A Short Excerpt from my PhD Thesis

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I would like to actually READ a passage from my doctoral thesis. I hope that this will lead to a better understanding of my view on the phenomena discussed than a mere oral, informal presentation. The first topic concerns adverb placement. I thought that this subject might be interesting for people from our department, who like rich cartographic projections, hierarchies, or - for our nanosyntacticians - fseqs. As you may know, I'm not a huge fan of these approaches to syntax. Please stop me at any time - I would prefer to cover less material in detail than a lot of material superficially. Ellipsis marks, [...], indicate that I left out some material. Sentences in [**boldface**] summarize what was deleted.

1

Adverb Placement in Modern English

[I discuss various Modern English word order diagnostics differentiating between auxiliaries and main verbs. A well-known diagnostic is negation: *I am not studying*, **I study not*. Adverb placement is another property that distinguishes between auxiliaries and main verbs.]

The position of adverbs differs substantially between sentences with and without auxiliaries. Adverbs are placed in front of finite transitive verbs, (1a), and cannot occur post-verbally before a verbal complement, (1b). However, the adverb diagnostic for the distinction between auxiliaries and lexical verbs is not always as stringent as the negation context. While adverbs typically occur after auxiliaries, (1c), they are often also acceptable in pre-auxiliary position, (1d). The former option, however, is considerably more common (Huddleston and Pullum 2002: 780).

(1) a. John **probably** visited Spain.
b. * John visited **probably** Spain.
c. John has **probably** visited Spain.
d. ok John **probably** has visited Spain.

There is a vast body of literature on adjunction in general and adverbs in particular. It is impossible to distill from the myriad of different (and often incompatible) analyses one that could be incorporated into my model as a version of the current consensus. Instead, I shall try to sketch, in as general terms as I can, the most important issues in the syntax of adverbs, and justify my decisions for how to address each of them.

[The subsequent paragraphs list a number of properties that distinguish the adverbial modifiers that I am interested in from other elements. I will delete this discussion except the following point, which I think is particularly interesting.]

(4) The relevant adverb must modify propositions: The adverbs I am interested in should, at least *prima facie*, allow for an analysis as propositional modifiers. They combine with propositions to yield propositions, i.e., they are elements of type $< t, t >$ (Halverson 1983). [...] It is sometimes doubted that any specific class of sentential adverbs could uniformly consist of propositional modifiers (e.g., Delfitto 2006: 90). In fact, it is usually difficult to determine the semantic type of any adverb. One relatively foolproof argument for an adverb's status as a propositional modifier consists in demonstrating that it participates in scopal ambiguities (for instance with generalized quantifiers in argument positions, e.g., Ruys and Winter 2011: 168). This is illustrated in (2).

(2) a. *The school festival used to involve a clown that all children found funny.*
All students **sometimes** laughed.
$sometimes(\forall x[student(x) \rightarrow laugh(x)])$
b. *Even the best students couldn't always pull themselves together.*
All students **sometimes** laughed.
$\forall x[student(x) \rightarrow sometimes(laugh(x))]$

In (2a), the subject scopes below the adverb yielding a cumulative reading ('it is sometimes the case that all students ...') whereas (2b) has the subject with wide scope resulting in a distributive reading ('for all students, sometimes ...'). Hence, an entire proposition must apply to the adverb, as sketched in the semantic formulas in the above examples. In contrast, manner adverbs do not engage in such scope ambiguities.

(3) *The teacher used to make a lot of bad jokes.*
All students **politely** laughed. (no scope ambiguity)

Unfortunately, it is difficult to use scope ambiguities as a reliable test for an adverb's semantic type. The scope ambiguities are often so subtle that it becomes difficult to see truth-conditionally relevant meaning differences. Moreover, the test requires the adverb to quantify over a (a set of) elements like times, worlds etc. But it is conceivable that an adverb is not quantificational in that sense and still scopes over a proposition. Hence the test may identify some but not all adverbs of type $< t, t >$.

[After a discussion of the adverbial properties that I am interested in, I give the following summary:]

To summarize, the adverbs that remain as potential candidates for the corpus study in the second half of this chapter are non-manner adverbs that can occur immediately before and / or after an auxiliary, but not normally in between a full lexical verb and its complement, and in a *be the case that...* paraphrase. Some examples of such adverbs are shown in the example below.

(4) a. Mexicans {**frequently** / **never** / **certainly**} will answer polls the way they think sounds best.
b. ≈ Mexicans will {**frequently** / **never** / **certainly**} answer polls the way they think sounds best.

[...]

Having identified the relevant adverbs for this study, I will now consider the best way to analyze them syntactically. In principle, there are two ways to model the initial observation that adverbs and verbs can be variably positioned relative to each other. The first possibility is that adverbs are fixed in one position (given an information-structural and syntactic context), and verbs are placed in a number of different positions before and after the adverbs. One of the most influential accounts of this option is the cartographic functional sequence of adverbs (Cinque 1999). Couched in derivational terms, it says (i) that verbs can move to higher or lower head positions of projections whose specifiers can be realized as adverb phrases, (ii) that these projections are rigidly ordered in the syntax as a hierarchy, and (iii) that this hierarchy is universal across all languages. A typical example of data that is cited in support of these claims is shown in (5).

(5) *Italian*
a. Non hanno mangiato **mica** **più**
b. Non hanno **mica** mangiato **più**
c. Non hanno **mica** **più** mangiato
not they-have (eaten) not (eaten) any-longer (eaten)
'They didn't eat any longer' (adapted from: Cinque 1999: 47, examples (7)-(11))

In this example, the adverb *mica* must necessarily precede the adverb *più*; the inverse ordering is ungrammatical in any configuration. The non-finite main verb can come before, in between or after this adverb sequence. This may indicate that "verbs, not AdvPs, can occupy different positions within a certain [...] 'space'" (ibid.: 51). Adopting this analysis for adverb placement in the English examples (1c) and (1d), one could thus claim that there are two positions for the finite perfect auxiliary *has* available, one before and one after the invariantly positioned adverb *probably* (ibid.: 109).

The second option is to assume that verbs are fixed in one position (given an information-structural and syntactic context), and that adverbs are placed in a number of different positions around them. There is currently no one model of this approach to adverbs that could be regarded as prototypical and dominant in the field. Instead, a large number of different proposals exist that roughly agree on variable adverb positions but differ substantially in detail (e.g., Jackendoff 1972, Potsdam 1998, Ernst 2002, Ramchand and Svenonius 2014; for an overview, see Haumann 2007: 71-102). In my understanding, these models all share the following basic assumptions. (i) Adverbs come in a (relatively) small number of classes that are ultimately determined by their lexical semantics, and specifically by the semantic type they select for. For instance, some adverbs modify propositions and are sentential in that sense, so called S-adverbs, while other adverbs are related to events or processes expressed by the verb phrase, so-called VP-adverbs (terminology from Jackendoff 1972 and Potsdam 1998, similarly Dalrymple 2001: 269-74, who discusses the difference between sentential *obviously* and manner *skillfully*; Ernst 2002 and Ramchand and Svenonius 2014 have a considerably more complex ontology). (ii) Adverbs are not sequentially ordered in a hierarchy. Rather, particular orders follow from a number of

unrelated factors. Perhaps most importantly, rules of semantic composition (e.g., Ernst's (2002) Fact-Event Object Calculus, Ramchand and Svenonius' (2014) "sortal domains") force a particular syntactic position for an adverb of a particular type to combine with an appropriate semantic argument. Such compositional rules are used, for instance, to account for the general order of S-adverbs before VP-adverbs, as in (6) (see also Ernst 2002: 127 for examples of the same kind within his system; see Bulkley Cobb 2006 for a feature-based implementation in LFG).

(6) a. Hulk Hogan [evidently]$_{S}$ [completely]$_{VP}$ annihilated his opponent.
b. * Hulk Hogan [completely]$_{VP}$ [evidently]$_{S}$ annihilated his opponent.
(from: Potsdam 1998: 402, ex. (18))

[I discuss some other factors that have been said to determine adverb placement.]

(iii) Finally, models of variable adverb positions tend to employ as their formal mechanism for adverb placement Chomsky-adjunction to specific syntactic categories. If one were to adopt an analysis along these lines, the English examples (1c) and (1d) would involve two adverb positions, one before and one after the invariantly positioned auxiliary *has*.

[I briefly argue that it is difficult to decide between Cinque and traditional adjunction on traditional grounds. I therefore want to conduct an experiment that could be informative.]

My Grammaticality Judgment Experiment - Yay

In order to base my answer to this question at least on some empirical material, I decided to conduct a grammaticality judgment experiment.

Hypothesis

The experiment[1] made use of the three non-manner adverbs *possibly*, *often* and *no longer*. These adverbs are of the type identified above as relevant for the current study. Furthermore, Cinque provides an explicit ordering relation between them by identifying dominance of the possibility modality (*possibly*) over the frequentative(I) aspectual (*often*) over the terminative aspectual (*no longer*) heads, as shown below.

(7) [*possibly* Mod$_{\text{possibility}}$ [... [*often* Asp$_{\text{frequentative(I)}}$ [... [*no longer* Asp$_{\text{terminative}}$ ...]]]]
(adapted from: Cinque 1999: 106, ex. (92))

Note that Cinque includes a second frequentative head lower in the structure, called aspect frequentative(II). Its specifier can also be realized by the adverb *often*. The adverb *often* of the higher head takes wide scope over the whole proposition, can be paraphrased as "it is often the case that ..." as well as by binding a bare subject DP with 'most' (*Texans often drink beer* ≈ 'Most Texans drink beer,' ibid.: 26). This is the kind of *often* that I am interested in here. In contrast, the adverb *often* of the lower head "indicates the *repetition* of the act denoted by the verb" (ibid.), i.e., it scopes over the event expressed by the verb phrase only, and usually occurs post-verbally (*Texans drink beer often* ≈ 'Typically all Texans drink beer more times than is usually the norm,' ibid.: 26-7). This is not the kind of interpretation of *often* targeted in my experiment. It is therefore fair to say that Cinque would predict the default word order *possibly* - *often* - *no longer* in sentences in which all three adverbs appear. Models of variable adverb placement, on the other hand, would predict that the relative order of these three adverbs is not inherently fixed but depends on their relative scope.

[1] The raw data in the form of 100 survey responses and a summary excel sheet can be found on the Dissertation DVD under `Chapter 2 - Possessive Have/01 Adverb Scope Study`.

Material and Procedure

The material for the experiment consisted of six test sentences and associated contexts. The test sentences were all passives involving the auxiliary *are* followed by the three adverbs in a row and a past participle. The contexts were meant to induce a particular scopal reading for the three adverbs, which might be mirrored by a corresponding surface word order. The first context targeted the scope corresponding to the word order predicted by Cinque, *possibly - often - no longer*. The other five contexts were designed to work best with one of the remaining scopal orders. Example (8) shows the six contexts and test sentences with the targeted adverb surface orders reflecting the most appropriate underlying scope.

(8) a. Context: People who are looking to purchase a house absolutely always had to pay a 20% down-payment in the past. However, economists believe that in many situations banks do not require any down-payments anymore at all! Surveys among banks are now being conducted to find out if that's really true.
Down-payment are **possibly often no longer** required on conventional mortgages.

b. Context: Planets outside of our solar system, so-called 'exoplanets,' have never been photographed before. Scientists will now attempt to take pictures of them for the first time. Their photography experiment will begin in December, and then continue once a week for the next 5 years. Hence, there will be very many situations in which the scientists might perhaps be able to see exoplanets directly.
Exoplanets are **often possibly no longer** blocked from our direct view.

c. Context: Newspapers have reported, incessantly and all the time, that cigarettes were the number one cause of cancer. But recently the incidence of lung cancer in smokers has declined sharply, perhaps as a consequence of the introduction of less harmful electronic cigarettes. Research is now under way to test if this is also reflected in a lower number of newspaper articles that are critical of smoking.
Cigarettes are **possibly no longer often** mentioned as a dangerous drug in newspapers.

d. Context: Based on certain evidence, one was justified in assuming for a long time that vaccines played a role in the development of autism. However, most (though not all) vaccines have now been proven beyond any reasonable doubt to be absolutely safe. In a great number of cases, it really is not plausible anymore to believe that vaccines contribute to neurodevelopmental disorders in any way.
Vaccinations are **often no longer possibly** associated with autism.

e. Context: Nurses used to face the possibility of catching a dangerous disease from their patients in many different situations: They could potentially get infected, for example, when they performed physical examinations, when they took someone's temperature, when they repositioned a patient, and so on. However, a new drug for nurses has been developed. It will definitely prevent 100% of all care-associated infections from now on.
Nurses are **no longer often possibly** exposed to communicable diseases.

f. Context: The international catalog of diseases was very imprecise. It might have led to diagnosis mistakes. Some doctors say that 3% of all diagnoses were wrong, but others believe mix-ups might have occurred as frequently as 8 out of 9 times. Nobody knows how often wrong diagnoses were made, but it is clear that it could have been frequently. Luckily, 100% of all confusion has now been removed from the disease catalog. Diseases definitely won't be misdiagnosed anymore.
Diseases are **no longer possibly often** diagnosed incorrectly.

The experiment took place in the form of an online survey designed with the Qualtrics platform. 100 participants were recruited from the online crowdsourcing marketplace Amazon Mechanical Turk. They were asked to take the survey only if they were native speakers of American English and their IP address was tracked to United States territory. Every participant was paid 75 US cents for their participation. On average, the experiment lasted about 6 minutes.

The experiment proceeded as follows. Participants were told that they were taking part in a science comprehension study. They first had to order adverbs in two test questions where the relative adverb order was uncontroversially fixed (speech act adverb before modal adverb, similar to (6) above; *not* preceding negative polarity item *any longer*). They were then randomly presented with two out of the six contexts in (8). They had to answer a very simple comprehension question about the context to ensure that they had read it attentively. Next, the participants were asked to select one of the six possible relative orders of *possibly*, *often* and *no longer* in the passive test sentences and confirm their answer by selecting the same word order again. The six possible answers were presented in a randomized order in both trials. If a participant either did not answer the comprehension question correctly or gave two different adverb word orders, their response was not considered for evaluation for that test item. Finally, participants were asked to rate the grammaticality of the sentence they had formed on a Likert scale ranging from 0 to 6. A filler was included between the two test items.

Predictions

I designed the experiment so as to make two different predictions under the hierarchical model of adverbs and the adjunction model of adverbs. If the order between adverbs is fixed, which could be attributed to a syntactic hierarchy of projections, then one should expect one word order (presumably Cinque's *possibly* - *often* - *no longer*) to emerge as dominant across the six test conditions. If, on the other hand, the order between adverbs is not inherently fixed, but rather due to surface reflections of underlying semantic scope, then one would predict a different, namely the targeted, word order to be predominant for each of the six contexts.

Results

The results of the experiment are as follows. Firstly, a surprisingly large number of responses had to be rejected. In total, I collected 200 responses (2 randomly chosen test items for each of the 100 participants). Of those, only 106 could be accepted. The remainder of the responses involved incorrect answers to the comprehension question or the submission of two contradictory word orders for the same test sentence. This may indicate either that the task was quite difficult or else that the recruited participants did not take the task seriously but just answered the questions quickly to receive their compensation. As a result, I skewed the probability with which certain contexts were displayed to the participants about halfway through the experiment to collect a comparable number of acceptable responses for each of the six contexts.

Secondly, the 106 accepted responses showed that the relative order of the three adverbs did indeed correlate with the scopal readings implied by the contexts. For each of the six context in (8a) - (8f), the word order targeted for that context emerged as the most frequent. The only exception was context six, (8f), for which the number of responses of the targeted word order shared the highest rank with two other word orders. These results are illustrated by the barplots in figure 1.1.

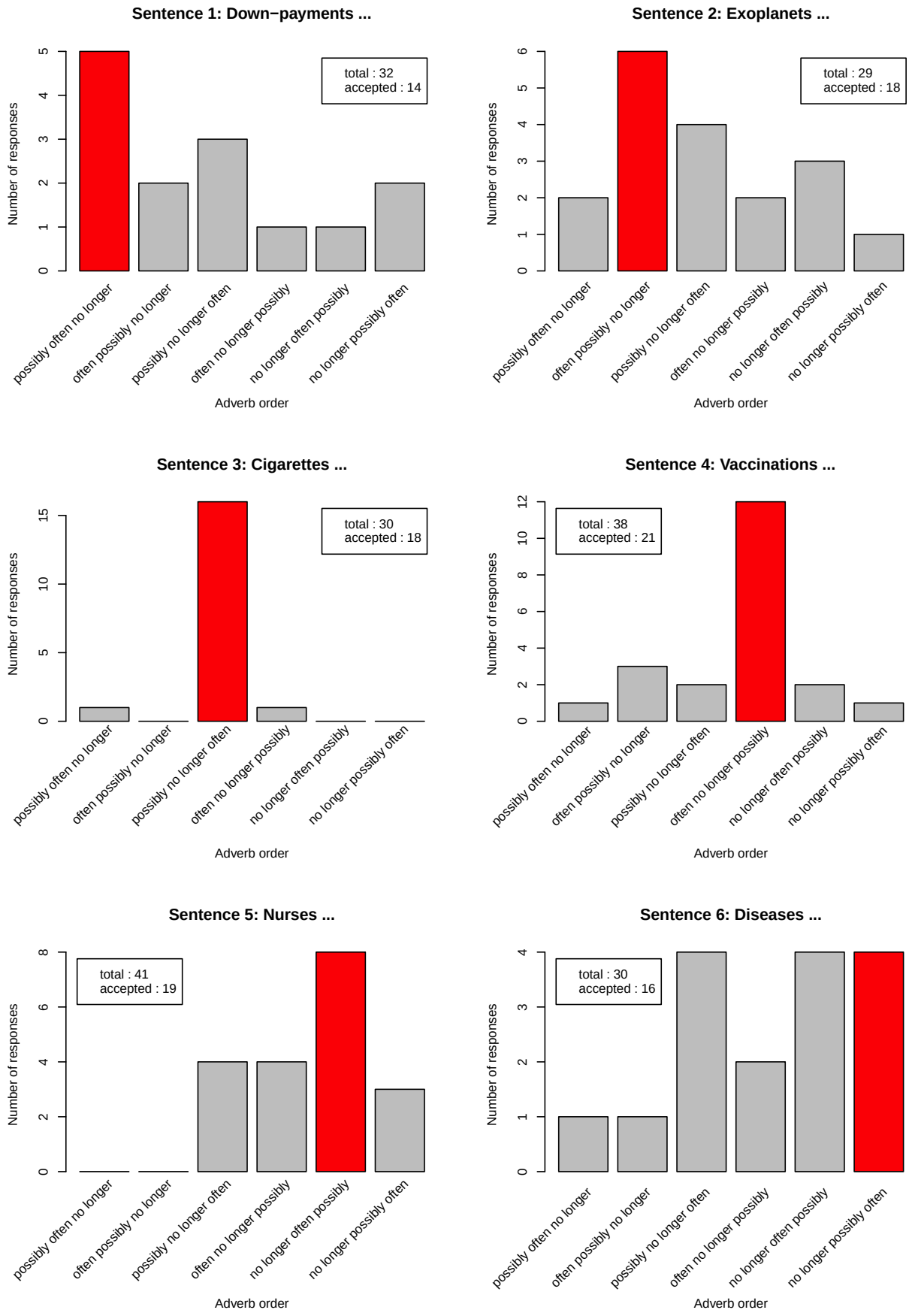

Figure 1.1: Results of the adverb ordering task

The six barplots correspond to the six test sentences in (8a) - (8f). Each plot indicates the six possible orderings of the three adverbs *possibly*, *often* and *no longer* on the x-axis and the frequency with which participants chose a particular word order on the y-axis. The dark gray bar highlights the word order targeted for that context. For each sentence, the dark gray bar has the largest number of responses. It is possible to test statistically if the targeted word order appeared significantly more often than would be expected by random chance. Assuming a binomial distribution in which each of the six word orders has a probability of 1/6 and the number of accepted responses corresponds to the number of trials (i.e., the participants were randomly picking a word order), one can calculate the probability of finding the observed number of responses or more as 1− the cumulative probability function up to the observed value minus 1. For example, the reasoning for context 1 is as follows: If the probability of choosing the order *possibly - often - no longer* is just 1/6, then the probability of finding 5 or more such responses out of a total of 14 accepted responses would be p= 0.069. Similarly, the probability of finding at least the observed number of responses of the targeted word order would be p=0.065 in context 2, $p<$ 0.001 in context 3, $p<$ 0.001 in context 4 and p=0.008 in context 5. Solely context 6 has a substantially higher p-value at p=0.271. Sentence 6 might be associated with a target word order that is genuinely harder to intuit than the others, or its context might have been poorly designed so that it did not provide enough information on the intended scope. Even though not all targeted word orders reached a significant value at the 5% level, and context 6 did in fact display quite a high chance of random guessing, the overall low p-values and consistent biases towards the targeted word orders suggest that participants were not picking word orders at random but were instead guided by the information provided in the contexts. This, then, lends support to the presence of a scope effect in the determination of surface adverb order and thus to the hypothesis that the order between adverbs is not inherently fixed. Furthermore, it is clear that the frequencies of the adverb word orders is very different across the six test items. For example, a Fisher's Exact test yields a significant difference between the frequencies of Cinque's default order *possibly - often - no longer* and all other word orders combined across the six contexts, p=0.021. Therefore, it seems very unlikely that the six response patterns are drawn from the same distribution. This argues at least somewhat against the hypothesis that one word order could constitute a default.

The third main finding of my experiment is that there may nevertheless be some evidence for a default order in the data. However, if there is a default order at all, it must be *possibly - no longer - often* rather than Cinque's *possibly - often - no longer*. This sequence is the most frequent order overall (33 of 106 responses) and significantly more common than would be expected by random chance, $p<$ 0.001. The context targeting this word order (sentence 3) yielded the least ambiguous result (16 targeted responses out of 18 responses) and the word order was also the strongest competitor to the targeted order in 4 out of the remaining 5 contexts. However, the principal reason why the word order *possibly - no longer - often* appears so frequently is precisely because context 3 yielded such unambiguous results. If test sentence 3 is removed from the data, this word order does not occur significantly more frequently than expected by random chance (17 of 88 responses), p=0.394. The evidence provided by this experiment in favor of a default adverb order thus remains relatively weak overall.

Fourth, one might speculate that a targeted word order was picked in its respective context simply as the result of some kind of puzzle solving activity but that one particular default order, possibly Cinque's *possibly - often - no longer*, actually sounded much more natural than all the others. Hence, the default order might be detected not through a task that forces participants to order adverbs in a context but rather through a grammaticality judgment task. To evaluate this conjecture, I calculated from the 106 accepted responses the mean acceptability rating for each of the six adverb orderings provided by the participants. The mean acceptability rating was also calculated for the filler item as a control. For the filler, participants had to order only two adverbs relative to each other, namely *no longer* before *slowly*, as shown in (9).

(9) Context: Due to a software bug, the Mars rover moved at an incredibly slow pace. Scientists at NASA have now fixed the problem. In the future, the rover will move much faster.
The Mars rover will **no longer slowly** move across the Martian surface.

The filler item showed a much higher success rate than the test items. 90 of 100 responses could be accepted; only 10% involved the untargeted word order, an incorrect answer to the comprehension question or the submission of two incompatible orders. The result of the grammaticality judgment task are shown in the barplot in figure 1.2. The six word order variants and the filler are shown on the x-axis, the height of the bar on the y-axis represents the mean of all the judgments given for that variant (with 6 being the most acceptable, natural or grammatical value), and the error bars represent one standard deviation above and below that mean. The ratings of every word order variant were compared to the ratings of every other word order variant to test for statistically significant differences between their means using Wilcoxon rank sum tests. These statistics are presented in table 1.1.

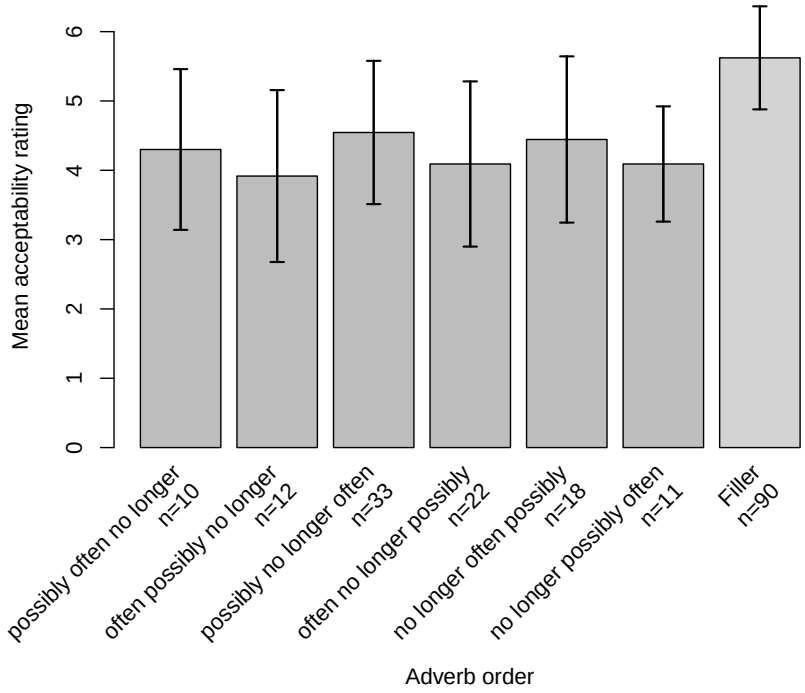

Figure 1.2: Grammaticality judgments for sentences with three adverbs and the filler

	often possibly no longer	possibly no longer often	often no longer possibly	no longer often possibly	no longer possibly often	Filler
possibly often no longer	W=72.5 p=0.406	W=147.5 p=0.609	W=124 p=0.566	W=84.5 p=0.804	W=63.5 p=0.553	W=137 p<0.001***
often possibly no longer	-	W=138 p=0.111	W=122.5 p=0.731	W=83 p=0.282	W=62 p=0.819	W=120.5 p<0.001***
possibly no longer often	-	-	W=444.5 p=0.147	W=309.5 p=0.806	W=230 p=0.174	W=585.5 p<0.001***
often no longer possibly	-	-	-	W=165.5 p=0.367	W=122 p=0.984	W=287 p<0.001***
no longer often possibly	-	-	-	-	W=118.5 p=0.376	W=334.5 p<0.001***
no longer possibly often	-	-	-	-	-	W=87 p<0.001***

Table 1.1: Wilcoxon rank sum tests for each word order pair

The six orderings of three adverbs all cluster around a mean acceptability score of about 4. Thus, participants seem to have found sentences involving three adverbs marginally acceptable irrespective of their specific word order alignment. Indeed, there are no statistically significant differences in the mean acceptability ratings for any pair of these orders. The control sentence with only two adverbs, in contrast, received an average rating of about 5.5. The filler sentence therefore seems to have been assessed as much more acceptable than any of the other sentences. This is also shown by the significance tests, which reveal significant differences in mean acceptability between the filler and each of the six configurations of three adverbs. The significant differences between the filler and the test sentences points towards an effect of the number of adverbs involved in a sentence. Sequences with 3 adverbs appear to be consistently less natural than sentences with a sequence of only 2 adverbs. Conversely, the fact that all of the three adverb orderings are equally acceptable makes it unlikely that any one of these alignments, in particular Cinque's presumed sequence, could constitute a default.

Discussion

In conclusion, my experiment provides some limited evidence against a hierarchical order of adverb sequences and in favor of scope effects in the determination of adverb orderings at least for the kind of adverbs that I am interested in here. Interestingly, Cinque himself recognizes in his concluding remarks that "many (perhaps most) of the relative orders among functional elements may ultimately reduce to scope relations among what we can take to be different semantic operators" (1999: 141). My experiment suggests that Cinque's reflection on this point is in fact correct. [...]

That's the end of my experiment

Before I continue to extend my grammar fragment accordingly, I would like to mention a few more arguments against the implementation of a model of adverbs that involves invariant adverb and flexible verb positions.
First of all, there appear to be some purely empirical problems with Cinque's model. It seems to make wrong predictions, at least for English (e.g., Edelstein 2012: 15-24, Zyman 2012).
Second, adjunction has traditionally been, and is still today, the most widely assumed formal device to integrate adverbs into the syntactic structure. It is also almost universally used in the LFG literature (see for example the guidelines for functional annotations to phrase structures rules in Bresnan 2001: 102, examples (21e), (22e)). Since it is my goal to construct as uncontroversial a model of Modern English clause structure as possible, it makes sense to me to follow the majority view regarding this issue.
Thirdly, and perhaps most importantly, it actually turns out to be extremely difficult to implement Cinque's theory in a formally rigid manner. Specifically, verb placement rules under different syntactic heads (i.e., head movement in derivational frameworks) are context-sensitive operations. For example, the `C`-head can be re-written to the finite verb if the clause type is interrogative or after negative initial constituents. These are well-defined and formalizable contexts. If no contexts were explicitly specified at all, nothing would seem to prevent just about any syntactic head to re-write to the verb (i.e., a verb could move too far or not far enough in derivational frameworks). The question is then which contexts account for the variable distribution of verbs across the twenty or so head positions proposed by Cinque (i.e., what features drive verb movement in derivational frameworks). Such context-sensitive rules impose quite a high computational burden from a grammar-engineering perspective. Thus, if I were to attempt to incorporate a version of Cinque's adverb hierarchy into my grammar model, I would run into problems of mathematical explicitness quite quickly.
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