Relative Clause Extraposition and Prosody in German*

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Abstract

Whether a relative clause (RC) can be extraposed has been argued to depend both on contextual focus and on whether an RC is restrictive or appositive. However, no previous study has looked at the interaction between these two factors in restricting extraposition, despite the fact that different types of relative clauses are generally taken to differ in how they relate to focus. Furthermore, previous studies have not looked at the role of prosody in accounting for the effect of focus on extraposition, and have found contradictory results with respect to the prosodic differences between appositive and restrictive relative clauses. This paper presents the results of a production experiment on German which crosses the location of focus and the type of RC in order to explore how they interact in affecting prosody and extraposition.

Keywords: EXTRAPOSITION, RELATIVE CLAUSES, APPOSITIVES, PROSODY, FOCUS

1 Relative Clause Extraposition

Relative Clauses (RCs), along with complement clauses and prepositional phrases, belong to the limited subset of constituents which can be 'extraposed' in German, that is, they can occur to the right of all other material of the clause that the constituent they modify belongs to. Consider the case of extraposition of a relative clause from subject position across a VP that contains a direct object NP:[1]

(1) a. Non-Extraposed:
Jeder Wanderer, der Schneeschuhe trug, hat das Riemannhaus
every hiker who snow shoes was wearing has the Riemannhaus
erreicht.
reached

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[1] In German orthography, all relative clauses are standardly separated from the head noun by a comma, while in English, only appositive relative clauses are.

'The hiker who was wearing snow shoes has reached the Riemannhaus.'

b. Extraposed:

Jeder Wanderer hat das Riemannhaus erreicht, der Schneeschuhe
every hiker *has the Riemannhaus reached* *who snow shoes*
trug.
was wearing,

'The hiker who was wearing snow shoes has reached the Riemannhaus.'

If the RC is pronounced next to the noun it modifies, as in (1a), it intervenes between it and the inflected matrix predicate. If, on the other hand, the RC is pronounced in the extraposed position as in (1b), the head of the subject and the verb stay adjacent, but the RC is separated from its head by the entire material contained in the VP. The dependency between the head noun and relative clause and the dependency between head noun and clause-final verb therefore can only be local if the other is not.

Each of these dependencies has been shown to cause processing difficulty, sometimes resulting in unacceptability, depending on the amount and type of material in the RC and the VP in (1a) and (1b) respectively. In English, for example, extraposition of a restrictive relative clause across another NP as in (1b) is often considered ungrammatical, in contrast to German. The question under which circumstances the extraposed word order is possible, preferred, or even obligatory has received considerable attention in the literature. According to Quirk et al. (1985, 1398), there are two types of motivation for the extraposition of a relative clause: One is to achieve 'endweight', that is, ordering longer and more complex constituents later in the sentence. The other is to order focused material last, which applies in cases in which the entire noun phrase that is modified by the RC or the RC itself is focused. These two factors have played a central role in recent theoretical and experimental work on extraposition, both on English and German.

Weight and focus are also generally correlated: Discourse new information tends to be linguistically expressed with longer and heavier (e.g., modified) constituents, while discourse given information is often pronominalized and less likely to be modified (Arnold et al., 2000). And they both have a close relationship to phonological content: The notion of 'weight' is often assumed to be dependent on phonological size and/or prosodic structure (cf. Zec and Inkelas, 1990; McDonald et al., 1993; Wasow, 2003; Anttila et al., 2010). Focus on the entire modified noun phrase or just on the RC is expected to an increase in prosodic prominence of the head and/or the RC, and reduced prosodic prominence of the material intervening between head and RC material (cf. Breen et al., 2010). And yet there have not been any controlled studies on extraposition trying to directly disentangle the role of prosody in explaining these effects.

The locality of extraposition has also been argued to depend on the type of relative clause. Restrictive relative clauses (RRCs) as in (1) are generally assumed to extrapose more easily compared to appositive relative clauses (ARCs),[2] both in English (Emonds, 1979; Potts, 2005a, i.a.), and in German (Zifonoun, 2001; Holler, 2005, i.a.). While this assumption seems to have gone unchallenged, it seems to be based only on very few comparisons of extraposition in ARC and RRC examples that differ in many ways from each other. To the extent that we know, there has not been a controlled experimental study

[2] 'Appositive' relative clauses are those non-restrictive relative clauses that modify nominal constituents.

that tested this hypothesis. Furthermore, many previous studies in both languages have noted that appositive relative clauses are separated from the head by prosodic boundaries, while restrictive relative clauses are not, or at least only optionally. Recent experimental work testing this claim have failed, however, to find systematic evidence for such a prosodic difference.

Finally, while both focus and RC-type are widely held to affect extraposition, a question that has not been explored before is whether these two factors interact with each other in constraining extraposability. From a semantic point of view, appositive and restrictive relative clauses show a very different pattern in how they semantically interact with contextual focus. Hence one might very well expect that they do interact in their effect on extraposition.

The production experiment reported in this paper explores these questions based on extraposition in German. The study has two goals: First, to establish the prosodic effects of the factors considered here; second, to explore their effects on extraposability, while considering whether these effects are modulated by the prosodic realization of the utterances.

1.1 Dependency and Distance

Increases in the complexity of the material between the head of the subject noun phrase and the inflected verb, as in (1a), or the head of the RC and the RC, as in (1b), have been shown to correlate with increased processing difficulty, sometimes even leading to ungrammaticality, and have been shown to be relevant in speaker's choices between extraposed and non-extraposed structures. Uszkoreit and Brants (1998), for example, showed based on corpus data that for German relative clauses the rate of extraposition is highest with heavy RCs and a minimal distance (one-word) between RC and head. With an increasing distance between RC and head, the extraposition rate decreased significantly, and RC-length no longer seemed to contribute to the likelihood of extraposition. An acceptability rating study confirmed the relevance of both factors. Konieczny (2000) similarly found that the acceptability of extraposition increases with RC length and decreases with the distance between RC and head. More recently, Bader (2014a) found that relative clause extraposition is almost obligatory (highly preferred both in corpora and in production experiments) when it only results in a verb separating head and RC, but the extraposition rate drops off rapidly when more material intervenes. When only the clause-final verb intervenes, extraposition is nearly obligatory in German (90% of extraposition in the production experiment), with one additional word the rate drops to 65%, and two additional words reduce the rate already to 35%. While the relevance of the 'distance' or 'length' of the two dependencies is generally acknowledged, what remains controversial is how to measure the 'distance' or 'length' of either dependency properly, such that the measures correlate with the actual difficulty of the structures.

There are mainly two different ways of how 'distance effects' have been approached, and many recent models incorporate aspects of both. The first idea is that word order preference are related to a more general preference to order heavier and longer constituents after lighter and shorter constituents (Behaghel, 1909). This very general pattern that has been observed across a number of typologically unrelated languages can be related to the preference to order more accessible information early in the sentence (Bock and Levelt, 1994). How exactly length or weight is defined in the literature varies. In corpus studies,

the number of words is often taken as a proxy for weight (Hawkins, 1994), but other authors have suggested to count the number of syllables (McDonald et al., 1993) or the number of lexical stresses instead (Anttila et al. 2010). See Wasow (1997), Wasow (2003), Culicover and Jackendoff (2005), Arnold (2007), and Francis 2010 for recent discussions.

The second idea is that the intrinsic properties of the intervening material, rather than just its length relative to the extraposed material, is relevant in in explaining restrictions on extraposition. Certain types of interveners might taxe memory resources more (Gibson 1998; Lewis and Vasishth 2005; Bader 2014b), might affect the likelihood of the occurrence of an RC (Levy et al., 2012), or might create syntactic locality effects (see Webelhuth et al., 2013a, for a recent overview).[3] Gibson (1998) and Warren and Gibson (2002) present evidence that integrating across material which introduces a new discourse referent is more costly than integrating across linguistic material referring back to a pre-existing discourse referent. For example, intervening indexicals such as 'I' and 'you' (which can be considered as discourse given) create less processing cost than newly introduced proper names of comparable length. Support for the relevance of discourse referents in relative clause extraposition was presented in Bader (2014a), who showed direct evidence that the measure of distance affecting extraposition is not the number of intervening words but rather the number of new discourse referents in the sense of Gibson (2000). It is clear then that the content of the intervening material matters.

One aspect of the intervening material that has not received much attention and that we are particularly interested in is its prosody. RCs can be extraposed relatively easily across a simple clause-final verb (see Levy et al. 2012 for English and Bader 2014a for German), but intervening NPs have been argued to hinder or even block relative clause extraposition (Altmann, 1981; Inaba, 2007). Since both verb and NP should count as introducing a new discourse referents (cf. Warren and Gibson, 2002; Gibson, 2000). Predicates, however, differ from NPs prosodically, in that they often remain unaccented, at least when preceded by their syntactic complement or an internal argument (cf. Wagner, 2005, and references therein). Could it be then that the prosodic prominence of the material intervening between head and RC plays a role? This is one of the questions that our experiments will explore.

An alternative reason why an intervening NP might hinder or even block RC extraposition is that any intervening NP is a potential modifiee of the RC, in other words, intervening NPs can be a source of ambiguity. If this is indeed a relevant factor, then one might expect this effect to go away or at least be ameliorated in cases in which, pragmatically or morphologically, the intervening NP is not a possible modifiee of the relative clause. Hemforth et al. (2000) and Bader (2014b) find that extraposition from subject position across an NP indeed improves if the object NP is ruled out morphologically as a potential modifiee of the RC, for example by case-matching. But even in these cases, extraposition still poses parsing problems, so potential ambiguity cannot be the only reason for the difficulties.

A correlation with prosody is made plausible by various previous results. For example, Kathol and Pollard (1995) observe that directional or locational adverbs do not block relative clause extraposition as much as a nominal argument does. Locational adverbs and similar modifiers, however, often remain unaccented (cf. Wells, 2006). Levy et al. (2012) find that extraposition from subject position in English intransitive clauses is easier across

[3]It is likely that all three types of effects are relevant. Levy and Gibson (2013), for example, argue that predictability is necessary but insufficient to account for reading times in relative clause processing, since the location of certain effects is incompatible with surprisal or predictability accounts.

'presentational' verbs compared to other verbs, confirming earlier observations by Guéron (1980). Such presentational verbs are particularly likely to remain unaccented (cf. Faber, 1987). Whether a constituent is accented or not might be a reflection of the degree to which its processing requires resources, in which case we might expect that accented constituents will interfere more than unaccented constituents.

The hypothesis that prosodic prominence affects the possibility of extraposition is not new. Loetscher (1972) reports that extraposition in German requires the main sentence accent to fall somewhere within the NP including the RC that modifies it (cf. also Shannon, 1992; Konopka, 2006). Bader (2014a) explicitly considers the specific idea we are interested in here, namely that the prosodic accentuation status and hence the degree of prominence of intervening material might play a role in explaining the distance effect in extraposition.

Bader ultimately rejects the idea that the accentuation of the intervening material is an important factor, based on the observation that unaccented indefinite pronouns that intervene between head and RC also decrease the rate of extraposition. However, the idea that the prosodic prominence of intervening material is important does not mean that it should be the only factor. The adverse effect of an intervening indefinite pronoun can be explained with the high likelihood with which they are modified by a restrictive relative clause (Roland et al., 2007). Encountering an intervening indefinite pronoun creates an expectation that an RC will follow that modifies it, and thus plausibly decreasing the likelihood that an RC modifies some other constituent. Levy et al. (2012) shows that the reading difficulty of an extraposed RC correlates with the degree to which it is predictable. And experiment reported in Walker (2013) found that extraposition from an indefinite NP is more acceptable than extraposition from a definite one, lending more credence to this interpretation of the effect of unstressed indefinite pronouns.

A first goal of this study is then to test the hypothesis that the prosodic prominence of intervening material modulates extraposability. If indeed it does, there are several possible interpretations of this. One possibility is that prosodic prominence is a reflex of the degree of salience of an intervening constituent, which might correlate with the extent to which it will interfere with interpreting the restriction the RC introduces. This would be the view one could adopt within resource-based approaches such as the Dependency Locality Theory (Gibson, 2000) or the theory based on skilled memory retrieval in (Lewis and Vasishth, 2005). Another possibility entertained in the literature is that prominence on the intervening material more directly creates problems for prosodic structure itself, and extraposition might be a tool to fix these. Truckenbrodt (1994); Göbbel (2012) and Féry and Schubö (2013) posit such prosodic views of constraints on extraposition. Under any of these interpretations, it is important to establish that prosody is really the relevant factor, and not another factor that correlates with prosodic prominence: contextual focus.

1.2 Extraposition and Focus

Prosodic prominence affected by context. Any effect of prominence of the intervening material on extraposition might therefore actually be an indirect consequence of the factors that affect it. This leads us to lines of inquiry on extraposition that has explored the idea that contextual focus affects extraposability.

If a linguistic constituent provides the answer to the question under discussion or is contrastive, it is focused and hence usually accented; if it is contextually given and forms

part of the background, it is likely to remain unaccented and hence less prominent. One way of accounting for this pattern is the alternatives theory of focus (Rooth, 1996). If prosody plays a role in RC-extraposition, it is possible that these effects are in fact due to focus. Consider sentence (1b) (here repeated as (3)) with a subject-modifying RC in the following three contexts (2):

(2) Focus Contexts

a. Wide-Focus

War die Wanderung schwierig?
was the hike difficult

'Was the hike difficult?'

b. Subject-Focus

Wer hat das Riemannhaus erreicht?
who has the Riemann-house reached

'Who reached the Riemann house?'

c. Object-Focus

Welches Ziel hat jeder Wanderer erreicht?
which goal has every hiker reached

'Which goal did every hiker reach?'

(3) Jeder Wanderer hat das Riemannhaus erreicht, der Schneeschuhe trug.
every hiker has the Riemannhaus reached who snow shoes was wearing
'Every hiker who was wearing snow shoes has reached the Riemannhaus.'

Which context is most helpful to make extraposition work? Gibson et al. (2005) argue that restrictive relative clauses are preferred in subject position over object position, because RCs typically form part of the old information in a sentence. One might then expect that extraposition is easier when the potential head constituent is already contextually more salient and hence part of the background information of a sentence, and object focus to be most helpful. In contexts that favor object focus, the subject is already contextually salient, and hence adding a restrictive relative clause to it should be easier. This, however, clearly seems at odds with intuitions about (3): The context in which the subject is focused and the intervening VP constitutes given information seems like the most helpful context in (3). In fact, even in the unextraposed position, an RC seems a little odd in subject position when the object is focused—if the referent of the subject constitutes discourse old information, why would one need to add a restrictive relative clause to pick out the right referent? If subject-focus is indeed most conducive to extraposition, this would be in line with the idea from Gibson (1998) and Warren and Gibson (2002) that processing difficulty arises if new discourse referents intervene between dependent constituents, but not, or less so, when given material intervenes. While in subject focus contexts the object referent might be more salient in some discourse-related sense, it seems to be less available as an antecedent for RC modification and hence create less interference. And indeed, Loetscher (1972), Guéron (1980), Huck and Na (1990), Rochemont and Culicover (1990), Shannon (1992), and Takami (1999) all argue that focus on the NP or RRC favors extraposition and can ameliorate otherwise unacceptable cases of extraposition.

The idea that extraposition is facilitated by focus is often related in these earlier studies to the more general tendency that focused material is presented toward the end of a sentence. Schafer (1996), on the other, hand, formulated the Focus Attraction Hypothesis, according to which focus on an NP more generally increases the likelihood that it will be taken to be the modifiee of a following RC (for example, when a complex noun phrase contains two potential attachment sites, as in *the sister of the colonel*). This effect has since been argued to be an indirect consequence of the salience of the focused material (Lee and Watson, 2011), rather than being due to a parsing principle that directly affects attachment decisions as proposed in Schafer (1996). Either way, this effect leads to the expectation that in extraposition, intervening material might interfere less when it is given, and more when it is focused. Another interpretation of this effect is that focus on the head simply increases the likelihood that it is modified by an RC. Levy et al. (2012) use focus operators like *only*, which they show increases the expectation of an upcoming RC modifier, and consequently improves extraposition. The expectation that free prosodic focus also ameliorates extraposition was directly tested in Bader (2014b). Bader shows that an extraposed clause that contains a subject and an object NP, which both are potential modifiees (as in (2)), focusing the subject increases the likelihood for the RC to be interpreted as modifying it. This is as expected by the Focus Attraction Hypothesis. And yet, even then there is still a preference to interpret the RC as modifying the more recent object, in other words, a preference for the non-extraposed structure. This shows that constraints other than information structure play a role.

Focus and prosody are highly correlated factors. In the extraposed structure, if the material from the matrix VP intervening between head and RC is discourse given and the subject focused, as in (2)a, it is likely that the VP material will be deaccented and hence prosodically reduced. If, on the other hand, the object is focused, the VP will contain an accented constituent and will be prosodically prominent. The broad focus case will likely be intermediate in terms of the prominence of the VP material relative to the head of the RC in subject position. Our study aims to test whether both factors play a role, or whether one can be reduced to the other.

1.3 Extraposition and RC Type

Restrictive relative clauses have been argued to differ from appositive relative clauses in their ability to extrapose. Let's first characterize the difference between the two types of RC before looking at their extraposition behavior. RRCs are usually analyzed as denoting properties, which, when attached to a nominal head, combine with its meaning in an intersective way, such that they further restrict the set denoted by nominal predicate they modify (Quine, 1960; Heim and Kratzer, 1998). ARCs, on the other hand, do not combine directly with the denotation of a nominal head, rather they convey additional information about the referent of the NP they relate to. Consider the following example:

(4) a. The students that had attended the tutorials passed the exam. (RRC)
b. The students, which (by the way) had attended the tutorials, passed the exam. (ARC)
c. The students passed the exam. They (all) had attended the tutorials.

The RRC in (4a) restricts the set of students that passed the exam to the subset of those who had attended the tutorials.[4] The sentence in (4b), by contrast, tells us that a certain group of students all passed the exam, and the ARC provides the additional information that these same students had all attended the tutorials.[5] In this respect, the ARC in (4b), despite its sentence-internal position, is similar in its contribution to the independent matrix clause in (4c). ARCs more generally act like independent sentences, and, in fact, separate speech acts. Ross (1967, 435), for example, points out that an appositive relative clause introduces an assertion even when it attaches to a constituent inside of a question. So (5a) can be roughly paraphrased with (5b):[6]

(5) a. Is even Clarence, who is wearing mauve socks, a swinger?
b. Is even Clarence a swinger? Clarence is wearing mauve socks.

ARCs differ from main clauses, however, in that their contribution does not seem to be presented by the speaker as being up for debate and their contribution is unlikely to be rejected by the addressee. Therefore, it is often treated as not-at-issue content (cf. Chierchia and McConnell-Ginet 1990; Potts 2005b; AnderBois et al. 2013 and Koev 2013 for detailed discussion).

Some analyses have tried to capture the autonomous status of ARCs by positing a discourse (e-type) pronoun that picks up a discourse referent (Sells, 1985; Del Gobbo, 2003) rather than analyzing them as relative clauses modifying a head. Others have interpreted this behavior as evidence that ARCs take wide scope outside the matrix clause, and that they attach high up in the syntactic tree (cf. McCawley 1981, 1982 and Schlenker 2009). A third type of syntactic analysis treat them as syntactic 'orphans' that do not form a proper part of the syntactic structure at surface structure (Safir, 1986), or at any point in the derivation at all (Fabb, 1990; Espinal, 1991). A more recent semantic account (Potts, 2005b) proposes that ARCs are syntactically part of the regular phrase structure, but are interpreted on a separate semantic dimension, and thus necessarily cannot interact with material in the main clause.[7]

The syntactic and semantic autonomy of appositive relative clauses is mirrored by a greater prosodic independence. Lee (1956, 351) notes that in English, restrictive relative clauses are not separated from the RC by a pause, while ARCs can be, and furthermore, the head carries a 'kinetic tone' in the case of ARCs. This tonal difference between the two RCs was later usually interpreted as the presence of a boundary. In German, Motsch (1965, 97) states that appositive relatives in German are optionally set off from the head by boundaries, while restrictive relative clauses are not. Ross (1967, 209), i.a., notes that appositive relative clauses are 'preceded and followed by heavy intonation breaks.' This assumption has been implicit or explicit in most of the following literature in English, starting with Downing (1970) and Emonds (1970, 1976). The claim is also pervasive in the more phonologically and phonetically oriented literature. For example, Pierrehumbert (1980, 20) claims that

[4]The relative clause in (4a) is a restrictive relative clause, as is clear because the relative pronoun *that* is used, which is incompatible with a non-restrictive interpretation (Ross, 1967)

[5]The relative clause in (4b) can be disambiguated toward the appositive interpretation by the insertion of the discourse modifier *by the way*.

[6]But see Schlenker (2009) for a discussion of examples with narrow-scope-readings of ARCs suggesting that they can be embedded.

[7]But see Schlenker (2009) for a discussion of examples with narrow-scope-readings of ARCs.

ARCs belong to a set of constructions that 'are obligatorily set off as a separate phrase,' and hence receive their own intonational contour, separate from that of the matrix clause. This is often taken for granted in current discussions of the prosody of relative clauses (cf. Selkirk 1984, Nespor and Vogel 1986, Truckenbrodt 1995, Selkirk 2005 for English; Altmann 1981, Zifonoun 2001 for German).

One way of accounting for the stronger boundary is the one recently endorsed by Potts (2005b), which is that the boundary itself is the reflex of a grammatical lexicalized element, called *comma*, which has no segmental content but only prosodic effects. This operator is involved when expressive linguistic content is added to a structure that does not enter the composition of truth-conditional content, but is rather interpreted on another dimension of conventionally implicated content. A second way of interpreting the often reported boundary associated with ARCs is to view it as a consequence of the syntactic attachment site of ARCs. McCawley (1981), for example, proposes that appositive relative clauses attach directly to the sentence root, rather than to the position their surface linear position suggests. If higher attachment results in stronger boundaries, then the difference between ARCs and RRCs might just be a consequence of attachment site (cf. Wagner, 2010, 228, footnote 8).

Although widely assumed as fact, there are actually only very few direct tests of the prosodic differences between ARCs and RRCs. An early instrumental study on English (Garro and Parker, 1982) found evidence that ARCs but not RRCs are set off by prosodic boundaries, based on recording a few speakers in a single minimal pair. But more recent corpus studies and production experiments cast doubt on whether the difference is real, or at least whether it is systematic. For example, Hirschberg and Avesani (1997) report that RRCs and ARCs are disambiguated prosodically only some of the times, and Watson and Gibson (2004) did not find a significant difference between the two types of relative clauses. Dehé (2009), on the other hand, found 90% of ARCs to be phrased separately in a corpus study of British English, in line with the widely held view that boundaries surrounding ARCs are (practically) obligatory. As for German, Schubö and Féry (2015) found that speakers of German only distinguish ARCs and RRCs phonologically when they are aware of the distinction between the two types of RC and are actively trying to distinguish them. Several studies found that both types of RCs can be separated by pauses (Schaffranietz, 1997; Birkner, 2008), and one perception study found that listeners could not reliably discriminate the two types by means of prosodic cues (Kaland et al., 2010). There is need then for more empirical tests of the reality of the prosodic contrast between the two types of RC.

There is another commonly assumed difference between appositive and restrictive relative clauses that has received little empirical scrutiny. The greater autonomy of ARCs has been argued to come at a cost: ARCs have often been reported to be harder to extrapose (cf. Vergnaud, 1974; Emonds, 1979; Huddleston and Pullum, 2002, for the case of English). Emonds (1979) for example judges the extraposed ARC in (6b) as ungrammatical, while the corresponding RRC in (6a) is acceptable.[8]

(6) (Emonds, 1979, 234)

a. Some men appeared at the door that Mary had been insulting. (RRC)

b. *These men appeared at the door, who Mary had been insulting. (ARC)

[8] A similar contrast is reported in Huddleston and Pullum (2002, 1066):

(i) A stranger came into the room who looked like Uncle Oswald. (RRC)

(ii) *John came into the room, who looked like Uncle Oswald. (ARC)

c. These men, who Mary had been insulting, appeared at the door. (ARC)

Certain analyses in fact entail that ARC extraposition should be impossible altogether. Emonds relates ARCs to their head by a process of co-indexing which can only apply under strict adjacency. Consequently, Emonds (1979, 234) concludes that an appositive relative pronoun 'can be formed only when the head immediately precedes the appositive'[9] The analysis of Potts (2005a) similarly requires adjacency, and in fact precludes extraposition by movement: 'Roughly speaking, movement of a CI phrase [a phrase with appositive content] would require a lambda term that takes CI [appositive] meanings to CI [appositive] meanings. The logic lacks such terms, though, rendering extraposition structures [...] uninterpretable.'

But is extraposition of ARCs really impossible? For both, German and English, at least the strongest version of this claim seems untenable. For English, extraposed ARCs are at least occasionally attested, as illustrated in the following examples (see also Schlenker 2009, and De Vries 2006 for Dutch):

(7) a. Only the flower is used, which is not poisonous and is attached to the plant by a very fine stem. Huddleston and Pullum (2002, 1066)
b. I was also given a Jubilee mug at school, which I still have. Arnold (2007, p.306)

Huddleston and Pullum (2002) therefore conclude that although 'postposed relative clauses are predominantly of the integrated (restrictive, P&W) type [...] postposed (non-restrictive, P&W) relative clauses do sometimes occur.'

In German, which is more liberal in word order in general, extraposition of appositive relative clauses is standardly assumed to be possible, but only across minimal distances (typically across the sentence-final matrix verb). Extraposition of an ARC across an intervening NP is generally taken to be ungrammatical in German (Zifonoun, 2001; Holler, 2005; Konopka, 2006). Note that, unlike in English, extraposition of a RRC across an NP is usually judged as grammatical in German (Zifonoun, 2001).[10]

(8) a. Maria hat Fred getroffen, der wie immer eine rosa Fliege trug.
Maria has Fred met who as always a pink bow tie was wearing
'Maria met Fred, who as always was wearing a pink bow tie.'
b. *Ihren Freund hat Emma auf dem Stadtfest getroffen, der wie immer eine
her friend has Emma at the city festival met who as always a
rote Krawatte trug.
red tie was wearing
'Emma met her friend at the city festival, who by the way was wearing a red tie.'

[9] As Schlenker (2009) points out, this adjacency requirement could in principle be checked before the ARC is extraposed, at least if extraposition is analyzed as movement.

[10] Even in English, there are some cases in which extraposition of an RC subject position across another constituent has been reported as acceptable in English. Huddleston and Pullum (2002, 1066) for example, judge the sentences in (i) and (ii) as equally acceptable.
(i) A stranger who looked like Uncle Oswald came into the room. (ii) A stranger came into the room who looked like Uncle Oswald.

Hence, in both languages, ARCs are usually taken to be more restricted than RRCs in their extraposition potential. However, the evidence for this difference in extraposability between ARCs and RRCs remains anecdotal. Many of the contrasts discussed in the theoretical literature, including the one in (8), are not very minimal, and many earlier experimental studies on extraposition only looked at one type of relative clause, or did not even include ways to ensure that the relative clauses used were RRCs or ARCs.

So both the prosodic difference between the two types of RCs and their respective effect on extraposition remain controversial. Furthermore, there has been no attempt at establishing how the prosodic differences might interact with extraposition. Looking at this interaction can inform our syntactic analysis of extraposition. Most syntactic analyses of extraposition, irrespective of whether they involve movement or base-generation, predict a higher attachment site for extraposed relative clauses compared to in-situ relative clauses, we might expect that extraposition results in a stronger prosodic boundary preceding the RC. Depending on what other assumptions one makes about the syntax-phonology interface, stronger prosodic boundaries preceding extraposed RCs could be used to argue against the idea that relative clauses remain low in the structure (Haider, 2010). It will not, however, distinguish between movement and base-generated syntactic analyses of extraposition order. If indeed extraposed RCs are preceded by stronger boundaries than non-extraposed ones, this is compatible with an analysis of extraposition as movement, as is assumed in Emonds (1976), Büring (1997) or Sternefeld (2008). But since in alternative non-movement analyses, extraposed clauses are usually also assumed to attach high (Culicover and Rochemont, 1990; Rochemont and Culicover, 1997; Kiss, 2005), prosody is actually not a way to distinguish different types of analyses of extraposition. For a thorough overview of issues in the syntactic analysis of extraposition, see Baltin (to appear) and Webelhuth et al. (2013a).

Looking the prosodic phrasing can, however, inform our analysis of the difference between RC types. Under the analysis that views prosodic differences as a consequence of attachment site, we might expect that the differences between ARCs and RRCs in terms of boundary strength will be neutralized in extraposed position, since in that case both types of RCs would attach high: RRCs because they are extraposed, and ARCs because they always do. There should then be no difference or a much smaller difference between ARC and RRC in terms of boundary strength in the extraposed word order. If, on the other hand, ARCs are preceded by a boundary because of a lexical comma-morpheme, we might expect ARCs and RRCs to be distinguished in terms of phrasing irrespective of where they occur in linear order. The presence of the intonational comma-morpheme should in principle be apparent both in the non-extraposed and in the extraposed word order, since in both cases the RC will compose with the other linguistic material via the comma-operator. While these seem like straightforward expectations for extraposition of the theories that have been proposed to account for their semantic and prosodic differences, we know of no prior study that tried to test them.

When considering extraposition of appositive relative clauses, there is one important complicating factor. Smits (1989, p.185), e.g., observes that extraposition of ARCs seems to ameliorate if the appositive 'has some specific type of meaning, continuative, resultative, or contrastive and maybe some others as well, with respect to the rest of the sentence.' If the ARC describes an event that either temporally follows or elaborates on the event described in the matrix clause and continues the narrative, extraposition over longer distances improves (9a), and even might become obligatory (9b) (example from Holler, 2005, 149–150).

(9) a. Extraposed

Ihre Lehrerin wollten die Kinder besuchen, die aber nicht zu Hause war.
Their teacher wanted the children visit who but not at home was

'The children wanted to visit their teacher, who was not at home.'

b. Non-Extraposed

*Ihre Lehrerin, die aber nicht zu Hause war, wollten die Kinder besuchen.
Their teacher who but not at home was wanted the children visit

'The children wanted to visit their teacher, who was not at home.'

Holler follows the convention in the German literature of calling such RCs *weiterführend* 'continuative' and distinguishes them from appositive relative clauses with 'non-continuative' reading.[11]

We propose that the RC in (9a) is preferred (the rating of b. as ungrammatical seems too strong) in final position because of the particle *aber* 'however', which arguably makes anaphoric reference to the proposition expressed in the matrix clause. More generally, we hypothesize that anaphors such as *then* or *therefore* will have the same effect, and they are what characterizes 'continuative' ARCs. They might prefer to be extraposed simply because picking up a propositional antecedent might only be possible after that proposition has been concluded. This would directly relate the preference for sentence-final position of continuative RCs to cases of non-restrictive relative clauses that modify entire clauses, which are also anaphorically dependent on the entire matrix clause. ARCs with a sentential antecedent usually follow the entire sentence they are anaphoric to:

(10) And that got me into the last three so I had to do it all again at the Barbican, which I think was to see if I could fill that theatre with enough presence and vocal range. [A06/1696] (Arnold, 2007, 306)

The anaphoric properties of particules such as *then* or *therefore* could then capture why final position would be the preferred word order for continuative ARCs. This idea might also shed light on why previous studies in German and English found differences between RRCs and ARCs with respect to their ability to extrapose in the first place. The examples looked at often include temporal or anaphoric relations between ARC and main clause whose interpretation might interact with a change in word order. As De Vries (2006, 255) notes, the contrast in Emonds' original example (example (6)) might be due to the fact that the discourse relation holding between the event in the ARC and the event in the matrix clause is affected if word order is changed, since the description of the event describing the consequence of the other would be ordered first in the extraposed word order.

The hypothesis is then that certain word order preferences for ARCs can be explained by anaphoric relations that they include, rather than being a result of an inherent ban on extraposition. This explanation presumes, however, that extraposition of ARCs is possible in general. It is therefore important to firmly establish whether RRCs and ARCs contrast with respect to their extraposability when other factors are controlled for. Since it is already known that continuative ARCs are able to extrapose, our test-items only contained non-

[11] According to Asher and Lascarides (2003), typical continuative (e.g. coordinating) discourse relations are Narration and Result.

continuative discourse relations (typically the relation 'explanation'), and did not contain any elements making anaphoric reference to the matrix clause proposition. For this subset of ARCs, the prior literature on the issue unanimously assumes that ARCs are more restricted in extraposition than RRCs.

1.4 The Interaction between RC-Type and Focus

Varying the focus in a sentence containing an RC should have very different effects depending on whether the RC is appositive or restrictive. Suppose that a sentence is uttered in a context in which the noun phrase that the relative clause pertains to is focused. Under these circumstances, RRCs and ARCs arguably differ radically in how they interact with the meaning contributed by focus. The following examples are from Arnold (2007, 288), with an added context question to put the relevant noun phrase in focus.

(11) Who did you see yesterday?

a. I saw someone yesterday that I hadn't seen for years. (RRC)
b. I saw my mother yesterday, who I hadn't seen for years. (ARC)

The restrictive relative clause in (11a) is used to identify the referent, and is hence a crucial part of the focus. In fact, the alternative set considered here include alternatives to the entire NP including the RC, which vary in the content of the RRC. The word *years* in the RRC can be the sole location of prosodic prominence inside of the NP, since *someone*, the RC head, is likely to be deaccented.

Now consider the ARC example. Here, the referent in focus, *my mother*, is established in dependent of the information in the ARC, which only provides additional information about that referent. The relevant alternatives considered here intuitively do not also include alternative ARCs, but only alternatives to *my mother*. This is why various authors have argued that ARCs, rather than forming part of the focus-background structure of the main clause, have their own independent focus-background structure (Loetscher 1972,Brandt 1990, Riester 2009, Holler 2005). Placing an accent only on *years* would be distinctly odd: the prominence of the ARC cannot by itself encode focus on the NP that it predicates over.

RRCs contribute to the identification of the referent of the NP they modify, while ARCs do not (Quine 1960, Heim and Kratzer 1998, cf. discussion in Riester 2009). ARCs typically contribute material that does not affect the resolution of the referent of the RC head, or the meaning of any other part of the clause their modifiee forms part of. This difference between appositive and restrictive clauses led Loetscher (1972) to posit that focus will not affect extraposability for ARCs but it will for RRCs. There is good reason, however, to think that focus might have an effect on ARCs as well, just a different one. While they cannot be part of the focus of the NP they modify, the information that ARCs encode is usually not given in the context. ARCs have in fact been argued to obligatorily convey new information (Potts, 2005b; AnderBois et al., 2013). A context-given ARC is simply redundant. In a context in which the material in parentheses is already salient, conveying it by an ARC is infelicitous:

(12) (Lance Armstrong survived cancer.) #When reporters interview Lance Armstrong, who survived cancer, he often talks about the disease.(Potts, 2005a, 34)

There are more conceivable interactions between focus and RC-type on extraposability. RRC extraposition across intervening material has been argued to improve when the determiner preceding the head is stressed and all material (including the head) up to the RC is deaccented (cf. Lenerz, 1977, 35), a claim supported by experimental results in Schubö and Féry (2015). These accented definite determiners in German are more comparable in interpretation to the English demonstratives *those* and *that*. The ambiguity of definite determiners might be one of the reasons why in German extraposition from a definite head is less restricted than in English—we return to this point when discussing the naturalness ratings in section 3.

(13) Peter hat DIE Schwester angerufen, die in HAMBURG lebt.
Peter has the sister called who in Hamburg lives
'Peter has called the sister (,) who is living in Hamburg.'

This type of intonational pattern has never been proposed for ARCs. Since our study fully crosses the manipulation of focus with the manipulation of RC-type, we will be able to test for the full range of conceivable interactions.

1.5 The Experiment

Our production experiment was aimed at investigating how focus, word order and RC-type affect RC extraposition, and how these factors interact. Participants were asked to respond to questions in scripted dialogues that required them to pronounce sentences that involved relative clauses. All our sentences contained a relative clause. We manipulated the discourse context with prerecorded questions such that the answer either had Wide, Subject, or Object focus:

(14) Focus Contexts

a. Wide-Focus
War die Wanderung schwierig?
was the hike difficult
'Was the hike difficult?'

b. Subject-Focus
Wer hat das Riemannhaus erreicht?
who has the Riemann-house reached
'Who reached the Riemann house?'

c. Object-Focus
Welches Ziel hat der/jeder Wanderer erreicht?
which goal has the/every hiker reached
'Which goal did the/every hiker reach?'

Participants listened to the pre-recorded question before saying their response. In the responses, we manipulated the type of the relative clause (ARC vs. RRC) and the word order (Extraposed vs. Non-Extraposed):

(15) Answers with ARCs

a. Non-Extraposed:

(Nein,) der Wanderer, der ja Schneeschuhe trug, hat das
no the hiker who PART snow shoes was wearing has the
Riemannhaus erreicht.
Riemannhaus reached

'No, the hiker, who was wearing snow shoes, has reached the Riemannhaus.'

b. Extraposed:

(Nein,) der Wanderer hat das Riemannhaus erreicht, der ja
no the hiker has the Riemannhaus reached who PART
Schneeschuhe trug.
snow shoes was wearing

'No, the hiker has reached the Riemannhaus, who was wearing snow shoes.'

(16) Answers with RRCs

a. Non-Extraposed:

(Nein,) jeder Wanderer, der Schneeschuhe trug, hat das
no every hiker who snow shoes was wearing has the
Riemannhaus erreicht.
Riemannhaus reached

'No, every hiker who was wearing snow shoes has reached the Riemannhaus.'

b. Extraposed:

(Nein,) jeder Wanderer h.at das Riemannhaus erreicht, der Schneeschuhe
no every hiker has the Riemannhaus reached who snow shoes
trug.
was wearing

'No, every hiker has reached the Riemannhaus, who was wearing snow shoes.'

The RC always modified the subject of the sentence. When the RC was extraposed, the object NP intervened between the RC and its head. To ensure that the RC was not interpreted with respect to the object of the sentence, we designed the test-items such that subject and object of each sentence differed either in gender or number.

To assure a restrictive interpretation of the relative clause we used the quantifier *jeder* 'every' in its head, which should rule out an appositive interpretation (Sells, 1985; Nouwen, 2007).[12] For the appositive relative clauses, by contrast, we used a definite determiner,[13] and forced an appositive interpretation by including the discourse particle *ja* 'as you know', which is incompatible with a restrictive interpretation. Evidence that our manipulation successfully disambiguates RC type is that if both criteria are combined, infelicity ensues:

[12]The reason an NP of the form *jeder Wanderer* does not allow for modification with an ARC is the quantificational nature of *every*, which means that there is no referent that the pronoun inside the ARC could pick up as an antecedent. Furthermore, it is impossible for *every* to bind a variable into the ARC (Ross, 1967; Emonds, 1979)

[13]Note that in German, unlike in English, extraposition from a definite head is reportedly freely available.

(17) # **Jeder** Wanderer hat das Riemannhaus erreicht, der **ja** Schneeschuhe
every hiker has the Riemannhaus reached, who PART snow shoes
trug.
was wearing
'Every hiker, who as you know was wearing snow shoes, has reached the Riemannhaus.'

All ARCs were constructed such that they bore non-continuative discourse relations to the content of the main clause, and they did not contain any additional anaphoric material (such as *then* or *but*) which are likely to affect word order preferences. In some wide focus contexts, we additionally used polarity tags like *ja* 'yes' or *nein* 'no', to render the answer more natural. A list of all items in all conditions is provided in the appendix at the end of this paper.

The design of the experiment therefore distinguished a total of twelve different conditions. We will use the common convention of referring to each set of 12 dialogues as one 'item'. Each experiment contained 18 different sets of dialogues, that is 18 items, which varied focus (Wide, Subject, Object), word order (Extraposed and Non-Extraposed) and RC-type (RRC vs. ARC). We ran the experiment in two blocks, one with the ARC stimuli and the other with the RRC stimuli. The order between the blocks was randomized between participants. Both blocks were run in a latin-square design, such that each participant saw one condition from each item, and an equal number from each condition across all items, for a total of 18 trials per block. The order of the trials was pseudo-random, such that the same condition could maximally occur twice in a row (an event that occurred with a chance of 1/12, so only rarely).[14]

Participants were able to read the entire dialogue silently before recording. When they were ready for the dialogue, they pressed a key and the context question was played to them via a Logitech USB Headset/Microphone, and their response was recorded subsequently. After their response was recorded, the participants were asked how natural they judged their response as an answer to the question that was posed (on a scale from 1 (completely unnatural) to 7 (completely natural)). A total of 35 subjects participated, all of which were native speakers of German, and most of which were undergraduate or Master's students at Goethe University in Frankfurt. Participants were compensated for their participation.

The results we report are based on all trials in which a usable sound file was recorded and in which there was no major disfluency, in which the soundfile was not incomplete (which may have occurred if a participant pressed a key too soon while still speaking), and in which what the participant said corresponded to the script (a total of 1174 trials out of 1440, or 82% of all trials).

In order to evaluate the prosody of utterances, we forced-aligned the data to create a segment-by-segment and word-by-word alignment, with the help of the prosodylab-forced aligner (Gorman et al., 2011). We trained models for German using about two hours of German lab speech collected from experiments run in the past years in the second author's lab. We excluded data in which the alignment seemed completely off, but included all data in which the alignment seemed to have worked reasonably well (92% of the data used for

[14]We decided not to include the block order as a predictor in the models reported below to keep the models simpler, since the ordering did not seem to have any important effect on the qualitative results.

the previous analyses). Sound measures were extracted (i) for each word of interest (in the example in (18), the words marked by $_x$), (ii) for each zone of interest (marked by underlining) using Praat (Boersma and Weenink, 1996):

(18) Der Wanderer$_1$, der ja Schneeschuhe trug$_2$, hat das Riemannhaus$_3$ erreicht$_4$

Both authors and three RAs also hand-annotated the data. First we wanted to exclude problematic files in which participants did not produce the desired target sentence, had disfluencies that would derail the aligner, or the alignment failed for some other reason. We also assessed how fluent the utterance was overall, although we didn't make use of this measure in the final analysis. The results reported here do not change if one only looks at the subset of particularly fluent data. We also annotated perceptually whether the VP and the RC contained a pitch accent or whether they were deaccented, and whether prominence was shifted from the head to the determiner *der* or quantifier *jeder*. Annotators were blind to the condition the response was recorded in. With respect to the prominence annotation, we picked one annotation for analysis. To chose the annotation, we fitted regression models for each annotation with the maximal intensity of the VP as dependent variable and the annotation of whether or not it was accented as predictor. In our experience (e.g. Breen et al., 2010), intensity is the best correlate of accentuation status. We picked the annotation with the highest R^2 value, which was the annotation of the second author.

2 The Prosodic Effects of Extraposition, RC-Type, and Focus

In order to understand how prosody affects extraposability, we first need to understand how prosody RC-type, focus, and extraposition generally affect the prosody of a sentence. We organize the discussion of the prosodic results of the production study by looking first at the prosodic realization of the VP, then of the RC, and finally at the realization of the boundaries surrounding the RCs.

2.1 The Prosody of the VP

The VP contained new information under wide focus and object focus, while it was entirely given in the subject-focus contexts. As expected, this manipulation affected measures of prominence of the VP. In particular, measures for pitch and intensity on the VP are lower when the discourse context motivates subject focus and makes the VP contextually given, as illustrated with boxplots in Fig. 1.[15]

Part of the perceptual annotation was to mark whether or not the VP contained a pitch accent. As one would expect, when the subject is focused and the VP given, speakers often realize the matrix VP without any accent, as illustrated in Fig. 2. And just as expected, the proportion of unaccented VPs is highest in contexts with Subject-Focus. Interestingly,

[15]Boxplots mark the median of the data by a line, and provide a box around the second and third quartile of the data. The 'whiskers' show 1.5 of the inter-quartile range. Boxplots give more information about the distribution of the data, and therefore have advantages over parametric visualizations such as plotting the means of a distribution. We considered using log duration and semitones, but since it didn't make a differences in the results we decided to use the raw measures as they are easier to interpret.

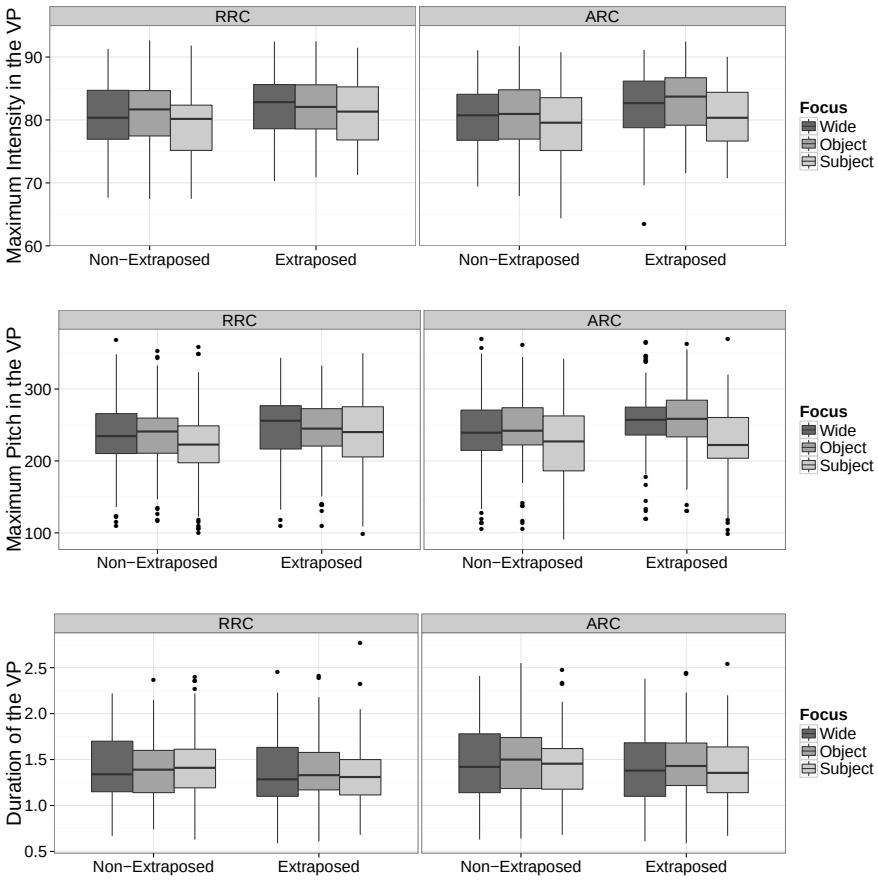

Figure 1: Acoustic prominence of the VP.

the rate of VP deaccentuation is much lower when the RC is not extraposed. In fact, when the RC is extraposed, the figure suggests that the VP often lacks an accent even when it provides new information, in the wide focus and object focus cases.

We tested statistical significance with mixed effects regression models, using the R-package lme4 (Bates et al., 2014). Mixed effects regression models allow us to add multiple predictors to a model and thus control for a greater number of potentially relevant factors compared to more traditional analyses such as repeated measures ANOVA. For example, when looking at duration, we can add the number of phonemes as a predictor to the model in addition to phonetic duration, thus avoiding a spurious effect because there might be slight differences in terms of number of phonemes between conditions. While phonemic length was controlled for within each item and should thus average out, there are missing observations due to disfluencies and recording failures which can introduce slight differences in mean phonemic length between conditions.

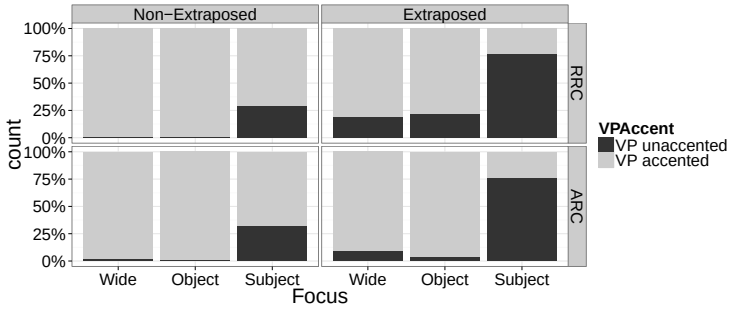

Figure 2: Proportion of utterances with unaccented VPs.

Mixed models have another important advantage. Individual productions of particular participants will be more similar to each other than to those of other speakers, hence they are not independent observations. By the same token, individual recordings of particular items will be more similar to each other than to those of other items, and can therefore also not be treated as independent observations. Assuming that confounds in the creation of the stimuli and the sampling of participants were successfully avoided, the differences between participants and items should be random effects that will average out. Still our statistical procedure needs to rule out the possibility that particular effect were driven by unusual items or participants. Repeated measures ANOVA, the most common analysis until recently, deals with this issue by pooling all data from a particular participant (by-participant repeated measures ANOVA) or an item (by-item repeated measures ANOVA). This method results in two separate statistics, F1 and F2, one from the by-item analysis and one from the by-participant analysis. It is non-trivial, however, to assess based on these statistics whether there was an overall effect (Clark, 1973). Mixed models allow us to avoid this issue by fitting random effects for *both* participants and items at the same time. For example, by adding a random effect for a participant in the pitch model we can control for individual differences in pitch due to gender and other factors. By adding a so-called 'slope' for predictors to the random effects we can make sure that if for some participants or items, focus had an exceptional effect, this will not be generalized to the group. The overall model then is then calculated in such a way that only consistent patterns shared among all participants or items contribute to the overall effect, while variability due to individual effects of participants or items is attributed to the random effects.

For each of the acoustic measures, we fit a linear mixed effects model with Focus, Word Order, and RC-type, and their interaction as main effects, and random effects for participant and item. In order to keep the model simpler, we did not include the three-way interaction between all three factors. All effects reported here are still present when the three-way interaction is included. The random effects included slopes for all main effects but not their interaction, since the models did not converge otherwise. Therefore, we used a simpler random effect structure, following the recommendation in Barr et al. (2013) of trying to fit the most maximal model that converges. In order to model the accentuation rate, we fit a logistic regression to analyze the accentuation transcription, with the same model structure

otherwise. The results are reported in Table 1.[16]

Table 1: Effects on Prosodic Prominence of VP

	Dependent variable:			
	VPintensity	VPmaxpitch	VPduration	VPAccent
	linear mixed-effects	*linear mixed-effects*	*linear mixed-effects*	*generalized linear mixed-effects*
	(1)	(2)	(3)	(4)
WordOrderNon-Ex.vs.Ex	−1.852*** (0.311)	−11.401*** (3.359)	0.034** (0.016)	2.787*** (0.522)
FocusSubj.vs.Other	−1.427*** (0.263)	−20.256*** (3.268)	−0.033** (0.014)	−4.542*** (0.580)
FocusWide.vs.Object	−0.080 (0.235)	−0.426 (2.909)	−0.019 (0.013)	0.167 (0.823)
TypeRRC.vs.ARC	0.039 (0.550)	−6.207*** (1.929)	−0.048*** (0.013)	−0.864** (0.380)
scale(VPphonelength)			0.170*** (0.049)	
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other	−0.024 (0.337)	4.274 (3.725)	0.020 (0.017)	0.051 (0.760)
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object	0.141 (0.392)	−0.046 (4.307)	0.003 (0.020)	0.167 (1.100)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC	0.279 (0.318)	−0.892 (3.493)	0.005 (0.016)	0.612 (0.540)
FocusSubj.vs.Other:TypeRRC.vs.ARC	0.377 (0.338)	13.731*** (3.726)	0.044*** (0.017)	1.394** (0.632)
FocusWide.vs.Object:TypeRRC.vs.ARC	0.031 (0.391)	1.433 (4.287)	0.011 (0.020)	0.957 (0.808)
Constant	80.536*** (0.883)	237.722*** (7.658)	1.409*** (0.075)	2.719*** (0.365)
Observations	1,059	1,030	1,059	1,133
Note:				*p<0.1; **p<0.05; ***p<0.01

The model table reports how various predictors in the model fared in explaining the variance of the dependent measure in question. Each line in the table starts with the label of the predictor (e.g., *WordOrder*). In the case of a categorical predictor, the label is followed by the information about which level were contrasted (e.g., *Non-Ex.vs.Ex*, meaning non-extraposed vs. extraposed position of the RC). The model in each column reports the estimate for each predictor and the standard error for the estimate for each of the dependent measures (in this case, intensity, pitch, duration, and accentuation rate of the VP). The estimate is the numeric difference that the model believes the predictor will cause on the dependent variable. We coded our categorical predictors in such a way that the value of the estimate is directly interpretable, at least in the case of the linear mixed models. For example, the intensity (maximal intensity over the course of the VP) when the RC is not extraposed is estimated to be 1.9db lower compared to VPs when the RC is extraposed (see intensity model under column (1) in the model output); the pitch is estimated to be 11Hz lower, and the duration (total duration of the VP) is estimated to be 34ms shorter when not extraposed. All of these effects are significant, as indicated by the stars on the estimates. To make our tables more reader-friendly, we additionally highlighted all significant effects by setting them bold. The determination of p-values in linear mixed models is not trivial, since the degrees of freedom can only be estimated (cf. Baayen et al., 2008). The significance levels for the linear regressions reported in the tables were estimated based on the t-distribution using the R-package 'stargazer' (Hlavac, 2013). In addition, we calculated a more conservative estimate of the p-values for linear regressions using the Satterthwaite approximation using the R-package lmerTest (Kuznetsova et al., 2013), which we report in parentheses in the running text.[17]

As Fig. 2 suggests, the VP was indeed significantly ($p < 0.001$) less likely to be accented

[16]Note that we added the length in terms of number phonemes to the model that evaluates the effect of duration. This way, we could control whether any differences in overall duration might be due to differences in the segmental setup. While our experiment was a fully crossed factorial design that should control for this already, it is possible that the distribution of missing cells just so happens to introduce confounding differences in constituent length. This can be controlled for by adding this predictor to the model.

[17]The p-value estimates in the running text for the logistic regressions are taken directly from the lme4 output.

when the RC was extraposed (see results in the first row in Tabel 1, WordOrderNon-Ex.vs.Ex). The estimates of a logistic regression are the log odds of the categorical outcome, in this case VP accentuation. The model estimates that the log odds of accenting a VP are 2.8 higher when the RC was in-situ compared to when it was extraposed. This number is not easy to interpret, but becomes interpretable when converted into odds. The model estimates that the ratio of the log odds of accenting a VP in the non-extraposed vs. the extraposed case. We can convert the estimate into an odds ratio ($e^{2.8} = 16.1$), which is easier to interpret: The odds of accenting the VP when the RC is not extraposed are about 16 times higher than in the extraposed case. The p-value of the effects in logit models can be estimated by the Wald statistic (reported here), or by model comparison (not reported here). The significant effect of extraposition on VP-accentuation constitutes a first piece of evidence that prominence of the VP might conflict with extraposition: Speakers actively avoid accenting the VP when it intervenes between head and RC. This is further supported by the observation that in extraposed word order, the VP was often deaccented even in object and wide focus, as is apparent in Fig. 2. These contexts do not provide an antecedent for deaccentuation of the VP, and are hence unexpected based on focus theory (Rooth, 1992). Overall, these effects support our hypothesis that decreased prosodic prominence of the intervening material facilitates extraposition.

When looking at the results for the effect of word order, it is notable that perceptual annotation and acoustic measures diverge: According to the annotations, there is a clear effect of extraposition on the proportion of deaccented VPs, such that extraposition makes VP deaccentuation much more likely and the VP hence less prominent. With respect to pitch and intensity, on the other hand, VP was significantly more prominent under RC extraposition ($p < 0.002$ for both), and only the duration of the VP was lower in that case ($p<0.5$). Our interpretation of this discrepancy is that the acoustic effects of focus are blurred due to an overall effect of sentence-finality: When the RC remains in-situ, the VP will be sentence- and utterance-final, resulting in greater duration, lower intensity, and lower pitch. This interpretation of the discrepancy will receive direct support when looking at the prominence of the RC. Comparing absolute acoustic measures across different sentence positions in a sentence does not give an accurate estimate of their perceived prominence. Perceptually, a listener is able correct for the effect of sentence-position, hence the perceptual annotation give a better basis for such comparisons.

When it comes to the effect of focus, all acoustic measures confirm that subject focus (FocusSubj.vs.Other) leads to less prominence on the VP (lower intensity, pitch, and duration), and makes it less likely to be accented ($p < 0.001$ for VPintensity, VPmaxpitch and VPaccent and $p < 0.03$ for VPduration). This confirms that our focus manipulation was successful in affecting the prosodic prominence of the utterance. It is also clear that prosodic prominence does not correlate perfectly with focus: There is a good proportion of subject-focus utterances in which the VP was accented, and there is a good proportion of cases where the VP remained unaccented in the other focus conditions when the RC was extraposed. This variability will allow us to test whether any observed effects on extraposability were due to context, prosody, or both, a question we will turn to the naturalness ratings in section 3.

RC-type (TypeRRC.vs.ARC) significantly affected the realization of the VP on all measures except intensity ($p < 0.003$ for VPmaxpitch and VPduration and $p < 0.03$ for VPaccent). The VP was generally more likely to remain unaccented when there was a

restrictive relative clause. It seems that in the presence of RRCs, the VP was more often deaccented when it was in fact in focus than with ARCs. This is reflected by a significant interaction between focus and RC-type (FocusSubj.vs.Other:TypeRRC.vs.ARC) on pitch and duration ($p < 0.001$) and a significant interaction on accentuation rate ($p < 0.03$). An interaction means that the effect of a predictor (in this case, the difference between subject focus and the other two foci) depends on another predictor (in this case, this difference is smaller when the RC is restrictive than when it is appositive). The model estimates how much smaller or bigger the difference is, in the case of pitch, for example, it predicts it to be about 14 Hz smaller (13.731). This effect of RC-type could be seen as an indication that VP-prominence is a greater problem in the case of RRC extraposition compared to ARC extraposition—except that this interaction was not modulated by word order, rather it affected extraposed and non-extraposed word orders alike. It therefore seems that participants took the presence of RRC as a cue that the constituent was in focus, sometimes despite of the context.

2.2 The Prosody of the RC

Extraposition might also affect the prosodic realization of the RC. Our focus contexts, on the other hand, kept the information in the RC always as new, and hence it is not clear that there should be any variation in terms of prosodic prominence due to that. Given the semantic differences in how different RC-type and focus relate to each other, however, it is still worth checking for prosodic effects of focus nevertheless. Acoustic measures of prominence of the RC are summarized in Fig. 3.

We first note that the RC data support our interpretation of the VP-measures, in that that there is indeed again a general downtrend for pitch and intensity when the constituent is final. This leads to lower pitch and intensity measures when the RC is extraposed. Also, the RC is longer when extraposed, due to a greater degree of final lengthening. The model in Table 2 shows that these effects were significant (see the comparison WordOrderNon-Ex.vs.Ex in the model outputs; p-value estimates for the three acoustic measures: $p < 0.001$).

The plots and the statistical analysis do not suggest any overall effects of focus on RC realization (FocusSubj.vs.Other, FocusWide.vs.Object). There was an interaction between word order and focus, however: The difference in the maximum pitch of the RC between the two word orders was less under subject focus ($p < 0.006$). This suggests that under focus, the final RC does not show the final lowering of pitch that is observed otherwise to the same extent.

The plot in Fig. 3 suggests that ARCs are longer than RRCs. Of course, our ARCs contained an additional word, the discourse particle *ja*, so this may not mean much. In our statistical analysis, we added the number of phonemes of the RC as a predictor to control for this. The model confirms that there was indeed a significant effect ($p < 0.04$) of RC type, such that RRCs were phonetically shorter than ARCs, after controlling for their length in terms of number phonemes (TypeRRC.vs.ARC). This is a first indication that ARCs might indeed be surrounded by stronger boundaries, since greater boundary strength correlates with a greater degree of final lengthening. The lack of an interaction between type of RC and word order suggests that this durational difference is present both in non-extraposed and extraposed word order. The greater autonomy of ARCs, which, as we will

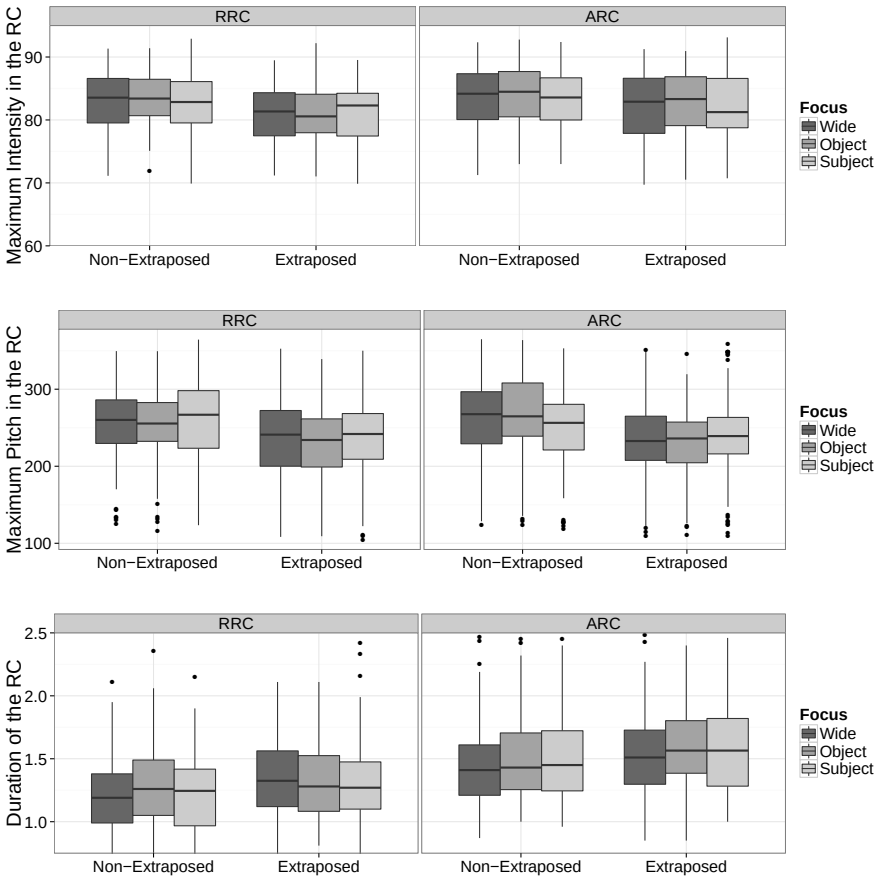

Figure 3: Acoustic prominence of the RC.

Table 2: Effects on Prosodic Prominence of the RC

	Dependent variable:		
	RCintensity	RCpitch	RCduration
	(1)	(2)	(3)
WordOrderNon-Ex.vs.Ex	1.770*** (0.227)	23.274*** (3.339)	−0.073*** (0.013)
FocusSubj.vs.Other	−0.218 (0.248)	1.878 (2.640)	−0.012 (0.009)
FocusWide.vs.Object	−0.272 (0.256)	1.186 (2.814)	−0.015 (0.010)
TypeRRC.vs.ARC	−1.081*** (0.163)	−3.694* (2.236)	−0.041** (0.018)
scale(RCphoneLength)			0.331*** (0.014)
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other	−0.267 (0.347)	−10.650*** (3.882)	0.009 (0.017)
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object	−0.060 (0.401)	−4.587 (4.503)	−0.002 (0.020)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC	0.701** (0.326)	−1.192 (3.656)	0.023 (0.016)
FocusSubj.vs.Other:TypeRRC.vs.ARC	−0.088 (0.346)	6.563* (3.878)	0.013 (0.017)
FocusWide.vs.Object:TypeRRC.vs.ARC	0.028 (0.400)	3.678 (4.492)	0.034* (0.020)
Constant	81.933*** (0.900)	245.869*** (7.801)	1.402*** (0.032)
Observations	1,059	1,059	1,059
Note:			*p<0.1; **p<0.05; ***p<0.01

see below, arguably includes the presence of an intonational tune separate from the matrix clause, thus has phonetic reflexes independent of position.[18]

2.3 The Prominence of the Head of the RC

Another way in which accentuation might affect extraposition was observed by Lenerz (1977, 35), among others, who noted that accenting the determiner of the head of a restrictive relative clause and leaving the head unaccented facilitates extraposition. As noted in the introduction, the cases for which accent has been argued to facilitate extraposition arguably involve demonstrative determiners (or rather, the demonstrative reading of the German definite determiner). We believe that the accent reflects focus on the restriction that the demonstrative determiner is anaphoric to. Since our stimuli involved universal quantifiers, this experiment was not really designed to test for these more typical cases. Our perceptual annotation, which included an annotation of whether prominence between determiner and head was shifted to the determiner, nevertheless showed some interesting patterns:

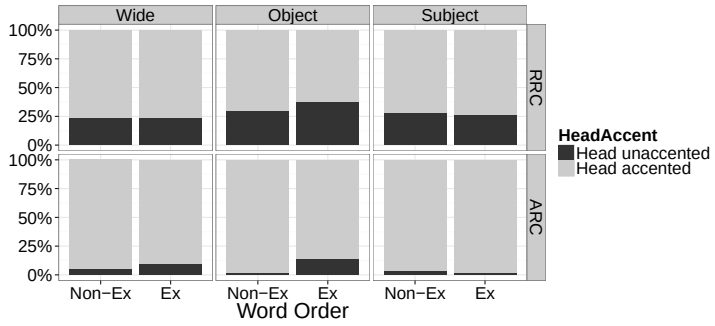

Figure 4: Proportion of utterances with unaccented heads and accented determiners.

The results show that a prominence shift to the determiner is more likely in the case of RRCs than ARCs, although not unheard of in the case of ARCs. A statistical model (not reported here for space reasons) shows that there was a main effect distinguishing RC-types ($p < 0.001$). There was also a small but significant effect word order, such that a prominence shift was more likely in the extraposed word order ($p < 0.01$). So speakers did use prominence shifts to the determiner slightly more frequently under extraposition, as would be expected if it was used as a tool to facilitate extraposition. There was also a significant interaction showing that speakers were more likely to use a prominence shift to the determiner in the case of extraposed ARCs, compared to RRCs, where the rate was generally higher, but did not change depending on word order ($p < 0.05$). That prominence

[18]There were two significant interactions involving RC-type. One is that the effect of subject focus (as opposed to object and wide focus) differs depending on RC-type, but we only find an effect on pitch ($p < 0.1$). The second interaction regards the durational effect of wide vs. object focus, which depends on RC-type ($p < 0.1$). Since we did not expect either of these interactions, we just note that they came out significant, but we do not have an explanation to offer. The figures make it clear that these are very small effects.

shifts to the determiner ever occur in the case of ARCs has not been reported in the previous literature.

2.4 Prosodic Boundary Preceding the RC

If appositive relative clauses are indeed surrounded by stronger boundaries, while restrictive ones are not (or only optionally), we would expect to find differences in the degree of lengthening of the word immediately preceding the RC. In the case of unextraposed RCs, we looked for lengthening on the head of the RC; and in the extraposed word order, we looked on the final word of the matrix clause. Figure 5 illustrates that in the non-extraposed word order, ARCs were indeed preceded by stronger boundaries across all focus conditions. There seems to be no difference, or at least a much smaller difference, between the two RC-types in the extraposed word order.

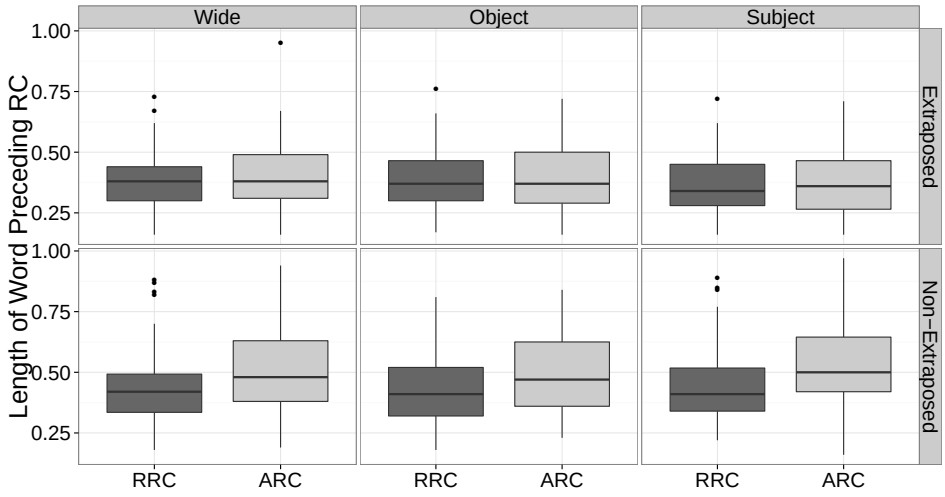

Figure 5: Duration of the word preceding the RC in non-extraposed and extraposed word order.

In addition to pre-boundary lengthening, we can also look for pauses as a correlate of stronger boundaries. Fig. 6 summarizes the proportion of utterances in each condition for which the aligner posited a pause separating the RC from the preceding word. There is a clear difference in the proportion of pauses depending on RC-type, such that an ARC is much more likely to be set off by a pause from the preceding word, but the difference is much smaller in the extraposed word order.

The duration of the word preceding the RC was analyzed using a mixed model regression with RC-Type, word order, focus and their interaction as fixed effects, and random effects for items and participants with random slopes for all three factors. The pause data were analyzed using a parallel logistic mixed model with the presence/absence of a pause as its dependent variable. Table 3 reports the results.

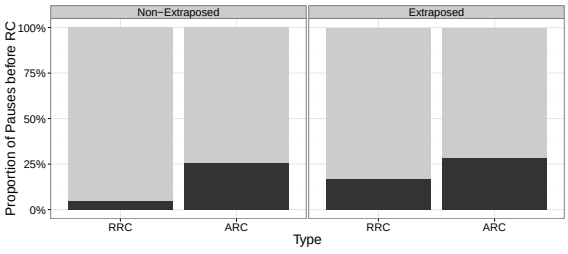

Figure 6: Proportion of utterances with a pause separating the RC and the preceding word.

There is indeed a significant main effect of RC-type on boundary strength (TypeRRC.vs.ARC), such that ARCs are preceded by stronger boundaries resulting in longer pre-RC words ($p < 0.003$) and more frequent pauses ($p < 0.001$). There was also a main effect of WordOrder, such that extraposition leads to stronger boundaries preceding the RC (WordOrderNon-Ex.vs.Ex) in terms of preboundary lengthening ($p < 0.002$).

Table 3: Linear mixed effects model for duration of the word preceding the RC, and logistic regression model for the odds of a pause before the RC.

	Dependent variable:	
	preRCDuration	preRCPause
	linear mixed-effects	*generalized linear mixed-effects*
	(1)	(2)
WordOrderNon-Ex.vs.Ex	0.089^{**} (0.045)	-0.825 (0.764)
FocusSubj.vs.Other	0.001 (0.005)	0.080 (0.452)
FocusWide.vs.Object	-0.0003 (0.006)	1.515^{**} (0.622)
TypeRRC.vs.ARC	-0.043^{***} (0.011)	-3.057^{***} (0.621)
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other	0.030^{***} (0.008)	1.354^{**} (0.544)
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object	0.006 (0.009)	0.253 (0.684)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC	-0.057^{***} (0.007)	-2.003^{***} (0.675)
FocusSubj.vs.Other:TypeRRC.vs.ARC	-0.011 (0.008)	-0.469 (0.621)
FocusWide.vs.Object:TypeRRC.vs.ARC	-0.011 (0.009)	1.530^{**} (0.716)
Constant	0.434^{***} (0.021)	-3.482^{***} (0.628)
Observations	1,059	1,133
Note:		*p<0.1; **p<0.05; ***p<0.01

There was also a significant interaction between RC-Type and WordOrder (WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC), such that the difference between the two types of relative clauses was either neutralized or at least weakened when extraposed ($p < 001$ for duration; $p < 0.002$ for pause frequency). This is compatible with the idea that the phrasing difference between ARCs and RRCs is generally a consequence of their different attachment sites, as proposed in McCawley 1981. In the extraposed word order, the difference is predicted to disappear under this view, because both types of RCs attach similarly high. If, on the other hand, the stronger boundary associated with ARCs is a direct consequence of the comma-morpheme posited in Potts (2005b), we would expect it to be present independent of where the RC attaches, and therefore we would expect additive effects of RC-type and word order on boundary strength, rather than an interaction. However, the interaction and the absence of an additive effect could be due to an upper threshold on how much a word can be lengthened - in other words, the lack of a difference

is due to a ceiling effect.[19]

As discussed in the introduction, some previous production studies failed to find consistent differences between RC types in English and German (e.g. Watson and Gibson, 2004; Schubö and Féry, 2015). One reason may have been the particular stimuli and the tasks they used. Both Watson and Gibson (2004) and Schubö and Féry (2015) used sentences that were globally ambiguous with respect to whether they involved RRCs and ARCs, relying on context to disambiguate. The contexts were constructed in such a way that an RRC was either necessary or unnecessary to pick out a unique referent given a visual display. This manipulation will only lead to crisp differences on the assumption that participants act like logicians: They will never use an RRC unless it is necessary to establish the uniqueness of the referent, and will always use an ARC instead. It is not clear, however, that participants would behave in this way, since redundant RRCs might not be unacceptable, nor is it clear that participants will always keep track of the contextual information accurately enough to be able to correctly choose between RRC and ARC construals. More likely, these assumptions are only probabilistically accurate: Information that is unnecessary to pick out a referent is less likely to be construed using an RRC, and participants will only be confident about all context information with a certain probability.[20] In our manipulation of RC-type, we did not rely on context, but instead used grammatical cues to assure that an appositive or a restrictive reading was intended (see section 1.5).

The observed interaction between RC-type and word order observed may shed more light on this. Watson and Gibson (2004) found comparable rates of boundary placement between a head and the following RC when the RC was sentence final (49.1% for ARCs, 38.6% for RRCs), but a much greater difference when the RCs occurred sentence-medially (27.7% for ARCs, 10.0% for RRCs). The overall effect of RC-type was only marginally significant, but this might in fact have been due to an interaction between RC-Type and position like the one observed here (which Watson and Gibson (2004) did not test for statistically). Given the effect of extraposition on boundary strength that we found in German, one interpretation of the results in Watson and Gibson (2004) is that in sentence-final position, the RC might actually have tended to extrapose. This offers an alternative interpretation to the information-structure-based explanation for the increased boundary rate in final position offered in Watson and Gibson (2004), and would also account for why no overall effect of RC-type on boundaries preceding the RC were found in this study. Our results are compatible with the idea that ARCs are indeed systematically set off by boundaries in German, as was found to be the case at least in naturally occurring data from British English in Dehé (2009).

Another way the boundary preceding ARCs and RRCs might differ, apart from boundary strength, is its tonal realization (Dehé, 2009, 2014). One way the intonation at the boundary could differ in the boundary tone preceding the RC. While ARCs have often been assumed to come with an intonational contour of their own, RRCs are, or at least can be, integrated into the intonational contour of the clause that their head forms part of. Our impression looking at the data was that ARCs are often preceded by a fall, while RRCs are often

[19] In addition to the interaction between RC-type and WordOrder, we also found a significant interaction between WordOrder and the comparison between Subject-Focus and the other two foci, which we are not sure how to interpret.

[20] A further potential issue with Schubö and Féry (2015) is that only 5 speakers were analyzed, so the failure to detect a difference could just have been a power issue.

preceded by a continuation rise. In order to test this we looked at the pitch immediately preceding the boundary, more precisely at the mean pitch of the last quadrant of the word preceding the boundary. Fig. 7 illustrates the results.

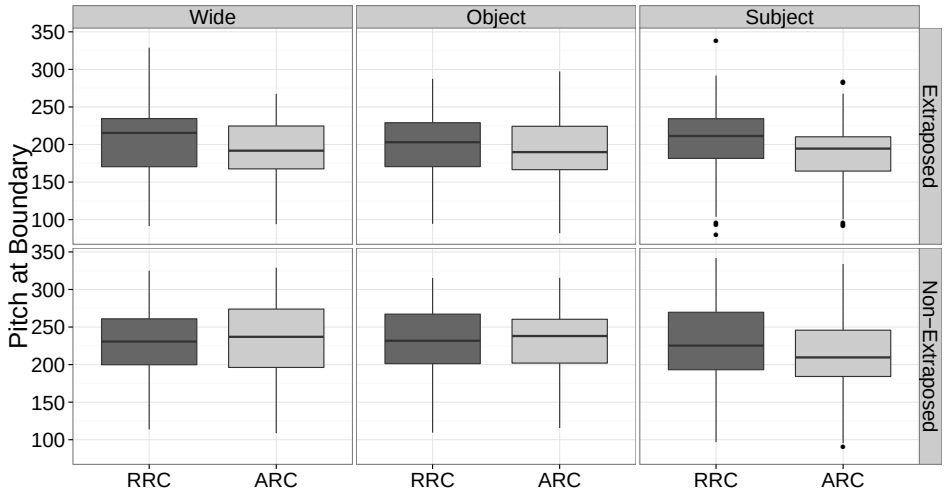

Figure 7: Mean pitch of the last quadrant of the word preceding the RC.

The figures suggest that indeed, in the extraposed word order and under Subject-focus in the non-extraposed word order ARCs are preceded by a relatively lower tone compared to RRCs. In other words, ARCs are preceded by a low tone precisely when a low tone would be expected to occur in this position if there was no ARC. A fall would be expected at the end of the sentence due to the declarative contour, but also following sentence-medial or sentence-initial focus, which is where the final fall of the sentence-final declarative contour begins. RRCs, as opposed to ARCs, form part of the main clause and, in the case of Subject-Focus, form part of the focused constituent. Therefore the declarative fall is expected in both cases to occur *after* the RC, not before it.

Table 4: Mean pitch of the last quadrant of the word preceding the RC

	Dependent variable:
	z-score of mean pitch
WordOrderNon-Ex.vs.Ex	28.601^{***} (3.928)
TypeRRC.vs.ARC	5.866^{**} (2.574)
FocusSubj.vs.Other	-5.203^{**} (2.460)
FocusWide.vs.Object	1.817 (3.279)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC	-10.667^{***} (3.583)
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other	-10.467^{***} (3.773)
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object	−1.712 (4.416)
TypeRRC.vs.ARC:FocusSubj.vs.Other	13.003^{***} (3.776)
TypeRRC.vs.ARC:FocusWide.vs.Object	−0.204 (4.402)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC:FocusSubj.vs.Other	11.698 (7.533)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC:FocusWide.vs.Object	−4.535 (8.805)
Constant	211.793^{***} (7.343)
Observations	996
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4 summarizes the statistical results. There was indeed a main effect of RC-type ($p< 0.04$). This suggests that indeed, ARCs differ intonationally from RRCs, compatible with the idea that they carry their own intonational tune. The difference was significantly greater under extraposition ($p< 0.003$). This could be because a stronger boundary gives more time to realize the intonational targets, but more likely it reflects the fact that a final declarative fall on the constituent preceding the RC in the host clause is expected for all focus conditions in the extraposed case but only for subject focus in the non-extraposed case. There was also an interaction between RC-Type and subject focus ($p< 0.001$), which we didn't expect, and do not know how to interpret. Finally, there were effects of word order and an interaction of word order with focus, which could just be a result of the overall lower pitch when the RC occurs finally.

Overall, the result of the acoustic results regarding the boundary preceding the RC suggest that ARCs indeed differ prosodically from RRCs in that they are preceded by a stronger prosodic boundary, and form a separate intonational domain. These quantitative results thus confirm earlier qualitative observations in this regard, e.g. those in Pierrehumbert (cf. 1980, 20). However, there is only a clear difference in the strength of the boundary preceding the RC in the non-extraposed word order, which is as predicted by accounts that relate the difference in prosodic phrasing directly to attachment height.

2.5 Summary: Prosodic Results

The prosodic results show that the context manipulation was successful: Subject focus resulted in lower prominence on the VP compared to object-focus or wide-focus. The correlation between focus and prominence was not perfect however, which will be important in analyzing the naturalness ratings, since we want to establish whether the effect of focus on extraposability is driven by prosody or whether both factors are independently relevant. The significantly lower accentuation rate of the VP under extraposition is a first indication that speakers avoid interrupting the dependency between head and RC with accented material.

Prior literature had observed that accenting the determiner of the NP modified by the RC can facilitate extraposition, but only in the case of restrictive relative clauses. We did find such prominence shifts, and they were indeed more frequent with RRCs. However, their presence only depended on extraposition in the case of appositive relative clauses—where in fact, their occurrence was unexpected.

The prosody of the RC and the boundary preceding the RC provide evidence that appositive restrictive clauses are set off by stronger boundaries, as is commonly assumed. This difference depending on RC-type, however, becomes undetectable (in the case of acoustic measures of pre-boundary lengthening) or at least becomes much smaller (when considering the likelihood of a preceding pause) when the relative clauses are extraposed, which is predicted if the differences in boundary strength preceding the RCs are actually due to differences in attachment, rather than due to an underlying comma-morpheme.

3 Extraposability

With a better understanding of the prosodic effects of the various factors we are interested in, we can now turn to how the various factors we manipulated affect extraposability, and whether differences in prosodic realization modulate these effects. In order to evaluate effects on extraposability, we look at the naturalness ratings provided by our speakers after each production. The utterances were rated for naturalness on a seven-point Likert scale.

There are at least two reasons why analyzing Likert-scale data with parametric statistical tests (such as linear regression models), which treat the ratings as a continuous variable, might be problematic: First, the scale is limited on the edges, and all utterances that are intuitively worse than some other utterance rated as 1 or better than one rated as 7 have to be rated as 1 and 7 respectively. This 'censoring' artificially decreases the variability in the data, and brings the means closer to the center, both of which can affect the statistical test. Second, it is not necessarily clear that the distances between different points on the scale are uniform, i.e., that the difference between 1 and 2 is really treated as the same as, say, the difference between 4 and 5. We therefore analyzed the ratings using a cumulative link mixed effects models Christensen (2014), which only assumes that the points on the scale were ordered relative to each other, but does not assume that they were equally spaced, or that values beyond the limits of the scale are interpretable. The model estimates the cumulative probability of a rating falling at or below a certain level on the scale. A positive estimate for a given factor estimates the probability (or rather, the odds ratio) of a higher rating on the scale.[21]

Our model included the main factors of interest, and some control variables such as the phonemic length of the VP and the RC. We also included random slopes for those predictors that we care most about.[22] In the following, we discuss the results in reference to the regression model, illustrating the main findings with various ways of plotting the ratings. Figure 8 plots the differences in acceptability depending on word order, focus, and

[21] We also fitted a linear mixed models to compare, and as expected the main difference was that the significance levels (as estimated by lmerTest) were higher—cumulative link models are more conservative. Bard et al. (1996) argue that ratings should be analyzed using magnitude estimation. This method is conceptually motivated for psychoacoustic measures (such as loudness), where intuitions correlate with ratios rather than differences of the physically measurable correlate (sound pressure in the case of loudness). The assumption is that at least certain psychoacoustic measures correlate with the logarithm of the physical measure (the Weber-Fechner law). The idea that acceptability or naturalness scales are similar in this regard is impossible to test directly, since there is no physical correlate of it that could be measured to test the relation between intuition and objective measure. Furthermore, magnitude estimation as a method has been shown to be flawed since participants do not treat the magnitude estimation scales as would be expected if they were indeed judging ratios, even for those psychoacoustic measures for which the Weber-Fechner law holds (Ellermeier and Faulhammer, 2000) (see Sprouse, 2011, for the case of acceptability ratings). We inspected our ratings to see whether a log-transformation would be justified, and help establish normality, but this was not the case. We therefore took the more conservative approach to use ordinal regression, which does not assume normality, and does not assume that the Weber-Fechner law applies to naturalness ratings.

[22] Including random slopes for all predictors was impossible for convergence reasons. The full model: ordinalModel=clmm(factor(response) WordOrder*Focus*Type + WordOrder *VPAccent *Type + WordOrder *HeadAccent *Type -(WordOrder:HeadAccent:Type)+ WordOrder *RCAccent *Type-(WordOrder:RCAccent:Type) + WordOrder *PreRCPause *Type-(WordOrder:PreRCPause:Type) + WordOrder *scale(VPphoneLength) + WordOrder*scale(RCphoneLength) + scale(VPduration) + scale(RCduration) + (WordOrder +Focus +Type+ scale(RCphoneLength)|participant)+(WordOrder +Focus +Type+ scale(RCphoneLength)|item), data=data_horizontal)

RC-Type. The statistical results are summarized in Table 5.

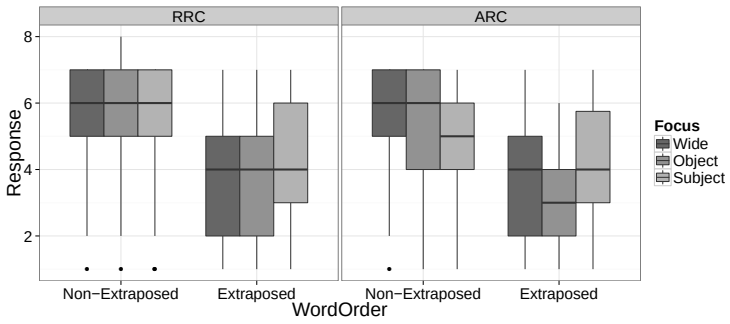

Figure 8: Responses by WordOrder, Focus, and RC-Type.

The effect of Word Order. In all conditions, the non-extraposed word order was rated better than the extraposed word order. These differences resulted in a highly significant main effect of word order (WordOrderNon-Ex.vs.Ex, $p < 0.001$). This result is not surprising given earlier studies, especially since the extraposition distance in our data is rather long. The only cases in which in the earlier literature extraposition has been argued to be preferred to non-extraposition are cases with a minimal distance between head and RC, where only a predicate intervenes (Uszkoreit and Brants, 1998; Bader, 2014b).[23]

The effect of Focus. There was a significant effect of focus ($p < 0.001$) such that wide focus is more acceptable than object focus, which is generally disfavored in our experiment (FocusWide.vs.Object). This is probably because it is odd to add a relative clause with new information (restrictive or appositive) in a context in which the subject is already established information, and the attention is shifted to the object. The effect runs counter to the idea that relative clauses are preferred when attaching to constituents that encode old information, proposed in Gibson et al. (2005).

There was no overall effect of subject focus vs. the other two foci, but as is evidenced in Figure 8, the adverse effect of extraposition is ameliorated by subject focus. This is reflected by a significant interaction between word order and focus (WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other, $p < 0.005$), as expected if extraposition is better when the NP it modifies or the RC itself is in focus, as was proposed in many earlier studies (Loetscher, 1972; Guéron, 1980; Culicover and Rochemont, 1990; Maynell, 2008, i.a.). Another interpretation of this effect is that processing difficulty arises if new discourse referents intervene between dependent constituents, but not or less so when given material intervenes

[23] In fact, Konieczny 2000 found that extraposed word order is less preferred in terms of acceptability even with such small distances, although extraposition is highly likely in these cases. Uszkoreit and Brants (1998) also found that acceptability ratings on extraposition word order were lower than would be expected based on the usage frequencies observed in corpora, speculating that this might show a perception/production asymmetry. Since our rating followed a production of the sentence, this interpretation seems implausible here.

	Coeff (SE)
WordOrderNon-Ex.vs.Ex	2.254204 (0.533467)***
FocusSubj.vs.Other	0.133429 (0.215559)
FocusWide.vs.Object	0.693149 (0.208645)***
TypeRRC.vs.ARC	0.647828 (0.513741)
VPAccentVPunaccented.vs.VPaccented	0.01208 (0.217548)
HeadAccentHeadUnaccented.vs.HeadAccented	−0.092004 (0.236161)
RCAccentRCUnaccented.vs.RCAccented	0.306245 (0.362816)
PreRCPausePause.vs.NoPause	−0.253573 (0.216539)
scale(VPphoneLength)	−0.072612 (0.12361)
scale(RCphoneLength)	0.446402 (0.183544)*
scale(VPduration)	−0.021194 (0.118403)
scale(RCduration)	−0.218933 (0.151131)
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other	−0.903702 (0.31887) **
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object	−0.037202 (0.287092)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC	0.261991 (0.386308)
FocusSubj.vs.Other:TypeRRC.vs.ARC	0.377664 (0.311931)
FocusWide.vs.Object:TypeRRC.vs.ARC	−0.095669 (0.286167)
WordOrderNon-Ex.vs.Ex:VPAccentVPunaccented.vs.VPaccented	−1.450321 (0.427489)***
TypeRRC.vs.ARC:VPAccentVPunaccented.vs.VPaccented	0.217208 (0.401996)
WordOrderNon-Ex.vs.Ex:HeadAccentHeadUnaccented.vs.HeadAccented	−0.639541 (0.39031)
TypeRRC.vs.ARC:HeadAccentHeadUnaccented.vs.HeadAccented	0.002469 (0.455177)
WordOrderNon-Ex.vs.Ex:RCAccentRCUnaccented.vs.RCAccented	0.134605 (0.575156)
TypeRRC.vs.ARC:RCAccentRCUnaccented.vs.RCAccented	0.202387 (0.728629)
WordOrderNon-Ex.vs.Ex:PreRCPausePause.vs.NoPause	−0.306116 (0.383532)
TypeRRC.vs.ARC:PreRCPausePause.vs.NoPause	−0.251177 (0.411961)
WordOrderNon-Ex.vs.Ex:scale(VPphoneLength)	0.146519 (0.164475)
WordOrderNon-Ex.vs.Ex:scale(RCphoneLength)	−0.279178 (0.165609).
WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other:TypeRRC.vs.ARC	−0.102014 (0.621825)
WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object:TypeRRC.vs.ARC	0.084191 (0.572954)
WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC:VPAccentVPunaccented.vs.VPaccented	1.240262 (0.806135)

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

Table 5: Cumulative Link Mixed Effects Regression Model for Naturalness Ratings

(Gibson, 1998; Warren and Gibson, 2002): Both in wide focus and object focus, the intervening object constitutes new information, and hence subject focus should be easier to process in comparison.

The effect of RC Type. There was no overall difference in acceptability depending on RC-type (TypeRRC.vs.ARC), indicating that overall, our restrictive and appositive stimuli were equally acceptable. A central claim in the literature analyzing relative clauses is that ARCs cannot extrapose, or are at least much more difficult to extrapose. In German, a sharp contrast between RC-types is generally assumed (Zifonoun, 2001; Holler, 2005; Konopka, 2006), at least when looking at extraposition over long distances, as in our stimuli. Various semantic theories predicted that extraposition of (non-continuative) ARCs is ungrammatical, or at least heavily degraded. However, the plots do not suggest that ARCs rate differently in naturalness when extraposed than RRCs, and there was no significant interaction between word order and RC-type in our model (WordOrderNon-Ex.vs.Ex:TypeRRC.vs.ARC). Based on the absence of such an interaction in one experiment one cannot conclude that in general, ARCs extrapose as easily as RRCs, but it clearly shows that this effect cannot be very strong.

The effect of boundaries preceding the RCs. There was no effect of whether or not the RC was preceded by a boundary as measured by the presence or absence of a pause

(PreRCPausePause.vs.NoPause), nor were there any interactions in this regard.

The interaction between RC type and Focus. Since ARCs, unlike RRCs, do not form part of the focus background structure of the matrix clause, one might have expected to find an interaction of RC-Type and Focus on extraposition. In our model, however, the three-way interaction between word order, RC Type, and focus comparisons was not significant (WordOrderNon-Ex.vs.Ex:FocusSubj.vs.Other:TypeRRC.vs.ARC, WordOrderNon-Ex.vs.Ex:FocusWide.vs.Object:TypeRRC.vs.ARC). More specifically, the ameliorating effect of subject focus on extraposition did not differ between ARCs and RRCs, contrary to a claim in Loetscher (1972). Focussing of the constituent that the RC pertains to significantly improved the naturalness of both extraposed ARCs and extraposed RRCs.[24] This cannot simply be explained by the assumption that focused tend to be ordered last. Given the fact that ARCs typically contribute new (focused) information and have an independent focus background structure, they should not be affected by manipulations of the focus structure of the matrix sentence. The results is as expected if RCs tend to modify focused heads (Schafer, 1996), or if they simply attach to more salient heads (Lee and Watson, 2011). They are also expected by the assumption that contextual givenness decreases the adverse interference caused by material disrupting the dependency between head and RC (Gibson, 1998; Warren and Gibson, 2002).

The effect of VP prominence. Fig. 9 shows the ratings varied depending on the accentuation status of the VP. While there was no overall effect of VP accentuation (VPAccentVPunaccented.vs.VPaccented), there was a significant interaction between word order and accentuation, such that the difference between non-extraposed and extraposed word order was smaller when the VP remained unaccented (WordOrderNon-Ex.vs.Ex:VPAccentVPunaccented.vs.VPaccented, $p < 0.001$). Leaving the VP unaccented made extraposed RCs more natural, but not non-extraposed RCs. This supports our hypothesis that the prominence of intervening material inversely correlates with extraposability. Although focus and prominence are correlated, each contributed to the overall model, as was further confirmed by a model comparison between a model including focus and to one excluding focus.[25]

The effect of head prominence. Whether or not prominence was shifted from the head to the determiner was not relevant for extraposability. Our data therefore do not support the idea that accents on the determiner facilitate extraposition. This may not contradict earlier observations in this vein, however, because the heads of our restrictive relative clauses all included the quantifier *jeder* 'every'. Previous claims about determiner accentuation were about definite determiners in German, which are arguably used as demonstratives in those cases. As noted above, German definite determiners are identical in pronunciation to

[24] As is apparent in Fig. 8, there was a tendency that non-extraposed ARCs are less preferred under subject focus. This is a configuration where the ARC is placed between the focus (which is prosodically boosted) and the given information (which is prosodically reduced). If both these effects are a consequence of being in the scope of the focus operator (Rooth, 1992), and the ARC should not be in the scope of the focus operator, then this effect would be expected—however, it did not reach significance.

[25] The interaction between RC-Type and prominence did not reach significance, despite the visible trend that there was a bigger effect RRCs.

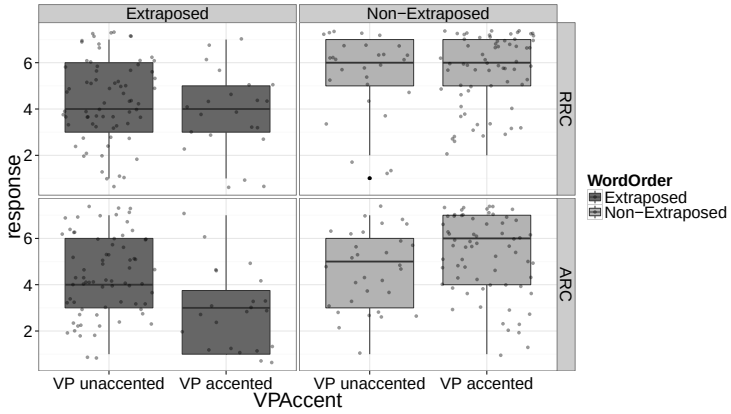

Figure 9: Acceptability rating by VP accentuation, both in extraposed and non-extraposed word orders.

demonstrative uses where in English one would would use 'that' or 'those'.[26] We believe that accenting a demonstrative determiner ameliorates extraposition is that it effectively places focus on the restriction, and makes the presence of an associated relative clause very likely. Focus on the restriction requires there to be a salient restrictive modifier that could serve as an antecedent. And cues that make an upcoming relative clause more likely have been shown to make extraposition much easier to process (Levy et al., 2012), as mentioned before. German even has a dedicated relative determiner that is composed of a determiner + *jenige* (e.g., *derjenige*), which is obligatorily accented, and makes a following relative clause obligatory, unless there is a very salient antecedent restriction in the context. The use of this relativiser intuitively facilitates extraposition. In our stimuli, however, we used the univeral quantifier *every*, which does not contain an implicit restriction, unlike demonstratives. It is intuitively not obvious that accenting this type of determiner increases the expectation for a restrictor, hence the absence of a facilitation effect might not be surprising.

The effect of phonological weight. While our study was not designed to directly test for the effects of phonological weight, there was some variability in the phonological weight of VPs and RCs as measured by the number of phonemes to check for weight effects in our model. There was an overall effect of the weight of the RC, such that longer RCs were rated as better ($p < 0.01$), and effect for which do not have an interpretation. More interestingly, the interaction between word order and RC length approached significance ($p < 0.09$). The difference between non-extraposed and extraposed word order was smaller when the RC was heavier ($p < 0.05$). This is exactly what is expected if heavier RCs have a greater tendency to extrapose, as has often been suggested. There was no effect of the phonological weight

[26] According to Baltin (to appear), *those* can improve extraposition even over long distances in English, although at least according to our elicitations it is not clear that in examples similar to our extraposition would be possible with *those* in English. For a detailed discussion of the restrictions on extraposition with definite determiners in English see Baltin (to appear); Walker (2013).

of the VP on the naturalness of the non-extraposed word order. It might be then that different dependencies are sensitive to different factors, and RC extraposition is sensitive to the weight of the RC.

4 Conclusion

This production study looked at the prosodic effects of focus, extraposition, and RC-type in German, and their effect on the naturalness of sentences as rated by the speakers of the utterance. The prosodic results provided evidence for the common assumption that appositive relative clauses are separated from their surroundings by prosodic boundaries. We also found evidence that the prosodic differences between ARCs and RRCs in terms of boundary strength interact with word order: ARCs and RRCs are similar to each other when extraposed. This is as expected if the boundary strength differences between the two types of relative clauses are due to their attachment site, rather than being the reflex of a lexical comma morpheme, and might therefore be derivable from syntax. The intonational difference between ARCs and RRCs, however, persevered in extraposed position, and was in fact even greater. This suggests that ARCs indeed come with a separate intonational tune, as has often been assumed.

We also found evidence that extraposition has the effect that speakers are less likely to accent material separating the head of the relative clause and the relative clause itself. This provides a first piece of evidence for our hypothesis that the effect of distance on the dependency between head and RC is modulated by prosodic prominence. The naturalness ratings lend further support for this idea. Extraposition was rated as better when the material separating the RC from its head remained unaccented. This modulating effect of prosodic prominence on extraposition was present for both types of RCs. Importantly, contextual focus and prosody, although highly correlated, both contribute to the effect on extraposition. While the ameliorating effect of focus on extraposition alone seems to potentially support the idea that RCs tend to modify focused information (Schafer, 1996), the combined effects of focus and prominence are more compatible with the interpretation of the focus effect in (Lee and Watson, 2011), who argue that RCs are preferentially interpreted to modify information that is contextually salient, and view focus as one of several factors contributing to that. Our results are incompatible with the idea that RCs preferentially attach to constituents that encode old information (Gibson et al., 2005).

In memory-based models of sentence processing, such as the Dependency Locality Theory (Gibson, 2000) or the skilled memory-retrieval model of Lewis and Vasishth (2005), the difficulty of integration across distances has been argued to be harder if intervening material is new to the discourse, which tend to be accented. These theories were tested mainly based on reading studies. Our results are compatible with the idea that these effects are equally present in production, when speakers already know what they are about to produce, and show that intervening material between the head and the relative clause increases the difficulty of interpreting a relative clause, and combining its meaning with the head that it restricts (in the case of RRCs), or the NP that it predicates over (in the case of ARCs). Both contextual focus and prosody modulate this effect.

Our results are also compatible with theories that link the difficulty of extraposition to the predictability of an upcoming RC (Levy et al., 2012)—it seems plausible that intervening

accented constituents make it less likely that an RC is still coming up, although this has not been tested, to our knowledge. The predictability account was designed to explain reading times in reading, where the upcoming material is not yet known to the reader. It is not clear whether it would predict that a speaker actively avoid placing an accent on intervening material in planned production, when she is aware of the entire structure beforehand, although see Jaeger (2010) for a discussion of predicability-based accounts of sentence production.

In sum, our findings establish that the possibility of extraposition is modulated by prosody, an effect which is compatible with several different interpretations that our results do not tease apart. It is also possible that the underlying source of the difficulty is that extraposition is harder to process whenever alternatives are evoked on constituents intervening between head and RC. Our focus contexts might not have perfectly succeeded in controlling whether a speaker considered such alternatives, since it is always possible that an additional contrasts were accommodated. A deeper understanding of why focus and prosody have the effects they have will require a better understanding of both the processing of focus, and the processing of the restrictions and predications that RRCs and ARCs introduce respectively.

A surprising finding is that, when other factors are controlled for, ARCs and RRCs seem equally natural when extraposed—even over long distances. This result run counter to many earlier claims on this issue. From a theoretical point of view, ARC extraposition is unexpected by various theories of appositive modification, which predict a strict adjacency requirement for ARCs and other appositive modifiers (Emonds, 1979; Potts, 2005a) for syntactic or interpretative reasons. From an empirical point of view, our findings differ from the specific claim about German that non-continuative ARCs, unlike RRCs, cannot be extraposed over distances greater a single word (Holler, 2005; Konopka, 2006).

The previous literature on German observed that the discourse relation holding between the ARC and its matrix clause can affect its extraposability (Smits, 1989; Holler, 2005). If the relation is continuative (such as the elation called 'narration' or 'result'), extraposition has often been reported to be in fact preferred (see section 1.3). In our experiment, however, we only used ARCs expressing a non-continuative discourse relation (the relation 'explanation'). And yet, even with these examples, which by all accounts should favor non-extraposition, we did not find a difference in extraposability to RRCs. We argued that one reason why previous authors came to the conclusion that ARCs cannot extrapose might be that the examples used include temporal or anaphoric elements which bias against the extraposed word order. Our conclusion based on our results is then that is that the difference between the two types of relative clauses with respect to their ability to extrapose, once these anaphoric relations are controlled for, must be much weaker than is usually assumed, and may in fact not exist. It seems very clear that the precise discourse relation of the ARC modulates its ability to extrapose, and there is some evidence that the prosodic realization of ARCs itself is affected by their discourse relation (Auran and Loock, 2011). It would therefore be of interest to systematically vary the discourse relation in a future experiment to further explore its effect on extrapositon.

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Appendix: Stimuli

A list of all dialogues:

(19) a. Wide-Focus

War die Wanderung schwierig?
was the hike difficult

'Was the hike difficult?'

b. Subject-Focus

Wer hat das Riemannhaus erreicht?
who has the Riemannhaus reached

'Who reached the Riemannhaus?'

c. Object-Focus

Welches Ziel hat der/jeder Wanderer erreicht?
which goal has the/every hiker reached

'Which goal did the/every hiker reach?'

d. ARC / non-extraposed

(Nein,) der Wanderer, der ja Schneeschuhe trug, hat das
no the hiker who PART snow shoes was wearing has the
Riemannhaus erreicht.
Riemannhaus reached

'(No,) the hiker, who was wearing snow shoes, has reached the Riemannhaus.'

e. ARC / extraposed

(Nein,) der Wanderer hat das Riemannhaus erreicht, der ja
no the hiker has the Riemannhaus reached who PART
Schneeschuhe trug.
snow shoes was wearing

'(No,) the hiker, who was wearing snow shoes, has reached the Riemannhaus.'

f. RRC / non-extraposed

(Nein,) jeder Wanderer, der Schneeschuhe trug, hat das
no every hiker who snow shoes was wearing has the
Riemannhaus erreicht.
Riemannhaus reached

'(No,) every hiker who was wearing snow shoes has reached the Riemannhaus.'

g. RRC / extraposed

(Nein,) jeder Wanderer hat das Riemannhaus erreicht, der Schneeschuhe
no every hiker has the Riemannhaus reached who snow shoes
trug.
was wearing

'(No,) every hiker who was wearing snow shoes has reached the Riemannhaus.'

(20) a. Wide-Focus

Was ist gerade so los bei Familie Müller?
what is now going on at family Müller
'What is going on at the Müller's place?'

b. Subject-Focus

Wer sieht gerade den "Tatort"?
who watches now the crime-scene
'Who is watching "Tatort"?'

c. Object-Focus

Welche Sendung sieht die Oma gerade?
which film watches the grandma now
'Which film is grandma watching?'

d. ARC / non-extraposed

(Nicht viel.) Die Oma, die ja einen eigenen Fernseher besitzt,
not much the grandma who PART a own tv-set owns
sieht den "Tatort".
watches the crime-scene
'(Not much.) Grandma, who has got her own tv-set, is watching "Tatort".'

e. ARC / extraposed

(Nicht viel.) Die Oma sieht den Tatort, die ja einen eigenen
not much the grandma watches the crime-scene who PART a own
Fernseher besitzt.
tv-set owns
'(Not much.) Grandma, who has got her own tv-set, is watching "Tatort".'

f. RRC / non-extraposed

(Nicht viel.) Jede Oma, die einen eigenen Fernseher besitzt, sieht
not much every grandma who a own tv-set owns watches
den Tatort.
the crime-scene
'(Not much.) Every grandma who owns her own tv-set is watching "Tatort".'

g. RRC / extraposed

(Nicht viel.) Jede Oma sieht den Tatort , die einen eigenen
not much every grandma watches the crime-scene who a own tv-set
Fernseher besitzt,
owns
'(Not much.) Every grandma who owns her own tv-set is watching "Tatort".'

(21) a. Wide-Focus

Was weisst Du schon von Kleinkindern?
what know you at all about infants
'What do you know about infants?'

b. Subject-Focus

Wer spielt eigentlich gern mit einem Raumschiff?
who plays actually with pleasure with a spacecraft
'Who does enjoy playing with a spacecraft?'

c. Object-Focus

Mit was spielt denn der Nachbarsjunge gern?
with what plays PART the boy next door with pleasure
'What does the boy next door enjoy playing with?'

d. ARC / non-extraposed

(Nicht viel. Aber:) Der Nachbarsjunge, der ja drei Jahre alt ist, spielt
not much but the boy next door who PART three years old is plays
gern mit einem Raumschiff.
with pleasure with a spacecraft

'(Not much.) The boy next door, who is three years old, enjoys playing with a spacecraft.'

e. ARC / extraposed

(Nicht viel. Aber:) Der Nachbarsjunge spielt gern mit einem
not much but the boy next door plays with pleasure with a
Raumschiff, der ja drei Jahre alt ist.
spacecraft who PART three years old is

'(Not much.) The boy next door, who is three years old, enjoys playing with a spacecraft.'

f. RRC / non-extraposed

(Nicht viel. Aber:) Jeder Junge, der drei Jahre alt ist, spielt gern
not much but every boy who three years old is plays with pleasure
mit einem Raumschiff.
with a spacecraft

'(Not much.) Every boy who is three years old enjoys playing with a spacecraft.'

g. RRC / extraposed

Nicht viel. Aber: Jeder Junge spielt gern mit einem Raumschiff,
not much but every boy plays with pleasure with a spacecraft
der drei Jahre alt ist.
who three years old is

'(Not much.) Every boy who is three years old enjoys playing with a spacecraft.'

(22) a. Wide-Focus

Warum gibt es im Kindergarten heute etwas Süsses?
why is there in the kindergarten today something sweet
'Why are there sweets in the kindergarten today?'

b. Subject-Focus

Wer bringt heute einen Kuchen mit in den Kindergarten?
who brings today a cake with in the kindergarten
'Who is bringing cake to the kindergarten today?'

c. Object-Focus

Was bringt Mia's Erzieherin heute mit in den Kindergarten?
what brings Mia's kindergartener today with in the kindergarten

'What does Mia's kindergartener bring with her today to kindergarten?'

d. ARC / non-extraposed

Mia's Erzieherin, die ja heute Geburtstag hat, bringt einen Kuchen
Mia's kindergartener who PART today birthday has beings a cake
mit.
with

'Mia's kindergartener, who celebrates her birthday today, brings a cake with her.'

e. ARC / extraposed

Mia's Erzieherin bringt einen Kuchen mit, die ja heute Geburtstag
Mia's kindergartener beings a cake with who PART today birthday
hat.
has

'Mia's kindergartener, who celebrates her birthday today, brings a cake with her.'

f. RRC / non-extraposed

Jede Erzieherin, die Geburtstag hat, bringt einen Kuchen mit.
every kindergartener who birthday has brings a cake with

'Every kindergartener who has birthday brings a cake with them.'

g. RRC / extraposed

Jede Erziehxerin bringt einen Kuchen mit, die Geburtstag hat.
every kindergartener brings a cake with who birthday has

'Every kindergartener who has birthday brings a cake with them.'

(23) a. Wide-Focus

War der Kurs zu schwierig?
was the course too difficult

'Has the course been too difficult?'

b. Subject-Focus

Wer hat den Abschlusstest bestanden?
who has the final test passed

'Who has passed the final test?'

c. Object-Focus

Welche Prüfung haben Bens Schüler bestanden?
which test have Ben's pupils passed

'Which test have Ben's pupils passed?'

d. ARC / non-extraposed

(Nein.) Bens Schüler, die sich ja auch entsprechend vorbereitet
No Ben's pupils who themselves PART also adequately prepared

haben, haben den Abschlusstest bestanden.
have have the final test passed

'(No.) Ben's pupils, who have prepared themselves carefully, have passed the final test.'

e. ARC / extraposed

(Nein.) Bens Schüler haben den Abschlusstest bestanden, die sich
No Ben's pupils have the final test passed who themselves
ja auch entsprechend vorbereitet haben.
PART also adequately prepared have

'(No.) Ben's pupils, who have prepared themselves carefully, have passed the final test.'

f. RRC / non-extraposed

(Nein.) Jeder Schüler, der sich entsprechend vorbereitet hat, hat den
No every pupil who himself adequately prepared has has the
Abschlusstest bestanden.
final test passed

'(No.) Every pupil who has prepared carefully has passed the final test."

g. RRC / extraposed

(Nein.) Jeder Schüler hat den Abschlusstest bestanden, der sich
No every pupil has the final test passed who himself
entsprechend vorbereitet hat.
adequately prepared has

'(No.) Every pupil who has prepared carefully has passed the final test."

(24) a. Wide-Focus

Gibt es spezielle Regeln für das Schlangenhaus?
are there special rules for the snake house

'Are there any special rules for the snake house?'

b. Subject-Focus

Welche Schlangen müssen eigentlich von einem Experten gefüttert werden?
which snakes must PART by an expert fed be

'Which snakes must be fed by an expert?'

c. Object-Focus

Von wem müssen die Mambas denn gefüttert werden?
by whom must the mambas PART fed be

'By whom must the mambas be fed?'

d. ARC / non-extraposed

(Ja.) Die Mambas, die ja noch ihren Giftzahn haben, müssen von
Yes the mambas who PART still their fang have must by
einem Experten gefüttert werden.
an expert fed be

'(Yes.)The mambas, who still have their fangs, must be fed by an expert.'

e. ARC / extraposed

(Ja.) Die Mambas müssen von einem Experten gefüttert werden, die ja
Yes the mambas must by an expert fed be who PART
noch ihren Giftzahn haben.
still their fang have

'(Yes.)The mambas, who still have their fangs, must be fed by an expert.'

f. RRC / non-extraposed

(Ja.) Jede Mamba, die ihren Giftzahn noch hat, muss von einem Experten
Yes every mamba who her fang still has must by an expert
gefüttert werden.
fed be

'(Yes.) Every mamba who still has her fang must be fed by an expert."

g. RRC / extraposed

(Ja.) Jede Mamba muss von einem Experten gefüttert werden, die ihren
Yes every mamba must by an expert fed be who her
Giftzahn noch hat.
fang still has

'(Yes.) Every mamba who still has her fang must be fed by an expert."

(25) a. Wide-Focus

Ist die Masernepedemie ein Problem für Euch?
is the measles epidemic a problem for you

'Is the measles epidemic a problem for you?'

b. Subject-Focus

Wer in Eurer Familie ist gegen Masern immun?
who in your family is against measles immune

'Who in your family is immune to measles?'

c. Object-Focus

Gegen welche Kinderkrankheiten ist Euer Kind immun?
against which childhood desease is your child immune

'To which childhood desease is your child immune?'

d. ARC / non-extraposed

(Nein.) Unser Kind, das ja standardmässig geimpft wurde, ist
No our child which PART standardly vaccinated was is
gegen Masern immun.
against measles immune

'(No.) Our child, which has been vaccinated standardly, is immune to measles.'

e. ARC / extraposed

(Nein.) Unser Kind ist gegen Masern immun, das ja standardmässig
No our child is against measles immune which PART standardly
geimpft wurde.
vaccinated was

'(No.) Our child, which has been vaccinated standardly, is immune to measles.'

f. RRC / non-extraposed

(Nein.) Jedes Kind, das standardmässig geimpft wurde, ist gegen
No every child which standardly vaccinated was is against
Masern immun.
measles immune

'(No.) Every child that has been vaccinated standardly is immune to measles."

g. RRC / extraposed

(Nein.) Jedes Kind ist gegen Masern immun, das standardmässig
No every child is against measles immune which standardly
geimpft wurde.
vaccinated was

'(No.) Every child that has been vaccinated standardly is immune to measles."

(26) a. Wide-Focus

Was gibt es Neues aus dem Raubtierhaus?
what is there new from the lion house
'What is there new from the lion house?'

b. Subject-Focus

Wer darf heute in den Aussenbereich?
who may today in the outdoor area
'Who may go to the outdoor area today?'

c. Object-Focus

Wohin dürfen die Löwenbabies heute?
where may the lion cubs today
'Where may the lion cubs go today?'

d. ARC / non-extraposed

Die Löwenbabies, die ja gesund und munter sind, dürfen heute in den
the lion cubs which PART healthy and cheerful are may today in the
Aussenbereich.
outdoor area

'The lion cubs, which are safe and sound, may go to the outdoor area today.'

e. ARC / extraposed

Die Löwenbabies dürfen heute in den Aussenbereich, die ja gesund
the lion cubs may today in the outdoor area which PART healthy
und munter sind.
and cheerful are

'The lion cubs, which are safe and sound, may go to the outdoor area today.'

f. RRC / non-extraposed

Jedes Löwenbaby, das gesund und munter ist, darf heute in den
every lion cub which healthy and cheerful is may today in the

Aussenbereich.
outdoor area

'Every lion cub which is safe and sound may go to the outdoor area today.'

g. RRC / extraposed

Jedes Löwenbaby darf heute in den Aussenbereich, das gesund und
every lion cub may today in the outdoor area which healthy and
munter ist.
cheerful is

'Every lion cub which is safe and sound may go to the outdoor area today.'

(27) a. Wide-Focus

Hatte die Äbtissin Neuigkeiten?
had the abbess news

'Is there any news from the abbess?'

b. Subject-Focus

Wer hat einen kleinen Garten angelegt?
who has a small garden laid out

'Who has laid out a small garden?'

c. Object-Focus

Was haben die Nonnen angelegt?
what have the nuns laid out

'What have the nuns laid out?'

d. ARC / non-extraposed

(Ja.) Die Nonnen, die sich ja mit Pflanzen auskennen, haben einen
yes the nuns who REFL PRT about plants know have a
kleinen Garten angelegt.
small garden laid out

'The nuns, who know about plants, have laid out a small garden.'

e. ARC / extraposed

(Ja.) Die Nonnen haben einen kleinen Garten angelegt, die sich ja
yes the nuns have a small garden laid out who REFL about
mit Pflanzen auskennen.
plants know

'The nuns, who know about plants, have laid out a small garden.'

f. RRC / non-extraposed

(Ja.) Jede Nonne, die sich mit Pflanzen auskennt, hat einen kleinen
yes every nun who REFL about plants knows has a small
Garten angelegt.
garden laid out

'Every nun who knows about plants has laid out a small garden.'

g. RRC / extraposed

(Ja.) Jede Nonne hat einen kleinen Garten angelegt, die sich mit
yes every nun has a small garden laid out who REFL about
Pflanzen auskennt.
plants knows

'Every nun who knows about plants has laid out a small garden.'

(28) a. Wide-Focus

War die Rodelbahn sehr vereist?
was the sled run very icy
'Was the sled run very icy?'

b. Subject-Focus

Wer rutschte gegen die Leitplanke?
who slid against the guarding rail
'Who slid against the guarding rail?'

c. Object-Focus

Wogegen rutschte der Rodler?
against what slid the bobsleigh rider
'Against what did the bobsleigh rider slide?'

d. ARC / non-extraposed

(Ja.) Der Rodler, der ja nicht sehr geübt war, rutschte
yes the bobsleigh rider who PART not very experienced was slid
gegen die Leitplanke.
against the guarding rail

'The bobsleigh rider, who was not very experienced, slid against the guarding rail.'

e. ARC / extraposed

(Ja.) Der Rodler rutschte gegen die Leitplanke, der ja nicht
yes the bobsleigh rider slid against the guarding rail who PART not
sehr geübt war.
very experienced was

'(Yes.) The bobsleigh rider, who was not very experienced, slid against the guarding rail.'

f. RRC / non-extraposed

(Ja.) Jeder Rodler, der nicht sehr geübt war, rutschte gegen
yes every bobsleigh rider who not very experienced was slid against
die Leitplanke.
the guarding rail

'(Yes.) Every bobsleigh rider who was not very experienced slid against the guarding rail.'

g. RRC / extraposed

(Ja.) Jeder Rodler rutschte gegen die Leitplanke, der nicht sehr
yes every bobsleigh rider slid against the guarding rail who not very

geübt war.
experienced was

'(Yes.)Every bobsleigh rider who was not very experienced slid against the guarding rail.'

(29) a. Wide-Focus

Warum war der Imker so in Panik?
why was the beekeeper so in panic

'Why has the beekeeper been in panic?'

b. Subject-Focus

Welche Insekten haben ihren Stachel verloren?
which insects have their sting lost

'Which insects have lost their stinger?'

c. Object-Focus

Was haben die Bienen verloren?
what have the bees lost

'What have the bees lost?'

d. ARC / non-extraposed

Die Bienen, die ja dem Gift ausgesetzt waren, haben ihren Stachel
the bees which PART the poison exposed were have their stinger
verloren.
lost

'The bees, which were exposed to the poison, have lost their stinger.'

e. ARC / extraposed

Die Bienen haben ihren Stachel verloren, die ja dem Gift ausgesetzt
the bees have their stinger lost which PART the poison exposed
waren.
were

'The bees, which were exposed to the poison, have lost their stinger.'

f. RRC / non-extraposed

Jede Biene, die dem Gift ausgesetzt war, hat ihren Stachel verloren.
every bee which the poison exposed was has her stinger lost

'Every bee which was exposed to the poison has lost her stinger.'

g. RRC / extraposed

Jede Biene hat ihren Stachel verloren, die dem Gift ausgesetzt war.
every bee has her stinger lost which the poison exposed was

'Every bee which was exposed to the poison has lost her stinger.'

(30) a. Wide-Focus

Wodurch spart die Baufirma im Winter Geld?
how saves the construction company in the winter money

'How does the construction company save money in winter?'

b. Subject-Focus

Wer bezieht im Winter Arbeitslosenhilfe?
who draws in the winter unemployment assistance
'Who draws unemployment assistance in winter?'

c. Object-Focus

Was bezieht der Maurer im Winter?
what draws the mason in the winter
'What does the mason draw in winter?'

d. ARC / non-extraposed

Der Maurer, der ja keinen festen Vertrag hat, bezieht im Winter
the mason who PART no firm contract has draws in the winter
Arbeitslosenhilfe.
unemployment assistance

'The mason, who does not have a firm contract, draws unemployment assistance in winter.'

e. ARC / extraposed

Der Maurer bezieht im Winter Arbeitslosenhilfe, der ja
the mason draws in the winter unemployment assistance who PART
keinen festen Vertrag hat.
no firm contract has

'The mason, who does not have a firm contract, draws unemployment assistance in winter.'

f. RRC / non-extraposed

Jeder Maurer, der keinen festen Vertrag hat, bezieht im Winter
every mason who no firm contract has draws in the winter
Arbeitslosenhilfe.
unemployment assistance

'Every mason who does not have a firm contract draws unemployment assistance in winter.'

g. RRC / extraposed

Jeder Maurer bezieht im Winter Arbeitslosenhilfe, der keinen
every mason draws in the winter unemployment assistance who no
festen Vertrag hat.
firm contract has

'Every mason who does not have a firm contract draws unemployment assistance in winter.'

(31) a. Wide-Focus

Was war bei der Casting-Show gestern Abend?
What was at the casting-show yesterday evening
'What happened at the casting-show yesterday evening'

b. Subject-Focus

Wer hat die junge Sängerin kritisiert?
Who has the young singer criticized

'Who criticized the young singer?'

c. Object-Focus

Wen ha(t/ben) der/die Juror(en) kritisiert?
who ha(s/ve) the juror(s) criticized

'Who did the juror(s) criticize?'

d. ARC / non-extraposed

Der Juror, der ja immer sehr streng ist, hat die junge Sängerin
the juror who PART always very strict is has the young singer
kritisiert.
criticized

'The juror, who is always very demanding, criticized the young singer.'

e. ARC / extraposed

Der Juror hat die junge Sängerin kritisiert, der ja immer sehr streng
the juror has the young singer criticized who PART always very strict
ist.
is

'The juror, who is always very demanding, criticized the young singer.'

f. RRC / non-extraposed

Jeder Juror, der streng ist, hat die junge Sängerin kritisiert.
every juror who strict is has the young singer criticized

'Every juror that is demanding has criticized the young singer.'

g. RRC / extraposed

Jeder Juror hat die junge Sängerin kritisiert, der streng ist.
the juror has the young singer criticized who strict is

'Every juror that is demanding criticized the young singer.'

(32) a. Wide-Focus

Lohnt sich denn die Erzeugung von Bio-Produkten?
is profitable PART the production of organic products

'Is the production of organic products profitable'

b. Subject-Focus

Wer bekommt dieses Jahr mehr Geld für seinen Käse?
who gets this year more money for his cheese

'Who gets more money for the cheese this year?'

c. Object-Focus

Für was bekomm(t/en) die Molkerei(en) dieses Jahr mehr Geld?
for what get(s) the dair(y/ies) this year more money

'What does/do the dair(y/ies) get more money for this year?'

d. ARC / non-extraposed

Die Molkerei, die ja jetzt nur noch Bio-Milch verwendet,
the dairy which PART now only PART organic-milk uses

bekommt dieses Jahr mehr Geld für ihren Käse.
gets this year more money for its cheese

'The dairy, who since recently is only using organic-milk, gets more money for its cheese this year.'

e. ARC / extraposed

Die Molkerei bekommt dieses Jahr mehr Geld für ihren Käse, die ja
the dairy gets this year more money for its cheese which PART
jetzt nur noch Bio-Milch verwendet.
now only PART organic-milk uses

'The dairy, who since recently is only using organic-milk, gets more money for its cheese this year.'

f. RRC / non-extraposed

Jede Molkerei, die nur noch Bio-Milch verwendet, bekommt dieses
every dairy which only PART organic-milk uses gets this
Jahr mehr Geld für ihren Käse.
year more money for its cheese

'Every dairy that is only using organic-milk gets more money for its cheese this year.'

g. RRC / extraposed

Jede Molkerei bekommt dieses Jahr mehr Geld für ihren Käse, die nur
every dairy gets this year more money for its cheese which only
noch Bio-Milch verwendet.
PART organic-milk uses

'Every dairy that is only using organic-milk gets more money for its cheese this year.'

(33) a. Wide-Focus

Bringt der Kälteeinbruch zusätzliche Arbeit für den Bauern mit sich?
brings the cold snap additional work for the farmer with it

'Does the cold snap mean additional work for the farmer?'

b. Subject-Focus

Welche Bäume müssen mit einer Hülle bedeckt werden?
which trees must with a cover covered be

'Which trees have to be wrapped with a cover?'

c. Object-Focus

Mit was müssen die/viele Obstbäume bedeckt werden?
with what must the/many fruit-trees covered be

'With what do many fruit-trees have to be covered?'

d. ARC / non-extraposed

(Ja.) Die Obstbäume, die ja schon Knospen tragen, müssen mit
(yes) the fruit-trees which PART already buds have must with
einer Hülle bedeckt werden.
a cover wrapped be

'(Yes). The fruit-trees, which are already budding, have to be wrapped with a cover.'

e. ARC / extraposed

Die Obstbäume müssen mit einer Hülle bedeckt werden, die ja
the fruit-trees must with a cover wrapped be which PART
schon Knospen tragen.
already buds have

'The fruit-trees, which are already budding, have to be wrapped with a cover.'

f. RRC / non-extraposed

(Ja.) Jeder Obstbaum, der schon Knospen trägt, muss mit einer Hülle
(yes) every fruit-tree which already buds has must with a cover
bedeckt werden.
wrapped be

'(Yes). Every fruit-tree that is already budding has to be wrapped with a cover.'

g. RRC / extraposed

(Ja.) Jeder Obstbaum muss mit einer Hülle bedeckt werden, der schon
(yes) every fruit-tree must with a cover wrapped be which already
Knospen trägt.
buds has

'(Yes). Every fruit-tree that is already budding has to be wrapped with a cover.'

(34) a. Wide-Focus

Wie ging die Geschichte denn weiter?
how went the story PART on

'How did the story continue?'

b. Subject-Focus

Wer hat seine Jungen gewarnt?
who has its young warned

'Who has warned its young?'

c. Object-Focus

Wen hat die Eule gewarnt?
who has the owl warned

'Who did the owl warn?'

d. ARC / non-extraposed

Die Eule, die ja die Gefahr gewittert hat, hat ihre Jungen gewarnt.
the owl which PART the danger got-wind-of has has its young warned

'The owl, which got wind of the danger, has warned its young.'

e. ARC / extraposed

Die Eule hat ihre Jungen gewarnt, die ja die Gefahr gewittert hat.
the owl has its young warned which PART the danger got-wind-of has

'The owl, which got wind of the danger, has warned its young.'

f. RRC / non-extraposed

Jede Eule, die die Gefahr gewittert hatte, hat ihre Jungen gewarnt.
every owl which the danger got-wind-of has has its young warned

'Every owl that got wind of the danger has warned its young.

g. RRC / extraposed

Jede Eule hat ihre Jungen gewarnt, die die Gefahr gewittert hatte.
every owl has its young warned which the danger got-wind-of has

'Every owl that got wind of the danger has warned its young.

(35) a. Wide-Focus

Warum war der Tierarzt da?
why was the vet here

'Why did the vet come?'

b. Subject-Focus

Wer musste eine Spritze bekommen?
who must a injection get

'Who must get an injection?'

c. Object-Focus

Was musste(n) Annas/die Lämmlein bekommen?
what must Anna's lamb get

'What did Anna's lamb have to get?'

d. ARC / non-extraposed

Annas Lämmlein, das ja ein bisschen krank ist, musste eine Spritze
Anna's lamb which PART a bit ill is must an injection
bekommen.
get

'Anna's lamb, which is a bit ill, had to get an injection.'

e. ARC / extraposed

Annas Lämmlein musste eine Spritze bekommen, das ja ein bisschen
Anna's lamb must an injection get which PART a bit
krank ist.
ill is

'Anna's lamb, which is a bit ill, had to get an injection.'

f. RRC / non-extraposed

Jedes Lämmlein, das krank ist, musste eine Spritze bekommen.
every lamb which ill is must an injection get

'Every lamb that is ill had to get an injection.'

g. RRC / extraposed

Jedes Lämmlein musste eine Spritze bekommen, das krank ist,
every lamb must an injection get which ill is

'Every lamb that is ill had to get an injection.'

(36) a. Wide-Focus

Was hat der Rektor gesagt?
what has the headmaster said

'What did the headmaster say?'

b. Subject-Focus

Wer kann die Prüfung nachholen?
who can the exam take-later

'Who can take the exam later?'

c. Object-Focus

Was kann/können unser/die Klassensprecher nachholen?
what can our/the class-representative(s) take-later

'What can our class-representative take later?'

d. ARC / non-extraposed

Unser Klassensprecher, der ja an der Lehrerversammlung teilnehmen
our class-representative who PART at the teachers-meeting attend
soll, kann die Prüfung nachholen.
should can the exam take-later

'Our class-representative, who should attend the teachers-meeting, can take the exam later.'

e. ARC / extraposed

Unser Klassensprecher kann die Prüfung nachholen, der ja an der
our class-representative can the exam take-later who PART at the
Lehrerversammlung teilnehmen soll.
teachers-meeting attend should

'Our class-representative, who should attend the teachers-meeting, can take the exam later.'

f. RRC / non-extraposed

Jeder Klassensprecher, der an der Lehrerversammlung teilnehmen soll,
every class-representative that at the teachers-meeting attend should
kann die Prüfung nachholen.
can the exam take-later

'Every class-representative that should attend the teachers-meeting can take the exam later.'

g. RRC / extraposed

Jeder Klassensprecher kann die Prüfung nachholen, der an der
every class-representative can the exam take-later that at the
Lehrerversammlung teilnehmen soll.
teachers-meeting attend should

'Every class-representative that should attend the teachers-meeting can take the exam later.'