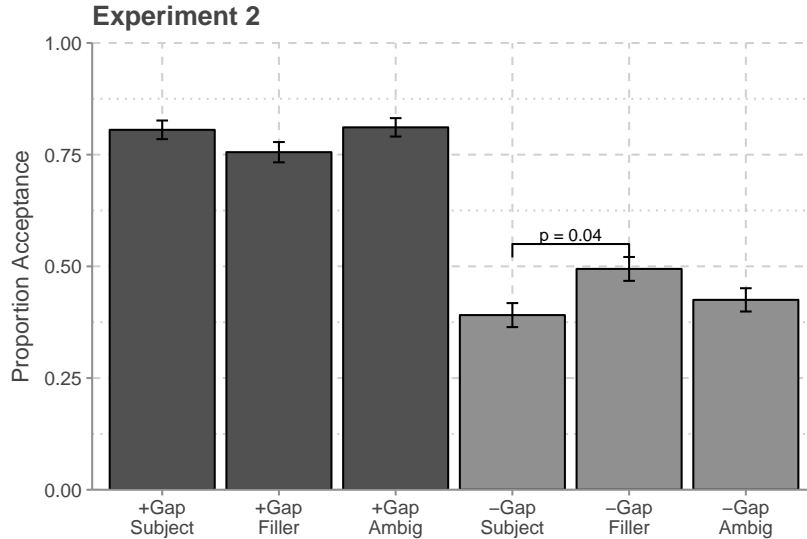


Figure 2: Mean acceptance rates by condition from Experiment 2, with error bars representing one standard error from the mean.

dependency increases acceptance rates only when the representation of the gap was susceptible to loss. These results support the hypothesis that comprehenders prioritize resolving a filler with an expected gap. But, when comprehenders forget the gap, anaphora allows for recovering a coherent interpretation.

Importantly, my account of resumption makes no specific reference to syntactic locality or islandhood. Instead, my account crucially relies on the status of a gap representation in working memory, and islands are only relevant insofar as they affect working memory resources. To test this, Experiments 3 and 4 are replications of Experiments 1 and 2 with an additional task that is designed to strain working memory resources external to the sentence. The prediction is that this should overall increase acceptance rates for the $-$ Gap conditions, i.e., increase the baseline acceptance of ungrammatical sentences overall, including resumptive dependencies.

4.3. Experiment 3

The goal of Experiment 3 was to determine whether external strain on working memory impacts the acceptability of gapless fillers in general, and sentences with resumption specifically. Experiment 3 used the same design and materials as Experiment 1. However, the speeded acceptability judgment task was flanked with a word list memorization task. Before the sentence was displayed, participants were shown a list of three monomorphemic nouns for 1000ms. After participants judged the sentence, they were given a probe word, and were instructed to respond whether the probe word was in the word list. Participants therefore needed to maintain the word list in working memory, decreasing the likelihood that the representation of the gap will be faithfully maintained. Thus, I predict increased acceptance rates across the board for the $-$ Gap conditions, and increased acceptance rates specifically for the $-$ Gap, Filler condition. This method is illustrated in Figure 3. There were 60 participants in Experiment 3.

The mean acceptance rates by condition are given in Figure 4. The results were analyzed with a logit mixed effects model with the same parameters as in Experiments 1 and 2. Again, there was a main effect of \pm Gap ($\hat{\beta} = 0.59 \pm 0.29, z = 2.00, p = 0.05$). There was also a main effect of one of the Reference coefficients ($\hat{\beta} = 0.59 \pm 0.28, z = 2.12, p = 0.03$). Pairwise comparisons reveal that the $-$ Gap, Ambiguous condition was accepted more than the $-$ Gap, Filler condition ($\hat{\beta} = 1.05 \pm 0.45, z = 2.35, p = 0.05$) and $-$ Gap, Subject condition ($\hat{\beta} = 1.37 \pm 0.50, z = 2.77, p = 0.02$), likely driving the main effect of Reference.

In Experiment 3, there was no evidence that externally taxing working memory resources

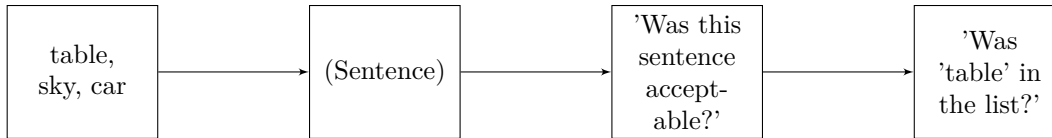


Figure 3: Method for Experiments 3 and 4. First, the word list was displayed. Then, the speeded acceptability judgment task was conducted. Afterwards, participants were asked to respond to a probe.

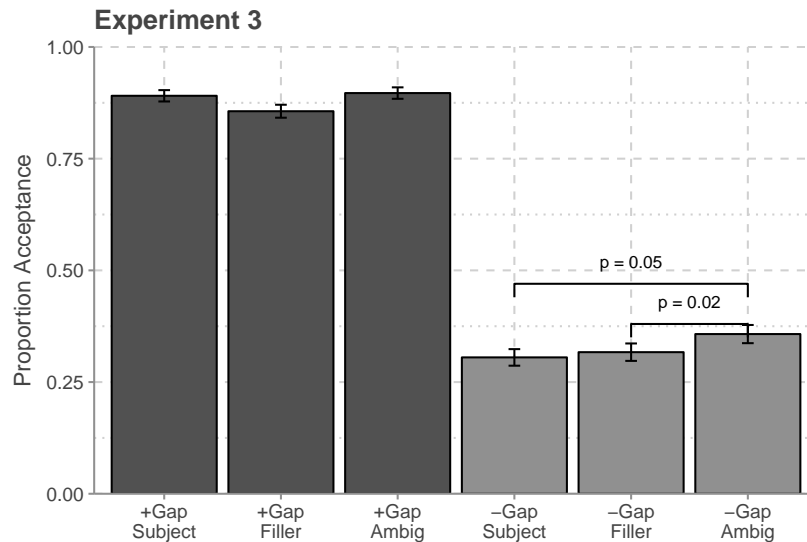


Figure 4: Mean acceptance rates by condition from Experiment 3, with error bars representing one standard error from the mean.

affected the relative acceptability of resumption. However, comparing the mean acceptance rates by condition from Experiments 1 and 3 reveals that the additional working memory task increased the acceptance rates of the $-$ Gap condition overall. The difference in means by condition for Experiments 1 and 3 is shown in Figure 5. I take this to demonstrate that the additional memory task resulted in higher loss of a predicted gap representation, i.e., participants were less likely to notice that the filler did not bind a gap with the additional working memory strain. In other words, increased working memory strain increases the likelihood that ungrammatical sentences – including resumption – are accepted.

4.4. Experiment 4

The goal of Experiment 4 was again to determine whether additionally straining working memory resources resulted in higher ratings for the gapless fillers, and specifically for the resumptive condition. Experiment 4 used the same materials as Experiment 2 using the additional memory task, as in Experiment 3. The word lists were the same as in Experiment 3. There were 60 participants recruited for Experiment 4.

The mean acceptance rates in Experiment 4 are shown in Figure 6. For analysis, we constructed a logit mixed effects model using the same parameters as in the previous three studies. As before, we found a main effect of \pm Gap ($\hat{\beta} = 1.63 \pm 0.29, z = 5.56, p < 0.01$). Additionally, we found an interaction effect between one of the Reference coefficients and \pm Gap ($\hat{\beta} = -0.53 \pm 0.25, z = -2.11, p = 0.03$). Pairwise comparisons again revealed that the $-$ Gap, Filler condition was accepted more often than the $-$ Gap, Subject condition ($\hat{\beta} = 1.09 \pm 0.41, z = -2.69, p = 0.03$). This condition was accepted more than chance ($p < 0.01$).

The results in Experiment 4 were consistent with the results from Experiment 2. Both

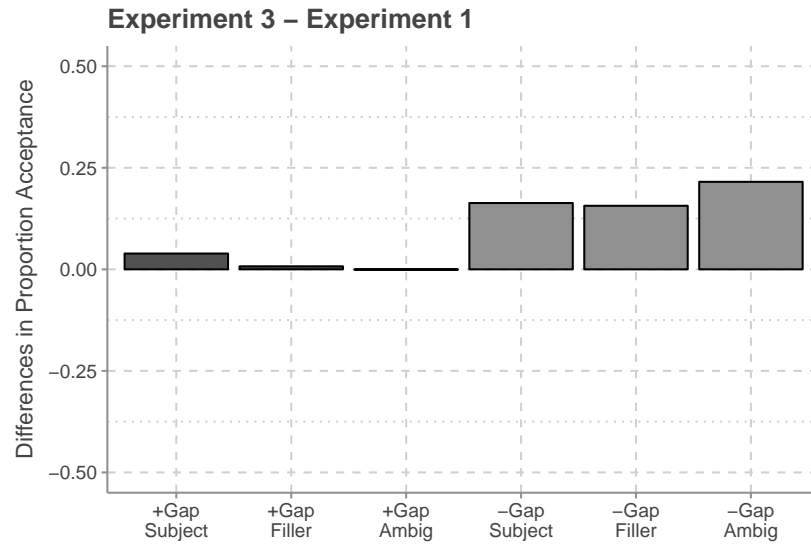


Figure 5: Mean acceptance rates by condition in Experiment 3 minus mean acceptance rates by condition in Experiment 1.

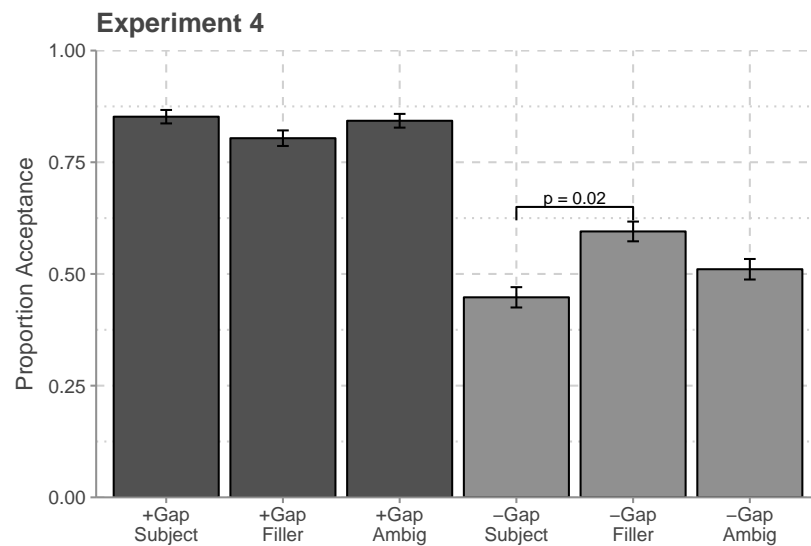


Figure 6: Mean acceptance rates by condition from Experiment 4, with error bars representing one standard error from the mean.

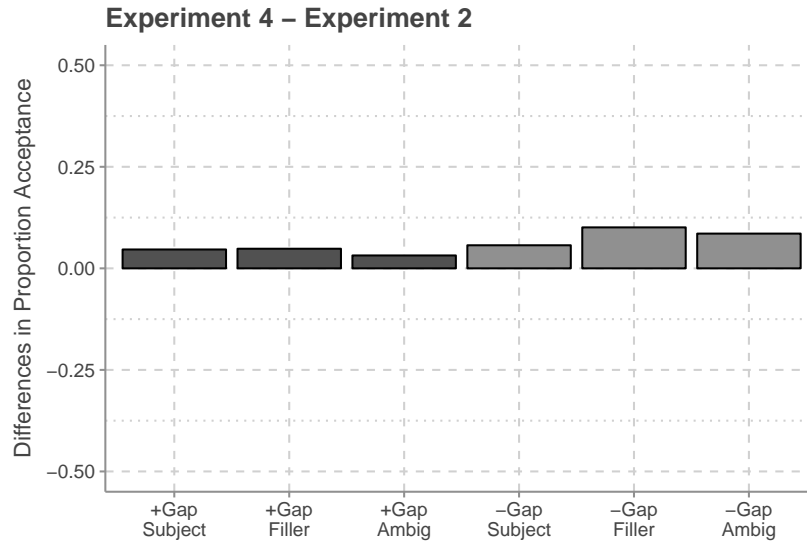


Figure 7: Mean acceptance rates by condition in Experiment 4 minus mean acceptance rates by condition in Experiment 2.

studies demonstrated that acceptance rates increased if a filler coreferred with a pronoun. However, the additional working memory strain in Experiment 4 resulted in increased ratings compared to Experiment 2, as shown in Figure 7. As in Experiment 3, this suggests that the addition of a memory recall task decreases comprehenders' sensitivity to whether the filler binds a gap. Again, I take this to support the claim that the previously constructed representation of the gap is likely to be lost with with additional working memory strain.

5. Conclusions

In this paper, I argued that comprehenders prioritize resolving a filler with a grammatically licensed gap. Upon detecting the filler, the comprehender constructs a representation of a gap that must be maintained in working memory over time. As long as this is maintained, comprehenders will not construct ungrammatical filler dependencies, including resumption, as shown in Experiment 1. However, when this representation is lost, due to length (Experiments 2 and 4) or due to increased strain on working memory (Experiments 3 and 4), then comprehenders become less sensitive to ungrammatical continuations of the sentence, and have no grammatical mechanism for incorporating the filler into the semantic representation of the sentence. In this situation, anaphora may permit the comprehender to recover the intended interpretation.

Importantly, this proposal makes no specific reference to islandhood. The pronoun was always embedded in a subject NP island in Experiments 1–4, but its facilitatory effect was only observed with longer dependencies. On my account, resumptive pronouns may be more common in island configurations, because islands induce strain on working memory resources (Kluender, 2004; Hofmeister & Sag, 2010). However, it remains controversial whether island configurations strain working memory generally (see Sprouse et al. 2012). My proposal predicts that islands that strain working memory resources more are better hosts for resumption. Similarly, my proposal makes no specific reference to dependency length, which improves resumption (Alexopoulou & Keller, 2007; Hofmeister & Norcliffe, 2013), as observed in Experiments 2 and 4. However, on my proposal, length is a proxy for decay over time. Thus, like islands configurations, length is implicated because of its effect on the comprehender's ability to maintain a representation of the gap.

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