Does resumption facilitate sentence comprehension?

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While filler-gap dependencies (FGDs) in English typically have an omitted constituent (a 'gap') at the end of the dependency, pronominals can also appear in this position under certain circumstances:

(1) There was one prisoner that we heard that the guard taunted (___/him) mercilessly.

As opposed to languages such as Hebrew or Irish, where such resumptive pronominals are in free variation with gaps and are grammatically unmarked (Sells, 1987, Sharvit, 1999, McCloskey, 2002), English resumptives lie at the margins of grammar. Referred to as 'intrusive' resumptive pronouns, they are often regarded as a 'last resort' device to preserve the grammaticality of the dependency (Ross, 1967, Sells, 1984). In particular, intrusive resumptive pronouns have famously been claimed to amnesty syntactic island violations, such as in the *wh*-island violation below (Ross, 1967, Kroch, 1981, Erteschik-Shir, 1992, Haegeman, 1994):

(2) This is the man whom$_i$ Emsworth told me when we will invite him$_i$.

The resumptive pronoun here purportedly 'saves' the island violation, and the result of this assumption has been a number of syntactic analyses explaining why islands are not violated in such circumstances.

As Alexopoulou and Keller (2007) (hereafter, AK) point out, the conclusion that resumptive pronouns save island violations was reached without precise measurements of acceptability, relying instead on researchers' intuitions. AK thus experimentally investigated judgments for island-violating

sentences in English with and without intrusive resumptives. They found that island-violating sentences with resumptives were no more acceptable than minimally different gapped sentences. Depth of embedding, however, did influence the acceptability of resumptive items. Specifically, sentences with resumptives in English were judged more acceptable the more embedded the pronouns are, e.g.

(3) a. Who$_i$ will we fire him$_i$?

      b. Who$_i$ does Mary claim we will fire him$_i$?

      c. Who$_i$ does Jane think Mary claims we will fire him$_i$?

These findings were replicated and expanded upon by Heestand et al. 2011. Given that resumptive pronouns never make sentences better than their gapped counterparts, they ultimately conclude that 'resumption does not help the hearer, or more accurately, the reader' (see also Ferreira and Swets 2005, Asudeh 2011).

The unacceptability of resumptives, compared to gaps, raises the question of why they appear in attested speech (Prince, 1990, Jaeger, 2006, Bennett, 2008). One explanation for their occurrence appeals to the idea that speakers resort to their use only in certain performance conditions (Kroch, 1981, Asudeh, 2004, Heestand et al., 2011). For instance, Heestand et al. (2011) suggest that 'performance pressures in production could lead to speakers resorting to resumptives as a way of adding more information without breaking the production chain' and thus that resumptives reflect time pressures on speaker fluency. In other words, resumptives are performance-based artifacts. They arise due to either poor planning (Kroch, 1981) or to the incremental nature of production which can produce locally licensed, but globally ungrammatical structures (Asudeh, 2004, 2011). In the sense that the occasional use of these items follows from local production difficulty and not grammatical principles, these items should not facilitate comprehension processes, or else hinder them.

If we accept the conclusion that resumptives do not help the hearer, we are left with the mystery of why different types of resumptive structures nevertheless lead to differences in acceptability (as in (3) above). One possibility is that the increased acceptability of resumptives in embedded structures is due to the reduced salience of a grammatical violation in longer, complex

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dependencies. An alternative is that resumptives do in fact facilitate comprehension processes in some conditions.

The idea that resumptives aid comprehension in certain contexts is not without precedent in the functional/typological literature. For instance, Hawkins (1994) suggests resumptives aid in dependency processing because these explicit elements serve to identify the syntactic position of the dependent argument (as opposed to empty categories). Other accounts sketch different mechanisms by which resumptives selectively facilitate processing, but these accounts share the common prediction that resumptives should be favored in difficult-to-process contexts (Ariel, 1999, Alexopoulou and Keller, 2007, Givón, 1973, Keenan and Comrie, 1977). An accompanying prediction of some of these accounts is that resumptives should be dispreferred where processing a linguistic dependency is easy or trivial. That is, a competing preference for economy in language penalizes overinformative expressions (see the literature on referential form choice, e.g. Ariel 1990, 1999, 2001, Almor 1999, Gundel et al. 1993). On this view, dependency processing is subject to two independent, but potentially conflicting constraints: (1) the preference for explicit features which support identification, retrieval, and integration of the dislocated element and (2) the preference for economy of referential forms.

Existing empirical data do not allow us to definitively rule in favor or against the hypothesis that resumptives can help the hearer. Experimental investigations into the role of resumptives in language comprehension have so far come entirely from acceptability judgments. Unfortunately, these one-dimensional measurements have a limited capability in reflecting processing differences (see Sprouse 2008). Although it is commonly accepted that processing difficulty influences acceptability judgments (Chomsky and Miller, 1963, Miller and Chomsky, 1963, Gibson, 1991), the precise nature of this relationship remains largely unexplored (Staum Casasanto et al., 2010). For instance, Staum Casasanto and Sag (2008) find that repetition of *that* in sentences like (4) facilitates processing at the subsequent subject NP, although it yields lower acceptability judgments than a minimally different sentence without the repeated *that*:

(4) I truly wish that if something like that were to happen that my children would do something like that for me.

Given the lack of a clear relationship between processing difficulty and acceptability, our goal in the current paper is to examine the effects of resumptive

pronouns on online sentence processing and on acceptability judgments for the same items. By looking at the moment-by-moment processing of sentences with and without resumptives, we can form more direct conclusions about the effect of resumption on language comprehension.

In this paper, we report the results from two experimental studies which test whether both the acceptability and processing difficulty caused by resumptive pronouns changes with the relative difficulty of local sentence processing contexts. Experiment I considers how resumption affects acceptability judgments for sentences with differing processing complexity. Experiment II takes the same materials and looks at whether resumption facilitates reading times in a self-paced, moving window reading experiment.

1 Experiment I: Acceptability judgments

1.1 Methodology

For the acceptability experiment in Experiment I, we used the thermometer judgment (TJ) methodology described by Featherston (2008) (see also Bard et al. 1996 and Sorace and Keller 2005 for the related methodology of Magnitude Estimation). In the TJ task, participants judge items relative to two reference sentences. One of these references is quite good and the other quite bad, and we follow Featherston (2008) in assigning these sentences the arbitrary values 20 and 30. In our study, we used the following reference sentences.

(5) a. The way that the project was approaching to the deadline everyone wondered. = 20

b. The architect told his assistant to bring the new plans to the foreman's office. = 30

Sentences were presented word-by-word at a fixed rate of presentation in the center of the screen (250 ms + 33.33 ms * the number of characters in the word), so that longer words remained visible for longer. We used word-by-word presentation over full sentence presentation to prevent participants from excessive introspection about the test sentences, and we used auto-paced presentation rather than self-paced presentation so that there would be no differences in how long each participant studied a given stimulus. After judging each item, participants also answered a comprehension question for each item to ensure reading.

Judgments were transformed into z-scores for each subject on the basis of their judgments for all experimental items, including fillers. After this, we excluded data points with z-scores more than 2.5 standard deviations from the subject's mean to further normalize the data and remove the skewing effects of extreme outliers.

We used linear mixed-effects models (LMEMs) to analyze the effect of experimental factors. All predictors/fixed effect variables were sum coded (which reduces effects of collinearity, as compared to treatment coding). As LMEMs with random effect correlation parameters do not yield p-values, we provide coefficient estimates, standard errors, and t-values (Baayen, 2008, Baayen et al., 2008, Pinheiro and Bates, 2000). As noted by Baayen et al. (2008), significance at the .05 level can be conservatively estimated for fixed effects coefficients with t-values above or below 2.

1.2 Materials & Participants

The experimental materials in the experiments described here involve two manipulations: dependency length (long vs. short) and resumption (pronoun vs. gap), as in the following sample item:

(6) a. Mary confirmed that there was a prisoner who the prison officials had acknowledged that the guard helped ___ to make a daring escape.

b. Mary confirmed that there was a prisoner who the prison officials had acknowledged that the guard helped him to make a daring escape.

c. The prison officials had acknowledged that there was a prisoner that the guard helped ___ to make a daring escape.

d. The prison officials had acknowledged that there was a prisoner that the guard helped him to make a daring escape.

In the long conditions, the filler-phrase (*a prisoner*) was always separated from its selecting lexical head by two clause boundaries—a relative clause and a complement clause. In the short conditions, only a single relative clause boundary intervened between the filler and its head. Longer dependency length should lead to higher levels of processing difficulty compared to the sentences with shorter dependencies. Several different sentence processing

accounts uniformly predict these longer dependencies should engender more difficulty than the shorter dependencies, although the details differ for the proposed mechanisms involved (Gibson, 1998, 2000, Gordon et al., 2002, 2001, Grodner and Gibson, 2005, Kluender and Kutas, 1993). Of importance here is merely the consensus view that the longer dependencies should burden processing more than the shorter dependencies.

In all long conditions, the gender of the sentence-initial proper name contrasted with the gender of the resumptive pronoun. Furthermore, in all conditions, there were no other singular referents in the sentence besides the target (the clefted indefinite) and the clause-mate subject noun phrase (*the guard* in (6d)).

Presentation of the items was pseudo-randomized by the experimental software DMDX (Forster and Forster, 2003). Each participant saw one and only one condition from each of the 24 experimental items. These were accompanied by 72 fillers.

In Experiment 1, we used the maximal random effect structure in the linear mixed effects model: in addition to random subject and item intercepts, the random effect structure included by-subject and by-item random slopes for dependency length, resumption, and their interaction. Outlier removal affected .006% of the data (4 out of 672 data points).

28 individuals from Stanford University—all of whom identified as native English speakers—participated in this study for $14/hr.

1.3   Results

As Figure 1 shows, both manipulations had significant effects on acceptability. Sentences with longer dependencies received significantly lower acceptability judgments than those with short dependencies. In addition, items containing a resumptive pronoun were judged far worse than sentences with gaps.

However, the results also reveal a highly significant interaction between dependency length and resumption. As noted above, resumptive pronouns lead to lower acceptability in both LONG and SHORT conditions; indeed, the mean ratings for the two conditions with resumptives are statistically indistinguishable. Comparing the difference between the gapped and resumptive versions at each dependency length, though, we see that the acceptability penalty is far smaller in the context of a long dependency (see Figure 1). That is, the difference between the means for the SHORT-GAP and SHORT-
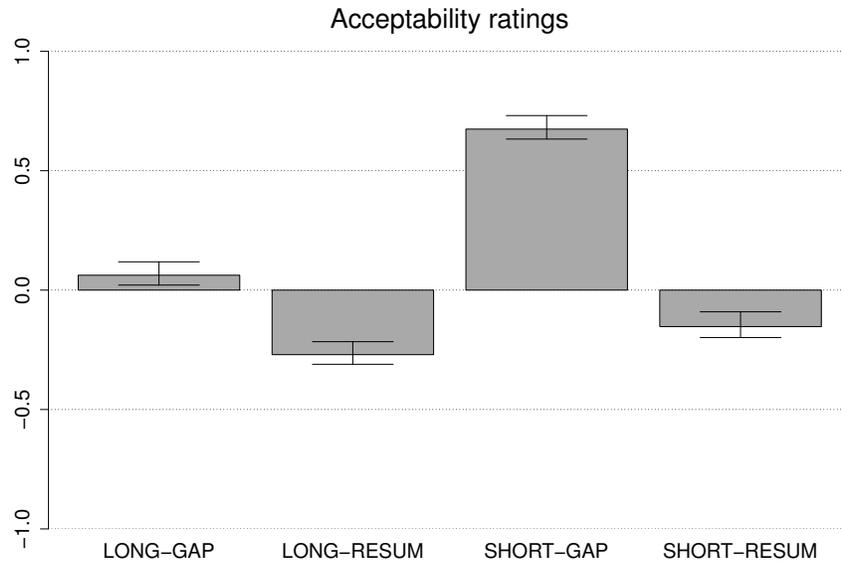
Figure 1: Mean acceptability z-scores for Experiment 1

RESUM conditions is roughly 2.5 times greater than the difference between the LONG-GAP and LONG-RESUM conditions. This is unlikely to be the result of a floor effect, as the experimental fillers in this study also included a set of twelve sentences with jumbled word orders (e.g. *Iran has gun-control strict laws that bar private citizens carrying from firearms*), which received substantially lower mean judgments ($\mu = -0.63$, SE $= 0.05$) than the items in the LONG-RESUMP condition ($\mu = -0.27$, SE $= 0.05$).

1.4 Discussion

Resumptive pronouns do not make sentences sound better than those with gaps, even in difficult-to-process contexts. However, the interaction shows that resumptives are less egregious in difficult-to-process contexts. If resumptives had a uniform effect on judgments across sentence contexts, then the LONG-RESUMP condition should have a significantly lower mean acceptability score. These findings replicate past results that resumptives never lead to more acceptable structures than gaps, but that increased embedding depth can reduce the penalty for resumptives (Alexopoulou and Keller, 2007,

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	Coffecients	Standard Error	t-value
DEPENDENCY LENGTH	−0.183	0.033	−5.55
RESUMPTION	−0.290	0.044	−6.60
DEPENDENCY LENGTH × RESUMPTION	0.123	0.026	4.77

Table 1: Effects of predictors on z-scores of judgments.

Heestand et al., 2011).

This pattern of results also echoes the findings of Staum Casasanto and Sag (2008) regarding the acceptability of sentences with multiple *that*s, as in (7):

(7) I truly wish that if something like that were to happen that my children would do something like that for me.

They observed that sentences with multiple-*that*s were always judged to be more unacceptable than their counterpart sentences with a single *that*; however, the unacceptability was modulated by the distance between the two thats. In particular, the acceptability difference for sentences with and without multiple *that*s was significantly smaller when the distance between the two *that*s was greater. To explain these findings, Staum Casasanto & Sag entertain several hypotheses: (1) the presence of multiple *that*s is more noticeable when they are close together or (2) a second *that* may have more functional utility the greater the distance from the initial *that* due to activation decay.

The question at hand, therefore, is why resumptives become more acceptable with embedding. Following the logic in Staum Casasanto & Sag (2008), if resumptive pronouns constitute an ungrammatical means for completing a long-distance dependency in English, then the salience of this violation may be reduced by increasing the distance between the filler-phrase and the pronoun. Alternatively, the resumptive pronoun may have some functional utility in long dependency contexts that it lacks in shorter dependency contexts. In Experiment II we consider these alternative hypotheses by looking at how resumptives are processed during on-line sentence comprehension.

2 Experiment II: Self-paced reading

One explanation for the reduced penalty for resumptives under embedding is that the ungrammaticality of the RPs becomes less salient in these environments. On this hypothesis, reading times should be faster after resumptives at the tail of long dependencies compared to short ones, but never faster than after gaps. Alternatively, RPs might possess functional utility in sentence contexts that impose substantial processing difficulty. In contexts without such difficulty, this functional utility may be absent or counteracted by principles of economy.

These two hypotheses make different predictions about how resumptive pronouns should affect online sentence processing. On the hypothesis that the grammaticality violation simply becomes less salient with embedding, resumptive pronouns are not predicted to make processing any faster than gaps in any context. That is, resumptives pronouns do not have a facilitatory role on this hypothesis. The violation of constraints on dependency formation is simply less conspicuous. But if resumptives prove to actually elicit faster reading times than gaps in certain contexts, this argues for a facilitating role of resumptives.

2.1 Methodology

We used the self-paced, moving window display paradigm in this experiment (Just et al., 1982). At the beginning of each item, participants see a row of dashes, separated by spaces, that represent the words in the sentence. By pressing a predefined key, the first word in the sentence appears, replacing the dashes. Each subsequent key-press uncovers the next word in the sentence and reverts the previous word to dashes. Longer reading times are interpreted as indicators of greater processing difficulty. Participants answered a comprehension question about each sentence and received feedback if they answered incorrectly. Materials were presented and randomized with the reading time software LINGER v. 2.94, developed by Doug Rohde (available at http://tedlab.mit.edu/~dr/Linger/).

Reading times were analyzed with LMEMs, using the `lme4` package in R (version 2.12.1). Prior to statistical analysis, raw reading times (greater than 2500 ms or less than 100 ms) were removed from each data set. In addition, data from subjects with overall question-answer accuracies below 67% or more than 2.5 standard deviations from the sample mean were entirely

excluded.

Subsequently, raw reading times were logged to normalize the data. Following this, the log reading times for all stimuli (fillers included) were regressed against a number of predictors known to affect reading times in self-paced reading tasks: word length, log list position, and material type, e.g. filler vs. critical item (Ferreira and Clifton, 1986, Hofmeister, 2011). The residuals of this model – residual log reading times – serve as the dependent variable in the model we report. In essence, these residual reading times reflect the variation in reading times that remains after eliminating the estimated effects of word length, list position, and material type. Once these residual log reading times were calculated, we removed data from all stimuli where the participant answered the comprehension question incorrectly. Finally, reading times more than 2.5 standard deviations from the mean at each word region were eliminated, affecting 2.74% of the total dataset.

In Experiment 2, we take the critical region for analysis to consist of the two words following the resumptive or gap. The reading time model for Experiment 2 also included a fixed effect factor that models the relationship between reading times at word region $n-1$ and n—that is, spillover effects from the preceding word regions (either the pronoun in conditions with a resumptive, or the verb in gapped conditions) on reading times at the critical region (Sanford and Garrod, 1981). Prior to analysis, we centered the factors of dependency length and resumption at the critical region. As in Experiment 1, we used a random effect structure with random intercepts for participants and items, and by-participant and by-item random slopes for dependency length and resumption.

2.2   Materials & Participants

The materials for this experiment were identical to those in Experiment I. 72 filler items accompanied the 24 critical items. For analyzing the reading time results, we take the critical region to include the two words after either the pronoun or the gap.

28 University of California-San Diego undergraduates participated in this study for course credit.

	Coffecients	Standard Error	t-value
DEPENDENCY LENGTH	0.006	0.020	0.27
RESUMPTION	0.065	0.019	3.37
DEPENDENCY LENGTH × RESUMPTION	0.080	0.036	2.22
SPILLOVER	0.179	0.028	6.32

Table 2: Fixed effects summary for averaged residual log reading times at two words after gap or resumptive pronoun.

2.3 Results

According to the reading time results, resumption significantly speeds up the reading rate in the critical region (see Table 2). The faster average reading times for resumptive conditions overall, however, is driven exclusively by the LONG-RESUMP condition, as shown in Figure 2: reading times in the LONG-RESUMP condition were the fastest overall. Moreover, while gap processing slows down with deeper embedding, processing after a resumptive speeds up with deeper embedding. This accounts for the significant interaction of dependency length and resumption, and the lack of a main effect of dependency length. Unsurprisingly, reading time differences at the previous word region also account for a significant amount of variation. As the positive coefficient indicates, longer reading times at the previous word region tend to make reading times at the next word region longer.

In short, the effect of resumption on processing depends on the length of the dependency. Resumptives in hard-to-process contexts lead to more efficient processing as compared to resumptives in easy-to-process contexts. In contrast, processing times after gaps increases with distance between the filler and gap. Crucially, the reading time results also clearly show that the resumptive pronoun facilitates processing compared to a gap in high difficulty contexts.
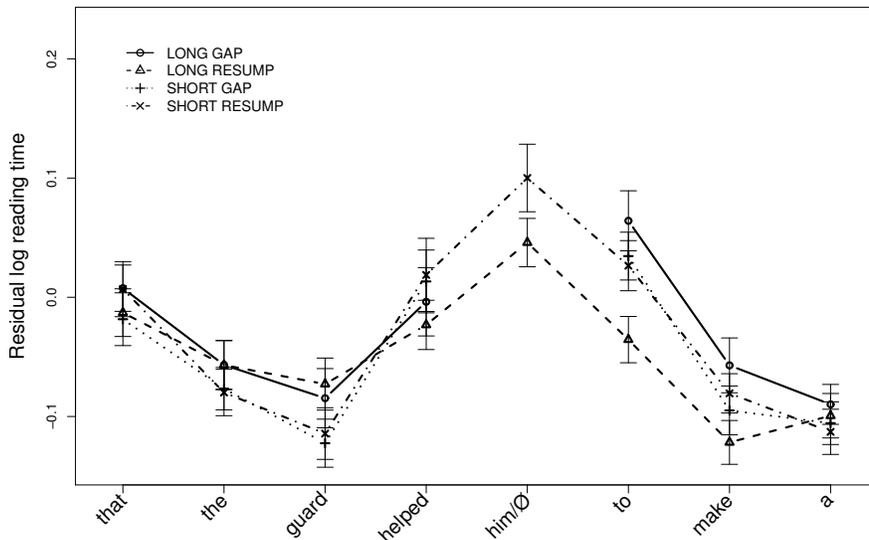
Figure 2: Mean residual log reading times by region in Experiment 2; error bars show ± one standard error

2.4   Discussion

In confirmation of the facilitation hypothesis of resumptives, the reading time data show that a resumptive at the tail of a relatively difficult dependency improves processing speed, compared to a gap. These results are unexpected if increasing the distance between a filler-phrase and a resumptive simply makes a grammatical violation less noticeable. In other words, the evidence argues for a facilitating role of resumptive pronouns in certain sentence contexts. While resumptives have some processing advantages compared to gaps in high difficulty contexts, there is no evidence of such an advantage in less difficult contexts.

3   General Discussion

The acceptability results from Experiment 1 indicate a significant interaction between dependency length and resumption: the penalty for resumptives is reduced in hard-to-process contexts. To explain these results, we explored

how the relevant items are processed in a self-paced reading study and found a facilitatory role for resumptives in these same hard-to-process contexts, whereas resumptives in easier-to-process contexts had no facilitatory effects. Put together, these results suggest that the cause of the decreased acceptability penalty for resumptives reflects the facilitated processing at or immediately after the retrieval site. That is, resumptive pronouns are preferable (in terms of processing difficulty) in hard-to-process contexts, as opposed to relatively easy-to-process contexts.

Following the logic of Staum Casasanto & Sag (2008), where they find a similar pattern of reading times results, the data from Experiment 2 demonstrate that not only are reading times after a resumptive in a long dependency faster compared to a short one, but also faster as compared to a gap in a long dependency. This argues against the hypothesis that the advantage for the resumptive in the long dependency context is due to reduced saliency of the grammatical violation. In other words, such a hypothesis fails to predict the processing advantage for the resumptive in the hard-to-process context, compared to a gap.

Assuming that differential processing difficulty is one source of variation in judgments of linguistic acceptability, the observed processing difference potentially lies behind the differing penalities of resumption in acceptability judgement tasks. Nevertheless, resumptives are judged worse than gaps in difficult-to-process contexts, meaning that processing difficulty by itself fails to accurately predict acceptability patterns. If we make the assumption, however, that resumptive pronouns are ungrammatical in English, then the cause of the pattern of acceptability judgments becomes evident: (i) long dependencies are harder to process than shorter dependencies, accounting for the acceptability difference in 'gapped' sentences; (ii) resumptives in English incur an acceptability penalty, regardless of context; (iii) resumptive pronouns aid in processing linguistic dependencies, compared to gaps; and (iv) a general constraint on reference processing requires referential forms in the sense of Ariel (1990, 1999, 2001) to be as economical as possible, while ensuring successful communication.

With respect to (iv), processing efficiency may be at a sufficiently high level in a short, easy-to-process dependency context, such that any functional support the pronoun provides amounts to overkill. Such a hypothesis is well-supported not only by pragmatic principles such as Grice's 1975 Principle of Quantity, but also psycholinguistic research that points to processing penalties for overly specific referential forms (Almor, 1999, 2004). Ariel (1990,

1999, 2001) argues in this regard that referential descriptions that are non-specific, such as pronouns and gaps, are preferentially used in contexts when the corresponding mental referent is highly salient or accessible. Thus, in long dependency contexts, where processing challenges can be substantial, the overall accessibility or retrievability of the dislocated constituent may be lessened (e.g. this can be realized in terms of lowered activation levels).

Up until now, we have not identified a precise mechanism that explains why resumptives facilitate comprehension. In fact, a number of different pragmatic, typological, and cognitive accounts lay out arguments to motivate such a conclusion. While the details of these accounts differ, they uniformly support the idea that resumptives should facilitate processing at the tail of long-distance dependencies. In the functionalist literature, for instance, Keenan and Comrie (1977) speculate that resumptives aid in the identification of an extraction site (see also Givón 1973, Givón 1975). More recently, Hawkins (1994, 1999) similarly argues that resumptive pronouns facilitate processing because an empty category does not need to be inferred from its environment, but rather, is expressed formally in the surface structure. On this view, the resumptive pronoun functions to explicitly identify the dislocated element's role in the structure, making it 'as clear as it can possibly be'.

In addition to this identification-based theory, the difference between gaps and pronouns can also be viewed in terms of principles of referential form choice (Almor and Nair, 2007). From this perspective, the information content of a referring expression is interpreted as a measure of cognitive accessibility, i.e. how cognitively salient a mental representation is and thus how hard it will be to restore from memory. Wherever an antecedent is difficult to retrieve from memory, more information is needed to aid that retrieval process (Ariel, 1990, 2001). Referential content thus acts as instructions to the comprehender for resolving a reference. Just as complex instructions for a simple task will be considered infelicitous (e.g. 'lift one of your hands, move it away from your body toward the wine bottle, grasp the wine bottle, and then move the grasped object until it is close enough for me to reach easily' as a request to pass the wine), so too will complex referring forms be infelicitous for easily restorable referents.

As pointed out by Ariel (1990), the distance between references to the same referent predicts the 'accessibility-marking' of anaphoric forms: greater distance between references lowers overall accessibility, thereby necessitating the use of more informative, weighty expressions to ensure successful refer-

ence. Where retrieval costs are minimal, excessive information is perceived as marked, because information is assumed to have a pragmatic purpose. In brief, the pressure for successful communication and reference competes with the requirement to be as economical as possible. Ariel (1999) argues that accessibility marking is visible not only at the discourse level, determining the degree of specificity of referents across sentences, but also intersententially, governing the distribution of resumptives and gaps: less accessible antecedents trigger less attenuated anaphoric forms (resumptives). As with the case of the multiple *that*s, a resumptive may serve to re-activate features of the dislocated phrase, making retrieval of the appropriate representation easier.

A third hypothesis for the processing advantage of resumptive pronouns concerns differential structural complexity (e.g. Hawkins 2004, Alexopoulou and Keller 2007, Alexopoulou 2010). Accounts along these lines presume that resumptive pronouns and gaps initiate two distinct types of syntactic resolution (see also Asudeh 2004, 2011, 2012 for theoretical arguments for distinguishing resumptive dependencies from gap dependencies). These structures have some similar and some different processing costs. Alexopoulou & Keller (2007) suggest that, whether a gap or a resumptive ultimately appears at the end of a dependency, processing expectations are set up for a gap upon encountering a filler-phrase, i.e. by default, the parser assumes a filler-gap dependency up until the point of the resumptive. Appealing to ideas expressed by Gibson (1998, 2000), they argue that storing these expectations incurs a cost that does not vary with the nature of the material at the end of the dependency. In other words, processing dependencies with resumptives is not cost-free.

However, when the parser encounters a resumptive pronoun rather than a gap, it initiates a 'backward search' through the preceding discourse for an appropriate discourse antecedent. In other words, resumptives trigger processing akin to standard intrasentential anaphor-antecedent dependencies. Hawkins (2004) similarly proposes that a resumptive pronominal causes the parser to abandon all lexical co-occurrence dependencies registered between the filler and the predicate. Restoring a filler-phrase in the presence of a gap, on the other hand, requires a 'cyclic resolution of the dependency'. This post-gap resolution process, they claim, is sensitive to distance in terms of syntactic units, á la Gibson (1998, 2000). Critically, their account requires the assumption that anaphor-antecedent dependencies lack these 'backward' locality costs, and that not all resumptives trigger these anaphoric depen-

dencies. That is, to explain why resumptives are worse in *wh*-questions like 'Who$_i$ will we fire him$_i$?' compared to 'Who$_i$ does Mary think that we will fire him$_i$?', AK assume that 'these structures are specied for movement (AGREE/MOVE) which yields a phonologically empty element in situ.'[1]

A fourth way of explaining the selective facilitation of resumptives relates to predictability theories of referential form choice (Arnold, 1998, 2010, Tily and Piantadosi, 2009). Probabilistic approaches to referential form choice in discourse assume that the referential form chosen (e.g. definite NP vs. pronoun) is dependent on how probable the mention of that referent is in context. Language users employ longer forms where the referent is less predictable (Tily and Piantadosi, 2009). This also has advantages for the listener, because it provides more instructions for reference resolution where comprehender expectations are low. On this view, comprehension processing should be easier for gaps over resumptives where the extraction site is highly predictable, while resumptives should be easier where it is less predictable.

Yet another hypothesis, previously unexplored in the literature, is that resumptive pronouns provide an additional region to complete processing related to the preceding lexical head, including retrieval and integration. Behavioral and electrophysiological studies show that processing difficulty at retrieval points in embedded or structural complex contexts spills over onto subsequent word regions (see, for instance, Hofmeister 2011, Vasishth and Lewis 2006). Hence, a reader or listener may have to struggle to complete processing related to a previous word, while simultaneously perceiving, categorizing, and integrating the next several words. Given sufficient difficulty, this overlap may lead to superadditive processing difficulty or a temporary processing breakdown. An informationally-light or even redundant lexical item in between regions would provide a buffer between them, allowing for more time to process the first region before the second is reached.

However one might interpret the functional role of resumptives, there seems to be clear theoretical support for the idea that resumptives facilitate

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[1]In general, accounts that pose different syntactic analyses for resumptive and gapped structures do not clarify why resumptives are not consistently preferable to gaps in embedded contexts, since the former arguably do not incur locality costs. Secondly, as noted above, the categorical distinction between resumptives under embedding and those in simple wh-questions is ad hoc and without explanation. Third, the available evidence does not support the view that anaphoric dependencies are not subject to locality costs. Sanford and Garrod (1981), for instance, show that processing an anaphoric expression becomes more difficulty as the distance to its antecedent increases.

comprehension. The results from the above reading time study add novel empirical data by showing that resumptives are not merely the byproduct of production pressures. When comprehension pressure is high, resumptive pronouns make reading easier than gaps; when comprehension pressure is low, resumptives present more information than is necessary for successful and efficient comprehension and thus have no beneficial effects on comprehension.

The current body of evidence, therefore, contradicts the claim that 're-sumption does not help the hearer' (Heestand et al. 2011). It seems reasonable to suppose that resumptive pronouns may have simultaneous advantages for both comprehension and production. While production pressures may sometimes drive production choices rather than the needs of the listener, this does not rule out the possibility that those production choices nevertheless result in a mutual advantage for the listener (see e.g. Arnold 2008, Brown and Dell 1987, Gennari and MacDonald 2009). Our claim that resumptive pronouns sometimes facilitate comprehension, however, does not exclude the possibility that incremental language production gives rise to unique demands that favor the use of resumptives (see Asudeh 2004, 2011, 2012).

Although our results suggest some parallel effects of resumption on comprehension and production, there also remain some unexplained contrasts. As noted by Heestand et al. (2011), resumptive pronouns tend to be produced most in English in the subject position of an embedded or relative clause. But this is also the context where it is judged most ungrammatical. It has also been shown in corpus studies that resumptives are more frequent for subjects in unembedded contexts than in embedded contexts (Jaeger, 2006, Bennett, 2008). It would be surprising if the contexts in which they occur most frequently in production are those in which they facilitate comprehension the least. It is an open question, therefore, whether the same cognitive mechanisms and discourse factors that promote the use of resumptives in production are those which cause resumptives to facilitate comprehension in contexts of high processing difficulty.

3.1   Grammar & Processing

To account for the pattern of acceptability found with resumptives and gaps, we claimed that resumptive pronouns live a double life in English. They aid dependency processing in difficult-to-process contexts, but they also incur a structural constraint violation. The basis for this interpretation is that

faster processing times for resumptives compared to gaps do not correspond to higher judgments of acceptability. The picture that emerges, therefore, is one where structural constraints and processing-based constraints can be in conflict with one another.

Looking within and across languages, such a combination of features is perhaps surprising. Syntactic constraints and typological implicational patterns often align with processing constraints: dispreferred or unacceptable structures frequently accompany high processing or learning difficulty, and vice versa (Bever, 1975, 2009, Hawkins, 1994, 1999, 2004, Jaeger and Tily, ress). Far less commonly noted are cases where the two are in conflict with another, although there are some attested cases where ungrammatical sentences are easier to read than minimally different, grammatical ones (Vasishth et al., 2008). Besides the previously mentioned cases of multiple *that*s (Staum Casasanto and Sag, 2008), Gibson and Thomas (1999) illustrate that acceptability judgments for doubly center-embedded constructions lacking a required verb are as acceptable as those with all three:

(8) The ancient manuscript that the graduate student who the new card catalog had confused a great deal (was studying in the library) was missing a page.

Gibson and Thomas (1999) convincingly argue that these unexpected results can be explained by appealing to the idea that the ungrammatical variant is actually easier to process, due to the forgetting of prior content.

Heestand et al. (2011) also report evidence that hints at facilitating effects of resumptive pronouns on comprehension. They found that acceptability judgments were faster for resumptives than for gaps. 'In cases where RP judgments were faster than judgments for sentences with illicit gaps, the gaps seem to be less helpful to the parser, despite being just as unambiguously ungrammatical'. To the extent these results replicate, they suggest that 'we can conclude that the extra information available in RPs is useful in parsing difficult dependencies, making its unacceptability all the more puzzling.'

The puzzle they allude to is the very same conflict between grammatical and processing constraints that we have argued for here. Nothing theoretically precludes the possibility that syntactic constraints penalize a particular structure or word order, while this same structure simultaneously poses functional advantages for the listener in certain sentential contexts. How such a competition between grammatical constraints and processing advantages arises is, of course, an unanswered question. On the assumption that

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language-specific grammatical constraints can emerge diachronically through frequency of use (Bybee, 1998, Haspelmath, 2008, Krug, 1998), the mismatch could ultimately be traceable to frequency distributions of *speaker-oriented* production choices. An important part of the puzzle will therefore be to determine under what conditions resumptives are preferred in production, and whether or not, as we discussed above, production preferences mirror comprehension preferences in this domain.

4   Conclusion

In keeping with prior research, our studies here show that while resumptives never make a sentence more acceptable than a minimally different 'gapped' sentence, resumptive pronouns are nevertheless considerably less 'intrusive' in hard-to-process sentence contexts. The limitation of previous studies in interpreting these effects relates to the lack of measurements of comprehension difficulty. The reading time evidence here, though, offers an explanation of the acceptability pattern based on processing difficulty. Namely, the reduced penalty for resumptives in embedded contexts, compared to resumptives in non-embedded contexts, aligns with reduced processing difficulty. Indeed, processing is faster after resumptive pronouns compared to gaps in embedded positions. On the straightforward assumption that processing difficulty feeds into acceptability judgments, this facilitation accounts for the reduced penalty. The persistence of unacceptability in sentences with resumptives follows from the assumption that structural constraints rule out resumptives in English, despite the processing facilitation. Such an account may be relatively anomalous, given the usual correspondence between structural and processing constraints, but it is not without precedent. Most importantly, our findings corroborate the general prediction of numerous treatises on resumption which claim that resumptive pronouns can not only compensate for production pressures, but also can ease comprehension difficulty.

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