Ungrammatical Sentences Have Syntactic Representations too

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Abstract

A number of experiments have found structural priming effects for grammatical sentences but not for ungrammatical ones. This has led to the hypothesis that ungrammatical sentences do not have a syntactic representation, because this could explain the absence of a priming effect. In this article ungrammatical Danish sentences with heavy NP shift of the object to the right of the particle are investigated in an acceptability judgment study. A syntactic processing account predicts that the sentences should be easier to parse if the syntactic heads (the verb, the particle, and the head of the object) are as close as possible i.e., when the order is short-before-long. The result reveals that participants find the ungrammatical sentences more acceptable when the object is long. This is exactly what is predicted from a processing perspective and suggests that the ungrammatical strings indeed do have syntactic representations. Consequently, I argue that the hypothesis about structureless ungrammatical sentences should be abandoned.

1. Introduction

In this article I will present evidence suggesting that ungrammatical sentences have syntactic representations just like grammatical sentences do. The main finding (see section 2 below) is that the processing preference for sentences with short constituents preceding long constituents (henceforth short-before-long) can also be detected when comparing ungrammatical strings. Since the short-before-long preference is commonly assumed to

be related to the syntactic structure – it minimizes the distance between the syntactic heads and this facilitates processing (Hawkins, 1994, 2004) – the fact that the preference is still observed in ungrammatical sentences suggests that they have syntactic representations too, contrary to the suggestion in Sprouse (2007).

In head-initial languages, such as Danish and English, a strong tendency to place short constituents before long ones has often been observed, and this preference is usually ascribed to a processing advantage of the short-before-long order (Bresnan, Cueni, Nikitina, & Baayen, 2007; De Cuypere & Verbeke, 2013; Hawkins, 1994, 1998, 2004, 2014; Kizach, 2015; Kizach & Vikner, 2016; Seoane, 2009; Wasow, 1997). The syntactic heads of the constituents are simply closer together if the order is short-before-long in a head-initial language, as illustrated here with the particle construction in English (with the relevant syntactic heads in bold type):

(1)   a.   Bill threw [**out**] [**the** old suitcase].
        b.   Bill threw [**the** old suitcase] [**out**].

In (1)a, the heads of the constituents, *out* and *the*, are adjacent and the shorter phrase (*out*) precedes the longer phrase (*the old suitcase*). In (1) b, on the other hand, the two heads are not adjacent and the longer phrase precedes the shorter one. If we accept the standard assumption that parsing is an incremental process where the structure is projected/built based on the incoming words (cf. Ferreira & Slevc, 2007; Frazier, 1987; Pritchett, 1992; Van Gompel & Pickering, 2007), then the parser can project both constituents after processing only two words in (1)a, but in (1)b four words have to be processed before the structure can be projected. If processing matters for how we order the strings of words, we would expect the short-before-long order in (1)a to be more frequent than the long-before-short order in (1)b. Indeed, a corpus study of the English particle construction demonstrated that 74% of 1,684 examples had the predicted short-before-long order, and the longer the DP was, the stronger the preference became (Lohse, Hawkins, & Wasow, 2004, p. 243).

In Danish there is no choice between orders in the particle construction: only the equivalent of the English (1b), i.e. (2)b, is grammatical (cf. Vikner, 1987):

(2)   a.   *Bent smed [ud]   [den   gamle   kuffert].
               Bent threw out   the   old   suitcase
               'Bent threw out the old suitcase.'

b. Bent smed [den   gamle   kuffert] [ud].
    Bent threw the   old   suitcase out
    'Bent threw the old suitcase out.'

The question is whether the quite robust preference for short-before-long extends to ungrammatical sentences such as (2)a. That is, does the short-before-long order still give a processing advantage when we parse ungrammatical strings? If the short-before-long preference can also be observed in the processing of ungrammatical sentences, it would suggest that ungrammatical sentences also have syntactic representations.

Precisely the opposite was suggested by Sprouse (2007) who argued that strings that are not licensed by the grammar do not get a structural representation, which in turn explains the alleged lack of syntactic priming effects for ungrammatical sentences. Henceforth I will call this hypothesis the *No Structure Hypothesis* (abbreviated NSH). After being exposed to a specific syntactic structure, people are relatively faster when reading another sentence with the same structure (Balling & Kizach, 2015; Branigan, 2007; Kizach & Balling, 2013). The syntactic priming effect can also be measured in acceptability judgment experiments where a primed structure is judged more positively as a function of how much exposure it gets (Christensen, Kizach, & Nyvad, 2013; Luka & Barsalou, 2005). In other words – participants tend to rate a structure better and better the more they are exposed to it.

Sprouse (2007) investigated the subject, adjunct, *wh-*, and complex NP island constructions exemplified in (3), which are all considered ungrammatical in English, and found no priming effects for any of them. He argued that the explanation is that the ungrammatical strings are not assigned a syntactic structure and consequently, structural priming is not possible.

(3) a. *<u>Who</u> do you think the email from ___ is on the computer?
                                              (subject island)
     b. *<u>Who</u> did you leave the party because Mary kissed ___?
                                              (adjunct island)
     c. *<u>Who</u> do you wonder whether Susan met ___?
                                              (*wh*-island)
     d. *<u>Who</u> did you hear the rumor that David likes ___?
                                              (complex NP island)

However, Snyder (2000, p. 796) tested some of the same structures and reported priming effects for wh-islands and complex NP islands. These results have been partially replicated, but the reliability of these results have been debated (Crawford, 2012; Sprouse, 2009).

Christensen et al. (2013) found priming effects for grammatical strings in Danish, but not for ungrammatical strings, which supports Sprouse's (2007) NSH. However, Ivanova et al. (2012) examined sentences such as (4), where an intransitive verb is used as a ditransitive verb, and found priming effects despite the fact that the sentences were ungrammatical.

(4)　　*The waitress exists the book to the monk.

The NSH suggests that if the sentence is ungrammatical, the parser does not assign a structure to it. If this is indeed the case, then we would predict that the preference for short-before-long disappears in ungrammatical strings – there simply is no structure to project and consequently no word order can speed up the structure building process.

To test this prediction, I investigated the contrast between particles followed by pronominal DPs, one word nominal DPs, and DPs modified by a relative clause in Danish, as in (5) below.

(5)　a.　　*Anita smed　　　[væk]　[den].
　　　　　　Anita threw　　　away　it
　　　　　　'Anita threw away it.'
　　b.　　*Anita smed　　　[væk]　[banan-en].
　　　　　　Anita threw　　　away　banana.the
　　　　　　'Anita threw away the banana.'
　　c.　　*Anita smed　　　[væk]　[den　store　kasse　bananer
　　　　　　Anita threw　　　away　the　big　box　bananas
　　　　　　der　　　stod　i　　garag-en].
　　　　　　which　　stood　in　garage.the
　　　　　　'Anita threw away the big box of bananas which was standing
　　　　　　in the garage.'

All the examples in (5) are ungrammatical in Danish, so none of them should get a structural analysis according to NSH, and this means that the general preference for short-before-long word order should not affect the acceptability judgments of these sentences.

Heavy NP shift (Ross, 1967) is possible in other constructions in Danish (see examples in Drengsted-Nielsen, 2014, p. 166), and the strings in (5) have a word order that would in principle be derivable if the object was shifted to the right across the particle. However, it is ungrammatical to move the object in a particle construction to the right in Danish. But we already know from studies of English that heavy NP shift is more acceptable when the shifted object is longer than the constituent it moves across, and the acceptability increases as the length difference increases (Arnold, Wasow, Losongco, & Ginstrom, 2000; Hawkins, 1994; Wasow, 2002; Wasow & Arnold, 2003).

If the sentences in (5) have syntactic representations (even though they are ungrammatical), a processing theory such as Hawkins' (2004) would predict that the length/weight of the object DPs influence processing. In (5)a the object DP is pronominal (*den*) and contains just one maximal projection (a DP) – counting the number of XPs is a common way of quantifying the length/weight of constituents (Hawkins, 1994; Kizach, 2010, pp. 53-55; Szmrecsanyi, 2004; Wasow, 1997). In (5)b the object DP contains two XPs (a DP and an NP), and in (5)c the DP object contains more than five XPs. Hawkins (2004) predicts that the longer the DP is, the easier it becomes for the parser, and the higher the acceptability ratings should be. Notice that it is the relative weight that is important here: The benefit of displacing the long DP in (5)c is simply higher than it is in (5)b due to the greater relative weight difference. The grammatical DP-particle order, as in (2)b above, results in a long-before-short order which is difficult to process (and the longer the DP, the worse it gets) – the ungrammatical heavy NP shift, as in (5), will reduce the processing difficulty, but the price is ungrammaticality. The point is that this trade-off might be detectable in the processing of the sentences in (5), in which case we would expect an acceptability hierarchy such that (5)c is better than (5)b, which is better than (5)a – (5)c > (5)b > (5)a – precisely because of the processing benefit of short-before-long.

Note that Hawkins' (2004) theory is only used here to test Sprouse's (2007) hypothesis – if the NSH is right and ungrammatical sentences have no syntactic representations, Hawkins' (2004) theory would not predict anything either (the facilitating effect of having syntactic heads adjacent is only relevant for strings with a syntactic representation, not for e.g. shopping lists).

If any differences between the conditions in (5) are found, it would potentially be problematic for the NSH, but we know that the absolute length of a constituent affects acceptability negatively. Christiansen & MacDonald (2009) varied the length of DP constituents and compared sentences as those in (6).

(6) a. The boss from the office says that <u>the posters across the hall</u> tell lies.
　　b. The boss says that <u>the posters in the office across the hall</u> tell lies.
　　c. <u>The posters on the desk in the office across the hall</u> tell lies.

Note that the underlined DP constituents are modified by one, two and three PPs respectively, and that (6)a and b contain embedded clauses. Christiansen & MacDonald (2009, pp. 141-142) report that the acceptability of the sentences in (6) is correlated with the length of the DPs. This means that (6)a is judged to be better than (6b) which is better than (6c) – the result suggests that even increasing the length of a DP with a single PP can decrease the overall acceptability.

So if the results show that there are differences between the sentences in (5) it may just be this absolute length effect and the NSH could still be right. The hierarchy predicted by Hawkins (2004) is in the opposite direction: The longer the DP, the *higher* the acceptability should be. If the results show this pattern it would lend further support to the idea that the NSH should be abandoned.

The evidence for the NSH is based on null-results – Sprouse (2007, p. 127) found no priming effects for various island-violations, and Christensen et al. (2013, p. 58) found no priming effects for ungrammatical sentences. In the experiment presented below the NSH would again predict a null-result (or a slight preference for shorter sentences as mentioned above), but by introducing Hawkins' (2004) theory we have an alternative prediction that is the opposite of NSH's prediction.

In summary, NSH predicts no difference (or a preference for short sentences) in acceptability between the sentences in (5), but Hawkins' (2004) theory predicts the following acceptability hierarchy: – (5)c > (5)b > (5)a.

2. The experiment – the particle construction

For this experiment I chose the acceptability judgment task to test the predictions instead of a task that would give me a reaction time measure (RT) such as self-paced reading or eye-tracking. The reason was that the

prediction of Hawkins' (2004) theory is that the shortest sentences should be the hardest to process, and we know that RT increases with sentence length. This means that an RT measure might hide the increased processing load (the shorter sentences increase RT, but on the other hand they are of course faster to read than the longer ones, so the effect might be neutralized and undetectable). Previous research has shown that processing difficulty affects acceptability ratings, so even completely grammatical sentences, such as e.g. *wh*-questions as in (7) get a lower mean acceptability rating than similar sentences without *wh*-movement (8) (Christensen et al., 2013; Fanselow & Frisch, 2006).

(7)   Hvad   ved   hun   godt at   man   kan   leje   dér?
      what   knows   she   well that   one   can   rent   there
      'What does she know that one can rent there?'

(8)   Hun   ved   godt at   man kan   leje   noget   dér.
      she   knows   well that   one can   rent   something   there
      'She knows that one can rent something there.'

The acceptability judgment task was thus ideal for my purposes since I could measure the processing difference and avoid the confounding effect of total length.

2.1 Participants, materials and methods

12 sets of sentences as in (5) were created and divided into three lists ensuring that each participant saw an equal number of items from each condition but never the same item in more than one condition. In addition to the experimental items each list contained 15 fillers which ranged from completely acceptable (9) to completely unacceptable (10) sentences. Google Forms on Google Drive was used to create the lists and collect the data.

(9)   Sonja   talte   i   telefon   med   en   veninde.
      Sonya   spoke   in   phone   with   a   friend
      'Sonya talked on the phone with a friend.'

(10)   *Omend   ham   så   gik   det jo   alligevel.
       Although   him   so   went   it   nevertheless   anyway
       'Even though him it went ok nevertheless anyway.'

Links to the lists were made available on-line on the Facebook site *Psycholab* (a forum for students at Aarhus University interested in syntax) and seventy people participated (18 males). The mean age was 24.3 with a range from 20 to 61.

An instruction was shown at the beginning of each list. The English translation of the instruction is: "*Judge the sentences on a scale from 1 (completely unacceptable) to 7 (completely acceptable). Try to follow your immediate intuition, and do not be affected by what you have been taught in school – there are no right or wrong answers here.*"

2.2 Results

As predicted, the results showed a (5)c > (5)b > (5)a acceptability hierarchy, as summarized in the table below:

Type of object	Example	Mean rating
Pronoun	(5)a	1.6
Nominal DP	(5)b	2.2
DP with a relative clause	(5)c	2.7

Table 1: Mean ratings across participants on a scale from 1 (completely unacceptable) to 7 (completely acceptable)

To see whether the mean ratings were statistically significant from each other, the data was analyzed with a linear mixed-effects model following the recommendations and practices common in the field (Gibson, Piantadosi, & Fedorenko, 2011; Sprouse, 2008). The software R and the R-package lmerTest were used to perform the analysis (Kuznetsova, Brockhoff, & Christensen, 2015; R Development Core Team, 2015).

The dependent variable was the acceptability score and the independent variable was condition – a factor with three levels as illustrated in (5) above (pronominal DP, nominal DP, and nominal DP modified by a relative clause). The so-called maximal model was fitted to the data (Barr, Levy, Scheepers, & Tily, 2013), and comparisons with the zero-correlation-parameter model did not justify a simpler model (Bates, Kliegl, Vasishth, & Baayen, 2015), and consequently the maximal model is reported. The reference level for the condition factor was set as the nominal DP because the question was whether the pronominal DP and the nominal DP modified by a relative clause where different from this reference level.

The results (see Table 2) showed that acceptability was significantly higher as a function of the length of the DP ($p<0.05$). In other words, the condition with pronominal DPs was judged to be less acceptable than the one with nominal DPs which was less acceptable than the one with DPs modified by a relative clause.

	Estimate	Std. Error	t-value	*p*-value
DP with a relative clause	0.451	0.197	2.288	0.045
Pronominal DP	-0.602	0.177	-3.396	0.004

Table 2: Results of the linear mixed-effect model – both rows show the comparison to the nominal DP condition

The analysis showed that the acceptability of the sentence types illustrated in (5) exactly followed the hierarchy predicted by Hawkins' (2004) model: (5c) > (5b) > (5a). The longer the DP, the higher the acceptability rating.

2.3 Discussion

The NSH is based on the absence of priming effects for ungrammatical strings in acceptability judgment experiments (Christensen et al., 2013; Sprouse, 2007), but as mentioned in the introduction, others have reported priming effects for ungrammatical sentences in English (Crawford, 2012; Ivanova et al., 2012; Snyder, 2000).

The prediction based on Hawkins' (2004) processing theory was fully borne out: the ungrammatical heavy NP shift resulting in the word orders we see in (5) is comparatively more acceptable with a longer DP. I interpret this as evidence for syntactic structure even in ungrammatical strings, since the prediction is based on the facilitating effect of having the syntactic heads close together.

Taken together the previous research and the experiment presented in this article seem to refute the NSH in its present form. One could, however, change the NSH to a universal version which would predict that there will be no priming effects for a structure only if it is disallowed by any possible grammar. In other words, only if the structure somehow violates universal principles will it fail to induce priming effects. In the following, I will briefly discuss this idea.

Three of the four island constraints investigated in Sprouse (2007) do not hold in Danish where there are grammatical examples with adjunct, *wh-*, and complex NP islands violations (Nyvad, Christensen, & Vikner,

2017, pp. 453-461). In Norwegian too there are grammatical examples with complex NP island violations (Åfarli & Eide, 2003, p. 268). Finally, Phillips (2006, p. 796) report that extraction from a subject island is acceptable in parasitic gap constructions in English as exemplified in (11):

(11)   What did the attempt to repair ___ ultimately damage ___?

The ungrammatical Danish example that fails to induce priming effects reported in Christensen et al. (2013, p. 55) is shown in (12).

(12)   *Ved   hun godt   hvor   hvad   man   kan leje?
        knows   she well   where   what   one   can rent
        'Does she know where what you can rent?'

In (13) a very similar but fully grammatical Czech construction is shown (Veselovská, 1993, p. 31; her (1c)):

(13)   Zajímá   mě   kdo   co   přinese.
        wonder   me   who   what   brings
        'I wonder who will bring what.'

Furthermore, the even more parallel (14) is perfectly grammatical, according to my two Czech informants.

(14)   Zajímá   mě   kdy   co   Petr   přinese.
        wonder   me   when   what   Peter   brings
        'I wonder when Peter will bring what.'

It seems that most of the structures examined in Sprouse (2007) and the ungrammatical one examined in Christensen et al. (2013) are all ungrammatical only because the English and Danish grammars happen to rule them out, not because they are in violation of what is possible in language as such. The only possible candidate among them for a universally ungrammatical structure is the subject island, but even extraction from this island type is possible in the right circumstances (namely in parasitic gap constructions as shown in Phillips, 2006). In summary, the examples investigated in Sprouse (2007) and Christensen et al. (2013) do not allow us to conclude anything about the universal version of the NSH. This means that it might still be true that sentences that somehow violate universal

principles may lack a structural representation, and as a result structural priming might not be possible with these structures. It is, however, not completely clear what structures this would concern. Given the flexibility of X-bar syntax it is difficult to imagine a sentence with a word order that is somehow against universal grammar. The reviewer pointed to a study by Musso et al. (2003) where participants attempted to learn artificial grammatical rules that were either natural, i.e. in correspondence with universal grammar (e.g. forming passive using a suffix on the verb), or unnatural (e.g. marking past tense with a suffix on the second last word in the sentence). An increased activation in Broca's area over time was observed in the learning sessions using the natural rules, but none was observed for the unnatural ones (Musso et al., 2003, p. 778), and this suggests that the unnatural rules simply cannot be learnt, and then maybe these sentences might not have a structural representation. Note, however, that this finding concerns rule types and not simply word order variation – so it seems as if the universal version of the NSH might possibly be true, but may have very little practical relevance (it may concern a very limited set of sentences).

3. Conclusion

The results reveal two things. First, ungrammatical sentences appear to be subject to the same processing constraints on relative length as grammatical sentences. The ungrammaticality of the examined Danish sentences is due to the fact that heavy NP shift of the object across the particle is not allowed by the Danish grammar. Nevertheless, there is a positive correlation between the acceptability of ungrammatical heavy NP examples and the relative length (weight) of the DP immediately following the particle: the longer the better – precisely as is the case with grammatical examples of heavy NP shift in English (Arnold, Wasow, Losongco, & Ginstrom, 2000; Hawkins, 1994; Wasow, 2002; Wasow & Arnold, 2003). The same pattern is observed for grammatical and ungrammatical sentences, demonstrating the similarity between processing grammatical and ungrammatical strings.

Second, the NSH is not accurate. Previous studies have found priming effects for ungrammatical sentences, and the present results strongly suggest that the processing of ungrammatical sentences is subject to the same constraints as the processing of grammatical ones.

The conclusion is that we should simply abandon the idea that the absence/presence of structural priming effects in acceptability judgment experiments correlates with grammaticality in a straightforward way.

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