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RESEARCH

No longer an orphan: evidence for appositive attachment from sentence comprehension

Brian Dillon[1], Lyn Frazier[1] and Charles Clifton[2]

[1] Department of Linguistics, University of Massachusetts, N408 Integrative Learning Center, 650 North Pleasant Street, Amherst, MA 01003, GB

[2] Department of Psychological and Brain Sciences, University of Massachusetts, 435 Tobin Hall, 135 Hicks Way, Amherst, MA 01003, US

Corresponding author: Brian Dillon (brian@linguist.umass.edu)

In this paper, we investigate the comprehension of appositive relative clauses and nominal appositives. First, we present experimental evidence that suggests that nominal appositives and appositive relative clauses behave like other adjunct phrases with respect to ambiguity resolution (Experiment 1). Second, we show that an ambiguous nominal appositive can modify a distant syntactic head as easily across an appositive relative clause as across a restrictive relative clause (Experiment 2). Last, we show that syntactic repair is as successful across an appositive relative clause or parenthetical as it is across an at-issue restrictive relative clause (Experiment 3). Taken together, our results suggest that i) appositive relative clauses and nominal appositives are syntactically sited in a fashion comparable to restrictive relative clauses and ii) appositive phrases do not substantially reduce the availability of the syntactic material that precedes the appositive phrase as might have been expected if processing an appositive involved shifting attention to a higher structure, away from local preceding constituents. These results constitute an argument from sentence comprehension for a local syntactic attachment of appositive relative clauses and nominal appositives (cf. Jackendoff 1977; Potts 2005; de Vries 2006), and against so-called *orphan* analyses of appositive content (e.g. Ross 1967; Haegeman 1988).

Keywords: Appositive relative clauses; nominal appositives; sentence processing; ambiguity resolution; memory

1 Introduction

Appositive structures, such as the appositive relative clause (ARC) and nominal appositive (NA) in (1), have attracted attention from both syntacticians and semanticists.

(1) a. This iPhone, which barely functions these days, is about to die.
b. This iPhone, a barely-functioning piece of junk, is about to die.

This attention is warranted because these structures display somewhat unexpected syntactic features (for a recent review, see de Vries 2006). From a semantic or pragmatic perspective, these structures are interesting because they appear to interact with their host utterances in somewhat limited ways, perhaps owing to their status as *not-at-issue* expressions (Potts 2005; Potts 2012). From a syntactic perspective, there remains a lack of consensus over fundamental questions about the grammatical organization of these phrases (de Vries 2006; Griffiths & de Vries 2013; Ott 2016).

Despite this attention, appositives have received relatively little attention from psycholinguists. As a result there are many open questions about how these structures are processed: how do appositive structures interact with their host utterances in sentence comprehension? Do listeners negotiate ambiguities in their interpretation in a way that mirrors similar at-issue content? In the present paper, we take up these questions. The result of our investigation, we suggest, in turn informs long-standing debates over the proper syntactic analysis of ARC and NA structures as in (1).

1.1 Not-at-issue content

Not-at-issue is a term coined by Potts (2005), who used it to refer to a broad class of content that included appositive relative clauses, nominal appositives, parenthetical asides, expressives, and honorifics (Potts 2005; 2012). What unifies this class of expressions is their typical behavior in several respects. For example, not-at-issue expressions have been argued to be generally "scopeless" in that they do not take scope with respect to semantic operators in their host utterances (Potts 2012; Nouwen 2014), although this does not appear to be a categorical restriction (Amaral et al. 2007; Schlenker 2013). In addition, although not-at-issue material is typically thought to reflect speaker commitments (Potts 2005), there is some evidence that this can be modulated in appropriate pragmatic contexts (Harris & Potts 2009). Lastly, and perhaps most importantly, the truth of an at-issue expression has been argued to be independent of the truth of any not-at-issue material associated with it. For example, (1a) above can be true even if the iPhone in question is in fact functioning at full capacity; this claim is supported by the naturalness of continuations that affirm the at-issue content while denying the not-at-issue content (e.g. "Yes, but it actually is functioning just fine."). It should be noted that as with other defining features of the not-at-issue class, it is also not clear that even this is categorically true: Syrett and Koev (2015) show that sentences where world knowledge renders an appositive false are frequently judged to be false, providing evidence that the truth of an appositive may modulate the perceived truth of its host utterance.

Broadly speaking, there is agreement that the collection of properties described above is the result of the not-at-issue content being independent of its at-issue host in some fashion. However, the precise source of this independence remains up for debate. Potts (2005) presents one strong theoretical interpretation of not-at-issue content's independence, using a multidimensional semantics. This system associates independent truth values with not-at-issue and at-issue material, fundamentally limiting the degree to which their semantics may interact. Alternative views hold that the distinction is less categorical in nature, perhaps reflecting pragmatic factors (Harris & Potts 2009), or the status of not-at-issue expressions as independent speech acts or assertions in their own right (Asher 2000; Syrett & Koev 2015; Frazier et al. 2017). Still other accounts hold that for at least some types of not-at-issue content, their exceptional behavior is at least partially a reflection of their syntax (McCawley 1988; Del Gobbo 2003; Schlenker 2013).

The goal of this paper is not to arbitrate theoretical debates concerning the source of some of the more notable features of not-at-issue content (see Frazier et al. 2017). Instead here we set ourselves the more modest goal of understanding how certain types of not-at-issue content, in particular ARCs and NAs, impact sentence comprehension. However, since at least part of the debate over the independence of appositive content has revolved around claims that they are syntactically "orphans" (Haegeman 1988), the study of how these phrases are treated in sentence comprehension can bear on the question of why NAI content is special by limiting the space of potential theoretical options. It is to this question that we turn first.

1.2 The syntax of ARCs and NAs

Consider again the appositive relative clause example from (1):

(2) a. This iPhone, which barely functions these days, is about to die.

There have been many claims made about the precise syntactic relation that holds between the appositive relative clause and its host material. In one early approach, Ross (1967) suggested that the appositive is generated as its own main (root) clause, and its relationship to its host clause is essentially one of clausal coordination. De Vries (2006) labels this view the "Main Clause Hypothesis" (MCH) approach to appositives, and describes numerous variations on this core approach (e.g. McCawley 1988; Schlenker 2013; see further references in de Vries 2006). There are a number of specific implementations of this core idea: on some accounts, the ARC is attached at a clausal or propositional node (e.g. McCawley 1988; Schlenker 2013). Even more radical approaches deny any syntactic relationship between the ARC and its host clause, instead positing that the relationship between these two clauses holds only at the level of discourse relations (Canac-Marquis & Tremblay 1998). Lastly, some authors have suggested a mixed approach to ARC syntax, suggesting that a high clausal coordination analysis for ARCs is available only for ARCs in clause-final positions (Syrett & Koev 2015; see similar observations in Anderbois, Brasoveanu & Henderson 2011; 2015).

There is some evidence for the Main Clause Hypothesis from syntactic diagnostics. For example, McCawley (1988) offers evidence that ARCs are not captured in VP ellipsis, suggesting an attachment site outside of the elided constituent using examples such as (3):

(3) McCawley (1988: 450)
John sold a violin, which had once belonged to Nathan Milstein, to Itzhak Perlman, and Mary did _ too.

(3) does not necessarily mean that Mary sold a violin that had once belonged to Nathan Milstein. In contrast, the goal argument *to Itzhak Perlman* is obligatorily part of the elided VP. On the basis of this observation, McCawley argued that the appositive relative clause may be located outside of the elided constituent, and therefore, outside of the VP that is elided (see also Schlenker 2013). In a similar vein, Schlenker (2013) observes that Condition C effects do not arise in appositives, suggesting that *c*-command does not obtain between the appositive and its host; we delay a full discussion of this important observation until the general discussion.

However, a competing view, what de Vries calls the "Subordinate Clause Hypothesis" (SCH), considers ARCs to be in a local syntactic relationship with their host, either as subordinated clauses somewhat comparable to integrated restrictive relative clauses or as a species of local coordination (Jackendoff 1977; Potts 2005; see further discussion in de Vries 2006). Some authors hold that the external syntax of the ARC is indistinguishable from a comparable restrictive relative clause (Potts 2005); an alternative is that the ARC attaches slightly higher within the DP (Jackendoff 1977; de Vries 2006). The latter view is supported by the observation that ARCs do not seem to be within the scope of the determiner in a DP (Jackendoff 1977). These models all hold, in some fashion or another, that the ARC forms a constituent with its host nominal or DP.

1.3 Processing ARCs and NAs

In a similar vein, we observe that there is evidence that the independence between not-at-issue and at-issue material extends to the realm of sentence comprehension and incremental sentence processing. Dillon, Clifton & Frazier (2014) used offline sentence acceptability

judgment measures to show that syntactic complexity effects were less pronounced when the complexity was nested inside of nominal appositives than when it was inside lexically matched restrictive relative clauses. Kroll and Wagers (2017) showed that this effect is not limited to discourse contexts where the appositive contributes supplemental material; appositives minimize complexity effects even in discourse contexts where the appositive addresses the Question Under Discussion (*responsive appositives;* Kroll & Wagers 2017). In a similar fashion, Dillon et al. (2017) showed that processing a complex filler-gap dependency was easier when the filler-gap dependency spanned an appositive relative clause (4b) than when it spanned a lexically matched restrictive relative clause (4a):

(4) a. The butcher asked who the lady who bought Italian ham **had invited** _ to dinner tonight.
b. The butcher asked who the lady, who bought Italian ham, **had invited** _ to dinner tonight.

Relative to matched baseline conditions without a filler-gap dependency, it was observed that (4a) was less acceptable than (4b). Importantly, in eye-tracking-while-reading measures, this offline acceptability effect was mirrored in two eye-tracking experiments by increased reading times at the gap site *had invited* in (4a) compared to (4b). Taken together, these findings provide both offline and online evidence that the appositive content is independent for the purposes of syntactic processing and sentence comprehension in a way that mirrors its interpretive independence. There are many open questions, however, about how at-issue and not-at-issue content interact during sentence comprehension. Resolving some of these questions, we believe, will shed light on questions concerning the syntactic organization of appositive phrases. In this paper we begin to address these questions, first considering how comprehension and acceptability data can shed light on some of the syntactic theories of appositivization offered above (*Experiment 1*); following that, we turn to a series of experiments that refine previous claims concerning how at-issue and not-at-issue material interact in comprehension (*Experiments 2 + 3*). Specifically, they test the effect of an intervening appositive on the availability of material preceding the appositive. On a "Main Clause" or orphan view of appositive attachment, shifting attention out of the local structure to the appositive might be expected to decrease the availability of the local (at issue) material.

The numerous fine-grained differences between specific theories of ARC (and NA) syntax, in general, make predictions that would seem to require subtle tests using various syntactic and semantic diagnostics. However, the broad distinction between the MCH and the SCH offer very different perspectives on how ambiguities concerning these structures should be resolved during sentence comprehension. For reasons that will become clear, we adopt the Construal theory of ambiguity resolution. Construal was laid out in Frazier and Clifton (1996; 1997), who investigated the question of whether there is underspecification in the syntactic analysis of sentences. They were trying to deal with the fact that with arguments, complements and obligatory constituents ("primary relations"), the processor seems to leap to an economical syntactic analysis of ambiguous input in the absence of biasing evidence. By contrast, adjuncts ("non-primary relations") do not seem to show premature parsing decisions, at least not to the same extent as primary relations. They attributed this to the fact that primary relations, but not non-primary relations, interact with the lexical analysis of the input, which could give rise to explosive ambiguity in the absence of a rapid syntactic analysis of the utterance. They proposed that there is a very narrow type of syntactic underspecification, which allows non-primary relations

to simply be "associated" into the current thematic processing domain, defined as the extended projection of the last theta-assigner. Association is an underspecified syntactic relation that does not entail immediate identification of a sister for the associated constituent; the parser only posits a dominance (but not *immediate* dominance) relation between the phrasal node headed by the last theta-assigner and the associated constituent. The claim that the parser may underspecify certain syntactic relations is shared by many contemporary processing models (Sanford & Sturt 2002; Ferreira & Patson 2007). One important related model is the Good Enough model of comprehension (Ferreira & Patson 2007), which holds that comprehenders may selectively underspecify or compute shallow syntactic representations in certain task contexts; we return to Good Enough processing in the discussion. There are numerous other models of syntactic underspecification, however (see e.g. Marcus 1980; Weinberg 1993).

For present purposes, one important empirical prediction of Construal is that there should be a difference in the preferred analysis of modifiers in sentences like (5) following prepositions that assign a theta-role (e.g. *with*) and those that do not (e.g. *of*). The reason is that the current thematic domain – the domain to which a non-primary item like the restrictive relative clause can be associated – will contain only the PP itself in the case of a theta-assigning preposition (5b) whereas it will include the entire DP in (5a), as indicated by the underlining in (5). This account predicts more ultimate low attachment in (5b) than in (5a), since only the low attachment site for the RC is available within the current processing domain in (5b). In order to achieve the high attachment interpretation in examples like (5b), the association to the local thematic domain must be broken, and the higher thematic domain must be accessed. Because this involves reanalyzing the association relation, it is assumed that this high attachment preference will be more costly and therefore dispreferred by comprehenders. This prediction has been tested many times for restrictive relative clauses (de Vincenzi & Job 1995; Gilboy et al. 1995; see Grillo & Costa 2014 for a recent overview).

(5) a. The journalist interviewed the daughter of the colonel who was on the balcony.
b. The journalist interviewed the daughter with the colonel who was on the balcony.

(6) a. The journalist interviewed the daughter of the colonel, who was on the balcony.
b. The journalist interviewed the daughter with the colonel, who was on the balcony.

Given this processing model, an interesting question to ask is how ARCs and NAs should be treated in examples like (6). If, as the SCH maintains, they create a constituent with their host noun, then we expect them to show the same sensitivity to the *of/with* distinction that restrictive relative clauses show, because the new thematic domain introduced by *with* will inhibit association to the higher noun. On the other hand, if ARCs and NAs are attached "high" or are otherwise structural orphans as the MCH maintains, then we predict no sensitivity to the *of/with* distinction: in this case, the attachment site for the ARC is always high in (6), predicting no sensitivity to the *of/with* distinction. In Experiment 1, we test how ambiguous ARCs and NAs are resolved, in an attempt to distinguish between local constituency analyses of the ARC, such as the SCH, and non-constituency or orphan approaches, such as the MCH.

2 Experiment 1

In Experiment 1, we investigated whether ambiguities in nominal appositives and appositive relative clauses are comprehended similar to restrictive relative clauses. In particular, we tested whether comprehenders resolved ambiguities with these three types of structures in a comparable fashion. Items were constructed crossing preposition (*of* vs *with*) with type of modifier (restrictive relative clause (RRC), appositive relative clause (ARC) or nominal appositive (NA); an example set is given in (7) below.

(7) Penny ignored …

… the child of the patient that had an annoying voice.	[**RRC**, ***of***]
… the child with the patient that had an annoying voice	[**RRC**, ***with***]
… the child of the patient, who had an annoying voice.	[**ARC**, ***of***]
… the child with the patient, who had an annoying voice.	[**ARC**, ***with***]
… the child of the patient, a young one with an annoying voice.	[**NA**, ***of***]
… the child with the patient, a young one with an annoying voice.	[**NA**, ***with***]

Recall that the Construal hypothesis predicts that there should be a greater proportion of low attachment interpretations for relative clauses in *with* conditions, because *with* introduces a new thematic domain that makes high attachment more costly or difficult to achieve. At issue in the present design is whether the choice of preposition has a similar effect on attachment preferences for ARCs and NAs as well.

2.1 Method

2.1.1 Materials

We created 24 item sets consisting of the six conditions in (7). The six versions differed in whether the preposition in the object noun phrase was *of* or *with,* crossed with whether the final phrase was a restrictive relative clause, an appositive relative clause, or a nominal appositive. All items appear in Appendix 1. The different versions of each sentence were assigned to six counterbalanced lists in a Latin Square fashion, such that a given participant only saw one sentence from each item set. One item (24) had to be discarded because of a typographical error. An additional 20 filler items, of various forms, were constructed.

2.1.2 Participants and procedure

Forty-eight participants were recruited via the web, using Amazon's Mechanical Turk, and assigned in equal numbers to the six counterbalanced lists. The mean age of the participants was 35 ($SD = 11$). Each was paid $1.25 for their participation. Only participants over 18 years old using US Internet addresses and reporting being native English speakers were recruited. Two participants were eliminated because of a failure to save their data.

Stimuli were displayed and responses were collected using the Ibex Farm software (spellout.net/ibexfarm). A session began with an informed consent form and a demographic information survey. Following that, the participant was given instructions to read and understand each sentence. Each sentence was followed by a 2-choice question, querying the head of the relative clause. For example, in (7) above, the question put to the participant was *Who had an annoying voice?* and possible responses were *the child* or *the patient*. Participants were told that some sentences would have two possible meanings, and they were asked to choose the one that came to mind first when reading the sentence. Three practice items were presented, and then followed by an individually randomized presentation of the 24 experimental and 20 filler items.

2.2 Results

The proportion of high attachment choices (in which the head of the final clause was the head of the modified clause, *the child* in (7), are presented in Table 1.

The data were analyzed using a logistic mixed model (Jaeger 2008) in R (R Core Development Group 2014). The fixed effect factors were type of preposition, and type of final phrase. Type of preposition was difference coded, with *of* as –0.5 and *with* as 0.5. The effect of final phrase was Helmert-coded. The first contrast was not-at-issue/at-issue, and compared nominal appositives and appositive relative clauses (both –.33) to restrictive relative clauses (.66). The second contrast compared appositive relative clauses (–0.5) to nominal appositives (0.5). In addition, we included all interactions of these fixed effects contrasts. We used the maximal random effects structure justified by the design, including random intercepts and slopes for all fixed effects by participants and items. However, due to convergence issues, the final model did not include random correlations.

The primary prediction was confirmed. There was a main effect of type of preposition (*Estimate* = –0.88, *SE* = 0.17, Wald's z = –5.10, $p < .001$), indicating more high attachment for sentences containing *of* than for sentences containing *with*. The contrast of restrictive relative clause vs. appositives was also significant (*Estimate* = – 1.16, SE = 0.19, Wald's z = –6.08, $p < .001$). There were fewer high attachments with restrictive relative clauses than with appositives. No other effect or interaction approached significance (largest Wald's z = 1.07). Crucially, as can be seen in Table 1, the effect of the preposition was comparable for RRCs, ARCs, and NAs alike.

2.3 Discussion

The results of Experiment 1 suggest that the processing factors that create bias towards low attachment are present in at-issue RRCs and not-at-issue *ARCs* and *NAs* alike. In addition, an overall increase in high attachment was observed for appositives. We take up each finding in turn.

Recall that on the Construal account, *with* creates a low attachment bias in these structures because it can introduce a new thematic domain. This sets the preferred domain of association for non-primary phrases such as RRCs, and creates a bias against modification of the higher or more distant NP. The observation that this preference is observed for appositive relative clauses, nominal appositives, and restrictive relative clauses alike suggests that they are associated into the parse in a similar fashion in sentence comprehension. This result finds no natural explanation if appositives are obligatorily attached at the level of the clause (or propositional node; McCawley 1988; Schlenker 2013). Instead, this result is immediately predicted if the syntactic position of appositives is exactly that of comparable at-issue adjunct phrases (Potts 2005). However, it would be too strong to conclude from these data that appositives attach at exactly the same position as restrictive relative clauses; these results would also follow naturally from any account that sites an appositive at some position within the maximal projection of its host DP (Jackendoff

Table 1: Proportion of high attachment interpretations per condition, as well as the difference between *of* and *with* conditions for each modifier type. Parentheses represent by-participant standard errors.

	RRC	ARC	NA
of	0.49 (0.04)	0.71 (0.03)	0.74 (0.03)
with	0.36 (0.04)	0.54 (0.04)	0.57 (0.04)
Difference	0.14	0.17	0.17

1977; de Vries 2006; Syrett & Koev 2015). Thus while we submit that the present data favor "Subordinate Clause" analyses of appositives over "Main Clause" analyses, they do not allow us to draw sharper distinctions among the various theories that posit some form of antecedent-local attachment of the appositive.

We also observed that appositives preferred high attachments to a greater degree overall than comparable restrictive relative clauses. This may be explained by appealing to well-understood effects of prosodic juncture on attachment preferences (Clifton et al. 2002; Fodor 2002; Jun 2003; Watson & Gibson 2005; Hemforth et al. 2015; Fromont et al. 2017). In particular, the comma used in our materials to convey an appositive structure also conveys a prosodic break, and is thus predicted to inhibit attachment to the immediately preceding NP. This effect in itself may be understood as the prosodic juncture directly indicating a larger syntactic juncture (e.g. Wagner 2010), or the result of a more general bias against modifying lexical heads that immediately precede intonational breaks (e.g. Watson & Gibson 2005).

Lastly, we note that the data do not provide strong evidence that appositives generally prefer high over low attachment. While this seems to be true for *of*, in the *with* conditions appositives show roughly equal rates of high and low attachment. This experiment thus provides very little evidence that appositives exhibit a general preference for discourse prominent antecedents (Schlenker 2013; Ott 2016). Overall, the interpretation preferences for appositives seem rather unlike discourse-level ambiguities, which display a preference towards discourse-prominent and potentially non-local antecedents (Frazier & Clifton 2005). Instead, they largely behave similarly to other at-issue adjunct phrases. If there truly is a preference for a local analysis of appositives, then this is in itself interesting; in particular, it is unexpected under any model that relies on discourse-level relations to derive an interpretation of the appositive. However, we acknowledge that Experiment 1 yielded unclear evidence on this score; although our preferred explanation of the observed high attachment bias appeals to the prosody, it remains possible that there is a general "high" bias for appositives above and beyond the effects of prosody. We return to this issue in the general discussion.

We now turn to Experiment 2, where we take up we take up a distinct, but related question of how appositive material interacts with its host sentence in comprehension. In particular, we ask whether establishing a dependency across not-at-issue content is easier than across very similar at-issue content generally.

3 Experiment 2

In Experiment 2, we looked at items with a final nominal appositive headed by *the one*, as in (8).

(8) a. That girl$_i$ was at the party, which was held in the big auditorium, the one$_i$ who you wanted to date. **[SUBJ, ARC]**

b. That girl$_i$ was at the party that was held in the big auditorium, the one$_i$ who you wanted to date. **[SUBJ, RRC]**

c. That girl was at the party, which was held in the big auditorium$_i$, the one$_i$ that has a capacity of 10,000. **[OBJ, ARC]**

d. That girl was at the party that was held in the big auditorium$_i$, the one$_i$ that has a capacity of 10,000. **[OBJ, RRC]**

In these examples, we manipulate whether the final appositive takes as its head/external argument either the preceding phrase *the big auditorium*, as a baseline, or the subject (subscripts indicate intended coreference). When the final phrase referred to the subject,

this long-distance dependency was interrupted by either a restrictive RC or an appositive RC, as illustrated in (8). This design allows us to test several questions concerning the processing of appositive structures.

First, this design allows us to test whether appositives prefer discourse prominent antecedents (e.g. the subject phrase *that girl*) or local, recent antecedents (*the auditorium*) for appositive phrases, addressing questions left open in Experiment 1. Second, we can ask the question of how the availability of the material inside the at-issue main clause is modulated by the status of the intervener as at-issue (a restrictive relative clause as in (8b, d)) or not-at-issue (an appositive relative clause, as in (8a, c)). The MCH and the SCH views on appositives do not make clear predictions concerning these questions. Thus, our goal in Experiment 2 is not to provide a direct test of these hypotheses.

In Experiment 2 we instead hope to offer more general insight into previous claims concerning how not-at-issue material is processed and comprehended (Dillon et al. 2014; Frazier et al. 2017). In these studies, we have shown that the material inside not-at-issue material does not interfere with the processing of the host clause as much as comparable at-issue material. However, there are a number of ways of modeling this result. One possibility is that the representations of the at-issue and not-at-issue content reside in entirely distinct processing workspaces or buffers. This broad view comports well with Main Clause and orphan views of appositives, because these hypotheses posit that the appositive and its host are entirely separate syntactic domains (on a strong interpretation, entirely different sentences). Since there is good evidence that syntactic material becomes unavailable extremely rapidly once it is no longer being processed (e.g. Sachs 1967), a strong interpretation of the MCH might lead one to expect that pivoting from the at-issue content to a not-at-issue relative clause as in (8a, c) should have the side effect of diminishing the availability of the at-issue content. That is, once the comprehender has moved on from the matrix sentence to the appositive, the material in the preceding main clause might be rendered unavailable. In examples like (8), then, this would mean that the subject construal of the final appositive would be particularly difficult to achieve when an appositive relative clause intervenes, because the syntactic representation of the matrix subject phrase is less available in memory.

An alternative view offered in Dillon et al. (2017) holds that the diminished interference between at-issue and not-at-issue content arises because the availability of not-at-issue content is diminished once the comprehender has finished processing it; in effect, its surface syntactic representation is lost or not refreshed once the parser moves on from it. On this view, it is only the intervening appositive structure that becomes unavailable after it has been processed: the availability of the *at-issue* material that precedes it is not substantially reduced by an intervening appositive. This view would predict that the status of the intervener should not interact with the recency of the antecedent.

3.1 Method

3.1.1 Materials

Sixteen sets of four sentences as illustrated in (8) were constructed. All items appear in Appendix 2. Each item had four versions, defined by the factorial combination of restrictive relative clause (8a, c) vs. appositive relative clause (set off by commas: (8a, c)) and a sentence final phrase beginning *the one* followed by a relative clause that referred to either the matrix subject (8a, b) or the noun in the relative clause predicate (8c, d). As in Experiment 1, the four versions of each item set were assigned to four counterbalanced lists in a Latin Square, such that a given participant only saw one sentence from each item set.

The 16 experimental items in a given list were combined with a diversity of different fillers in a single half-hour experimental session. These included 76 filler sentences from unrelated experiments (involving negative raising, polar vs. non-polar questions, and syntactic ambiguity) that participants were asked to judge on a 7-point scale. In addition, in the same experimental session, participants were presented with 36 items followed by a two-choice interpretation question. Judgment trials and question trials were interspersed in a single experimental block.

3.1.2 Participants and procedure

Forty-eight participants were recruited in individual half-hour sessions for course extra credit. We did not collect age or gender information for these participants; all were undergraduates at the University of Massachusetts, Amherst. Equal numbers of participants received each of the four counterbalanced lists. A session began with the presentation of instructions on a computer terminal. Participants were told that they would see a sentence or short discourse and should press the space bar on a keyboard when they understood it. They would then see a question about what it meant, or a seven-point naturalness rating scale. The scale went from "very unnatural" (1) to "very natural" (7). Participants were told to choose *1* if the item was bad or difficult or unnatural and *7* if it was good and easy and natural. Questions were two-alternative forced choice questions After three practice items, the 128 experimental and filler items were presented in individually-randomized order.

3.2 Results

The mean ratings appear in Table 2, together with standard errors. These data were analyzed using R (R Core Development Group, 2014) as a linear mixed model with fixed effects of type of relative clause and referent of final sentence phrase. These effects were sum coded. As before, subject and item intercepts and slopes were the random factors, although the maximal model did not include random correlations. We adopted $|t| > 2$ as a criterion for statistical significance at the 0.05 level (Gelman & Hill 2007).

The main effect of type of relative clause was significant (*Estimate* = 0.19, SE = 0.06, $t = 3.10$): when the first relative clause was a restrictive relative clause (and thus AI), it was rated higher than when it was an appositive (and not-at-issue). The main effect of the head of the sentence-final relative clause was also significant: items with a recent referent as head (in the initial relative clause) were rated higher than those with a main clause subject as head (*Estimate* = –0.141, SE = 0.09, $t = -4.76$). The interaction was not significant (*Estimate* = –0.03, SE = 0.05, $t = -0.56$).

3.3 Discussion

The results of Experiment 2 reveal a main effect of head position (subject vs. relative clause object), with object rated higher. This is consistent with a recency preference at play in the interpretation of an appositive relative clause; we found no evidence that the appositive prefers discourse prominent antecedents. In addition, there was also a main effect of the sentences containing a restrictive RC being rated higher than those containing an appositive RC. This latter effect could reflect a variety of differences between appositives and restrictives; we return to this effect in the discussion of Experiment 3.

Table 2: Mean ratings (with SEs), Experiment 2.

	Matrix Subject	RC Object
RRC	3.29 (0.11)	4.16 (0.12)
ARC	2.95 (0.11)	3.72 (0.12)

Finally, and interestingly, the interaction was not significant. This suggests that in these items, the material inside the at-issue matrix clause was as available when an appositive intervened as when a restrictive relative clause did. This is not expected on analyses where the appositive is not structurally related to local structure or to any model that posits specialized buffers or processing workspaces that cleave at-issue from not-at-issue constituents. Such views imply that the availability of the at-issue material is diminished with a not-at-issue intervener, making it difficult to explain the non-interaction of intervener status and attachment site in these results. Instead, these results fit more naturally with the view that the availability of the not-at-issue material alone is diminished after it has been understood.

The observation that the availability of the at-issue material seems to persist across a not-at-issue intervener fits very naturally with this view. However, one concern with the results presented here is that that anaphoric dependency initiated by *the one* may have vitiated any opportunity to observe such an effect; perhaps it is simply the case that the anaphoric dependency introduced by this item can relatively easily reinstate previously discarded at-issue material to a fully active status. Thus in Experiment 3, we seek to corroborate the main conclusions of Experiment 2 using syntactic reanalysis as a secondary diagnostic.

4 Experiment 3

In Experiment 3, we looked at examples as in (9):

(9) a. Becca found (that) the security guard who Anne argued is a trained cop fell asleep on duty. **[RRC]**

b. Becca found (that) the security guard, who Anne argued is a trained cop, fell asleep on duty. **[ARC]**

c. Becca found (that) the security guard, who – Anne argued – is a trained cop, fell asleep on duty. **[ARC + PAREN]**

The examples in (9) realize a widely studied syntactic ambiguity known as the *NP/S ambiguity* (Sturt et al. 1999). When the complementizer *that* is absent in these examples, the phrase *the security guard who Anne argued is a trained cop* is incrementally ambiguous. It could either be attached as the direct object of *found,* or it could be attached as the subject of a clausal complement to *found*. Although this preference is modulated by the lexical biases of the verb (Trueswell et al. 1993; but cf Kennison 2001), in general, the parser exhibits a preference to analyzing this ambiguous phrase as the object of the preceding verb (Sturt et al. 1999; van Dyke & Lewis 2003). If a comprehender pursues the object reading for an example such as (8a), then reanalysis will be required at the final verb phrase *fell asleep on duty*; at this point, it will be necessary to detach the phrase headed by *the security guard* and reattach it as the subject of a newly created clausal complement to the matrix verb. This reanalysis exacts a measurable cost in reading measures (Sturt et al. 1999; van Dyke & Lewis 2003). Importantly for present purposes, reanalysis difficulty of this sort leads to lower judgments of acceptability in a wide range of experimental paradigms, both timed and un-timed (Warner & Glass 1987; Ferreira & Henderson 1991; Henderson & Ferreira 1993; van Dyke & Lewis 2003; Tabor & Hutchins 2004). This effect is thought to reflect the ultimate likelihood of successful reanalysis: if comprehenders cannot reanalyze (or cannot do so in a timely fashion), they are left with an unacceptable sentence, which will negatively impact ratings (Ferreira & Henderson 1991; Sprouse 2008). Thus while the measure we adopt here cannot provide insight into how easily reanalysis proceeds during incremental comprehension, it can offer a measure of how probable successful reanalysis is for any given structure.

Assuming this link between acceptability measures and successful syntactic reanalysis, we can use the relative acceptability of examples like (9) to shore up our claims of how at-issue and not-at-issue material interact. First, consider the claim that the at-issue material remains available across a not-at-issue intervener. If this is correct, then we expect reanalysis to be equally successful across an at-issue intervener phrase (9a) as when either one or two comparable not-at-issue phrases intervene (9b, c). On the other hand, if not-at-issue interveners render the preceding at-issue material relatively unavailable, then reanalysis should be less likely to succeed in (9b, c), because the parser will have a harder time accessing *found* to reanalyze its argument structure.

4.1 Method

4.1.1 Materials

We created thirty-two item sets consisting of the six conditions in (9), yielding six observations per condition in this experiment. The six versions resulted from crossing whether or not the sentence was ambiguous (i.e. whether it had *that* or not following the matrix verb), with the structure of the ambiguous phrase. The ambiguous phrase contained a single complex RRC, a single ARC, or an ARC that had a parenthetical nested inside of it. Only punctuation distinguished these three structures: they were otherwise entirely lexically matched. We marked ARCs with a comma before *who* and preceding the critical disambiguating verb; we used double dashes to indicate a parenthetical.

We used nine distinct matrix verbs in our materials, all of which exhibited a lexical bias towards NP attachment of the following NP. The verbs we used were: *suspect*, *find, discover*, *know*, *notice, see*, *hear*, *overhear*, and *believe.* All items appear in Appendix 3. The different versions of each sentence were assigned to six counterbalanced lists, such that each sentence was tested in each form in one list. The experimental items in each list were combined with 32 filler items.

4.1.2 Participants

Twenty-four participants were recruited via the web, using Amazon's Mechanical Turk and assigned in equal numbers to the six counterbalanced lists. We did not collect age or gender information for these participants. Each was paid $1 each for their participation. Participants were connected using US Internet addresses, and reported being native speakers of English over 18 years old. Two participants were eliminated because of a failure to save their data.

Stimuli were displayed and responses were collected using the Ibex Farm software (spellout.net/ibexfarm). A session began with an informed consent form and a demographic information survey. Following that, the participant was given instructions to read and understand each sentence. Each sentence was followed by a 7-point Likert scale. Four practice items were presented, and then followed by an individually randomized presentation of the thirty-two experimental and thirty-two filler items.

4.2 Results

The average ratings by condition, along with by-participant standard errors, are presented in Table 3. In addition, the average reanalysis cost, defined as the difference between the unambiguous and ambiguous variants of a structure, is presented as well.

The data were analyzed using a linear mixed effects model in R. The fixed effect factors were ambiguity and intervener type. Type of clause was sum-coded, with ambiguous as 1 and unambiguous as –1. Intervenor was Helmert-coded, with the first contrast representing RRC vs (ARC and ARC + PAREN), and the second contrast comparing ARC to ARC + PAREN. As in previous experiments, we used the maximal random effects structure

Table 3: Mean ratings per condition, along with cost of reanalysis (*unambiguous-ambiguous* ratings)-per structure. Parentheses represent by-participant standard errors.

	RRC	ARC	ARC+PAREN
Unambiguous	4.6 (0.2)	5.5 (0.2)	4.9 (0.2)
Ambiguous	4.2 (0.2)	5.1 (0.2)	4.6 (0.2)
Reanalysis cost	0.4 (0.1)	0.4 (0.2)	0.4 (0.2)

justified by the design, including random intercepts and random slopes for all fixed effects by participants and items. As in Experiments 1 and 2 we did not include random correlations. We accepted $|t| > 2$ as a criterion for statistical significance at the 0.05 level.

The analysis revealed three main findings. First, there was a significant main effect of ambiguity, with ambiguous sentences judged significantly worse than unambiguous sentences (*Estimate* = –0.22, SE = 0.06, t = –3.6). Second, there was a main effect of the RRC versus ARC contrast, such that sentences with ARCs were rated higher overall (*Estimate* = 0.21, SE = 0.06, t = 3.6). Lastly, within the ARC conditions, ARC + PAREN conditions were rated as significantly worse than ARC (*Estimate* = –0.27, SE = 0.08, t = –3.4). No other effect or interaction approached significance (largest t = 0.55). Critically the reanalysis cost, defined as the difference between ambiguous and unambiguous conditions, was comparable across all types of intervener.

4.3 Discussion

The results of Experiment 3 reveal several things. First, we observe that the NP/S ambiguity is reliably observed in offline judgments; raters consistently dispreferred the ambiguous variants of our sentences. Second, we observe that the reanalysis cost was comparable across all three intervener types; we failed to find any evidence for differences in this cost as a function of intervener. Lastly, ARC structures were overall preferred to RRC structures, although within the ARC conditions there was a preference for less complex ARCs. We take up these findings in turn.

The simple observation of an ambiguity penalty in our ratings validates our choice of dependent measure, and suggests that we can reason about reanalysis costs even using untimed offline measures. This is perhaps not surprising in and of itself, and it replicates a number of other previous findings about untimed judgments and reanalysis (Warner & Glass 1987; Ferreira & Henderson 1991; Frazier & Clifton 1998; van Dyke & Lewis 2003).

The observation that the cost of reanalysis is comparable across all three structures corroborates the critical insight from Experiment 2: the availability of at-issue material is not adversely impacted by intervening not-at-issue material. If this were the case, then we would have expected reanalysis to be less successful across not-at-issue interveners; this was not observed. Instead, in our experiment reanalysis appeared to be equally successful across not-at-issue interveners and at-issue interveners alike. This observation is interesting because it suggests that the switch to a not-at-issue ARC does not freeze or otherwise entrench any commitment to the parser's analysis of the material that comes before; on this view, the probability of successful reanalysis would be negatively impacted by intervening appositive material. Our results suggest that it is not, indicating that the comprehender's commitment to the matrix clause structure remains similarly labile across the three intervener types.

Finally, we observed an overall preference for ARC interveners, even when those ARCs themselves contained a nested parenthetical. The source of this effect is unclear. One possibility suggested to us by an anonymous reviewer is that the presence of the commas in

this condition may have made the final interpretation of these sentences clearer or easier to achieve. Interestingly, we note that this effect reflects a consistent pattern that we have observed across several experiments: when modifying subjects, appositive relative clauses are preferred to restrictive relative clauses (e.g. Experiments 3 and 4 of Dillon et al. 2014), but when modifying objects, the opposite preference is observed (Dillon et al. 2014; see also Experiment 2 above). We have no firm explanation of this effect, although we have speculated elsewhere that it might reflect informational-structural considerations: subjects tend to be given information, and it is possible that appositives preferentially comment on given information (Dillon et al. 2014).

5 General discussion

In this paper, we presented data from three offline judgment experiments. In Experiment 1, we observed that comprehenders resolve interpretive ambiguities with not-at-issue appositive relative clauses and nominal appositives in a way similar to at-issue restrictive relative clauses. Specifically, the thematic properties of the preposition influenced interpretation preferences for all three types on modifiers in the same manner. In Experiments 2 and 3, we observed that i) the acceptability of subject-modifying nominal appositives was not reliably impacted by the type of intervening constituent and ii) the drop in acceptability associated with ambiguous sentences was not reliably influenced by the type of intervening constituent.

The data presented in Experiment 1 suggest that the ultimate resolution of not-at-issue appositive phrases is similar to that for at-issue restrictive relative clauses. All modifier types we examined exhibit a bias towards attachment into the local thematic domain. We interpret this pattern as support for a subordinate clause analysis of appositive material, the broad claim that they form a syntactic constituent with their host noun. Such a subordinate clause external syntax of ARCs and NAs, when embedded into a Construal model of the processor, would directly explain the results: the syntactic attachment site of the appositive is ambiguous, and so comprehenders resolve that ambiguity just as they do for other adjunct phrases. The Main Clause Hypothesis for appositives predicts no such sensitivity. Overall, the results of Experiment 1 fit into the Construal account nicely, showing that one of the hallmark predictions of Construal – non-primary relations are associated into the current thematic processing domain – applies equally to at-issue and not-at-issue content.

Experiments 2 and 3 addressed the question of whether the availability of at-issue material was negatively impacted by intervening not-at-issue material. The results of both experiments suggest that the answer to this question is no: modification, and reanalysis, of at-issue material appears to be as easy across long at-issue intervening material as across intervening appositive material. We suggest that this result is broadly consistent with the subordinate clause analysis of appositive dependencies. Appositives do not seem to trigger the comprehender to move on and forget the at-issue material they were processing prior to encountering the appositive material, as might be expected on a Main Clause analysis of appositives; instead, the superordinate syntactic material remains similarly available across at-issue and not-at-issue interveners. Although based primarily on offline data, this conclusion aligns well with findings from both cross-modal naming paradigms (Redeker 2006) and eye-tracking-while-reading (Dillon et al. 2017). A range of evidence suggests that appositive material does not negatively impact the availability of the previous syntactic encodings any more than comparable at-issue material.

Nonetheless, appositive content is treated distinctly from its host clause in comprehension and processing. Consider the sentences in (10), repeated from (4) above:

(10) a. The butcher asked who the lady who bought Italian ham **had invited** _ to dinner tonight.
b. The butcher asked who the lady, who bought Italian ham, **had invited** _ to dinner tonight.

Across two eye-tracking-while-reading studies, Dillon et al. (2017) observed that the contents of the appositive relative clause interfered less with processing the gap site than did the restrictive relative clause. This suggests that integration of the filler *who* at the gap site *had invited* was easier across an intervening appositive than across a restrictive relative clause. We interpret this finding as evidence that the surface form of the subordinate speech act represented by the relative clause becomes rapidly unavailable after the comprehender finishes processing it, such that it is less available to create retrieval interference at the gap site. In other words, subordinate appositive relative clauses seem to undergo a forgetting process in incremental comprehension, an on-line reflection of well-known findings that the surface form of sentences becomes unavailable quite rapidly (e.g. Sachs 1967; Potter & Lombardi 1990). An interesting but compatible alterative view is that the syntactic form of the appositive is quickly re-encoded into a compressed state after it has been processed. This second possibility is inspired by Parker and Phillips (2016), who develop the hypothesis that the processor can compress syntactic encodings at certain points in comprehension. This compression process changes the encoding of a constituent so that its internal contents are no longer available to interfere with subsequent syntactic and semantic processing (see Parker & Lantz 2017 for a computational model). Either view – a compression model or a forgetting model – would help understand the puzzling finding that the processor can both maintain the main clause in an accessible state while selectively setting aside the appositive material: the parser can forget, or compress, sentence-medial appositive material once it is finished, because it cannot participate in any further dependencies. In contrast, the main clause material may need to remain active for further modification.

An interesting question arises as to why appositives, but not other subordinate clauses, should display this behavior. One possibility is that this is because appositives contribute not-at-issue content, which is analyzed as a separate speech act from that of the main utterance. While appositive relative clauses and nominal appositives contribute distinct speech acts from this main clause, those acts are subordinate discourse units (see Loock 2007; Jasinskaja 2016; and references therein). On this view, it is their status as distinct but discourse-subordinated speech acts that triggers this behavior. However, an alternative possibility is that it is the distinct prosodic phrasing of appositives that is at the root of this effect (Kroll & Wagers 2017). On either analysis, there is mounting evidence that the syntactic form of appositive material that has come and gone, such as appositive relative clauses in medial position, becomes rapidly unavailable in short term memory (Dillon et al. 2014; Dillon et al. 2017; Kroll & Wagers 2017). This leads to diminished interference from the contents of appositive constituents on the processing of their host clause. However, at present the evidence seems to support the view that not-at-issue constituents have no deleterious impact on the availability of at-issue material that precedes them.

5.1 Syntactic ambiguity, sentence processing and appositive relations

Somewhat more speculatively, we would like to consider some more general consequences of applying the Construal model to not-at-issue phrases such as appositive relative clauses and nominal appositives. Recall that the Construal theory holds that the processor can temporarily underspecify the attachment of non-primary phrases, allowing the comprehender to associate them into the current thematic domain and delay any determinate attachment of the non-primary phrase. The underspecified association relation in the

construal model means that a given phrase is analyzed as part of a thematic domain, but that it is not assigned a determinate sisterhood relation with any node in that domain.

For all at-issue non-primary phrases, such as restrictive relative clauses, it is sometimes assumed that this underspecified relationship is eventually resolved, and full sisterhood and dominance relations are established for all phrases. However, this does not appear to be true for adjunct phrases: the pressure to determinately attach an adjunct appears to be partially task dependent. Swets et al. (2008) argue that in task contexts where it is not necessary for comprehenders to resolve the attachment of a restrictive relative clause, comprehenders may do not do so at all. Swets et al.'s proposal is based on the Good Enough model of sentence comprehension (Ferreira & Patson 2007), which holds that the depth of syntactic analysis engaged by the comprehender is partially controlled by the goals in their task environment. Thus, like the Construal model, Good Enough models allow the parser to underspecify certain syntactic relations, but extends these claims in allowing these relations to remain indefinitely underspecified if this nonetheless allows the comprehender to achieve her goals in the current task context. Given the possibility of task-dependent, syntactic underspecification, an interesting – but speculative – possibility is that not-at-issue material, like relative clauses in Swets et al.'s (2008) shallow task contexts, can remain indefinitely underspecified. In effect, the parser could leave the appositive material permanently *associated* into the current thematic domain, never requiring a full determinate attachment of this phrase in the general case. A more graded version of this proposal could admit a continuum of attachment pressure, with the pressure to find a determinate attachment site for non-primary material modulated by i) the task context (Swets et al. 2008) and ii) the at-issue or discourse status of the modifier phrase. If the parser may simply underspecify the relationship of the not-at-issue material to its host utterance, this may offer a different avenue for modeling the intuition that appositive material is somehow more loosely related to its host clause. We reiterate that this must remain speculative at present, although it suggests interesting avenues for future research.

One important question that must be specified in further work concerns the different possible attachment sites for appositive material. Above, we argued that the sensitivity to the *of/with* distinction broadly supports the subordinate clause analysis, and that the appositive material syntactically modifies its NP/DP host. However, this should not be taken as evidence *against* the Main Clause hypothesis: the two need not be mutually exclusive possibilities. For example, Syrett and Koev (2015) argue for a mixed syntactic approach for appositive relative clauses. They argue that sentence final appositive relative clauses are syntactically ambiguous, and can attach either high (at the root node) or low (modifying their host DP). However, if we suppose that appositives are always ambiguous, allowing root-clause or local attachment, then we are in a position to offer an explanation for some of the observations that have buoyed the Main Clause analyses of appositive structures that we have argued against. Consider, for example, these examples from Schlenker (2013; updated to reflect the current president of France):

(11) *French*
Le président$_i$ est si compliqué qu'…
the president is so complicated that
"The president is so complicated that …"

a) *…il$_i$ a donné au ministre qui n'aime pas Macron$_i$ une
he has given to.ART minister who NEG-like not Macron a.F
tâche impossible.
task impossible
"… *he$_i$ gave the minister who doesn't like Macron$_i$ an impossible task."

b) ?...il$_i$ a donné au ministre, qui n'aime pas Macron$_i$, une
he has given to.ART minister who NEG-like not Macron a.F
tâche impossible.
task impossible
"… ?he$_i$ gave the minister, who doesn't like Macron$_i$, an impossible task."

Schlenker observes that the Condition C effect generated in (11a) by coindexing *il* and *Macron* is alleviated in (11b), when the offending R-expression is situated inside an appositive relative clause. To our ear, the judgments on the English translations receive similar judgments (* and ?, respectively) to the French examples reported by Schlenker. Schlenker offers similar examples using weak crossover effects as a diagnostic.

Examples like these suggest that there may not be a c-command relationship that holds between an appositive relative clause and its host. This is difficult to accommodate under subordinate clause analyses of appositive material. However, if appositives are always in principle ambiguous in their attachment site, then data points like these can be accommodated: in (11) the parser can attach high to obviate the Condition C violation in (11).

5.2 Offline data and incremental processing

Before closing, we would like to comment briefly on our choice of dependent measure. In the present study, we limited our evidence to offline data. We derived predictions about likelihood of successful reanalysis and ultimate interpretations from processing models. It is important to underline, however, that the present results do not provide direct support for the incremental processing claims implied by these models. They only validate the claims about the final attachment preferences, or the probability of successful reanalysis, made by these models. Thus we need only make the weaker assumption that offline data provide some reflection of the end result of processing (see also Ferreira & Henderson 1991; Fanselow & Frisch 2006; Sprouse 2008; Clifton & Frazier 2010). In particular, we cannot make precise claims at present about the incremental processing of appositive ambiguity.

This caveat is important, because the broader literature on RC attachment suggests that caution is warranted in reaching conclusions about how incremental processing of appositive attachment would proceed. It is possible that there is not much difference between the offline data and how comprehension proceeds incrementally; indeed, many studies suggest that incremental comprehension of RC attachment can mirror the offline data closely (Carreiras & Clifton 1993; 1998; Carreiras et al. 2004; Swets et al. 2008; Hemforth et al. 2015). Furthermore, there is evidence that offline acceptability data do reflect temporary representations created during the course of incremental processing (Fanselow & Frisch 2006; Sprouse 2008; Clifton & Frazier 2010). Even so, it is true that in some cases the online data do seem to diverge from the offline data. For example, Traxler, Pickering & Clifton (1998) observe comparable reading times for high and low RC attachment in English, despite a low attachment bias in the materials. In a study on Italian, De Vincenzi and Job (1993) observed that incremental reading time data pointed to a low attachment preference for relative clauses, while offline comprehension data pointed to a high attachment preference. There are still other divergences between offline attachment preferences and online parsing. For a further discussion, we point the reader to Grillo and Costa (2014). We regard it as an open question how readers commit to an analysis of ambiguous appositive phrases during incremental comprehension.

6 Conclusion

In this paper, we have presented experimental evidence in the form of three offline judgment experiments on the processing of appositive relative clauses and nominal appositives. We have shown that the processing of appositives is well described by Construal

theory, suggesting that processing appositives involves forming a local association relation between the appositive and its host. Further, the processing of an appositive does not lower the availability of at-issue material that precedes it any more than its restrictive counterpart does. Taken together, these results suggest a refinement and extension of the Construal theory of syntactic processing, and offer a new perspective on the apparent "orphan-like" character of appositive phrases.

Abbreviations

ART = article, F = feminine, NEG = negation.

Additional Files

The additional files for this article can be found as follows:

- **Appendix A.** Experiment 1 materials. DOI: https://doi.org/10.5334/gjgl.379.s1
- **Appendix B.** Experiment 2 materials. DOI: https://doi.org/10.5334/gjgl.379.s1
- **Appendix C.** Experiment 3 materials. DOI: https://doi.org/10.5334/gjgl.379.s1

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Competing Interests

The authors have no competing interests to declare.

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