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Grammatical Weight and Relative Clause Extraposition in English

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Abstract

In relative clause extraposition (RCE) in English, a noun is modified by a non-adjacent RC, resulting in a discontinuous dependency, as in: *Three people arrived here yesterday who were from Chicago*. Although discourse focus is known to influence the choice of RCE over truth-conditionally equivalent sentences with canonical structure (Rochemont & Culicover 1990; Takami 1999), Hawkins (2004) and Wasow (2002) have proposed in addition that RCE should be preferred when the relative clause is long (or ‘heavy’) relative to the VP because such structures are processed more efficiently in comprehension and production. The current study tested this hypothesis based on Hawkins’ (2004) domain minimization principles. In an acceptability judgment task, canonical sentences were rated significantly higher than extraposition sentences when the RC was light, but this difference disappeared when the RC was heavy. In a self-paced reading task, extraposition sentences were read significantly faster than canonical sentences when the RC was heavy, but there was no difference when the RC was light. In an analysis of RCE in the ICE-GB corpus, extraposed RCs were significantly longer than the VP on average, whereas canonical RCs were significantly shorter, and the proportion of

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sentences with extraposition decreased as the ratio of VP-to-RC length increased. These findings support Hawkins’ (2004) domain minimization principles and help explain why a discontinuous dependency is allowed and sometimes preferred even in a language with relatively fixed word order.

**Keywords**: grammatical weight, relative clause extraposition, sentence processing, English syntax

1. **Introduction**

In relative clause extraposition from subject NP, a relative clause modifies a noun within the subject NP but occurs in a position following the VP. In sentence (1a) from the International Corpus of English Great Britain (henceforth, ICE-GB), for example, the VP *soon appeared* intervenes between the noun *sets* and the relative clause *that were able to receive all the TV channels*. The extraposition sentence in (1a) can be used to express the same proposition as the canonical sentence in (1b), in which the relative clause directly follows its head noun.

(1)  

a. New sets soon appeared *that were able to receive all the TV channels*. (ICE-GB)  

b. New sets *that were able to receive all the TV channels* soon appeared.

Relative clause extraposition (henceforth RCE) in (1a) violates the prescriptive rule banning ‘misplaced modifiers’ and would likely be corrected to (1b) if found in a student’s essay (see Trenga 2006: 51-56). Nevertheless, this type of extraposition occurs naturally in formal speech.
and formal writing as well as informal styles, as illustrated in the additional examples in (2) from the ICE-GB corpus:

(2) a. The indications are that Europe will once again become the priority because slowly and awkwardly, a treaty is taking shape which will most likely emerge by the end of this year as a new European union. (formal speech)

b. However, a close look at the nature of these countries' development experiences will reveal that certain conditions existed which cannot be applied to all other countries at all times. (formal writing)

c. I think it would take uh oh three-quarters of an hour to an hour for somebody to start who didn't have any any any experience at all. (informal speech)

Linguists agree that the ‘misplaced modifier’ in RCE involves some kind of discontinuous dependency between the subject NP and the extraposed relative clause. However, the precise nature of this dependency has been a matter of debate within formal approaches to syntax. Since the relative clause (henceforth, RC) occurs in a position completely outside the subject NP, this dependency apparently violates the requirement of X-bar structure that modifiers should occur as either complements to the head or as adjuncts to a phrasal projection of the head. As a way of reconciling RCE with X-bar theory, the earliest generative accounts assumed rightward movement of the RC from its canonical position (e.g., Baltin 1981; Ross 1967). However, as Rochemont and Culicover (1990) point out, this solution was problematic because RCE is both more and less constrained than typical movements like wh-movement. For example, RCE is subject to a locality condition that prevents the extraposed RC from occurring
outside the clause containing its antecedent (originally formulated as the Right Roof Constraint, Ross 1967), while at the same time freely allowing certain island violations, for example extraction of the extraposed element out of the subject NP, as in the examples in (1a) and (2a-c) above.

Because of its special properties, RCE and related extraposition constructions have been problematic for syntactic theories and have resulted in a number of different analyses, all of which involve special formal or interpretive mechanisms. In addition to rightward movement (Ross 1967, Baltin 1981), other accounts have included discontinuous constituency of the NP (McCawley 1987, 1998) and stranding of the extraposed phrase due to leftward movement of non-extraposed elements (Kayne 1994). Another more surface-oriented approach favors base-generated adjunction of the extraposed constituent to IP or VP (a normal case of adjunction as far as constituent structure is concerned), with the addition of a special interpretive rule to state the discontinuous dependency and the relevant locality constraints (Rochemont and Culicover 1990). Along the same lines, Culicover and Jackendoff (2005) characterize RCE as a case of simple adjunction in the syntax, but as involving a radical mismatch between syntax and semantics. In his review of the literature on extraposition, Baltin (2006) argues that each of these approaches has its merits, but that none of them provides a fully satisfactory explanation of all the relevant data (see also Bianchi 2002).

Regardless of which formal approach one takes, however, it is clear that RCE is unexpected from a purely formal perspective. Why should English allow a discontinuous dependency that requires special syntactic or interpretive mechanisms when a canonical structure can be used to express the same proposition? Why are RCE structures allowed and even preferred in some contexts in a language with relatively fixed word order and constituent
structure? The answer that has been proposed most often is that RCE is used to express a particular type of discourse information. Although the details of various accounts differ, the general consensus is that RCE tends to occur when the RC expresses new, contrastive or important information and the VP expresses old or backgrounded information (cf. Huck and Na 1990, 1992; Kuno and Takami 2004; Rochemont and Culicover 1990; Takami 1999). In (2b) above, for example, the RC expresses the most important information of the sentence while the VP existed merely asserts the existence of the subject certain conditions, helping to introduce the subject. More generally, RCE adheres to the tendency of focused constituents to occur later in a sentence than old or backgrounded information. Thus, the marked word order of RCE may be exploited by speakers to highlight the information status of the RC.

Another factor that has been discussed in relation to this type of extraposition is predicate type. Rochemont and Culicover (1990: 65) observe that extraposition from subject typically occurs with unaccusative predicates such as predicates of existence and appearance. However, they show that other predicate types such as unergative and transitive predicates are also permissible as long as the predicate can be understood as “c-construable” (i.e., old or backgrounded) information. This is in contrast to other constructions such as Presentational there Insertion (PTI), which appear to be more strictly limited to occur with unaccusative predicates, as illustrated by the contrast in (3a-b).

(3)  a. A man phoned her up who she didn’t know. (RCE)
    b. *There phoned her up a man who she didn’t know. (PTI)
Thus, Rochemont and Culicover (1990: 66) argue that the preference for unaccusative predicates derives from their typical use in discourse rather than from any lexically specified constraints on extraposition.

While acknowledging the importance of discourse information structure, the current study investigates the possible role of a different factor—grammatical weight—in licensing RCE in English. Exact definitions vary, but the term ‘grammatical weight’ usually refers to the length and/or complexity of a phrase in relation to other phrases in the same sentence: ‘heavier’ constituents are longer or structurally more complex than ‘lighter’ constituents. Grammatical weight has been implicated in a number of phenomena involving non-canonical word order in several languages (Arnold et al 2000, 2004; Cheung 2006; Hawkins 1994, 2004; Konieczny 2000; Lohse et al 2004; Matthews and Yeung 2001; Siewierska 1993; Stallings et al 1998; Uszkoreit et al 1998; Wasow 1997; Yamashita and Chang 2001) and I will propose that it plays an important role in English RCE as well.

Following Quirk et al (1972), Wasow (2002: 3) presents the following descriptive generalization:

(4) **Principle of End Weight (PEW):**

Phrases are presented in order of increasing weight. 2

For example, in a phenomenon known as Heavy NP Shift (henceforth, HNPS), the direct object of a transitive verb occurs at the end of the sentence following an oblique argument or adjunct (usually a PP), as in (5b), rather than occurring in its canonical position adjacent to the verb, as in (5a). In accordance with the PEW, corpus studies have shown that HNPS normally occurs
when the object NP is heavier than the PP, as in (5b) (Arnold et al 2000; Wasow 1997).

Sentences with a light object NP in a shifted position, as in (5c), do sometimes occur, but are uncommon and are typically judged as less acceptable in the absence of special intonation or discourse conditions.

(5)  

    a. The waiter brought the wine we had ordered to the table. (Canonical)
    b. The waiter brought to the table the wine we had ordered. (HNPS)

    (Arnold et al. 2000: 28)
    c. ?The waiter brought to the table the wine.

Why should longer, more complex constituents tend to occur later in the sentence? Wasow (1997) and Arnold et al (2000) have argued that placing heavy constituents later facilitates production and planning of utterances by giving speakers extra time to formulate the heavier constituent (see also Arnold et al 2004, Stallings et al 1998, Yamashita 2002, and Yamashita and Chang 2001). In addition, Hawkins (1994) has proposed that placing heavy constituents at the end allows listeners and readers to process sentences more efficiently by allowing faster recognition of the major constituents of the sentence (see also Matthews and Yeung 2001). Similarly, Gibson (1998) has proposed that moving heavy constituents to the end can reduce integration costs in the processing of non-local dependencies. To the extent that these explanations can be distinguished from each other empirically, experimental and corpus studies of production and comprehension of alternative word orders have provided evidence in favor of both production and parsing-based explanations. As a result of such findings, Hawkins (2004)
has extended his approach to apply more globally to both production and comprehension through a general principle of domain minimization (see also Cheung 2006, Lohse et al 2004).

Culicover and Jackendoff (2005: 167) and Wasow (2002: 6-7) have suggested that RCE in English should be sensitive to grammatical weight in a similar manner to HNPS. As Wasow states, “Both the final position of the (usually heavy) extraposed element and the lightening of the NP serve to increase the probability of satisfying the PEW” (Wasow 2002: 7). Although Wasow’s remarks are suggestive, there have been no previous empirical studies testing this prediction for English. The current study seeks to fill this gap by investigating the role of grammatical weight in the processing, acceptability, and usage of RCE in English.

One challenge for investigating the role of grammatical weight is that it is correlated with discourse status: lighter constituents tend express old information while heavier constituents tend to express new information (e.g., Givón 1983). Furthermore, only discourse status has been investigated in previous studies of RCE, and even this factor has not been investigated using quantitative data. However, previous studies of other syntactic alternations have shown that discourse status and grammatical weight can have independent effects. For example, Arnold et al (2000) found that each factor had an independent effect on the likelihood of people producing a particular variant for HNPS and Dative sentences. While discourse status is not directly investigated in the current study, it is held constant in the experiments so that the effect of weight can be isolated, and it is investigated indirectly in the corpus study by means of an analysis of predicate types.

In the following sections, I report on the results of two psycholinguistic experiments and a corpus study of weight effects in RCE. The results of Experiment 1, a self-paced reading experiment, showed a significant reading time advantage for RCE when the RC was heavy and
no difference between RCE and canonical structure when the RC was light. The results of Experiment 2, an acceptability judgment task, showed that canonical sentences were judged as significantly more acceptable than RCE sentences when the RC was light, but that this difference disappeared when the RC was heavy. Finally, a corpus study found that on average, extraposed RCs were longer than the VP while non-extraposed RCs were shorter, and that the proportion of sentences with RCE decreased as the ratio of VP length to RC length increased. I argue that these results support Hawkins’ (2004) theory and help explain why RCE is preferred in some contexts despite the discontinuous dependency.

The paper is structured as follows. Section 2 discusses previous research on grammatical weight and RCE in German and sets out the predictions of Hawkins’ (2004) theory for RCE in English. Sections 3-4 discuss two psycholinguistic experiments that tested the effects of grammatical weight on sentence processing: a reading time task (Experiment 1) and an acceptability judgment task (Experiment 2). Section 5 discusses a corpus study of naturally-occurring examples of RCE to show how grammatical weight affects speakers’ and writers’ structural choices. Section 6 concludes the paper and discusses some of the implications of the results reported here.

2. Relative clause extraposition, grammatical weight, and processing

As Wasow (2002: 7) points out, the discontinuous dependency in RCE not only complicates the syntax but also presumably increases processing complexity. However, studies of grammatical weight have shown that moving heavy constituents to the end, as typically happens with RCE, can also facilitate processing. To see how these two opposing constraints might interact in the
case of RCE, it is necessary to consider some examples within a particular theoretical framework.

Two major theories have dealt specifically with weight effects in sentence processing: Gibson’s (1998) Syntactic Prediction Locality Theory (SPLT) and Hawkins’ (1994, 2004) performance-based theory of constituent order. Both theories are locality based in that both predict that there should be a greater cost to working memory when listeners or readers must integrate linguistic information across a distance. Thus, in the case of RCE, integrating the RC with its head noun across an intervening VP constituent should incur some cost to working memory. However, the same theories predict that in cases where the RC is heavy, the cost of integrating the subject NP with the verb will be greater, and processing efficiency may be maximized by placing the heavier constituent at the end. The two theories differ in a number of details, most importantly in the way that the distance between constituents is measured and in how the processing domains are defined. However, they make similar predictions with respect to end weight effects, and I will not attempt to distinguish between them empirically in this study. Rather, I will couch the study in terms of Hawkins’ (2004) theory because this theory spells out the predictions for extraposition phenomena in a more detailed manner. In addition, Hawkins’ theory is more comprehensive in making predictions for choice of structure in production as well as for processing ease in comprehension, and for dealing with diverse linguistic phenomena in a variety of typologically distinct languages.

Hawkins’ (2004) theory of efficiency and complexity in grammars sets out very specific predictions for weight effects in the production and comprehension of language. The main thrust of this theory is the principle of Minimize Domains, as defined in (6):
(6) **Minimize Domains**: The human processor prefers to minimize the connected sequences of linguistic forms and their conventionally associated syntactic and semantic properties in which relations of combination and/or dependency are processed. The degree of this preference is proportional to the number of relations whose domains can be minimized in competing sequences or structures, and to the extent of the minimization difference in each domain. (Hawkins 2004: 104)

One thing this principle predicts is that speakers should prefer to rearrange heavy constituents to minimize the domains in which relations between linguistic elements are processed. Several syntactic and semantic domains are relevant for processing, including syntactic dependencies in phrase structure, lexically specified dependencies between head words and their complements (e.g., subcategorization, theta roles, collocations), semantic dependencies between modifiers and modified phrases, and various kinds of co-indexation (e.g., pronominal coreference, filler-gap dependencies). The most important domain for our purposes is the Phrasal Combination Domain (called Constituent Recognition Domain in earlier versions of the theory) as defined in (7):

(7) **Phrasal Combination Domain (PCD)**: the smallest string of elements required to construct a mother node and its immediate constituents (Hawkins 2004: 107).

The assumption is that constituents can be constructed as soon as the head word (or other constructing category) is encountered. In English Heavy NP-Shift, for example, the PCD for the VP includes the verb and head word of each of its complements (i.e., the verb, the preposition...
head of PP, and the determiner or noun introducing the NP). When the NP is heavy, the PCD for VP can be made smaller by moving the NP to a position following the PP, as shown in (7a-b).

(8) a. PCD for canonical VP

The waiter brought the wine we had ordered to the table.

b. PCD for VP with HNPS

The waiter brought to the table the wine we had ordered.

A simple way of calculating PCDs is in terms of IC-to-word ratios (Hawkins 1994). In (8a-b) the VP has three immediate constituents: the verb, the object NP, and the PP. Thus, the IC-to-word ratio for the VP in (8a) is 3/7 (43%), while the IC-to-word ratio for the VP in (8b) is 3/5 (60%). Thus, the shifted structure in (8b) is predicted to be more efficient than the canonical structure in (8a).

Although no previous studies of grammatical weight have investigated RCE in English, Hawkins’ theory has been tested in two studies of a similar type of extraposition in German (Uszkoreit et al 1998; Konieczny 2000). Both studies looked at the effect of grammatical weight on preferences for constituent order in sentences similar to those in (9a-b) below from Hawkins (2004: 137). Note that in German, the main verb comes at the end of the verb phrase (when there is an auxiliary verb), and the object NP comes before the verb. In this type of extraposition, the RC is moved from the canonical object position as in (9a) to a position following the verb as in (9b). I will refer to this type of extraposition as RCE from Object NP.
a. PCDs for canonical sentence

Er hat gestern das Buch das der alte Professor verloren hatte gefunden.
he has yesterday the book that the old professor lost had found.

Object NP

 VP

“He found the book yesterday that the old professor had lost.”

IC-to-word ratios: Object NP = 3/3 (100%), VP = 3/10 (30%)

b. PCDs for extraposition sentence

Er hat gestern das Buch gefunden das der alte Professor verloren hatte.
he has yesterday the book found that the old professor lost had.

Object NP

 VP

“He found the book yesterday that the old professor had lost.”

IC-to-word ratios: Object NP = 3/4 (75%), VP = 3/4 (75%)

As shown above in (9a-b), the PCD for the object NP (i.e. the distance for integrating the head noun with its RC) is minimized in the canonical sentence, with an IC-to-word ratio of 100%. However, the PCD for VP (i.e., the distance for integrating the verb with its object) is minimized in the extraposition sentence, with an IC-to-word ratio of 75%. To determine which structure is most efficient for a given sentence, what matters is the overall minimization of all the relevant domains. For example, when the RC is heavy and there is only a one-word intervening verb, as in (9b), the most efficient structure should be extraposition because the combined PCDs for Object NP and VP are minimized. This is shown in both the higher average IC-to-Word ratio for extraposition (75% vs 65%) and in the lower number of words needed to construct both the
NP and VP domains in the extraposition sentence (8 words vs. 13 words) (Hawkins 2004: 138). More generally, extraposition should be more efficient than the corresponding canonical structure to the extent that RC length exceeds extraposition distance (i.e. length of the main verb and any modifiers preceding it). This is because making the RC longer increases the VP domain in the canonical sentence, while making the extraposition distance shorter decreases the NP domain in the extraposition sentence.

Both Uszkoreit et al (1998) and Konieczny (2000) found some evidence in support of Hawkins’ predictions for German RCE. In a corpus study that looked at sentences similar to those in (8a-b) above, Uszkoreit et al (1998) found that the rate of extraposition was highest when extraposition occurred over a short distance (a one-word verb) and when the RC itself was long. For example, extraposition occurred about 95% of the time for sentences with a one-word main verb (gefunden in 8 above) but only about 10% of the time when the main verb was preceded by a four-word modifying phrase (Uszkoreit et al 1998: 7). The length of the RC also affected the rate of extraposition. For example, when a one-word phrase preceded the verb and the RC was short (two or three words), extraposition only occurred in about 33% of the relevant sentences. However, this increased to 82% when the RC was long (10-15 words) (Uszkoreit et al 1998: 9). Uszkoreit et al also conducted an acceptability judgment task for which they systematically varied the extraposition distance and the length of the RC. As expected, extraposition sentences were rated higher as RC length increased and as extraposition distance decreased. Contrary to expectation, however, canonical sentences were rated as more acceptable than extraposition sentences in almost all cases. Extraposition sentences were rated as highly as canonical sentences only when the extraposition distance was short (one word) and the RC was long (1998: 12).
Konieczny (2000) conducted an acceptability judgment experiment and a self-paced reading experiment to investigate weight effects in the processing of German RCE. Results of the acceptability judgment task were very similar to the results of the acceptability study by Uszkoreit et al (1998). Acceptability of extraposition was highest when the extraposition distance was short (one word) and when the RC was medium or long (2000: 638-639). Also similar to Uszkoreit et al’s (1998) results, acceptability of canonical sentences was overall higher than acceptability of extraposition sentences in all conditions. Konieczny (2000) also conducted a self-paced reading experiment in which it was found that, as expected, the relative pronoun was read slower when the RC was extraposed, indicating some processing cost for integrating the noun with a non-adjacent RC. However, contrary to locality-based predictions, reading time at the main verb was significantly slower in the extraposition sentences than in the canonical sentences even though the verb was closer to its object in the extraposition sentences. Konieczny (2000: 643) explains this effect (sometimes called ‘antilocality’ since there is a processing advantage for non-local structures) as possibly the result of the RC in the canonical sentence helping readers anticipate the phrase-final verb by providing additional information about one of its arguments and by allowing extra time for readers to deduce information about the verb. Also contrary to locality-based predictions, longer RCs did not significantly affect reading time of the verb, nor did longer extraposition distance have any significant effect on reading time of the relative pronoun. Given the very different results of the acceptability task (which patterned with Uszkoreit et al’s acceptability data) and the self-paced reading task, Konieczny (2000: 644) suggests that locality-based predictions are clearest for production, whereas online comprehension is subject to other effects such as anticipatory processing. However, he does not explain why locality effects in comprehension have been shown in other studies.⁴
RCE from Object NP in German is not quite the same as RCE from Subject NP in English, but the predictions of Hawkins’ theory are quite similar. As illustrated in (9a-b), the PCD for the subject NP is minimized in the canonical sentence, while the PCD for the matrix clause is minimized in the extraposition sentence. Similar to the case of German RCE, extraposition is preferred to the extent that the length of the RC exceeds the length of the matrix VP. When the RC is heavier than the VP, as in (10a-b), there is predicted to be an overall advantage for extraposition because the combined minimization, as measured in total number of words needed to construct both domains (Hawkins 2004: 138), is smaller for extraposition. In (10a-b), for example, the total is 14 for the canonical sentence and 6 for the extraposition sentence. The same advantage for extraposition is also shown in the IC-to-Word ratios, where the average ratio is higher for extraposition than for canonical structure (87.5% vs 59%).

(10) a. PCDs for canonical sentence

New sets that were able to receive all the TV channels appeared.

Subject NP

|                                   |

Matrix S

|__________________________________|

IC-to-word ratios: Subject NP = 3/3 (100%), Matrix S = 2/11 (18%)
b. PCDs for extraposition sentence

New sets appeared that were able to receive all the TV channels.

Subject NP

Matrix S

IC-to-word ratios: Subject NP = 3/4 (75%), Matrix S = 2/2 (100%)

The experiments reported here are based on the predictions of Hawkins’ theory as outlined above.\(^5\) Experiment 1 uses a self-paced reading task to test the effects of grammatical weight on the processing of canonical vs. extraposition structures in English. Similarly, Experiment 2 investigates the effects of grammatical weight on acceptability judgments for the same kind of sentences as in Experiment 1. With the weight of the VP held constant (longer than the RC in the light RC condition and shorter than the RC in the heavy RC condition), predictions for these experiments (based on PCDs alone) are as follows:\(^6\)

- When the RC is shorter than the VP, canonical sentences should be read faster and judged as more acceptable than extraposition sentences.
- When the RC is longer than the VP, extraposition sentences should be read faster and judged as more acceptable than canonical sentences.
- As grammatical weight of the RC increases, acceptability ratings for canonical sentences should decrease and reading times for canonical sentences (mean RT per word) should slow down because of the longer distance for integrating the subject NP with the main verb.
However, note that if reading time is subject to anti-locality effects as found in Konieczny’s (2000) study of German RCE, canonical sentences should be read faster than extraposition sentences regardless of RC weight because the RC should facilitate processing of the verb.

An analysis of RCE in the ICE-GB corpus investigates the related issue of how grammatical weight affects speakers’ choice of structure in language use. Since the principle of Minimize Domains applies to production as well as perception, the theoretical predictions for the corpus analysis are similar to those of the experiments. All else being equal, extraposition should be preferred in language use in cases where RC length exceeds VP length, and this preference should be stronger as the difference in length becomes greater. When all relevant examples of sentences with RCs modifying the subject are included in the analysis, we predict the following:

- The proportion of sentences with extraposition should be highest when the ratio of VP length to RC length is lowest (i.e. when the RC is much longer than the VP) and should decrease as this ratio increases.
- For extraposition sentences, the RC should be longer on average than the VP, while the converse should be true of canonical sentences.
- These weight effects are distinct from the effects of predicate type and should hold when predicate type is held constant.

Sections 3-5 report the results of Experiments 1-2 and the corpus analysis. We will see that all of the results showed significant effects of grammatical weight in the expected direction, and that the predictions were borne out most clearly in the corpus analysis.
3. Experiment 1: Reading time

The goal of Experiment 1 was to test whether grammatical weight affected processing efficiency of sentences with an extraposed or non-extraposed RC modifying the subject NP. A self-paced reading task, for which whole sentence reading time was measured, was used to assess processing efficiency. As is standard for self-paced reading tasks, it was assumed that faster reading times indicate faster, more efficient processing, at least for sentences that are understood correctly.

3.1 Methods

3.1.1. Participants

Forty participants were recruited from the student body at Purdue University. All were native speakers of American English between the ages of 18 and 39 (average age 22). There were 17 men and 23 women. Participants gave informed consent and were each paid $6 for completing a 35-45 minute session.

3.1.2. Materials

Experimental stimuli consisted of five sets of nine sentences each in a 3x3 repeated measures design. Three levels of RC weight (4, 8, and 15 words) and three levels of structure (canonical RC, extraposed RC, adjunct clause) were manipulated, and VP length was held constant at five words. Lexical content of the sentences was chosen to be maximally felicitous in both RCE and canonical configurations. To satisfy semantic and pragmatic conditions on RCE, only indefinite, quantified subject NPs were used, and only intransitive, unaccusative VPs were used (see Rochemont and Culicover 1990: 60-68). In addition, sentences were constructed so that the RC
could readily be construed as new information. A sample stimulus set is shown in Table 1 below. Grammatically acceptable filler sentences of varying lengths were also included in the experiment.

3.1.3. *Procedure*

Following a brief background questionnaire, participants were presented with a series of sentences on a computer screen. Each sentence was presented in its entirety, and participants were instructed to press a button as soon as they had read and understood the sentence. Following each sentence, participants were presented with a true-or-false question about the content of the sentence (see Appendix A for exact instructions). To ensure validity of the results, only sentences with accurate responses to the comprehension question were included in the analysis of reading time. An E-Prime program was used to present the stimuli and record the whole-sentence reading times and true-false responses.

Sentences were presented in 4 blocks of 33 sentences each. Each block consisted of 11 test sentences and 22 fillers, except for block 4, which consisted of 12 test sentences and 23 fillers. For each participant, sentences were ordered randomly within each block, and ordering of blocks was also random. Participants were given the opportunity to take a break at the end of each block.
<table>
<thead>
<tr>
<th>Condition</th>
<th>Sample Stimulus Sentence</th>
<th>IC-to-Word Ratios</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canonical RC</td>
<td>Three people who were from Chicago arrived here early yesterday morning.</td>
<td>Subject NP: 3/3 (100%)&lt;br&gt;Matrix S: 2/6 (33%)&lt;br&gt;Total words: 9</td>
</tr>
<tr>
<td>Extrapolated RC</td>
<td>Three people arrived here early yesterday morning who were from Chicago.</td>
<td>Subject NP: 3/8 (37.5%)&lt;br&gt;Matrix S: 2/2 (100%)&lt;br&gt;Total words: 10</td>
</tr>
<tr>
<td>Adjunct Clause</td>
<td>Three people arrived here early yesterday morning after they left Chicago.</td>
<td>Subject NP: 2/2 (100%)&lt;br&gt;Matrix S: 3/7 (43%)&lt;br&gt;Total words: 9</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canonical RC</td>
<td>Three people who were from a northern suburb of Chicago arrived here early yesterday morning.</td>
<td>Subject NP: 3/3 (100%)&lt;br&gt;Matrix S: 2/10 (20%)&lt;br&gt;Total words: 13</td>
</tr>
<tr>
<td>Extrapolated RC</td>
<td>Three people arrived here early yesterday morning who were from a northern suburb of Chicago.</td>
<td>Subject NP: 3/8 (37.5%)&lt;br&gt;Matrix S: 2/2 (100%)&lt;br&gt;Total words: 10</td>
</tr>
<tr>
<td>Adjunct Clause</td>
<td>Three people arrived here early yesterday morning after they left a northern suburb of Chicago.</td>
<td>Subject NP: 2/2 (100%)&lt;br&gt;Matrix S: 3/7 (43%)&lt;br&gt;Total words: 9</td>
</tr>
<tr>
<td><strong>Heavy</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 words</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Canonical RC</td>
<td>Three people who were originally from a far northern suburb of Chicago which is called Lake Forest arrived here early yesterday morning.</td>
<td>Subject NP: 3/3 (100%)&lt;br&gt;Matrix S: 2/17 (12%)&lt;br&gt;Total words: 20</td>
</tr>
<tr>
<td>Extrapolated RC</td>
<td>Three people arrived here early yesterday morning who were originally from a far northern suburb of Chicago which is called Lake Forest.</td>
<td>Subject NP: 3/8 (37.5%)&lt;br&gt;Matrix S: 2/2 (100%)&lt;br&gt;Total words: 10</td>
</tr>
<tr>
<td>Adjunct Clause</td>
<td>Three people arrived here early yesterday morning after they secretly left a far northern suburb of Chicago which is called Lake Forest.</td>
<td>Subject NP: 2/2 (100%)&lt;br&gt;Matrix S: 3/7 (43%)&lt;br&gt;Total words: 9</td>
</tr>
</tbody>
</table>
3.1.4. Hypotheses

Following Hawkins (2004), it was predicted that there should be a reading time advantage for extraposition over canonical structure when the RC is heavier than the VP due to the longer distance for integrating the verb with its subject. Conversely, there should be a reading time advantage for canonical structure over extraposition when the RC is lighter than the VP because integration of the subject noun with the RC is easier when they are adjacent. Finally, reading time for canonical sentences should get slower as RC weight increases due to the increased distance for integrating the subject with the main verb. These predictions are reflected in the total number of words for combined PCDs, as shown in Table 1 above. Extraposed relatives stay the same in all three weight conditions, at 10 words. Canonical relatives start at 9 words in the light condition, where they should be read faster than extraposed relatives, but increase to 13 and 20 words in the medium and heavy conditions, where they should be read slower than extraposed relatives.

A third structure – adjunct clause – was included as a control condition. This type consisted of a main clause identical to the main clause of the other two structures and a finite subordinate clause adjoined to the main clause following the VP (see examples in Table 1 above). Similar to extraposed RCs, adjunct clauses occur at the end of the sentence, but adjunct clauses are not involved in any discontinuous dependency with the subject NP. Therefore, reading times for sentences with adjunct clauses are predicted to be faster than reading times for extraposition sentences when the clause is light, similar to canonical sentences. However, since adjunct clauses do not intervene between the subject and the verb (unlike canonical RCs), reading times for adjunct sentences are not expected to slow down in the medium and heavy
conditions. In terms of total number of words for combined PCDs, sentences with an adjunct clause stay at 9 words in all three conditions.

3.2. Results

For purposes of comparison across light, medium, and heavy conditions, mean reading time per word rather than whole sentence reading time was used in the analysis. Mean reading time per word (henceforth RTW) was calculated by dividing each whole sentence reading time by the number of words in the sentence. All test sentences within each category (light, medium, heavy) were of the same length in words and the three length conditions differed only in the length of the relative clause. Sentences within each condition of each stimulus set consisted of the same words, with the exception of the adjunct clause condition where the first three words of the adjunct clause had to be changed to accommodate the different clause type (see Table 1 above).

As shown in Figure 1 and Table 2 below, RTW for all three structures decreased (got faster) as clause weight increased. This trend was strongest for extraposition sentences, for which mean RTW decreased from 382ms in the light condition to 293ms in the heavy condition—a difference of 89 ms. In contrast, RTW for canonical and adjunct sentences decreased by only 25ms and 15ms, respectively.
Figure 1: Mean reading time per word by clause weight

Table 2: Mean reading time per word by clause weight

<table>
<thead>
<tr>
<th></th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canonical mean</td>
<td>356.44</td>
<td>322.07</td>
<td>330.53</td>
</tr>
<tr>
<td>std. error</td>
<td>15.38</td>
<td>16.90</td>
<td>21.22</td>
</tr>
<tr>
<td>n</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Extraposed mean</td>
<td>381.88</td>
<td>346.40</td>
<td>292.94</td>
</tr>
<tr>
<td>std. error</td>
<td>23.84</td>
<td>21.66</td>
<td>14.83</td>
</tr>
<tr>
<td>n</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Adjunct mean</td>
<td>361.93</td>
<td>341.43</td>
<td>346.62</td>
</tr>
<tr>
<td>std. error</td>
<td>15.32</td>
<td>16.43</td>
<td>20.99</td>
</tr>
<tr>
<td>n</td>
<td>40</td>
<td>40</td>
<td>40</td>
</tr>
</tbody>
</table>

A two-way repeated measures ANOVA showed a significant main effect of clause weight by participants, but the effect did not reach significance in the by items analysis: $F_{1}(2, 38) = 6.56$, $p < 0.01$; $F_{2}(2, 3) = 4.07$, $p = 0.14$. There was also a significant interaction between clause weight and structure in the participant analysis, but the interaction did not reach significance in the item
analysis: $F_1(4, 36) = 3.18, p = 0.02; F_2(4, 1) = 11.15, p = 0.22$. No main effect for structure was
found: $F_1(2, 38) = 0.66, p = 0.52; F_2(2, 3) = 0.33, p = 0.74$. The difference between participant
and item analyses is most likely due to the fact that there were forty participants, but only five
items (sentence sets) were used.

Pairwise t-tests confirm that the main effect of weight and the interaction between weight
and structure were primarily due to the decrease in RTW for heavy extraposition sentences.
While there was a significant difference in RTW between light and heavy extraposition
sentences ($t = 4.77, p < 0.01$), there was no significant difference between light and heavy
canonical sentences ($t = 1.33, p = 0.19$) or between light and heavy adjunct sentences ($t = 0.91, p
= 0.37$). RTWs for extraposition sentences were significantly faster than for canonical sentences
in the heavy clause condition ($t = 2.59, p = 0.01$). In the light clause condition, RTWs for
canonical sentences were slightly faster than for extraposition sentences, but this difference was
not significant ($t = 1.45, p = 0.16$).

3.3. Discussion
As predicted by Hawkins (2004) theory, there was a significant reading time advantage for
extraposition over canonical structure in the heavy clause condition. Unlike Konieczny’s (2000)
findings for German RCE, in which readings times on the main verb were uniformly faster for
canonical sentences than for extraposition, the present study found no ‘antilocality’ effects. The
different results for German vs. English are not necessarily at odds with each other, however.
Konieczny (2000) measured reading time on the main verb, whereas the present study measured
only whole sentence reading time. While Konieczny’s results show a consistent advantage for
canonical structure with respect to reading time on the verb, possibly reflecting readers’ early
anticipation of the verb, it is still possible that the reading time for the entire sentence might have shown no such advantage, or even an advantage for extraposition, if such data had been collected. Arguably, the whole sentence reading times collected for the present study are a more direct reflection of overall processing time for the sentence than are the localized reading times reported in the German study, and therefore might be expected to align more closely with corpus data, as they in fact do (see Section 5 below).\(^8\) Due to limitations of both studies, however, it is not possible to compare the results directly.

Some of the other findings are not exactly as predicted by Hawkins (2004). Although reading times were slightly faster for canonical and adjunct sentences than for extraposition sentences in the light condition, these differences were not significant. Despite the discontinuous dependency in the extraposition sentences, there was no evidence of added processing cost for extraposition. This result may, however, be due to limitations of the experimental design. In the light clause condition, the RC had four words and the VP had five words, so that only a one-word advantage for canonical structure was predicted. It may be that the difference between the relevant NP and Matrix S domains was too small to show up as a difference in reading time. If, instead, the experiment had included a light clause condition in which the VP was twice as long as the RC, as in (11a-b) below, we might have found a significant advantage of canonical structure over extraposition.

(11)  

a. Three people who were from Chicago arrived in Albuquerque early yesterday morning at 6am. (Canonical)

b. Three people arrived in Albuquerque early yesterday morning at 6am who were from Chicago. (Extraposition)
Experimental evidence for a difference in reading time between sentences like (11a) and (11b) awaits future research. However, in Section 5 below, we will see evidence from a corpus analysis that canonical structure is in fact strongly preferred in language use when VP length exceeds RC length.

Also contrary to prediction, RTW for canonical sentences did not slow down as clause weight increased, but instead got slightly (though not significantly) faster. In addition, RTW for extraposition sentences got significantly faster as clause weight increased even though increased clause weight would have had no effect on the relevant PCDs. Because only whole sentence reading times were measured, it is difficult to determine why this happened. However, one possibility is that there was a general effect of sentence length such that longer sentences were read faster per word than shorter sentences. If so, this could help explain both patterns. For canonical sentences, the general speeding up with longer sentences might have counteracted the predicted slowing effect of heavy RCs, resulting in no significant change in RTW. For extraposition sentences, the speeding up of RTW in the heavy condition could be entirely due to a general effect of sentence length, since heavier RCs would have had no effect on the PCDs for extraposition. However, since I am unaware of any previous studies showing such an effect, this explanation must be considered speculative.

4. Experiment 2: Acceptability judgment task

The goal of Experiment 2 was to test whether grammatical weight affected acceptability judgments of sentences with an extraposed or non-extraposed RC modifying the subject NP. A written survey was used to collect sentence judgments using a 9-point scale. It was expected that
acceptability judgments should reflect domain minimization preferences in a similar manner to reading time.

4.1. Methods

4.1.1. Participants

Thirty-one participants were recruited from the student body at Purdue University. All were native speakers of American English between the ages of 18 and 54 (average age 24). There were 19 men and 12 women. Participants gave informed consent and were each paid $6 for completing a 35-45 minute session. Data from one participant were excluded from the analysis because the participant turned out to be a native speaker of Spanish. Data from thirty participants were included in the analysis. People who had participated in Experiment 1 were excluded from the subject pool.

4.1.2. Materials

Sentence materials were the same as in Experiment 1 (see Table 1 above), with the exception of the filler sentences. As in the previous experiment, five sets of nine test sentences were used. Each set included three levels of RC weight (4, 8, and 15 words) and three levels of structure (canonical RC, extraposed RC, adjunct clause). VP length was held constant at five words. Unlike in Experiment 1, where only grammatically acceptable filler sentences were used, filler sentences covered a wide range of different levels of acceptability as well as different sentence lengths. Fillers were categorized in advance as ‘good’, ‘medium’, or ‘bad’ in acceptability based on judgments of the same or similar sentences given in published sources such as syntax textbooks and research articles.
4.1.3. *Procedure*

Following a brief background questionnaire, participants were asked to complete a written survey. The survey consisted of a series of sentences for which participants were asked to rate each sentence on 9-point scale, where 9 means ‘completely acceptable’ and 1 means ‘completely unacceptable’ (see Appendix B for exact instructions). Rating scores were entered by circling a number from 1 to 9 below each sentence.

As in Experiment 1, sentences were presented in 4 blocks of 33 sentences each. Each block consisted of 11 test sentences and 22 fillers, except for block 4, which consisted of 12 test sentences and 23 fillers. Participants filled out one of four different survey scripts with two different orderings of sentences within each block and two different orderings of blocks. Pseudo-random order was used to arrange sentences within each block to avoid similar sentences on the same page of the survey. Participants were given the opportunity to take a break at the end of each block. Responses were later entered by hand into an Excel spreadsheet.

4.1.4. *Hypotheses*

Because canonical and extraposition sentences are equally ‘grammatical’ (in the sense of being permitted by the grammar), and acceptability judgments are predicted to follow domain minimization preferences, weight-based predictions for acceptability are similar to those for reading time in Experiment 1. Following the domain minimization preferences shown in Table 1 above, it was predicted that extraposition should be rated higher than canonical structure when the RC is heavier than the VP (medium and heavy conditions) due to the longer distance for integrating the verb with its subject. Conversely, canonical sentences should be rated higher
than extraposition sentences when the RC is lighter than the VP (light condition) due to the longer distance between the subject noun and the RC. Acceptability of canonical sentences should decrease as RC weight increases due to the increased distance between the subject and the main verb. Finally, adjunct sentences should be rated similarly to canonical sentences (and higher than extraposition sentences) in the light condition, but unlike canonical sentences, ratings of adjunct sentences should not decrease in the medium and heavy conditions.

4.2. Results

As shown in Figure 2 and Table 3 below, mean ratings for canonical sentences decreased from 8.05 in the light clause condition to 6.69 in the heavy clause condition. Ratings for adjunct sentences similarly decreased from 7.63 in the light condition to 6.97 in the heavy condition. In contrast, ratings for extraposition sentences started lower, at 6.33 in the light condition, and increased slightly to 6.41 in the heavy condition.

A two-way repeated measures ANOVA showed a significant main effect for weight in both the participant and item analyses: F1(2, 28) = 11.06, p < 0.01; F2(2, 3) = 19.15, p = 0.02. There was also a significant main effect of structure for both participant and item analyses: F1(2, 28) = 13.13, p < 0.01; F2(2, 3) = 60.84, p < 0.01. There was a significant interaction between clause weight and structure in the participant analysis but this trend did not reach significance in the item analysis: F1(4, 26) = 8.59, p < 0.01; F2(4, 1) = 17.87, p = 0.18.
Figure 2: Mean acceptability ratings by clause weight

Table 3: Mean acceptability ratings by clause weight

<table>
<thead>
<tr>
<th></th>
<th>Light</th>
<th>Medium</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Canonical</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>8.05</td>
<td>8.09</td>
<td>6.69</td>
</tr>
<tr>
<td>std. error</td>
<td>0.16</td>
<td>0.15</td>
<td>0.25</td>
</tr>
<tr>
<td>n</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td><strong>Extraposed</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>6.33</td>
<td>6.67</td>
<td>6.41</td>
</tr>
<tr>
<td>std. error</td>
<td>0.33</td>
<td>0.29</td>
<td>0.31</td>
</tr>
<tr>
<td>n</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td><strong>Adjunct</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean</td>
<td>7.63</td>
<td>7.60</td>
<td>6.97</td>
</tr>
<tr>
<td>std. error</td>
<td>0.24</td>
<td>0.18</td>
<td>0.24</td>
</tr>
<tr>
<td>n</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
</tbody>
</table>

Pairwise comparisons suggest that the main effect of structure was due to the lower acceptability of extraposition sentences as compared with canonical and adjunct sentences in the light and medium conditions. Canonical sentences were rated significantly higher than
extraposition sentences in the light condition ($t = 5.94, p < 0.01$), and in the medium condition ($t = 5.83, p < 0.01$), while there was no significant difference between canonical and extraposition sentences in the heavy condition ($t = 1.24, p = 0.23$). Adjunct sentences patterned similarly to canonical sentences, except that ratings did not decrease as much in the heavy condition. Adjunct sentences were rated significantly higher than extraposition sentences even in the heavy condition ($t = 2.60, p = 0.01$).

The main effect of weight and the interaction between weight and structure were apparently due to the decrease in ratings for canonical and adjunct sentences (but not for extraposition sentences) in the heavy condition. Pairwise t-tests confirm that there was a significant difference between light and heavy canonical sentences ($t = 6.34, p < 0.01$) and between light and heavy adjunct sentences ($t = 3.25, p < 0.01$), but no significant difference between light and heavy extraposition sentences ($t = 0.45, p = 0.66$).

### 4.3. Discussion

Canonical and adjunct sentences started at high acceptability in the light condition and decreased in acceptability in the heavy condition. On the other hand, extraposition sentences stayed at moderate acceptability in all three conditions, converging with canonical sentences in the heavy condition (though adjunct sentences were still rated higher). This pattern of results partially confirms the initial hypotheses. As predicted, acceptability ratings for canonical sentences decreased as clause weight increased. Also as predicted, there was a significant advantage for canonical sentences and adjunct sentences over extraposition sentences in the light clause condition. Contrary to prediction and unlike in Experiment 1, however, there was no advantage for extraposition in the heavy condition. Rather, the advantage for canonical sentences shown in
the light and medium conditions simply disappeared in the heavy condition. Also unexpectedly, ratings for adjunct sentences decreased in the heavy condition, though not as much as ratings for canonical sentences did.

While clear effects of grammatical weight were shown in both Experiment 1 and Experiment 2, it is interesting that the results patterned in a different way. Reading time results showed no difference among structures in the light condition, but an advantage for extraposition in the heavy condition. In contrast, acceptability results showed an advantage for canonical structure in the light condition, but no significant difference among structures in the heavy condition. It is likely that the different results are due to differences between the two tasks. While reading time is an online measure assumed to reflect processing difficulty in a relatively direct manner, acceptability judgments are collected offline and may be subject to additional factors such as prescriptive rules and stylistic considerations. Since extraposition from NP occurs naturally in both spoken and written English, we know that this structure is permitted by the grammar of English. Therefore, all the test sentences used in Experiments 1 and 2 should be grammatical in the sense of being part of speakers’ grammatical competence. However, in prescriptive terms, extraposed RCs are a type of ‘misplaced modifier’ of which highly educated people (in this case, university students) are likely to be aware. The misplaced modifier is especially noticeable since the subject-modifying RC occurs completely outside the subject NP in a position normally reserved for VP or sentence modifiers. In addition, it is possible that the lower acceptability for RCE reflects a frequency-based preference for adjacency between the head noun its modifying relative clause. As shown in a corpus study reported in section 5 below, RCE occurred in only 15% of the relevant cases. Although both canonical order and RCE are licensed by the competence grammar, speakers may have a sense that the canonical order is more
frequent and therefore more basic, resulting in lower acceptability ratings for RCE sentences.  
Finally, although the lexical content was chosen to be fully felicitous with extraposition, the  
isolated sentences in the experiment were not situated in any discourse context, possibly drawing  
more attention to the extraposition structure than a natural context would have done. It is  
plausible, therefore, that the discrepancy between reading time and acceptability results could be  
explained as follows. In the light clause condition, there was no difference in reading time  
between canonical and extraposition sentences, suggesting that processing efficiency for the two  
structures is similar. Thus, a prescriptive and/or frequency-based bias in favor of canonical order  
might help explain the lower acceptability of extraposition in the light condition. In the heavy  
clause condition, there was a clear reading time advantage for extraposition over canonical  
structure, suggesting that extraposition sentences are processed more efficiently than canonical  
sentences when the RC is heavy (just as the theory predicts). The weight-based advantage in  
processing efficiency for extraposition sentences might have counteracted the normative bias in  
favor of canonical structure, resulting in approximately equal acceptability for canonical and  
extraposition structures in the heavy condition. However, it is still not clear why adjunct  
sentences decreased in acceptability in the heavy condition rather than staying the same in all  
conditions.

It is interesting that Uszkoreit et al (1998) and Konieczny (2000) got very similar results  
to these in their acceptability judgment experiments for RCE sentences in German. Uszkoreit et  
al (1998: 12) found that canonical sentences were rated higher than extraposition sentences  
overall, but that this difference was neutralized when the extraposition distance was short and the  
RC was long. Similarly, Konieczny (2000: 638-639) found that canonical sentences were rated  
higher in all conditions, but that there was the least difference between canonical and
extraposition sentences when the extraposition distance was short and the RC was long. A frequency-based explanation is less plausible for German than for English, since RCE is more common in German. For example, Uszkoreit et al (1998: 6) found that extraposition occurred in 43% (340 out of 789) of the relevant cases. Therefore, I conjecture that prescriptive rules or other stylistic considerations affected metalinguistic judgments in both English and German, causing extraposition sentences to be rated somewhat lower than the domain minimization preferences would predict, while a frequency-based bias in favor of canonical structure might have been an additional factor for English.

We now turn to an additional kind of evidence for grammatical weight effects—a corpus study of naturally-occurring speech and writing.

5. Corpus analysis

Hawkins’ (2004) idea of processing efficiency through domain minimization applies not just to comprehension but also to production. It is therefore predicted that preferences for choice of one structure over another in language use should reflect domain minimization preferences. This prediction has been confirmed in previous corpus studies of Heavy NP Shift, Particle Shift, and Dative Shift in English (Arnold et al. 2000; Lohse et al. 2004; Wasow 1997) as well as RCE in German (Uszkoreit et al 1998). For the current study, it was predicted that RCE from Subject NP should occur most often in naturally occurring speech and writing when the RC is longer than the VP, and that incidence of extraposition should decrease as the ratio of VP to RC length increases.
5.1. Methods

5.1.1. Corpus

The International Corpus of English Great Britain (henceforth ICE-GB) was used for this study (Nelson, Wallis, and Aarts 2002). The corpus includes about one million words of British English in a variety of genres of both speech and writing.

5.1.2. Data collection and coding

Finite and non-finite clauses for which the subject NP was modified by a RC were collected by means of category and tree fragment searches in the ICE-GB corpus. Each clause was then coded by hand for the following categories: extraposition status, Subject NP length, VP length, RC length, verb complex, main predicate, predicate type, RC type, head noun of RC, relative pronoun, and discourse type.

RCs were classified as extraposed or canonical depending on their position, with canonical RCs occurring within the subject NP and extraposed RCs occurring at the end of the sentence following the VP. Phrase length was counted in words as defined by units of text separated by blank spaces. Repetitions and restarts were excluded from the word count. Verb complex included the main verb and its auxiliaries in the exact form used in the sentence. Main predicate was coded as the lemma form of the main verb (or adjective, in the case of predicate adjectives). The main predicate was then assigned to one of following predicate types: transitive action verb, transitive stative verb, intransitive unergative verb, intransitive unaccusative verb, passive verb, copular verb, raising verb, and predicate adjective. The distinction between unaccusative and unergative was based on the ‘presentational there’ test: unaccusative verbs are those verbs that fit into a sentence such as: ‘There arrived three guests’. Passive verbs, which
were almost always forms of transitive action verbs, were included as a category separate from both transitive and unaccusative verbs. RC type was coded according to the following categories based on the grammatical function of the relative pronoun within the RC: subject, direct object, object of preposition, possessive, and adjunct. Grammatical function of the head noun was not coded, since the head noun was always the subject. The form of the relative pronoun was also noted (e.g., which, that, who, where, to whom, etc.). Discourse type was coded as either speech or writing depending on whether the sentence came from a spoken or written source.

5.1.3. Hypotheses

Based on the same domain minimization preferences used in Experiments 1 and 2, extraposition should be preferred to the extent that RC length exceeds VP length. This is because extraposition minimizes the combined PCDs for Subject NP and Matrix S in just those cases for which the RC is longer than the VP. (See predictions for reading time in Section 3 above.) It was therefore predicted that, in a corpus of sentences with a subject-modifying RC, the RC should be longer on average than the VP when extraposition is used. Conversely, the RC should be shorter on average than the VP when the canonical structure is used. In addition, the proportion of sentences with extraposition should be highest when the ratio of VP length to RC length is lowest and should decrease as this ratio increases.

Although spoken English is arguably a more direct reflection of online demands in sentence production than written English is, previous studies of grammatical weight have found similar effects in speech and writing (Wasow 1997: 99). Therefore, it was predicted that similar weight effects would show up in both spoken and written sentences in the ICE-GB corpus.
The category of predicate type was coded to see whether lexical and semantic properties of the RCE sentences were in line with previous findings and to test whether grammatical weight effects are independent of predicate type. Gueron (1980), Kuno and Takami (2004), Rochemont and Culicover (1990), and Takami (1999) have proposed that extraposition from subject NP is subject to certain semantic or pragmatic constraints that affect which predicate types occur with RCE. Based on this previous research, intransitive, unaccusative predicates were predicted to occur most frequently in RCE sentences because of the tendency for predicates of this type to represent old or backgrounded information and to serve a presentational function with respect to the information following the verb (see Rochemont and Culicover 1990: 65-68). Transitive predicates, which rarely serve this kind of function, were predicted to occur only infrequently with extraposition. However, following Rochemont and Culicover (1990: 65-68), it was expected that no predicate types should be completely excluded from occurring with extraposition because the relevant restriction is contextual rather than strictly lexical or semantic in nature. Finally, the effects of grammatical weight were predicted to hold independently of predicate type.

5.2. Results

Of the 391 sentences collected for this study, 332 (85%) had canonical structure, while 59 (15%) had extraposition. As predicted, extraposed RCs were significantly longer than the VP on average (12.36 vs. 3.44 words; t = 8.19, p < 0.01), while nonextraposed RCs were significantly shorter than the VP (8.37 vs. 12.94 words; t = 8.06, p < 0.01), as shown in Figure 3.
Also as predicted, the proportion of sentences with extraposition consistently decreased as the ratio of VP length to RC length increased. While 91% of sentences for which the RC was at least five times longer than the VP (VP-to-RC ratio of 0.2 or less) involved extraposition, only 2% of sentences for which the RC was the same length or shorter than the VP (VP-to-RC ratio of 1.0 or greater) involved extraposition, as shown in Figure 4 below. No examples of extraposition were found when the VP was more than 1.3 times longer than the RC. Thus, the weight of the RC in relation to the VP appears to be a strong predictor of extraposition. Similar results were found looking at VP length alone: 90% of sentences with a one-word VP involved extraposition while only 32% of sentences with four-word VPs had extraposition, and no examples of extraposition were found when the VP had more than 11 words. Results for RC length alone were less dramatic, but in the predicted direction. Only 12% of three and four word RCs were extraposed, but this increased to 33% for RCs of 15 words or more.
Results for discourse type (spoken vs. written) and predicate type were in line with previous findings. Similar to the results of Wasow’s (1997: 99) study of weight effects in double object constructions, length of VP in relation to RC showed the same general pattern for speech and writing. As shown in Table 4 below, canonical RCs were shorter than the VP on average while extraposed RCs were longer than the VP on average for both spoken and written sentences.

Table 4: Mean VP and RC length (words) in spoken vs. written sentences

<table>
<thead>
<tr>
<th>Extraposition</th>
<th>Speech</th>
<th>Writing</th>
</tr>
</thead>
<tbody>
<tr>
<td>VP length</td>
<td>3.60</td>
<td>3.32</td>
</tr>
<tr>
<td>RC length</td>
<td>12.88</td>
<td>11.97</td>
</tr>
<tr>
<td>Canonical</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VP length</td>
<td>12.95</td>
<td>12.94</td>
</tr>
<tr>
<td>RC length</td>
<td>6.92</td>
<td>9.31</td>
</tr>
</tbody>
</table>

Findings for predicate type were compatible with Rochemont and Culicover’s (1990) observations. As shown in Figure 5, the two most common predicate types occurring with
extraposition were passive (46%) and unaccusative (24%), together accounting for 70% of all RCE sentences. In contrast, transitive and copular predicates were the two most common predicate types occurring with canonical clauses. It is interesting that passives were more frequent than unaccusatives, since only unaccusatives had been discussed in previous work on RCE. This novel finding underscores an advantage of using quantitative corpus data, since previous studies used mostly constructed examples or individual attested examples (e.g., Huck and Na 1990, 1992; Rochemont and Culicover 1990; Takami 1998). However, these results are still in line with the prediction that unaccusatives should be the most frequent predicate type, provided that passive predicates are classified together with unaccusatives. Although passives and unaccusatives do not have exactly the same behavior, this categorization is justifiable based on the similar syntactic, semantic, and aspectual properties of passive and unaccusative predicates in English and other languages (cf. Burzio 1986) as well as their similar discourse functions. As expected, there were no strict constraints, since all six predicate types were represented in both data sets (Figure 5). These results are consistent with Rochemont and Culicover’s claim that the apparent restriction on predicate type is pragmatic in nature rather than strictly semantic, syntactic, or lexical (1990: 66-68).
As shown in Table 5, the frequency of extraposition was lower than the frequency of canonical structure overall (15% vs 85%), but it was much higher with unaccusative/passive predicates (37%) than with other predicate types (6%). Thus, it appears that both predicate type and weight help predict the occurrence of extraposition.

Table 5: Frequency of extraposed and canonical clauses by predicate type

<table>
<thead>
<tr>
<th>Predicate Type</th>
<th>Extraposessed</th>
<th>Canonical</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unaccusative/Passive</td>
<td>37% (n=41)</td>
<td>63% (n=69)</td>
<td>100% (n=110)</td>
</tr>
<tr>
<td>Other Predicate Types</td>
<td>6% (n=18)</td>
<td>94% (n=263)</td>
<td>100% (n=281)</td>
</tr>
<tr>
<td>Total</td>
<td>15% (n=59)</td>
<td>85% (n=332)</td>
<td>100% (n=391)</td>
</tr>
</tbody>
</table>
Furthermore, it appears that predicate type is independent of weight, since weight effects were apparent even when predicate type was held constant. Figure 6 shows the proportion of clauses with extraposition by weight ratio for all clauses containing passive or unaccusative predicates. Similar to the overall results shown in figure 4 above, 100% (17 of 17) showed extraposition when the RC was at least five times longer than the VP, while only 8% (4 of 51) showed extraposition when the RC was the same length or shorter than the VP.

![Figure 6: Percentage of extraposed RCs by ratio of VP length to RC length: unaccusative and passive verbs only](image)

Similar results were found when examining only the clauses containing other predicate types (i.e., all clauses except those with a passive or unaccusative predicate): 67% (4 of 6) showed extraposition when the RC was at least five times longer than the VP, while only 1% (2 of 190) showed extraposition when the RC was the same length or shorter than the VP.

Following the approach of Diessel (2008), a binary logistic regression analysis was conducted to confirm whether grammatical weight and predicate type were really independent factors predicting the occurrence of extraposition vs. canonical structure. The two independent
variables included in the model were weight ratio (i.e. ratio of VP to RC length, a continuous variable) and predicate type (i.e. passive/unaccusative vs. all others, a binary categorical variable). Both factors were significant in predicting extraposition, with weight being the stronger of the two predictors: weight ratio ($X^2 (1) = 14.88, p < 0.01$), predicate type ($X^2 (1) = 10.47, p < 0.01$). In addition, there was no significant interaction between the two factors ($X^2 (1) = 0.28, p = 0.59$), meaning that the effects of weight were independent of the effects of predicate type. Note that these results are consistent with an account in which discourse status is also independent of weight and perhaps a stronger predictor of extraposition than predicate type. However, since the corpus was not coded for discourse status, additional studies would be needed to confirm this possibility.

5.3. Discussion

Results of the corpus analysis showed a strong effect of RC weight in accordance with the domain minimization preferences of Hawkins’ (2004) theory. Although RCE was relatively infrequent overall, at only about 15% of the sentences with subject-modifying RCs, extraposition was strongly preferred in cases where the VP length (extraposition distance) was one or two words or where the RC was at least four times longer than the VP. In contrast, extraposition happened in only about 2% of cases in which the RC was the same length or shorter than the VP. Furthermore, in sentences where extraposition occurred, the RC was almost always longer than the VP and was more than three times longer on average. Conversely, in sentences with canonical structure, the VP was about 1.5 times longer than the RC on average.

Although the trends are clearly in the expected direction, these results are not exactly as the domain minimization preferences predict. In cases where the RC and VP were exactly the
same length, for example, extraposition occurred in only 9% of sentences even though the PCDs for Subject NP and Matrix S domains would have been approximately equal. These results suggest that grammatical weight needs to be strongly skewed in favor of extraposition before speakers will use extraposition consistently. But of course grammatical weight is not the only relevant factor. As we have already seen, semantic and pragmatic constraints, as identified in previous work on RCE, limit the occurrence of extraposition. Since canonical structure tends to occur in a wider range of semantic and pragmatic contexts, we would expect canonical structure to occur more frequently in general. Indeed, we saw that the rate of extraposition went up to 37% with passive and unaccusative verbs, as compared with only 6% with other predicate types (Table 5 above). However, 37% is still a minority of cases, and most of those cases occurred when the RC was at least twice as long as the VP (Figure 6 above). Thus, even when considering only semantically felicitous unaccusative and passive predicates, the rate of extraposition was still lower than domain minimization principles would predict.

An additional reason for the relative infrequency of RCE may be that RCE is in competition with other constructions besides the canonical structure. For example, RCE sentences with unaccusative main verbs can often be paraphrased using the presentational there construction, as illustrated in (11c).

(11) a. New sets that were able to receive all the TV channels soon appeared. (Canonical)

   b. New sets soon appeared that were able to receive all the TV channels. (Extraposition)

   c. There soon appeared new sets that were able to receive all the TV channels.

   (Presentational there)
Presentational *there* serves a discourse function similar to that of extraposition, and, in addition, allows a heavy subject NP to occur at the end of the sentence together with its modifiers.\(^{12}\) Because the presentational *there* construction does not require extraposition and minimizes the NP and Matrix S domains at the same time, it may be preferable to either canonical structure or RCE in sentences with a heavy subject-modifying RC and an unaccusative main verb.\(^{13}\) Further investigations would be needed, however, to confirm this hypothesis.

A final reason why RCE only occurred consistently when the RC was much heavier than the VP might be related to conventionalized preferences for certain phrase structure configurations. Hawkins (1994: 90) observed a similar result for HNPS (Heavy NP Shift) in a corpus study of English: HNPS only applied in about 30% of cases for which the NP was longer than the PP and only occurred consistently when the NP was at least five words longer than the PP. Hawkins (1994) proposed that the large weight difference required to induce a preference for Heavy NP Shift (in contrast to the smaller difference required to show a preference for placing a heavy PP at the end in a V-PP-PP sequence) may be due to a conventionalized preference for verb-object order in English phrase structure. A similar explanation could apply to the present case as well, since adjacency between a head noun and its modifying RC is also a highly conventional property of English phrase structure, with extraposition requiring special syntactic and interpretive rules. It is not clear, however, where such an adjacency preference would come from. One possibility is that the preference reflects speakers’ sensitivity to stylistic considerations, such as the prescriptive rule banning misplaced modifiers. Alternatively, an adjacency preference could be simply the result of biases developed through encountering the canonical structure much more frequently in language use—a case of infrequent use of RCE perpetuating infrequent use of RCE. This would then be similar to the idea of frequency bias.
used to help explain the acceptability results in Section 4. Finally, the adjacency preference might be encoded in the grammar itself. Hawkins (1994: 89-90) proposed that canonical verb-object order is licensed by the phrase structure grammar whereas HNPS may be licensed only by weight-based principles. I believe that all of these possibilities may be at least partially correct, and I will suggest in Section 6 that such an adjacency preference might best be stated in the grammar in terms of a default constraint on the syntax-semantics interface, as proposed by Culicover and Jackendoff (2005).

6. General discussion and conclusions

RCE from Subject NP involves a discontinuous dependency which deviates from the normal X-bar structure of phrases (at least on the surface), adding complexity to the grammar with little or no effect on the meaning of the sentence. In addition, RCE is subject to a prescriptive rule banning misplaced modifiers and is singled out in some style guides as an example of poor writing (e.g., Trenga 2006: 56). From this perspective, it is perhaps surprising that RCE occurs naturally in both formal and informal language use. While it is known from previous research that discourse information structure plays a role in licensing this construction, the current study shows that grammatical weight is also an important factor in determining how and when speakers use RCE. Furthermore, the current study provides evidence that the increased incidence of RCE with heavy RCs is related to processing efficiency.

Hawkins’ (2004) theory of domain minimization predicts that the degree to which RCE is be preferred in both comprehension and production should be correlated with the degree to which RC length exceeds VP length. In support of this hypothesis, corpus analyses reported here showed that the incidence of RCE increased as the proportion of VP to RC length decreased and
that RCE was strongly preferred over canonical structure when the RC was four or more times longer than the VP. Incidence of RCE was lower overall than was predicted by domain minimization principles alone, but this can plausibly be explained by semantic and pragmatic constraints on RCE, competition from other non-canonical sentence types, and perhaps a conventionalized preference for adjacency between a head noun and its modifying clause. Importantly, a logistic regression analysis showed that weight was a significant predictor of extraposition and that the effects of weight were independent of predicate type.

Also in support of Hawkins’ proposals, reading time results showed that when the RC was three times heavier than the VP (the heavy condition), RCE was processed significantly faster than canonical structure. Importantly, lexical content and information structure were controlled in the reading time experiment and only grammatical weight was manipulated, meaning that there was an effect of weight independent of lexical and informational factors.

The results of the acceptability judgment task also supported the idea of domain minimization, though perhaps not as clearly as the results for reading time and corpus analysis. Results showed that canonical structure was rated higher than RCE overall, but that this preference disappeared when the RC was heavy. Although RCE was not the preferred structure in the heavy condition, the effect of grammatical weight was still in the predicted direction and was very similar to the effect shown in previous acceptability judgment studies of German RCE (Konieczny 2000; Uszkoreit et al 1998). It may be that the lack of preference for RCE in the heavy condition is related to the nature of the judgment task, since asking for judgments of isolated sentences may serve to highlight the fact that RCE deviates from the canonical (and much more frequent) phrase structure pattern in which the relative clause is adjacent to its head noun and also violates a prescriptive rule. In contrast, the self-paced reading task (which
supported Hawkins’ predictions more clearly) did not ask participants to make any evaluative judgments and may be viewed as a more direct measure of processing efficiency.

The overall pattern of these results strongly suggests that grammatical weight is a gradient factor related to processing efficiency rather than part of a categorical rule of grammar. Nevertheless, these results also have implications for the syntactic analysis of RCE. For example, one finding of the corpus analysis was that RCE never occurred in cases where the VP was more than 1.3 times longer than the RC. Similarly, in the acceptability judgment experiment, RCE sentences in the light and medium conditions were rated significantly lower than canonical sentences. If one were to ignore the gradient effects of weight that were also shown in these studies, this might give the appearance of a categorical constraint in which weight is somehow specified as a binary syntactic feature. Although weight (or ‘heaviness’) is not a feature of any of the major theories of RCE syntax (unlike for some analyses of Heavy NP Shift, for example), syntactic locality conditions such as Subjacency are. Given the controversial nature of locality conditions in the literature on extraposition (cf. Baltin 2006) and the heavy reliance on constructed examples within this body of research, there is a real danger that gradient effects related to processing might be mistaken for categorical syntactic rules. Strunk and Snider (2008) in fact provide systematic evidence that syntactic locality conditions on RCE from Object NP are gradient rather than categorical. In their acceptability experiments on RCE from Object NP in English and German, they found that many Subjacency-violating sentences were judged no worse than non-violating sentences and that the Subjacency effects that did show up were gradient in nature, depending on the depth of embedding of the extraposed RC’s antecedent. In addition, Strunk and Snider (2008) report a corpus study of RCE in German showing that Subjacency-violating sentences occurred naturally in discourse and that the effects of syntactic
locality on frequency of RCE were gradient, patterning similarly to the effects of grammatical weight in Uszkoreit et al.'s (1998) corpus study of German and the current study of English. Thus, if structurally-defined locality conditions are gradient and reside outside the syntactic component of grammar, the syntax of RCE may be simpler than has been assumed in most generative approaches to extraposition. The current study does not speak to this issue directly, but provides a pattern of data to look for in determining whether a proposed constraint is gradient and performance-based, or whether it is more accurately stated as a categorical syntactic rule.14

An additional implication for the grammatical analysis of RCE comes from the reading time results. These results suggest that the dependency between the RC and its head noun is processed similarly to the dependency between the verb and its subject—both are subject to weight-based locality effects that can be measured in terms of IC-to-word ratios. Following Hawkins (1994, 2004), the ratios are calculated as though the head noun and its extraposed RC were part of the same NP just as the subject NP and its predicate are part of the same clause. This is reminiscent of McCawley’s (1987, 1998) analysis of RCE as involving a single, discontinuous NP constituent. While McCawley’s proposal is probably too strong a conclusion on the basis of these results, the similarity of the two dependencies suggests that extraposing the RC is not, in itself, a significant source of additional complexity. Rather, what contributes to complexity is the cost of integrating information across a distance. Culicover and Jackendoff’s (2005: 166-167) approach is appealing from this perspective because it states the usual correspondence between syntactic constituency and semantic modification as a default pattern (soft constraint) that is violated in RCE rather than trying to reconcile RCE with X-bar structure through some kind of rightward or leftward syntactic movement. Hawkins’ (1994) idea of a conventionalized grammatical preference for adjacent word order can perhaps best be thought of
in terms of such a default constraint. Rather than claiming, as Hawkins (1994: 89) does for HNPS, that the non-canonical word order pattern is not licensed by the grammar at all, I would propose instead that RCE is licensed by the grammar, but that it violates a default constraint which specifies the preferred syntax-semantics correspondence. Such a constraint violation captures the intuition that canonical ordering is the more basic option, as reflected in corpus frequency and acceptability judgments, but does so without complicating the syntactic structure (extraposed RCs are simply clausal adjuncts in syntax). Although the current study does not directly argue in favor of a particular syntactic analysis, the reading time results, which showed no preference for canonical structure, lend themselves nicely to such an approach.

In sum, the results of all three experiments (self-paced reading, acceptability judgment, and corpus analysis) suggest that grammatical weight plays a significant role in licensing RCE from Subject NP in English. Grammatical weight is therefore helpful for explaining why RCE is permitted by the grammar and preferred in certain contexts of language use, despite the discontinuous dependency that is incurred.
Appendix A: Instructions for Experiment 1

You will be presented with a series of sentences, each followed by a statement. Your first task is to read the sentence and then press the left button as soon as you have understood the sentence. Following each sentence, you will be presented with a simple statement. Your second task is to decide whether the statement is true or false based on the information in the sentence you just read. To make your response, press the left button for “true” and the right button for “false”.

In making your decision, use only the information contained in the sentence itself. Avoid making any inferences beyond the actual content of the sentence. Please make your responses as quickly and accurately as possible. After you have made your selection, there will be a brief pause and the next sentence will appear.

There will be four sets of sentences. Following each set, the computer will prompt you to take a short break. After you have rested, you may press the space bar to continue with the next set. When the last set is finished, you will be prompted to inform the experimenter. Any questions? Please place your index and middle finger on the response pad to select the left button for “true”, right button for “false”. You may press the spacebar with your other hand when you are ready to begin.
Appendix B: Instructions for Experiment 2

Please read each of the sentences listed below. For each sentence, we would like you to indicate your reaction to the sentence. Mark your response sheet by circling a number from (1) to (9). Use (9) for sentences that seem fully normal, and understandable to you. Use (1) for sentences that seem very odd, awkward, or difficult for you to understand. If your feelings about the sentence are somewhere between these extremes, use one of the middle responses from (2) to (8). Please try to use the entire scale, not just the end points of the scale.

THERE ARE NO “RIGHT” OR “WRONG” ANSWERS. Please base your responses solely on your gut reaction, not on rules you may have learned about what is “proper” or “correct” English. Please work straight through the survey and DO NOT turn back to a page after you have completed it.

You will have the opportunity to take three short rest breaks during the survey. Rest breaks are indicated at the bottom of certain pages.

For example, you may encounter sentences like the following in the survey:

We persuaded there to be strike.  

<table>
<thead>
<tr>
<th>Worst</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
</tbody>
</table>

Phil wrote a poem for his mother in honor of her fortieth birthday.

<table>
<thead>
<tr>
<th>Worst</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
</tbody>
</table>

She asked that whether she should come to the party.

<table>
<thead>
<tr>
<th>Worst</th>
<th>Best</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9</td>
<td></td>
</tr>
</tbody>
</table>

Please turn to the following page when you are ready to begin.
References


Press.

Diessel, Holger. 2008. Iconicity of sequence: A corpus-based analysis of the positioning of


(Typological Studies in Language 3). Amsterdam: John Benjamins.

11: 637-678.

Cambridge University Press.


Press.


325-334.


29(6). 627-645.

unergative-unaccusative distinction*. Amsterdam: John Benjamins.


Notes

1 I remain neutral as to whether nominals with determiners are best analyzed as NP or DP since this issue is not important for the research questions addressed in the current study.

2 Wasow (1997: 82) points out that this idea has been around for a long time and was, for example, noted by Otto Behaghel (1909).

3 Note that in Hawkins’ theory, this is only true for head-initial languages. For head-final languages such as Japanese and Turkish, it is predicted that heavy constituents should be shifted forward to facilitate constituent recognition (2004: 108-109).

4 See Vasishth and Lewis (2006) for additional evidence of anti-locality effects with head-final structures in Hindi. The authors attempt to explain both locality and anti-locality effects using a theory of activation decay.

5 It should be noted that Hawkins’ (2004) theory takes account of several domains in addition to PCD. Within the Subject NP, there is a semantic dependency between the head noun and the RC, since the RC restricts the meaning of the noun, and there is co-indexing between the head noun and the relative pronoun. Similarly, within the Matrix S, there are additional dependencies between the predicate and the subject (e.g., selectional restrictions, theta role assignment). However, since there are additional dependencies within both the NP and VP domains, the overall predictions turn out to be very similar to the predictions for PCD alone. Therefore, following John Hawkins’ suggestion (p.c. 2007) the hypotheses for the current study are based on the simpler metric of PCDs alone.

6 As an anonymous reviewer points out, additional factors other than weight or domain minimization could invalidate the first two hypotheses. However, since weight is the only factor that was manipulated, with other known factors held constant, and since sentence materials were designed to be fully felicitous with both extraposed and canonical structures (apart from any weight effects), I will assume as a starting point that the first two hypotheses should hold.

7 Another difference between Konieczny’s (2000) study and the present study is that in German RCE from Object NP, a head-final transitive verb must be integrated with the direct object preceding it, but in English RCE from Subject NP, a head-initial intransitive verb must be integrated with the subject. Since all verbs need a subject in English, and since the subjects in the stimuli were equally plausible with or without the relative clause, there might be less reason for anticipatory effects to occur.
I am grateful to an anonymous CL reviewer for pointing this out.

Error bars in all figures represent standard error of the mean and are based on the by participant data.

For example, see Bresnan (2006) for evidence that fully grammatical but infrequent or improbable structures are commonly judged as less acceptable.

For this study, (active) unaccusative predicates were identified based on their ability to occur with presentational *there*. Note that many passive predicates also allow presentational *there*:

i. There appeared no evidence of any mistakes. (unaccusative)

ii. There was found no evidence of any mistakes. (passive)

The underlined portion of (11c) is not the surface grammatical subject, but it is the ‘logical subject’ in that it represents the single argument of a one-place predicate (with *there* being an expletive subject) and corresponds to the grammatical subject of the canonical sentence in (11a).

Presentational *there* is restricted to occur with unaccusative predicates, and unlike RCE is usually infelicitous with other types of predicates regardless of pragmatic context (Rochemont and Culicover 1990: 66).

Following the general approach of Culicover and Jackendoff (2005), my assumption is that a categorical syntax exists, but need not include rules for patterns that are predictable from semantics, pragmatics, processing, or other non-syntactic factors. Another possibility I have not considered here is that of gradient rules within the syntax (cf. Featherston 2005). Since grammatical weight is evidently a performance-based phenomenon in the current study, I will not address this possibility any further here. See Wasow (2002: 115-158) for relevant discussion.