CHAPTER 10

Cognitive Complexity and Non-Canonicity
Zooming in on Particle Placement

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10.1 Introduction

Even though English has a rather rigid word order, it allows for some discontinuous forms such as a relative clause that is extraposed and thus separated from the head it modifies, or the fronting of a noun phrase (NP) without the prepositional head which it complementises, resulting in a stranded preposition. Discontinuous forms can also occur at the word level in multi-word expressions, such as the transitive particle verb. As illustrated in (1), particle verbs consist of two elements, a verb and a particle. In the joined order, shown in (1a), the particle immediately follows the verb – the multi-word verb is presented as one unit. However, it is possible for the direct object to intervene between the verb and its particle, resulting in a split multi-word expression. This variant is illustrated in (1b).

(1) a. Jane picked up the book. joined variant
b. Jane picked the book up. split variant

Which of the two variants is the canonical, which is the non-canonical one? The answer to this question might be less straightforward than for information-packaging structures such as object fronting, where the departure from the basic SVO order is motivated by particular discourse functions. As will become evident in what follows, the default is much more difficult to determine for split multi-word expressions, because 'theory-based' and 'frequency-based' definitions make different predictions for this particular case of syntactic variation. First of all, one could argue that discontinuous structures in general are non-canonical because they depart from a basic SVO order: even though the verb precedes the object, a second part of the complex word follows it. What is more, they violate Behaghel's first law, which says that elements that belong together will also have adjacent positions in the structure (Behaghel 1932). There is another factor which has been widely discussed in the literature on syntactic

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variation but has received less attention in accounts of non-canonical syntax: the cognitive load associated with the variants. If we take a higher degree of cognitive complexity to translate into non-canonicity, the split particle verb, again, turns out as the non-canonical variant because it is associated with a higher processing load than the joined verb. This is because of the distance between two dependent elements (Gries 2002a, 2003; Lohse et al. 2004). The latter explains why the discontinuous variant is not an option if further factors contribute to cognitive complexity, such as a long or structurally complex direct object (see (2)), as shown by previous corpus studies (e.g., Fraser 1976; Chen 1986; Gries 2002a, 2003; Lohse et al. 2004).

(2) a. Fred picked up the book John had bought him while he was in Europe.
b. *Fred picked the book John had bought him while he was in Europe up. (Gries 2003: 14)

This begs the question of why speakers would ever use the non-canonical variant – it departs from the default order and is said to be more difficult to process. Actually, in contrast to other discontinuous orders such as preposition stranding, the split particle verb can be linked to a particular discourse function more clearly, which might motivate its existence: in the joined variant, the head noun of the direct object NP is in end-focus position; in the split variant, it is the particle (see Gries 2003). Example (3) demonstrates that the position after the verb is connected to contrastive stress on the particle (see also Dehé 2002).

(3) So, that's another reason why the market for oil just seems to drive the price up and not down. (*COCA*, 1990 SPOK)

This function brings about an interesting effect: with unstressed pronouns, speakers do not have a choice, as the verb has to be split, that is, the discontinuous variant is not just the more frequent option, it is the *only* option. This reveals a divergence between theory-based and frequency-based approaches to (non-)canonicity, as the non-basic order is the default in certain syntactic contexts. Interestingly, even with lexical heads, the split option is more frequent in spoken English (60%, Biber et al. 1999: 932). In written English, in contrast, the joined variant is much more frequent (90%, Biber et al. 1999: 932).

Against this backdrop, it is not clear which of the two variants is the non-canonical order. Is the split particle verb a departure from the default which can be motivated by information-structuring functions? However, if it serves more particular functions we would probably expect it to be less frequent. So, could we argue that the joined particle verb is the non-canonical form with reduction of cognitive complexity as a further factor motivating non-canonicity?

Cognitive complexity has been argued to be a determinant in many syntactic variation phenomena, such as the ordering of postverbal prepositional phrases (Hawkins 2000; Wasow & Arnold 2003), the placement of adpositions (Berlage 2009, 2014), preposition stranding (Gries 2002b; Hoffmann 2011), adjectival comparison (Mondorf 2003), and the use of zero forms (Hawkins 2003; Rohdenburg 2003). The general idea underlying the explanations in these studies can be summarised as follows: whenever they have the choice, speakers will choose the variant that results in a lower processing load.

As intuitive as psycholinguistic explanations for these phenomena might seem, they have to be taken with a grain of salt: most of them are based on corpus data and these data provide only indirect evidence for processing-based choices. Psycholinguistic studies have shown that distance dependencies can facilitate processing. Konieczny (2000), for example, has identified these so-called 'anti-locality effects' in the processing of verbs following relative clauses in German. A sentence-final verb is read faster when preceded by a complex direct object containing a relative clause than with a two-word NP. Konieczny (2000) has shown that the type of data does matter – while the offline data from his experiments is aligned with corpus findings, the online data is not. This indicates that corpus studies do not necessarily provide support for processing-based assumptions, even though they certainly yield highly interesting results for the study of syntactic variation. In order to determine whether the reduction of cognitive complexity could be considered a factor motivating the use of non-canonical constructions, this chapter investigates the complexity-based explanations that have been put forth for particle placement in English (cf. Gries 2002a, 2003; Lohse et al. 2004) from an experimental perspective. The aim is to provide the missing experimental data for a phenomenon that is well researched from a corpus-linguistic perspective. To this end, a self-paced reading study was conducted. This experiment was complemented by a split rating task (cf. Bresnan & Ford 2010). It will be shown that, as reported by Konieczny (2000), the offline data is aligned with the corpus findings but that the online data is not, suggesting that a discontinuous structure is not necessarily connected to a higher cognitive load.

The chapter is structured as follows. Section 10.2 discusses the above-mentioned corpus studies on particle placement, which relate the phenomenon to processing. Section 10.3 reports the self-paced reading study; Section 10.4 reports the split rating task. The mismatch between the results and the implications are discussed in Section 10.5.

10.2 Cognitive Complexity as Determinant of Particle Placement

There are two corpus studies which make explicit reference to processing complexity as determinant of particle placement, Lohse et al. (2004) and Gries (2002a, 2003), which is why they are discussed in the following. Lohse et al. (2004) relate two factors, direct object complexity operationalised as NP length in words and verb idiomaticity,[1] to Hawkins' 'Minimise domains' (MiD) as a single underlying principle. According to this principle, domains in which syntactic or lexical dependencies hold should be kept as short as possible (Hawkins 2014). Lohse et al.'s (2004) corpus study finds effects of length that are predicted by MiD: while the ratio of joined and split constructions is almost balanced for one-word NPs (47% of split constructions), there is a sharp decline at an NP length of three words (18% of split constructions) and a second one for NPs that comprise five or more words (5% of splits). This is accounted for as follows: the phrasal combination domain of the verb phrase (VP PCD) comprises the elements that must be processed for the construction of the VP, that is, the verb, the particle and the 'first constructing word in the object NP' (Lohse et al. 2004: 240), the determiner. Example (4) illustrates the effects of minimising VP PCDs for particle placement.

(4) a. Joe [$_{VP}$ looked up [$_{NP}$ the number of the ticket]]
VP PCD 1 2 3

b. Joe [$_{VP}$ looked [$_{NP}$ the number of the ticket] up]
VP PCD 1 2 3 4 5 6 7

In the joined variant (4a), the VP PCD comprises only three words – *looked*, *up*, and the definite article. In the split variant (4b), in contrast, the domain comprises seven words. This makes the role of complexity evident: the longer the NP, the longer the VP PCD, which – according to MiD – should be minimal.

[1] Length and complexity are closely related – the more embedded phrases, the more words the NP will comprise (cf., e.g., Berlage 2014). Yet, there are studies which suggest that the syntactic category of the nominal dependent does play a role when length is controlled for (e.g., Ferreira 1991; Wasow & Arnold 2003). Gries (2002a, 2003) finds that, for particle placement, both length (word and syllable count) and complexity are predictors.

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The second relation of interest here is idiomaticity, a lexical dependency between the verb and the particle. For dependent particles (i.e., particles that lack a literal interpretation), Lohse et al. (2004) predict the joined variant to be more frequent. This is due to the lexical dependency domain (LDD) for particles that depend on the verb (Pt_d) being increased in the split order as shown in (5a) and (5b). In the latter, the verb *look* is separated from its particle. The longer the NP, the greater the domain, as evident in (5c).

(5) a. look up_d [$_{NP}$ the number]
Pt_d – V LDD 1 2
b. look [$_{NP}$ the number] up_d
Pt_d – V LDD 1 2 3 4
c. look [$_{NP}$ the number of the hotel] up_d
Pt_d – V LDD 1 2 3 4 5 6 7

Lohse et al.'s (2004) corpus data confirm what is predicted on the basis of minimal LDDs and PCDs – joined particle verbs are more frequent than split ones with dependent particles, and this preference for the joined construction is enhanced by an increase in length of the direct object. In other words, with idiomatic particle verbs the cut-off point for NP length is reached earlier than for transparent ones.

Gries (2002a, 2003) also reports a corpus study on particle placement. He discusses a range of previously identified determinants and links all of them to his so-called 'Processing Hypothesis', which reads as follows:

> By choosing one of the two constructions for an utterance U a speaker S subordinates to different processing requirements of both constructions in that he formulates U in such a way as to communicate the intended message with as little processing effort as possible. More specifically, for most variables at least, this means that construction$_0$ [the joined variant] will be preferred for verb particle constructions with DOs requiring a lot of processing effort – construction$_1$ [the split variant] will be preferred for verb-particle constructions with DOs requiring little processing effort. (Gries 2002a: 274)

According to Gries, the joined variant is easier to process from both the speaker's and the hearer's perspective: in the split construction, the speaker has to hold the particle in memory until after the direct object is uttered, while 'the hearer has to wait longer for assigning the correct parse to the incoming expression, namely until some yet unknown particle completes … the verb' (2003: 58). An object that requires more processing effort will add to the difficulties induced by the split construction and hence the joined order is the preferred option. With idiomatic verbs, the

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semantic dependencies between verb and particle make the joined order more economic in terms of processing and hence the preferred option.

The subsequent sections report an online and an offline study on particle placement in English, which put these processing-based hypotheses to the test. The central research question is whether the non-canonical version is more difficult to process. If corpus frequencies reflect processing difficulties, this should be the case – in the corpus studies, the joined variant is more frequent overall. Follow-up questions target the factors that are said to add to processing difficulties in particle placement: the complexity of the direct object and the idiomaticity of the verb-particle combination. A rating task addresses the question whether the easier-to-process variant is also the preferred one.

10.3 Experiment 1: Self-Paced Reading Study

This section reports a self-paced reading study (SPRT) on particle placement. The idea behind this is that reading times are a window to cognition and that processing difficulties are reflected in reading latencies (e.g., Just & Carpenter 1980).

10.3.1 Factors

As pointed out above, the factors ORDER, COMPLEXITY, and IDIOMATICITY were integrated into the analysis. ORDER has two levels, split and joined. Since NP length has been shown to be an accurate measure of nominal complexity (see Berlage 2014), it was chosen to operationalise complexity of the direct object. The factor COMPLEXITY has two levels, simple and complex. Lohse et al.'s (2004: 243) corpus study showed that there is still quite a high ratio of splits (258/647 = 40%) for two-word NPs and it revealed a clear cut-off point at five and more words (14/461 = 3% splits). This is why a simple direct object is operationalised as a two-word NP, and a complex direct object is operationalised as a five-word NP (see (6) and (7) below).

For the lexical dependency between the verb and the particle, a binary distinction was adopted, that is, the factor IDIOMATICITY has two levels, idiomatic and transparent. 'Transparent' denotes fully compositional structures, which corresponds to the combination of independent verb + independent particle in Lohse et al.'s (2004) study. 'Idiomatic' denotes the opposite end on the scale, non-compositional verb-particle combinations, corresponding to dependent verb + dependent particle. Dependency was determined with the help of an entailment test applied by Lohse et al. (2004).[2]

10.3.2 Materials and Design

The factors ORDER, COMPLEXITY, and IDIOMATICITY were crossed. Seventeen opaque and 15 transparent verb-particle combinations were used. Example (6) illustrates the four conditions with an idiomatic verb and (7) shows the four conditions for a transparent one.

(6) Idiomatic

a.	Harold looked up the address before the trip.	simple, joined
b.	Harold looked the address up before the trip.	simple, split
c.	Harold looked up the address of the hotel before the trip.	complex, joined
d.	Harold looked the address of the hotel up before the trip.	complex, split

(7) Transparent

a.	Steven typed in the password before the crash.	simple, joined
b.	Steven typed the password in before the crash.	simple, split
c.	Steven typed in the password for the account before the crash.	complex, joined
d.	Steven typed the password for the account in before the crash.	complex, split

Word order variation brings about a complication for reaction time experiments. In *Harold looked the address up*, for instance, the particle occurs in the final position, while the joined counterpart *Harold looked up the address* hosts a lexical noun in that position. In order to provide a more uniform point of measurement for each condition, a temporal adverbial was added as a clause-final constituent. A temporal PP was chosen to keep potential attachment ambiguities minimal: as the head nouns of the direct object are non-event nouns, an interpretation of the temporal PP as nominal modifier is implausible. The number of syllables of each word was constant across items and, apart from the temporal prepositions, lexical items occurred only once in the trial.

The experimental material contained 32 target stimuli, 24 stimuli for another experiment, and 46 fillers. The fillers were followed by a *yes-no*-question in order to make sure participants stayed focused. The

[2] The test was originally developed for classifying dependency relations between verbs and prepositional phrases (Hawkins 2000). If an element is entailed, it is independent. The verb particle combination *lift up* as in *they lifted up the child*, for instance, contains an independent verb and an independent particle because both *they lifted the child* and *the child* GOES *up* are entailed. In *look up* as in *they looked up the number*, in contrast, both the particle and the verb are dependent because this neither entails that **they looked the number* nor that *the number* IS/BECOMES/COMES/GOES/STAYS *up*.

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experiment used a mixed design and each participant received the stimuli in a different, pseudo-randomised order.

10.3.3 Predictions

If corpus frequencies reflect processing effort, the following effects are expected. The non-canonical variant should overall be more difficult to process due to the distance between verb and particle. A complex NP and an idiomatic verb should enhance this difficulty.

H1 ORDER. There are longer reaction times for the split than for the joined variant.
H2 Interaction of COMPLEXITY and ORDER. In the split order, there are longer reaction times with complex NPs than with simple ones.
H3 Interaction of IDIOMATICITY and ORDER. In the split order, there are longer reaction times in idiomatic verb-particle combinations than in transparent ones.
H4 Interaction of ORDER, IDIOMATICITY, and COMPLEXITY. The relative advantage of the joined over the split order should be lowest with transparent particle verbs and simple NPs and highest for idiomatic particle verbs and complex NPs.

10.3.4 Participants and Procedure

The experiment was conducted at the University of Edinburgh. Fifty-one students (L1-speakers of British English) participated. They were paid for their participation. Participants received oral and written instructions. They were given practice items to familiarise themselves with the procedure before they started the experiment. The experiment was run using E-Prime 2.0.

10.3.5 Data and Analysis

One participant was excluded from the final data set because they had misunderstood the task and read the stimuli out aloud. Nine participants were excluded because they had eight or more wrong answers to the comprehension questions, which reduced the set to 41 participants. Table 10.1 illustrates the different points of measurement for the reaction times for the simple-NP condition.

Since the particle assumes different positions – it either follows or precedes the direct object – the main focus is on the material following the critical region. The following reaction times will be analysed in the subsequent sections: PREPRT, NOUNRT, and SENTENCERT. PREPRT is the

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Table 10.1 *Points of measurement in self-paced reading experiment*

			PRECRITICAL	CRITICAL	PREPOSITION	ARTICLE	NOUN
Joined	. . .looked	up	the	address	before	the	trip.
Split	. . .looked	the	address	up	before	the	trip.

reaction times on the preposition following the critical region (i.e., *before* in Table 10.1). This point is used to see whether processing difficulties spill over to the following material. The final element of a clause has been shown to have longer reaction times (cf. Mitchell & Green 1978), which is enforced by a further processing difficulty. NOUNRT, the reaction times on the clause-final noun (*trip* in Table 10.1), serves to measure this potential wrap-up effect. SENTENCERT is the cumulative RT of the entire clause.

For each dependent variable, data points that were more than 2.5 standard deviations away from the mean (by ITEM and by PARTICIPANT) were removed. This resulted in a loss of 2–3.1% of the observations.

10.3.6 Statistical Models and Effects

As the experiment had a mixed design with repeated-measures elements, mixed-effects linear models (Baayen et al. 2008) were fitted, using the lme4 (Bates et al. 2015) and lmerTests package (Kuznetsova et al. 2017) for *R* (version 4.2.2). The null model contained all fixed effects (to be discussed below) and a maximal random effect structure with varying intercepts for ITEM and PARTICIPANT, as well as varying slopes of ORDER, COMPLEXITY, IDIOMATICITY, and TRIAL for each PARTICIPANT and ITEM. First, the random effect structure was simplified stepwise using a principal components analysis, removing random effects that made up for less than 5% of the variance. The fixed-effects structure was reduced step by step starting out with the highest *p*-value (Gries 2021). The final models hence contain a simpler random effect structure and only significant fixed effects. To reduce non-normality in the residuals, the models were subjected to model criticism (cf. Baayen & Milin 2010), where the observations with absolute standardised residuals exceeding a distance of 2.5 standard deviations to the mean were removed. This resulted in an additional loss of 1.6–2.6% of the data points. Since many of the numeric variables showed a skewed distribution, they were transformed using logging to the base of 2 ('LOG') or box-cox transformations

('Bcn'). To avoid convergence problems in model-fitting arising from different scales, some of the variables were scaled ('Sc'). An overview of the effects is presented in what follows.

- Order The particle verb can be *joined* or *split*.
- Complexity The direct object can be *simple* or *complex*.
- Idiomaticity The particle verb can be *transparent* or *idiomatic*.
- Order*Complexity*Idiomaticity Interaction term.
- Trial and TrialSc The position of an item in the trial (and as scaled variable).
- CritRTBcnSc The transformed and scaled reaction times in the critical region (i.e., the element preceding the temporal preposition).
- PreCritRTBcnSc The transformed and scaled reaction times to the element preceding the critical region.
- ArticleRTSc The scaled reaction times to the article (i.e., the penultimate element in the sentence).
- SurprisalPrep The degree of surprisal of the preposition.
- Age and AgeSc The age of the participant (and as scaled variable).
- Gender The gender of the participant.

The variables CritRTBcnSc and PreCritRTBcnSc as well as ArticleRTSc and SurprisalPrep were added as controls. As the difference in ordering across conditions results in different lexical items in the critical and precritical region, the reaction time at these previous points of measurement were included to control for a potential spillover onto PrepRT (see Bartek et al. 2001). The same rationale applies to the sentence-final point of measurement NounRT; however, since the point is more uniform, only the RT of the immediately preceding word was included.

Since reaction times can also be influenced by the degree of predictability of words (e.g., Levy 2008), the degree of surprisal of the preposition was included as a control in the form of a negative binary log of a bigram frequency of the preposition and the element preceding plus 1 divided by the frequency of the first word (see, e.g., Rühlemann & Gries 2020).[3] The frequency data were obtained from the *British National Corpus* (*BNC*), accessed via *English Corpora*. The fixed effect structure of each final model is summarised in the Appendix (Tables 10.4, 10.5, 10.6, and 10.7).

[3] Some of the bigrams were not attested, which would have resulted in undefined values.

Table 10.2 *Mean reaction times in milliseconds and standard deviations (SD)*

	Preposition		Noun		Sentence	
Condition	Mean	SD	Mean	SD	Mean	SD
Simple, transparent, joined	250	112	450	231	3,242	1,142
Simple, transparent, split	232	110	417	214	3,139	1,151
Complex, transparent, joined	259	108	421	196	4,419	1,501
Complex, transparent, split	235	103	435	204	4,294	1,381
Simple, idiomatic, joined	247	119	424	228	3,255	1,245
Simple, idiomatic, split	237	109	424	227	3,155	1,057
Complex, idiomatic, joined	251	107	440	241	4,402	1,533
Complex, idiomatic, split	246	127	439	219	4,396	1,513

10.3.7 Results

Table 10.2 summarises the raw mean reaction times for the three points of measurement.

The null model for PrepRTSc, the scaled reaction times to the preposition, contained Order, Idiomaticity, and Complexity as three-way interaction, SurprisalPrep, the scaled and transformed reaction times on the two words preceding it (i.e., CritRTBcnSc and PreCritRTBcnSc), as well as Age and Gender. The random intercept structure was simplified to a random intercept for Item and Participant as well as a random slope of Complexity for each Participant. Order had a significant effect ($t = 4.624$, $p = 0.000042$) but it did not interact with Complexity and Idiomaticity. The latter two variables did not have a significant effect; neither did SurprisalPrep. Trial and the reaction times to the two previous elements had significant effects, as expected. Interestingly, the effect of Order is not as predicted: there are higher reaction times for *joined* than for *split*, as illustrated in Figure 10.1. That means that the split verb facilitates processing in the spillover region. Hypotheses H1–H4 are thus not confirmed.

As pointed out before, in the wrap-up region, the reaction time to the immediately preceding element only was included as control. The final model for NounRT has a random intercept for Participant as well as Item, and a random slope of Complexity for each Participant. It contains a significant effect of TrialSc ($t = 8.783$, $p < 0.0001$), the interaction of Complexity, Idiomaticity, and Order ($t = -2.237$, $p = 0.025$) as well as AgeSc (3.018, $p = 0.005$). While the first two are expected, the latter is not. However, the effect of Age – an increase of reaction time with an increase of AgeSc – is caused by an outlier: While

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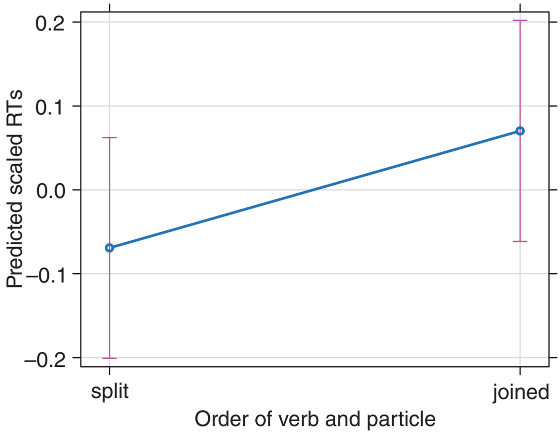

Figure 10.1 Predicted scaled reaction times (RTs) in the spillover region across orders

the age range for all participants is 18 to 25, there was one participant aged 39. In a subsequent model fitted to data excluding this particular participant, AgeSc was not significant anymore.

Figure 10.2 illustrates the three-way interaction of Complexity, Idiomaticity, and Order. As can be seen, for both orders, complex NPs with idiomatic particle verbs result in a longer reaction time than simple phrases. This difference, however, is not significant. There are slightly longer reaction times for the split than for the joined order in the idiomatic condition, but this difference is not significant either.

For transparent verb-particle combinations, there are longer predicted reaction times for the split with complex NPs than for the joined ($t = 2.334$, $p = 0.0198$). For simple phrases with transparent verbs, the opposite effect is displayed: the joined order has longer predicted reaction times, but this difference fails to reach significance ($t = 1.897$, $p = 0.0581$). The difference between the complex and the simple condition with transparent verbs is significant for the split ($t = 2.096$, $p = 0.037$) but not for the joined order, thus providing support for H2, but only for transparent particle verbs. Figure 10.3 illustrates the same interaction from a different perspective.

In the simple condition, there are longer reaction times for splits with idiomatic than with transparent particle verbs, but this difference is not significant. For complex NPs, there are slightly longer reaction times for split verbs in the transparent condition than in the idiomatic. This difference is not significant either. This implies H3 and H4 do not receive support at the wrap-up position.

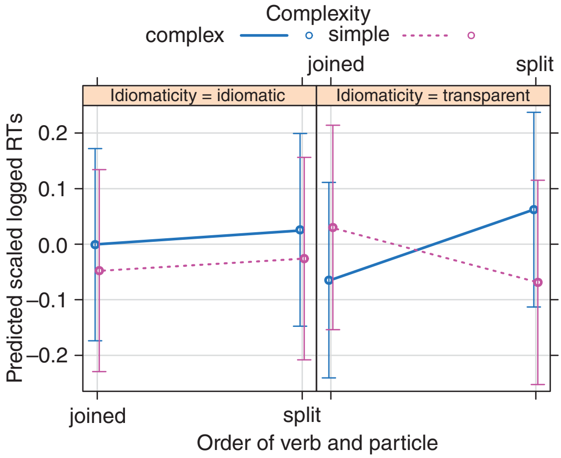

Figure 10.2 Predicted logged and scaled reaction times (RTs) in the wrap-up region for the ORDER*COMPLEXITY*IDIOMATICITY interaction

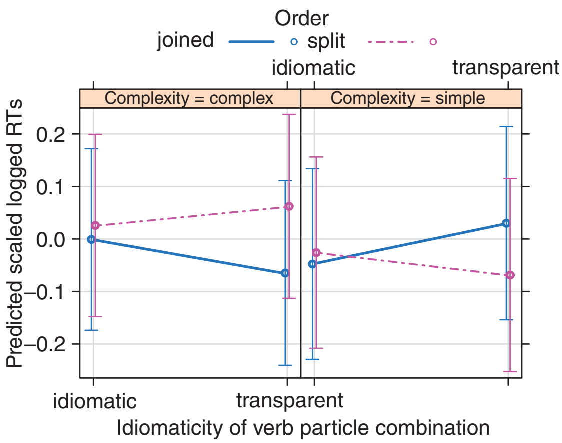

Figure 10.3 Predicted logged and scaled reaction times (RTs) in the wrap-up region for the IDIOMATICITY*ORDER*COMPLEXITY interaction

Finally, the cumulative reaction times to the entire sentence were analysed. Here, the surprisal variable and preceding reaction times were not included. The final model has a random intercept for PARTICIPANT and a random slope for COMPLEXITY. Again, there is a significant three-way interaction of ORDER, COMPLEXITY, and IDIOMATICITY. As shown

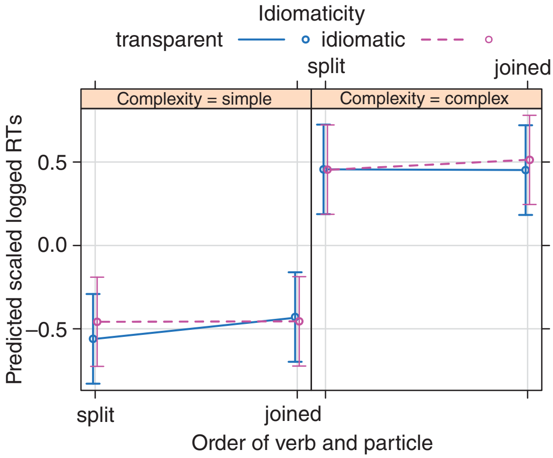

Figure 10.4 Predicted logged and scaled reaction times (RTs) of the whole stimulus for the *Order*Idiomaticity*Complexity* interaction

in Figure 10.4, there is a clear effect of Complexity resulting in much longer predicted reaction times.

However, this is not surprising, because the complex condition contains three additional words. What is less expected, though, is an advantage of the split over the joined variant in the simple transparent condition ($t = 2.717$, $p = 0.0067$). Again, none of the four hypotheses is supported by the data.

10.3.8 Discussion

The reading study revealed several effects. In the spillover region, there is a speed-up in the split condition (i.e., a distance dependency facilitates reading). This effect is neither modulated by the complexity of the object nor the semantic status of the particle verb. In the wrap-up region, there are effects of Complexity and Idiomaticity which go into the predicted direction: with idiomatic verbs, the split condition has longer reaction times than the joined, and complex phrases require more reading time. The differences, however, are not significant. The effect of Complexity is also found in the transparent condition: the split requires more reading time than the joined order with complex NPs; splits with complex NPs have longer reaction times than splits with simple objects, which is as expected. With simple objects and transparent verbs, in contrast, the joined verb has longer reaction times than the split. The

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relative advantage of the split ORDER across COMPLEXITY and IDIOMATICITY conditions in the spillover position and the relative advantage of the joined ORDER in the simple and complex idiomatic condition as well as the complex transparent condition later on in the sentence cancel each other out, so that the differences are not significant anymore on the sentence level. The (not significant) advantage of the split in the simple transparent condition in sentence-final position adds to the advantage of the split in the position following the critical region, making the simple transparent split condition the fastest for the whole sentence.

The results are rather unexpected: only H1 and H2 are partially confirmed for merely one of three points of measurement. What is more, there is an effect that goes against the predicted direction. There are several possible explanations. First, the processing advantage of the split particle verb could just be an apparent one, a spillover effect that is caused by the different elements across conditions in the critical region. This, however, was controlled for by including the preceding reaction times as predictors. Apart from that, the effect persists in the transparent simple condition for the whole clause. A second explanation derives from expectation-based models of syntactic comprehension (Levy 2008). The higher the expectation of an item (and, likewise, the lower its surprisal), the easier it is to process. The more information the reader has on an element, that is, the more material precedes an element, the more they will expect that word. The words preceding the critical one narrow down the number of alternatives. In the present study, the observed advantage of the split in the spillover region could result from a highly predictable particle. Thus, the verb followed by the direct object in *looked the address* creates a high expectation of the particle *up*, which could speed up reading. This does not only hold for the idiomatic verb-particle combinations but also for the transparent ones (e.g., *lift up*, *shave off*), which could explain why this factor does not have an influence in the spillover region.

It is not just the particle's predictability which could cause the facilitation effect in the spillover position: if the particle follows the direct object NP, it signals that the multi-word verb and its argument are completed, which might then increase the predictability of a VP-adjunct. Since the particle is not followed by a punctuation mark and hence is not the clause-final element, an upcoming adjunct or a coordinator are the only syntactic options. This is not the case in the joined order – once the reader has encountered the nominal head (or the nominal head in the post-head PP), they might expect either a (further) post-head dependent of the noun, a dependent of the verb or a coordinator, that is, there are more options. As Levy (2008) shows, expectations about upcoming constituency influence processing, so readers need not predict the exact identity of a word. This can explain why the SurprisalPrep, the variable operationalising the degree of expectation of the preposition, turned out as non-significant in all models. A higher expectation of a VP-adjunct is a more likely explanation for the speed-up at the preposition in the split condition. It also accounts for the fact that Complexity and Idiomaticity do not play a role at this point of measurement.

Even though the corpus-based predictions do not receive support from the reaction times to the preposition, the longer distance dependency does induce difficulties at a later point. While the reaction times in the wrap-up region are not significantly longer for split constructions than for joined, this effect cancels out their relative advantage earlier on in the sentence in both the idiomatic (simple and complex) and the complex transparent condition. Mixed results for processing distance dependencies have been reported in the literature: On the basis of conflicting results for English relative clauses, Levy (2008: 1166) hypothesises that a word-by-word processing difficulty is modulated by expectation but that 'the retrieval and integration of a long-distance dependent incurs a substantial processing cost'. Vasishth and Drenhaus (2011: 69) also find both a processing cost and a facilitatory effect of distant elements (i.e., locality and anti-locality effects), in German relative clauses and conclude that expectation-based facilitation and the cost of distance dependencies 'operate at different stages of processing'. Even though the split construction facilitates reading, possibly due to an increased expectation of a particle and/or a postverbal adjunct, the integration of the particle across a distance could still come at a certain cost, which displays later on. A complex NP that is more difficult to process in combination with an idiomatic particle verb could contribute to this difficulty, as predicted by Gries (2002a, 2003) and Lohse et al. (2004). This could explain why the relative advantage of the split only shows on sentence level in the simple transparent condition.

To sum up: the processing-based hypotheses from the corpus-linguistic literature are not supported by the present data. Implications will be discussed in detail in Section 10.5, but it should be pointed out here that even though the differences reported are significant, the effects are rather small.

10.4 Experiment 2: Split Rating Task

The split rating task (Bresnan & Ford 2010) is a judgment task that contrasts two alternatives which have to be rated according to naturalness.

Participants are asked to compare the two alternatives and distribute 100 points between them to express their rating, for example, 50/50 if there is no difference or 10/90 if the second variant is much more natural than the first. Every combination that adds up to 100 is possible, which means the only option not available is to reject both variants (Bresnan & Ford 2010: 186). What is important to stress here is that this test does not measure the absolute acceptability of certain constructions but rather their relative acceptability.

10.4.1 Factors and Predictions

This experiment tested the same factors as the previous one: ORDER, COMPLEXITY, and IDIOMATICITY. If corpus frequencies reflect processing difficulties, participants should identify the easier of two variants as the more natural variant. Previous corpus studies (Gries 2002a, 2003; Lohse et al. 2004) give rise to the following predictions: the non-canonical variant should receive lower ratings than the canonical, even more so with complex direct objects and/ or idiomatic verbs.

H1 ORDER. There are lower ratings for the split than for the joined variant.
H2 COMPLEXITY and ORDER. In the split order, there are lower ratings with complex NPs than with simple ones.
H3 IDIOMATICITY and ORDER. In the split order, there are lower ratings in idiomatic verb-particle combinations than in transparent.
H4 ORDER, IDIOMATICITY, and COMPLEXITY. The relative preference of the joined over the split order should be lowest with simple NPs and transparent particle verbs and highest with complex NPs and idiomatic particle verbs.

10.4.2 Materials and Design

In the split rating task, the same items as in the self-paced reading experiment were used to establish one-to-one comparability. The comprehension questions were left out. Two variants were presented as minimal pairs, contrasting the two orders.

10.4.3 Participants and Procedure

The split rating task followed the reading experiment (i.e., there were the same participants in both experiments). To minimise potential priming effects on the rating task as well as fatigue effects, the first experiment was followed by a break during which participants filled in a questionnaire inquiring about demographic information. Participants received the same random order as in Experiment 1.

Again, E-Prime 2.0 was used. The procedure of the rating task was also identical to the preceding reading experiment, that is, oral and written instructions were followed by a set of practice items and the actual experiment. To avoid miscalculations, participants only had to enter the value they assigned to the first sentence of the pair and confirm this by pressing a button. The difference to 100 was given out automatically.

10.4.4 Data and Statistical Models

As in Experiment 1, linear mixed-effects models were fitted. In order to establish direct comparability, the same participants were excluded. Ratings which were 2.5 standard deviations away from the mean (by Item) were excluded, resulting in a loss of data points and thereby reducing the set to 1,305 observations. Again, the model was subjected to model criticism which resulted in an additional 31 observations being removed. The model selection process was as described in Section 10.3.4, but the fixed effect structure of the null model was simpler, since SurprisalPrep and reaction times were not included as controls. A summary of the final model is provided in the Appendix.

10.4.5 Results

Table 10.3 summarises the raw ratings across conditions.

The final model has varying intercepts for Participant and Item and varying slopes of Order for each Participant and Item. The fixed effect structure contains three significant two-way-interaction terms: Order*Complexity ($t = 5.293$, $p < 0.0001$), Order*Idiomaticity ($t = 4.713$, $p < 0.0001$), and Complexity*Idiomaticity ($t = 2.104$, $p = 0.0356$). For both Complexity and Idiomaticity conditions, the joined order obtains higher ratings than the split, thus confirming H1. Figure 10.5 illustrates the first interaction.

In both the complex and the simple condition, the split receives lower ratings than the joined variant. Both differences are significant (simple: $t = 3.488$, $p = 0.0009$, complex: $t = 6.513$, $p < 0.0001$). As predicted, the difference is more pronounced in the complex condition (difference in predicted ratings: 18.7) than in the simple (difference in predicted ratings:

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Table 10.3 *Mean ratings and standard deviations (SD) across conditions in Experiment 2*

Condition	Mean	SD
Simple, transparent, joined	44.9	17.6
Simple, transparent, split	43.0	17.2
Complex, transparent, joined	48.4	18.6
Complex, transparent, split	39.9	18.5
Simple, idiomatic, joined	51.5	18.5
Simple, idiomatic, split	36.2	16.8
Complex, idiomatic, joined	52.5	21.6
Complex, idiomatic, split	29.7	17.4

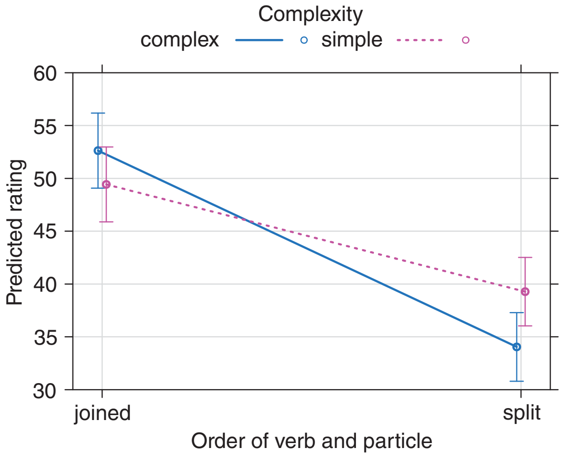

Figure 10.5 Predicted ratings for the ORDER*COMPLEXITY interaction

10.2). This provides support for H2. Figure 10.6 illustrates the effect of ORDER*IDIOMATICITY.

The joined order has higher ratings than the split for both idiomatic ($t = 7.040$, $p < 0.001$) and transparent particle verbs ($t = 1.921$, $p = 0.0596$), even though the latter difference fails to reach significance. As predicted by H3, the relative advantage of the joined order is larger for idiomatic (difference in predicted ratings 21.8) than for transparent verbs (difference in predicted ratings 6.1). Figure 10.7 shows the final interaction.

For idiomatic verb-particle combinations, the simple-NP condition has higher ratings than the complex condition ($t = 2.351$, $p = 0.0189$). For

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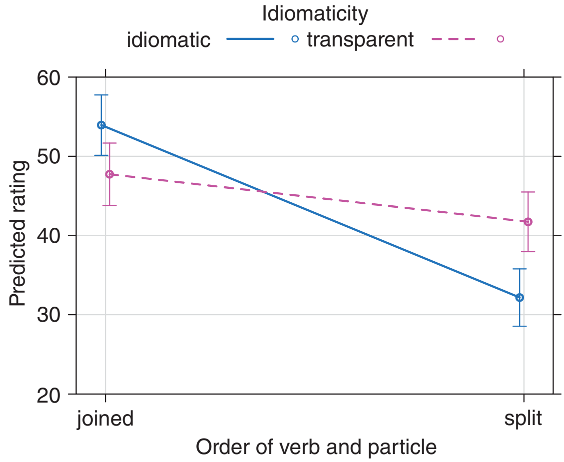

Figure 10.6 Predicted ratings for the *Order*Idiomaticity* interaction

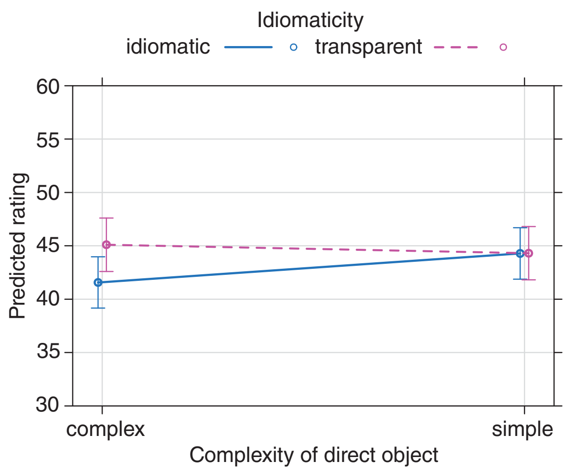

Figure 10.7 Predicted ratings for the *Complexity*Idiomaticity* interaction

transparent verbs, the simple condition receives slightly lower ratings than the complex condition. However, the difference is small and not significant ($t = 0.678$, $p = 0.489$). As predicted by H4, the predicted *relative* preference for the joined order over the split is very low (estimate = 1.919, $t = 0.581$, $p = 0.56307$) for simple NPs and transparent verb-particle combinations and highest for complex NPs and idiomatic particle verbs

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(estimate = 26.043, $t = 8.138$, $p < 0.0001$). The remaining two combinations are positioned in between: for complex NPs and transparent verbs, the relative advantage of the joined order over the split is smaller but still significant (estimate = 10.394, $t = 3.145$, $p = 0.0025$). For simple NPs with idiomatic particle verbs, the relative preference for joined over split is higher and also significant (estimate = 17.568, $t = 5.494$, $p < 0.0001$).

10.4.6 Discussion

Interestingly, all four hypotheses are confirmed in this experiment. Participants prefer joined constructions over split. Both a complex direct object and an idiomatic particle verb add to the relative preference for joined constructions. This experiment thus mirrors Gries' (2002a, 2003) and Lohse et al.'s (2004) corpus findings and stands in stark contrast to the experiment reported in Section 10.3. The implications of this mismatch will be addressed below.

10.5 General Discussion and Conclusion

This chapter has investigated effects of cognitive complexity on the choice between a canonical and a non-canonical verb-particle order, using an online experiment and an offline task. The most interesting finding of this chapter is the discrepancy between different types of data: the offline experiment supports the corpus-based hypotheses, the online task does not. There are several possible explanations. First, since Experiment 1 does not provide expected results, there could be a flaw in the design. However, since the very same items tested on the same participants yield results as predicted in Experiment 2, this is unlikely. Second, the method might not be suitable: the actual differences in reading times are significant but small. Maybe differences in processing complexity with a two-word and a five-word NP are too subtle to be captured by an experimental method that still requires an active response, a press of a button, and hence is only 'quasi'-online. A third potential reason also relates to the methods: in an offline task like the split rating task here, participants provide a reaction after processing has been completed. Subtle differences in processing load might not be relevant here. A fourth reason relates to the question of whose processing efficiency is at issue – the speaker's or the hearer's. Lohse et al. (2004) point out that a minimal domain has advantages for both phrase recognition and production. Gries (2002a, 2003) considers the difference between the speaker's and the hearer's processing effort 'not decisive' (2002a: 287), making reference to Arnold et al. (2000) who claim

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that a processing facilitation for the speaker corresponds to a facilitation for the hearer as well. However, corpus data are production data, a reading experiment collects perception data. The mismatch found here could hence imply that speakers choose particular constructions not so much to reduce the cognitive load for the hearer; they might do so to minimise their own processing effort (see Kunter 2017 for a discussion of this matter for the genitive alternation and adjectival comparison). Konieczny (2000: 644), who found a similar mismatch of online and offline data on German relative clauses, considers processing costs of distance dependencies to be 'primarily a production phenomenon'. Again, this is because the processing-based hypotheses receive support from corpus studies, and corpus data is production data. Konieczny (2000) suggests that judgment tasks – even though they are usually considered to be perception experiments – might comprise production components because participants compare the sentence they rate against a possible alternative which they have to generate first. In the task that was used here, the split rating task, the alternative is given, that is, subjects do not have to produce the structure. Still, comparing two alternatives to determine which one sounds more natural might involve production strategies. This could explain why the rating task reflects the corpus findings from previous studies.

As pointed out above, the results from Experiment 1 have to be taken with a grain of salt: the differences are significant but rather small. What is more, the experiment tested the phenomenon in one particular syntactic context, simple clauses with a postverbal temporal modifier. For more robust conclusions, further studies are needed. These should test a wider range of syntactic contexts and manipulate the complexity of the direct object to a greater extent than has been done here.

So, in the light of the above, which one of the two variants is the non-canonical one? As has been pointed out in Section 10.2, the split particle verb has information-structural properties that could motivate its existence. The data presented here suggest that there could be an additional function: a split particle verb provides a clear signal of the boundaries of the direct object, which could reduce cognitive complexity, at least up to a certain cut-off point. These two aspects could be argued to motivate the existence of a non-canonical, discontinuous construction. The continuous order, in contrast, could *also* qualify as the non-canonical variant whose use is motivated by similar processing factors: corpus studies have shown that the longer the direct object, the less likely the split, as discussed in Section 10.2. Even though this has not been tested in the experiment reported here, it seems plausible that this is because once a distance dependency exceeds a certain length, cognitive complexity increases. A frequency-based approach to non-canonicity does not resolve the issue of a categorisation either, as the distribution of the variants differs across modes and depends heavily on the nature of the direct object. This may not seem like a satisfying answer, but it highlights the fact that 'the syntactic canon is elusive' (Pham & Leuckert, Chapter 1 in this volume) and that we are looking at a moving target here.

Appendix

Table 10.4 *Fixed effect structure of final model for* PrepRTSc *(spillover region)*

	Estimate	*t* value	*p* value
Intercept	3.234e-01	4.626	2.56e-05
Trial	−4.349e-03	−8.262	3.73e-16
CritRTBcnSc	2.314e-01	10.024	< 2e-16
PreCritRTBcnSc	2.882e-01	11.952	< 2e-16
Order=split	−1.326e-01	−4.624	4.20e-06

Table 10.5 *Fixed effect structure of final model for* NounRTLogSc *(wrap-up region)*

	Estimate	*t* value	*p* value
Intercept	−4.961e-03	0.056	0.95541
TrialSc	−1.253e-01	−8.783	< 2e-16
AgeSc	2.393e-01	3.018	0.00459
ArticleRTSc	3.815e-01	17.568	< 2e-16
Order=split	1.990e-02	0.388	0.69822
Complexity=simple	−4.210e-02	−0.706	0.48114
Idiomaticity=transparent	−6.443e-02	−1.106	0.26989
Order=split: Complexity=simple	6.061e-03	0.084	0.93322
Order=split: Idiomaticity=transparent	1.418e-01	1.436	0.15126
Complexity=simple: Idiomaticity=transparent	1.418e-01	1.896	0.05815
Order=split: Complexity=simple: Idiomaticity=transparent	−2.364e-01	−2.237	0.02545

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Table 10.6 *Fixed effect structure of final model for* SentenceRTLogSc *(whole sentence)*

	Estimate	t value	*p* value
Intercept	0.50860	3.887	0.000348
TrialSc	−0.20572	−18.580	< 2e-16
Complexity=simple	−0.97000	−21.086	< 2e-16
Idiomaticity=transparent	−0.05846	−1.331	0.183443
Order=split	−0.05499	−1.291	0.197034
Complexity=simple: Idiomaticity=transparent	0.09006	1.444	0.148963
Complexity=simple: Order=split	0.05756	0.954	0.340232
Idiomaticity=transparent: Order=split	0.06749	1.089	0.276533
Complexity=simple: Idiomaticity=transparent: Order=split	−0.19325	−2.198	0.028139

Table 10.7 *Fixed effect structure of final model for Experiment 2*

	Estimate	t value	*p* value
Intercept	35.589	18.005	< 2e-16
Order=joined	17.568	5.494	6.46e-07
Complexity=complex	−6.829	−5.041	5.39e-07
Idiomaticity=transparent	7.968	3.453	0.00141
Order=joined: Complexity=complex	8.475	5.293	1.44e-07
Order=joined: Idiomaticity=transparent	−15.650	−4.713	5.34e-05
Complexity=complex: Idiomaticity=transparent	3.383	2.104	0.03557

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