

# Revisiting prosodic reconstruction

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## 1 Introduction

- For English (and German) sentences with **canonical word order**, we have reached quite a good understanding of factors that influence prosody:

- For example, the position of sentence stress (marked by double underlining throughout this handout) in (1)–(2) depends on formal and information-structural properties of verb and object:

- |     |                                      |  |
|-----|--------------------------------------|--|
| (1) | a. Mary is reading <u>a book</u> .   | <i>object = NP</i>                           |
|     | b. Mary is <u>reading</u> something. | <i>object = pronoun</i>                      |
| (2) | a. Mary is reading <u>a book</u> .   | <i>felicitous out of the blue</i>            |
|     | b. Mary is <u>reading</u> a book.    | <i>focus, givenness or emphasis involved</i> |

- The interaction between syntax, information structure and prosody has been formalized in terms of interface rules, which mostly concern local prominence relations between adjacent elements; roughly:

- \* By default, in a [ V NP ]<sub>VP</sub> constellation, NP is more prominent than V.
- \* This can be overwritten by the preference to destress given elements or by the preference to stress focused elements.

- For syntactically **non-canonical** sentences, the question arises how these mapping rules apply:

- |     |  |                       |
|-----|--|-----------------------|
| (3) | a. What book is Mary reading?  | <i>wh-question</i>    |
|     | b. Tell me about the book that Mary is reading.  | <i>relativization</i> |
|     | c. Maria liest heute aufmerksam ein Buch.<br>Mary reads today attentively a book.<br>'Mary is attentively reading a book today.' | <i>V2 clause</i>      |

- It has been proposed that the mapping rules do not apply in a strictly surface-oriented way; rather, underlying syntactic structure can play a role.

- For example, the prosodic realization of the verb has been suggested to depend on the form and interpretation of the object even if one of the elements is syntactically displaced.

- |     |                               |                                      |
|-----|-------------------------------|--------------------------------------|
| (4) | a. Mary is reading a book.    | <i>local prosodic dependency</i>     |
|     | b. What book is Mary reading? | <i>non-local prosodic dependency</i> |

- This idea is sometimes referred to as “**reconstruction for stress/prosody**” (Truckenbrodt & Darcy 2010, Korth 2014, Truckenbrodt 2019):

- **Theoretical challenge:** Syntactic and prosodic structure are not isomorphic (Selkirk 2011), and abstract syntactic entities like copies or traces are typically not represented in the latter. The challenge is to find a model of the syntax-prosody interface that allows to capture non-local prosodic dependencies.

→ **My proposal:** represent unpronounced copies as part of the prosodic structure at an intermediate step of the mapping process.

- **Empirical challenge:** In this empirical domain, many factors interact (syntax/prosody/information structure); judgments involve optionality and gradience. The challenge is to derive testable predictions and to disentangle the involved factors.

→ **My approach:** associate proposed constraints with precise predictions for acceptability; test against a set of acceptability ratings for a range of structures.

## 2 Prosodic reconstruction effects

### 2.1 Relative clauses

- First widely noticed article on the relation between syntactic movement and accentuation: Bresnan (1971).
- Presents data showing that sentences that are **structurally very similar on the surface** nevertheless **differ in their accentuation pattern**.
- Example: relative clauses; in (5a) that George left is a relative clause, similar string in (5b) is interpreted as a complement clause of proposal.

- (5) Bresnan (1971:258–9); based on Newman (1946)
- |  |    |  |                          |
|--|----|--|--------------------------|
|  | a. | Mary liked the <u>proposal</u> that George left.   | <i>relative clause</i>   |
|  | b. | Mary liked the proposal that George <u>leave</u> . | <i>complement clause</i> |

- Bresnan argues that the accentuation contrast is due to **structural differences at earlier stages of the derivation**; here, the absence/presence of an object to the right of the verb<sup>1</sup> (I am deviating from Bresnan’s notation).

- (6) a. Mary liked the proposal that George left proposal. *relative clause*  
 b. Mary liked the proposal that George leave. *complement clause*

- Bresnan proposes to model this by cyclic application of the Nuclear Stress Rule, which strengthens the stress on leave in (6b), where it is the rightmost element even at early derivational stages, but not in (6a).
- Bresnan’s article triggered a series of critical responses, including Berman & Szamosi (1972), Lakoff (1972), and Bolinger (1972). They all provide examples showing that other factors besides syntax influence stress/accent patterns, e.g., semantic/pragmatic properties and frequency/predictability of the verb.

→ Bresnan’s response: “[w]hile there may be semantic and surface-structure generalizations about primary-stress placement, the ordering hypothesis is essential to project these generalizations onto complex cases” (Bresnan 1972:332–333).

→ I.e., it is true that further information-structural and lexical properties play a role for the prosodic prominence relation between verb and object—but crucially, the relation seems to hold in simple and complex syntactic structures in a similar way. If *left* is less prominent than *proposal* in (7a), this also holds in (8a). If *defeat* is more prominent than *proposal* in (7b), this also holds in (8b).

- (7) a. George left the proposal. *left* less prominent than *proposal*  
 b. George defeated the proposal. *defeat* more prominent than *proposal*

- (8) a. Mary liked the proposal that George left. *left* less prominent than *proposal*  
 b. Mary liked the proposal that George defeated. *defeat* more prominent than *proposal*

→ Bresnan’s main goal is to explain the **correlation between simple and complex/derived structures**.

### 2.2 Wh-movement

- Bresnan (1971:259) reports similar observations about wh-movement; Truckenbrodt (2012:86) reports that the same pattern is found in German.

<sup>1</sup>In more recent work, it is a controversial question whether there is a movement relation between the relativization site and the relative head position (Vergnaud 1974, Kayne 1994), or whether the relative operator and the head noun are only linked via a semantic relation (Sauerland 2003, Salzmann 2006). As Adger (2007) shows, the distinction between the two options is not crucial for Bresnan’s system: the presence of the direct object at earlier stages of the derivation causes the prosodic weakening of the verb.

- |      |   |                              |
|------|---|------------------------------|
| (i)  | Mary liked the [proposal] [ which [proposal] ] George left [which [proposal]] | <i>Head raising analysis</i> |
|      |   |                              |
| (ii) | Mary liked the [proposal] [ which [proposal] ] George left [which [proposal]] | <i>Matching analysis</i>     |
|      |   |                              |

- For (9a), Bresnan reports a preference for sentence stress on the verb; in (9b), it is preferably deaccented.

- (9) a. What has Helen written?  
b. What books has Helen written?

- Again, Bresnan argues that this can be explained by taking **earlier stages** of the derivation into account: in (9b), the verb is prosodically weakened due to the presence of the complement *what books*; the wh-pronoun in (9a) does not cause a weakening.

- (10) a. What has Helen written what?  
b. What books has Helen written what books?

- A similar pattern is observed in the more basic sentences in (11). Thus, the wh-movement data also point towards a prosodic parallel between simple and derived structures.

- (11) a. Helen has written something.  
b. Helen has written books.

### 2.3 VP-internal subjects

- Selkirk (1995) also discusses wh-movement and agrees with Bresnan that prosodic reconstruction is involved, but proposes a different model to capture it (based on focus projection rules).
- Additionally, Selkirk discusses unergative vs. unaccusative verbs. Unaccusatives like *die* in (12a) can have an information-structurally neutral reading when the verb is deaccented. Unergative verbs like *whistle* in (12b) tend to require accents on both the argument and the verb.

- (12) a. Johnson died. *unaccusative*  
b. John whistled. *unergative*

- Selkirk argues that this can also be seen as a case of prosodic reconstruction, following the assumption that the argument on an unaccusative verb is generated **within the verb phrase** and then moves up to a higher position (see e.g. Diesing 1992), whereas the subject of unergatives is generated in a higher position.

- (13) a. Johnson [ ~~Johnson~~ died ]<sub>VP</sub>. *unaccusative*  
b. John [ whistled ]<sub>VP</sub>. *unergative*

- Although this tendency is relatively uncontroversial, it is debated to what extent it is due to syntactic structure. Further factors that have been proposed to play a role include givenness (Rochemont 2013), topicality (Hirsch & Wagner 2011), and predictability (Verhoeven & Kügler 2015); some of them might correlate with the unergative/unaccusative distinction, making it difficult to isolate the influence of syntax.
- Selkirk extends the proposal to further cases of VP-internal vs. VP-external subjects: non-generic vs. generic predicates, and stage-level vs. individual-level predicates.

### 2.4 Verb movement

- Bierwisch (1968), Truckenbrodt & Darcy (2010), and Korth (2014) report that in German, the prominence relation between the verb and the object carries over from verb-final clauses (which are assumed to represent the basic word order) to V2 clauses (which are assumed to be derived from verb-final order).
- This concerns e.g. the difference between unergative and unaccusative verbs discussed above, as Truckenbrodt & Darcy (2010) show:

- (14) a. ...dass [ Otto kommt ]<sub>VP</sub>.  
that Otto comes  
'...that Otto comes.'  
b. Otto kommt [ ~~Otto kommt~~ ]<sub>VP</sub>.

- (15) a. ...dass Otto [ geigt ]<sub>VP</sub>.  
 that Otto fiddles  
 ‘...that Otto fiddles.’  
 b. Otto geigt Otto [ geigt ]<sub>VP</sub>.

- (14) does **not differ** from (15) **on the surface**, but nevertheless they show different accentuation patterns.

## 2.5 Object topicalization

- In German, object-initial sentences can have a wide-focus interpretation when sentence stress falls on the object. (Höhle 1982, Büring 1997; experimental support provided by Féry & Drenhaus 2008, Fanselow et al. 2011)

- (16) What did Maria do next? (Krifka 1998)  
 Einen Roman hat sie gelesen.  
 a novel has she read  
 ‘She read a novel’.

- This is **parallel** to canonical subject-initial transitive clauses, in which sentence stress would also fall on the object. Krifka (1998) proposed to capture this by a cyclic application of mapping rules (reminiscent of Bresnan’s 1971 proposal).
- Similarly, object-initial clauses can have a wide-contrastive-topic interpretation (Büring 1997, Jacobs 1997; experimental support provided by Wierzba 2011, 2013).

- (17) Q: ‘*What did Maria do in the afternoon?*’  
 A: Sie hat /das Zimmer aufgeräumt\... S/OV\  
 aber abgewaschen hat sie nicht.  
 ‘*She tidied up her room... but she did not wash the dishes.*’  
 A’: /Das Zimmer hat sie aufgeräumt\... /OSV\  
 aber abgewaschen hat sie nicht.  
 Contrastive topic: [ das Zimmer aufräumen ]

- For a more detailed discussion of these phenomena, see Wierzba (2017).

## 2.6 Summary of prosodic reconstruction effects

- For a range of syntactic structures which are assumed to involve movement, a prosodic pattern is observed that is similar to the prosodic pattern of corresponding simpler sentences without movement.
- In the simple sentences, the prosodic pattern can be described by local dependencies, whereas the complex structures involve non-local prosodic dependencies.

## 2.7 Movement types showing *no* reconstruction effects

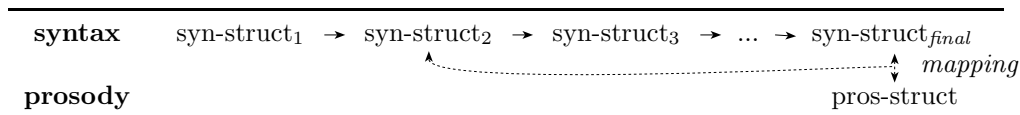
- For some other constructions, it has been argued that they show surface-oriented syntax-prosody mapping:
  - verb-particle constructions (Legate 2003)
  - scrambling of objects in Persian (Kahnemuyipour 2009) and German (Selkirk 1995:footnote 10)
  - extraposition (Rochemont 1998).

### 3 Consequences for the syntax-prosody interface

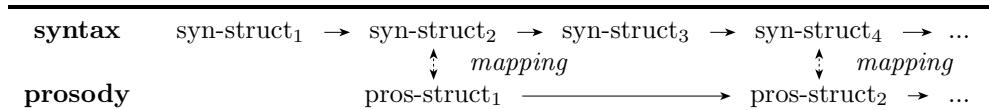
#### 3.1 Previous approaches

- Previous approaches to prosodic reconstruction can be divided into two types:

1. Trace-based post-derivational mapping (Lakoff 1972, Selkirk 1995, Korth 2014, Truckenbrodt 2019):



2. Surface-based cyclic mapping (Bresnan 1971, Krifka 1998):



- Example for a **trace-based** approach: Selkirk (1995). The basic idea is that the focus projection rules (Selkirk 1984; Rochemont 1986), which determine the prosodic pattern, apply also to syntactic traces.
- Example for a **cyclic** approach: Bresnan (1971). The basic idea is that the Nuclear Stress Rule (Chomsky & Halle 1968), which determines the prosodic pattern, applies at early points of the syntactic derivations.
- A note on **phased-based** approaches with ‘cyclic/multiple spell-out’: cyclic application of mapping rules does not necessarily predict prosodic reconstruction effects, for the following reason:
  - It is part of phase-theory that spelled-out constituents are not available for further syntactic operations like movement (Phase Impenetrability Condition, Chomsky 2000).
  - If a constituents appears outside of a phase, by assumption it has to have moved to the edge of that phase first, in order to escape Spell-Out when the phase is completed.
  - Whether phase-based approaches lead to surface-oriented mapping (Kahnemuyipour 2009) or (at least partial) reconstruction effects (Legate 2003) depends on the assumptions about the Spell-Out mechanism.

#### 3.2 Challenges

- Bresnan’s (1971) and Selkirk (1995) models are representative of a problem that arises when trying to implement prosodic reconstruction within modern syntactic/prosodic frameworks: they involve a **very direct connection between accents and syntactic objects**.
  - In Bresnan’s (1971) model, the Nuclear Stress Rule assigns numeric values to lexical items, which express the prosodic prominence level.
  - In Selkirk’s (1995) model, accentuation depends on F-marking—a property of syntactic nodes.
- In Truckenbrodt’s (2019), the STRESS-XP constraint (Truckenbrodt 1995) is extended to traces/copies; this constraint also establishes a direct connection between syntactic phrases and “beats of stress”.
- It is not trivial to reconcile such a direct connection between syntax and stress with current, independently motivated assumptions in prosodic theory (Selkirk 2011):
  - syntactic and prosodic structure are related, but **not isomorphic**
  - prosodic structure is built from phonological objects
- Under this view, the **verb-object prominence relation**, which plays a central role in the observations about prosodic reconstruction effects, can be captured along the following lines (Selkirk 2011, Féry 2011):
  1. Prosodic structure consists of a limited set of hierarchically ordered categories, but allows for recursion (Ito & Mester 2007, Ishihara 2007, Féry 2010).

2. There are (violable) mapping rules that favor correspondence between syntactic constituents and prosodic constituents, in particular between lexical phrases (NP, VP, ...) and phonological phrases ( $\phi$ ).
  3. Each  $\phi$  contains one element that is prominent at the  $\phi$  level, which is realized as a pitch accent in English and German.
- Applied to (18), assumption 2 predicts that the VP will be mapped to a phonological phrase. If the object contains an NP like *books*, it will also be a phonological phrase. Only a pitch accent on the object will satisfy assumption 3 in this structure.

(18) (Helen) $_{\phi}$  (read (books) $_{\phi}$ ) $_{\phi}$

- In contrast, if the object is an inherently unstressed functional element like a pronoun, as in (19), it will not be mapped to a phonological phrase. Here, the verb needs to be accented in order to satisfy assumption 3.

(19) (Helen) $_{\phi}$  (read something) $_{\phi}$

- The following **challenge** arises when we want to extend this model to the cases showing prosodic reconstruction effects:
  - The explanation crucially depends on the verb and the object both being located **in the VP**; if one of them is in VP-external position, different predictions emerge.
  - **Prosodic phrasing** plays a crucial role; if prosodic structure is built from phonological entities, it is problematic to assume that a phonologically empty element (like a trace or deleted copy) could be part of it.

### 3.3 Proposal

- Under the view that syntactic and prosodic structure are non-isomorphic, and accentuation is derived from prosodic structure (rather than directly from syntax), the following assumption is necessary to account for prosodic reconstruction effects:<sup>2</sup>

- **Unpronounced copies are represented as part of the prosodic structure** at an intermediate step of syntax-prosody mapping
- This can be achieved by ordering **copy deletion after syntax-prosody mapping**.

- (20) illustrates how this proposal can account for non-local prosodic dependencies in wh-movement. The crucial point is that both copies of the object are still present when syntax-prosody mapping applies, and that they are both parsed prosodically. The presence of the lower copy of *what books* exempts the verb from being stressed. Only after the mapping, copies are deleted. This process can introduce problems for the prosodic structure, e.g., phonological phrases without a head. I assume that a repair mechanism can restructure the representation, integrating the headless phrase with an adjacent one.

(20) a. Building the syntactic structure:

[ O ]<sub>NP</sub> [ S ]<sub>NP</sub> [ V [ O ]<sub>NP</sub> ]<sub>VP</sub> *syntax* e.g.: *What books has Helen written what books*

b. Syntax-prosody mapping:

( x ) $_{\phi}$  ( x ) $_{\phi}$  ( ( x ) $_{\phi}$  ) $_{\phi}$  *prosody*  
 [ O ]<sub>NP</sub> [ S ]<sub>NP</sub> [ V [ O ]<sub>NP</sub> ]<sub>VP</sub> *syntax* e.g.: *What books has Helen written what books*

c. Copy deletion:

( x ) $_{\phi}$  ( x ) $_{\phi}$  ( ) $_{\phi}$  *prosody*  
 [ O ]<sub>NP</sub> [ S ]<sub>NP</sub> [ V [ ~~O~~ ]<sub>NP</sub> ]<sub>VP</sub> *syntax* e.g.: *What books has Helen written ~~what books~~*

d. Repair:

( x ) $_{\phi}$  ( x ) $_{\phi}$  ( ) $_{\phi}$  *prosody*  
 [ O ]<sub>NP</sub> [ S ]<sub>NP</sub> [ V [ ~~O~~ ]<sub>NP</sub> ]<sub>VP</sub> *syntax* e.g.: *What books has Helen written ~~what books~~*

<sup>2</sup>See Murphy (2015) for a similar claim for the level of syllable structure based on observations about tones in Kikuyu.

- In contrast, if the object is not an NP, but an unstressable functional element like *what*, the verb is predicted to be stressed.

(21) a. Building the syntactic structure:

O [ S ]<sub>NP</sub> [ V O ]<sub>VP</sub> *syntax* e.g.: *What has Helen written what*

b. Syntax-prosody mapping:

( x )<sub>φ</sub> ( x )<sub>φ</sub> *prosody*  
O [ S ]<sub>NP</sub> [ V O ]<sub>VP</sub> *syntax* e.g.: *What has Helen written what*

c. Copy deletion:

( x )<sub>φ</sub> ( x )<sub>φ</sub> *prosody*  
O [ S ]<sub>NP</sub> [ V ⊖ ]<sub>VP</sub> *syntax* e.g.: *What has Helen written ~~what~~*

- As noted above, to account for prosodic reconstruction effects, the assumption *syntax-prosody mapping*  $\prec$  *copy deletion* is necessary even in models with phases and cyclic spell-out.
- This model captures reconstruction for prominence at the level of the **phonological phrase**. Another question that arises is whether there is also reconstruction for prominence at the **level of the intonation phrase** (sentence stress).
  - Interestingly, Bresnan’s model does predict it (because it is based on cyclic application of a nuclear stress assigning rule), whereas Selkirk’s (1995) model is only concerned with the distribution of accents (not nuclear accents).
  - In principle, a mixed system (reconstruction at one level, but not at the other) is conceivable; see Wierzba (2017) for implementation options.
  - Empirical question: Is it really *books* that is the most prominent element in (20), or the subject *Helen*?  
→ This question is addressed in the following experiment.

## 4 Experiments

### 4.1 Methodology

- In a first series of experiments, I tested wh-movement and other object-initial structures in German.
- To illustrate my general approach and challenges that arise, I only present a part of the wh-movement data here (8/12 conditions; the other conditions tested split questions and exclamatives).
- Task: rating the acceptability of auditory stimuli on an 1-7 scale.
- The data stems from 48 items, distributed among 42 native speakers of German via a Latin-Square Design.

### 4.2 Materials

(22) Subordinate SOV clause (baseline)

- Ich habe gelesen, dass Emma Anderson ein Buch geschrieben hat.  
I have read that Emma Anderson a book written has  
'I read that Emma Anderson has written a book.'
- Ich habe gelesen, dass Emma Anderson ein Buch geschrieben hat.
- Ich habe gelesen, dass Emma Anderson ein Buch geschrieben hat.
- Ich habe gelesen, dass Emma Anderson was geschrieben hat.  
I have read that Emma Anderson something written has.  
'I read that Emma Anderson has written something.'

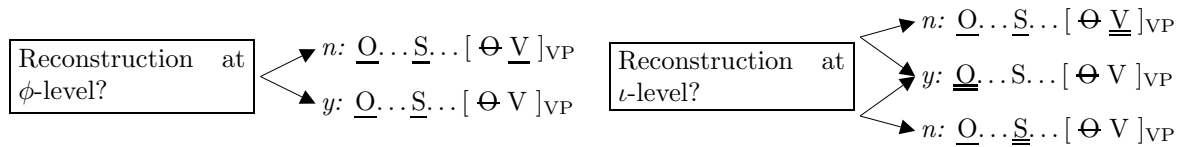
(23) Wh-question

- Was für ein Buch hat Emma Anderson geschrieben?  
what for a book has Emma Anderson written  
'What book has Emma Anderson written?'

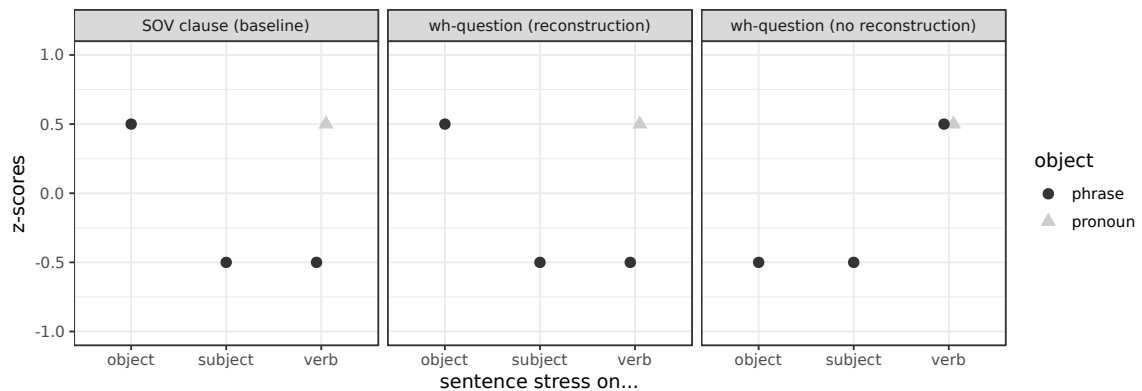
- b. Was für ein Buch hat Emma Anderson geschrieben?
- c. Was für ein Buch hat Emma Anderson geschrieben?
- d. Was hat Emma Anderson geschrieben?  
 what has Emma Anderson written  
 ‘What has Emma Anderson written?’

### 4.3 Predictions

- If there is reconstruction at the level of the **phonological phrase** ( $\phi$ ), then the lower copy of an NP object can exempt the verb from being stressed.
- If there is reconstruction at the level of the **intonation phrase** ( $\iota$ ), then the position of the lower object copy should count for sentence stress assignment.

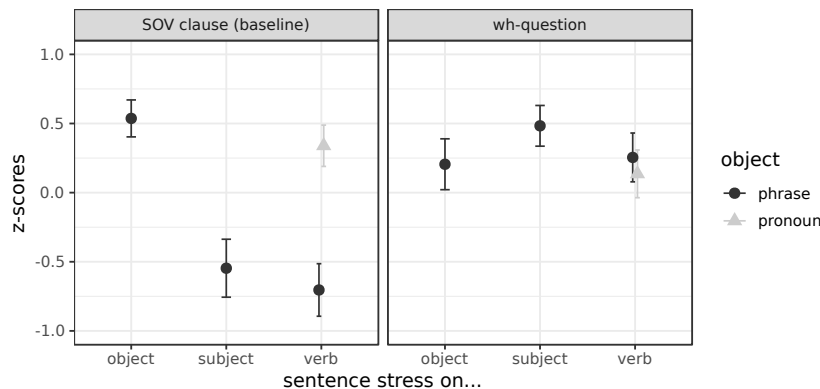


- **Linking hypothesis:** violations of linguistic constraints leads to a consistent decrease in acceptability (cf. Keller’s 2000 Linear Optimality Theory).
- In comparison to a baseline with **canonical SOV** word order, wh-questions should show a **similar pattern** (preference for sentence stress on the object) **if there is prosodic reconstruction** at all levels. If mapping rules apply in a surface-oriented way, only sentence stress on the verb should be acceptable:



### 4.4 Results

- The results are illustrated in the following plot:





- Wh-questions show a reversed preference for sentence stress on the subject in comparison to the SOV baseline (LMM: STRUCTURE [*wh-question vs. SOV*] × STRESS [*subject vs. object*]:  $t = 10.57$ ; both factors treatment-coded with *SOV / stress on the object* as the baselines).
- In wh-questions, the difference between phrase and pronoun (within the condition with verb stress) is smaller than in the subordinate clause (STRUCTURE × OBJECT TYPE:  $t = -9.03$ ; the latter factor was treatment-coded with *phrase* as the baseline).

## 4.5 Discussion

- The SOV clause showed the expected pattern: sentence stress on the object is the only acceptable option if is the object is an NP, and sentence stress on the verb is the only acceptable option if it is a pronoun.
- However, the wh-question shows a result pattern that does not correspond to any of the predictions: **all stress patterns show relatively high acceptability**.
- I suspect that one of the reasons for this finding has to do with **question semantics**. The items were embedded in a context that was supposed to represent an ‘out of the blue / all new’-setting, e.g., “There was something you wanted to ask me?”. However, wh-questions involve an existence presupposition, which might lead to more accommodation of additional context than in the declarative sentences.
  - Accommodation of, e.g., givenness or contrast might make any stress pattern felicitous.
  - Potential semantic confounds should be controlled for better by extending the context.

## 5 Summary and outlook

- Sentences can involve non-local prosodic dependencies.
- Modeling this is challenging because in simple clauses, these dependencies have been proposed to depend on prosodic structure, in which the base position of moved constituents is not represented.
  - **Proposal: Syntax-prosody mapping precedes copy deletion**; unpronounced copies are represented as part of the prosodic structure at an intermediate step of the derivation.
- Investigating prosodic reconstruction is challenging, because marked syntactic structures often involve marked interpretation. This can influence prosody and make it difficult to observe pure syntax-prosody mapping.
  - My approach: compare acceptability patterns of different realizations in comparison to a canonical baseline; similar patterns point towards reconstruction.
  - Next step: find ways to control for confounds that arise in marked syntactic structures.
- **Outlook:** in follow-up studies, I would like to do the following:
  - Try to establish empirical facts about prosodic reconstruction in wh-movement and relativization.
  - Extend the empirical range to different kinds of movement. The reported intuitions in the literature suggest that there might be something special about  $\bar{A}$ -movement.
  - Explore the relationship between prosodic reconstruction and reconstruction in the more standard sense (e.g., for binding and scope). Truckenbrodt (2019) suggests that there is a correlation, which would be very interesting to test empirically.

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