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Preface

This is the fourteenth volume of the series *Empirical Issues in Syntax and Semantics* (EISS), which, like the preceding thirteen volumes of the series, is closely related to the conference series *Colloque de Syntaxe et Sémantique à Paris* (CSSP). The 12 papers included in the present volume are based on presentations given at CSSP 2021, which took place on December 9–11 2021 at the Université de Paris.[1]

The contributions to this volume have been submitted to an additional round of reviewing. We would therefore take the opportunity to thank the reviewers, whose comments have helped the authors to, sometimes substantially, improve their papers. With their permission, the reviewers were (in alphabetical order by row):

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[1]http://www.cssp.cnrs.fr/cssp2021/index_en.html

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Gabriela Bîlbîie
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Paris, December 2022

Morphosyntactic coding and local coherence in Hungarian

Kata Balogh

Abstract This paper presents a study on the discourse functions of two morphosyntactic strategies in Hungarian: *zero coding* and *structural topic marking*. We investigate these phenomena in naturally occurring narratives, and propose an analysis within the framework of *Centering Theory*. In earlier work on Hungarian, these two strategies are mostly discussed at the sentence-level syntax and semantics, but a detailed investigation of their discourse-level behaviour is generally missing. In this paper, we extend the earlier analyses on these phenomena and provide a more elaborate characterization of them, with special attention to their function in discourse. Next to our primary goal, we also discuss the issue of plural referents and their proper treatment within Centering Theory, and propose an extension to the rules of determining the transition types.

Keywords Centering Theory · Hungarian · zero coding · structural topic

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1 Introduction

The central aim of this paper is the investigation of the discourse functions of two morphosyntactic strategies in Hungarian: *zero coding* and *structural topic marking*. Both strategies are predominantly discussed within the generative tradition, and mainly analyzed at sentence-level syntax, in terms of the 'pro-drop property' and the 'topic position' respectively; however, a detailed investigation of their discourse-level behaviour is generally missing. This paper aims to contribute to filling this gap.

Both our target strategies can be associated with *salience* (von Heusinger 1997; Chiarcos & Claus & Grabski 2011) and with *aboutness topic* (Reinhart 1981; Roberts 2011).[1] Structural topic marking corresponds to a kind of high-

[1]In this paper, we only discuss 'sentence topics', and not 'discourse topics' and 'contrastive topics'. To avoid confusion of different terminologies (see Tomioka 2020), we strive to distinguish syntactic and semantic uses consequently. The terms 'topic', 'topicality' and

lighting, identifying a referent for predication, while zero coded referents are mostly the ones that are identifiable without effort, hence already in the center of attention. We are particularly interested in the characterization and modeling of the two in terms of *discourse processes*. A proper characterization of their functions must be given beyond the sentence-level. To achieve this goal, an analysis in terms of Centering Theory provides an appropriate ground. The work reported here is inspired by Shimojo's (2016) study on Japanese. We mainly adopt the same methodology, but the core parameters of our study are different and adjusted to the specific questions in Hungarian. Furthermore, we tackle the issue of plural reference, which is not present in Shimojo's (2016) analysis. In turn, using the same methodology offers a good ground for a future cross-linguistic comparison.

1.1 Structural topic marking

Hungarian has a rich morphology with an extended case marking system and verbal inflection. These morphosyntactic devices code most grammatical information. Grammatical functions such as 'subject' and 'object' are not marked by syntactic configurations. However, it is not the case that in Hungarian the word order is entirely free. The unconstrained order of the words only concerns the grammatical functions. Word order variations play an important role, too, though from the perspective of discourse-semantics. In Hungarian, the surface order is closely related to the information structure of the utterance, as certain syntactic positions are driven by the discourse-semantic functions: *topic* and *focus*. Languages having this structural behaviour are called *discourse configurational* (É. Kiss 1995; Surányi 2015), and can be further distinguished by virtue of which functions are overtly marked in the morphosyntax. Topic-prominent languages mark the discourse function 'topic' on the surface structure (e.g., Japanese, Korean), while focus-prominent languages have overt focus marking (e.g., Aghem, Basque). Hungarian manifests both topic- and focus-prominence.

In Hungarian, the relative order of the constituents behind the verb does not encode grammatical differences, as all word order variations are associated with the same semantic content. On the other hand, the topic/focus structure of the utterance determines the surface structure of the prever-

'topic referent' will be used in interpretational terms, while 'structural topic', 'topic position' and 'topicalization' refer to syntactic notions.

bal elements, motivating the 'topic-' and 'focus-positions' in the syntactic representation.[2]

(1) *Mari-nak tegnap minden fiú a népmesé-t mondt-a el.*
Mary-DAT yesterday every boy the folk.tale-ACC told-3SG.D PRT
'Every boy told [Mary]^TOP [the FOLK TALE]^FOC yesterday.'

As (1) illustrates, an *aboutness topic* is expressed structurally, placed in the clause-initial, 'topic position', preceding the narrow identificational focus and the quantifier positions. Structural topic marking in Hungarian is also shown by the fact that categorical and thetic judgements are structurally different. A verb-initial structure (2) expresses a thetic judgment, while in categorical judgments (3), a constituent is selected and placed in the topic position (e.g., É. Kiss 2004).[3] The referent of the constituent in this position is the one the sentence makes a statement about.

(2) *Kerget-i egy fiú a kutyá-t.*
chase-3SG.D a boy the dog-ACC
'A boy is chasing the dog.' thetic

(3) *A kutyá-t kerget-i egy fiú.*
the dog-ACC chase-3SG.D a boy
'A boy is chasing the dog. (≈ The dog, a boy is chasing him.)' categorical

Constituents in the topic position are restricted by the requirements of being referential and specific, where specificity is taken as a familiarity condition: the referent must be present in the discourse (see Kálmán 2001; É. Kiss 2004). It is generally assumed that the constituent in the topic position expresses the *aboutness topic* of the sentence. É. Kiss (2004) also defines the 'function of topic' along these lines.

1.2 Zero coding

In Hungarian, the subject pronoun is generally omitted in unmarked (or neutral) sentences (4a). This phenomenon is referred to as the *pro-drop property* in generative (syntactic) approaches (e.g., Jaeggli & Safir 1989;

[2] The preverbal field also hosts universal quantifiers, *also*-phrases and negation.

[3] Note that some simplification is at place here. The structural differences of the thetic and categorical judgements are not always clear-cut (e.g., Gécseg & Kiefer 2009). However, this does not undermine the existence and importance of the Hungarian topic position.

Koeneman & Zeijlstra 2019). Given that this morphosyntactic phenomenon often considers the subject, pro-drop languages are also called null subject languages. This phenomenon is present in a great number of languages (e.g., Hungarian (4a), Italian (4b), Chinese, Spanish, etc.), while this strategy is generally not available in English (4c).[4]

(4) Did Anna invite Bea?

a. *Igen, meg-hívt-a (Beá-t).*
yes PRT-invited-3SG.D (Bea-ACC)
'Yes, she invited her/Bea.'

b. *Sì, (lei) la ha invitata.*
yes (she) her has invited
'Yes, she invited her.'

c. Yes, she invited her. / *Yes, invited her.

The above examples illustrate that Hungarian and Italian allow for an unpronounced subject without loss of grammaticality, as opposed to English, where both the subject and the object pronouns must be overtly expressed. Despite the fact that pro-drop is used most often on the subject pronoun, it is not restricted to it. In certain languages (e.g., in Hungarian), it is also possible to leave out the object pronoun or other elements.

It is widely accepted that there are different types of pro-drop, however, a precise characterization of these different types, as well as the typological distribution of the phenomenon is still under discussion (Koeneman & Zeijlstra 2019). As for the different types of pro-drop and their distribution across languages, one of the leading questions in morphosyntactic approaches is what the licensing conditions are for omitting pronouns. Along this line, different types of pro-drop are distinguished, such as agreement-based (or consistent) pro-drop (Jaeggli & Safir 1989; Koeneman & Zeijlstra 2019) and discourse-based (or radical) pro-drop (Neeleman & Szendrői 2007). As Koeneman & Zeijlstra (2019) conclude, it is rather difficult to precisely characterize the various pro-drop types merely based on the morphological properties of the given languages. Next to pro-drop, a similar strategy of *topic-drop* is

[4]Note that zero coded arguments can appear in English in very specific constructions (e.g., conjunction reduction) or in informal speech. However, a possibility of omitting arguments is generally not present in English, hence it is not considered a pro-drop language.

proposed (e.g., Huang 1984). Evidence from Germanic languages show that ‘pro-drop’ and ‘topic-drop’ are distinct phenomena. German, for example, is not considered a pro-drop language, but the subject/object can be omitted from the sentence if it occupies a topic position in the pre-field of root clauses.

Hungarian is considered a ‘pro-drop’ language, the subject pronoun is generally left out in unmarked sentences (see (4a), (5a)). When the subject pronoun is overt, it indicates contrast (5b). Next to the subject pronoun, the object pronoun can also be omitted under given circumstances, however, there is an asymmetry. Contrary to an overt subject pronoun, an overt object pronoun itself does not signal contrast, the sentence in (5a) receives the same interpretation with or without overtly expressing the direct object.

(5) a. *Lát-od (ő-t).*
see-2SG.D (s)he-ACC
‘You see him/her.’

b. *Te lát-od (ő-t).*
you see-2SG.D (s)he-ACC
‘[You]$^{\text{CT}}$ saw him/her.’

Zero coding of arguments in Hungarian is often taken as agreement-based pro-drop, but a detailed discussion of the licensing conditions is missing. If we consider the relevant morphosyntactic properties proposed by Jaeggli & Safir (1989), Koeneman & Zeijlstra (2019) and Neeleman & Szendrői (2007), we find phenomena specific for both agreement- and discourse-based pro-drop. For example, similar to Japanese and Chinese, various pronouns can be omitted, which is a characteristic property of discourse-based pro-drop. In the following, we will not target the issue of licensing conditions and the type of pro-drop in Hungarian. We are rather interested in the relation between discourse interpretation, discourse modeling and zero coding, as well as the processes that are behind this phenomenon. Despite the rich agreement and verbal inflection in Hungarian, which strongly points to the direction of agreement-based pro-drop, we inquire here into the aspects that possibly relate Hungarian to the Japanese-/Chinese-type pro-drop. We are not investigating what morphosyntactic features make zero coding possible, but rather pose the question: since this strategy is available in Hungarian, what is its function (or role) in the discourse.

2 Centering Theory

Centering Theory (Grosz, Joshi & Weinstein [GJW] 1983; 1995; Walker, Joshi & Prince [WJP] 1998; Brennan, Friedman & Pollard [BFP] 1987) is the local-level component of the theory of discourse structure proposed by Grosz and Sidner (Grosz 1977; Sidner 1979; Grosz & Sidner 1986). Centering Theory models the *attentional state* of the discourse, explaining local coherence between utterances. In their theory of discourse structure, Grosz & Sidner (1986) make a distinction between *global coherence* and *local coherence*, as the two major angles of discourse interpretation. Local coherence concerns the relation between individual utterances, while global coherence relates discourse segments, larger spans of texts.

Morphosyntactic choices within an utterance are related to the given discourse context. This relation is bidirectional: the discourse context restricts the morphosyntactic choices, while marking of information structure at the sentence-level helps discourse processing, as it reflects the underlying discourse structure. The structure of information in discourse is reflected in different linguistic structures contributing to the topic-comment and focus-background divisions. Such structures are manifested by special constructions (e.g., topicalization, clefts), by prosodic prominence, and by anaphora and ellipsis. Looking at the side of discourse processing, more coherent discourse is easier to interpret. In interpreting the discourse, the central processing tasks are: (1) determining the coherence relations and (2) finding the referents of the expressions in the sentence. Centering Theory concerns the *local discourse coherence* between the utterances. It models the focus of attention of the discourse participants, i.e., a local-level component of the Attentional State. Centering establishes the relation between salient discourse entities and the ways of their linguistic expression.

2.1 Centers and ranking

The salient discourse entities (≈ referents) at a given point of the discourse are called *centers*. At each utterance, two types of centers are distinguished: the set of *forward-looking centers* (CFs) and a distinguished single *backward-looking center* (CB), which establishes the connection to the previous utterance. The CB of the utterance roughly corresponds to the notion of *(aboutness) topic* in other theories. After the initial proposal (GJW 1983, 1995; WJP 1998), Centering Theory has undergone several developments resulting in differences in setting the basic parameters within the various analyses. One of these differences is whether only a single or also multiple CBs are allowed. In this paper, we follow the classical analysis with a single CB.

The set of forward-looking centers (CF-set) constitutes the local attention state, which is updated at each utterance. This set is partially ordered, based on a ranking of the relative salience of its elements. The ranking indicates the relative likelihood of a referent to be the CB in the subsequent utterance. The highest ranked element is the *preferred center* (CP), the center that is most likely to be the CB of the next utterance. Hence, the CP can be seen as the predicted next CB. Grosz, Joshi & Weinstein (1995) argue that various features – syntactic, semantic, lexical – play a role in determining the ranking. They propose that grammatical relations have the major role in ranking, which is sufficient for English (BFP 1987). Nevertheless, it is generally accepted that ranking is language specific and various ranking strategies are proposed. Kameyama (1985) included *-wa* marked topicalization and zero coding above grammatical functions for Japanese, Rambow (1993) added word order for German, Turan (1998) argues for thematic relations for Turkish and Cote (1998) argues for ranking by *lexical conceptual structures* (Jackendoff 1990).

Determining the ranked CF-set and the CB is driven by different constraints (see (6); WJP 1998: 3). For identifying the CB, the ranking of the CF-set in the previous utterance plays a crucial role (see 3. below).

(6) For each utterance U_i, in a discourse segment D, consisting of utterances $U_1, \ldots, U_m$:

1. There is precisely one backward-looking center $Cb(U_i, D)$.
2. Every element of $Cf(U_i, D)$ must be realized in U_i.
3. The center, $Cb(U_i, D)$, is the highest-ranked element of $Cf(U_{i-1}, D)$ that is realized in U_i.

The first constraint in (6) states that each utterance has exactly one CB. This does not allow utterances without a CB or utterances with multiple CBs. Nevertheless, CB-less utterances are common. They are typical at the beginning of a discourse, but can occur at any place later. Therefore, a weaker version of the constraint is applied that states that there is no more than one CB in an utterance (WJP 1998: ftn. 2). This allows CB-less utterances different from the initial one, while keeping the restriction that no multiple CBs are allowed. This is the view we adopt within our study.

The 'realize-relation' is based on the particular semantic theory assumed for interpretation. It is a generalization of the relation 'directly realize': "*U directly realizes c iff U is an utterance (of a phrase) for which c is the semantic interpretation.*" (GJW 1995: 9). The precise definition depends on the semantic theory used. In an earlier draft of the same work (GJW 1986), the realize-relation is based on situation semantics (Barwise & Perry 1983).

2.2 Transition types

Between the subsequent utterances, four transition types are defined: Continue (con), Retain (ret), Smooth-shift (ssh) and Rough-shift (rsh). These transitions are determined by (i) the relation between the CB of U_i and the CB of the previous utterance U_{i-1}, i.e., whether the CB is changed, and (ii) by the relation between the CB and the CP of U_i, i.e., whether keeping the CB is predicted. We take the definitions of the basic transition types as given by WJP (1998).

Transition type	**relation between** $CB(U_i)$ and $CB(U_{i-1})$		**relation between** $CB(U_i)$ and $CP(U_i)$
Continue	$CB(U_i) = CB(U_{i-1})$ or no $CB(U_{i-1})$	and	$CB(U_i) = CP(U_i)$
Retain	$CB(U_i) = CB(U_{i-1})$ or no $CB(U_{i-1})$	and	$CB(U_i) \neq CP(U_i)$
Smooth-shift	$CB(U_i) \neq CB(U_{i-1})$	and	$CB(U_i) = CP(U_i)$
Rough-shift	$CB(U_i) \neq CB(U_{i-1})$	and	$CB(U_i) \neq CP(U_i)$

Figure 1 Transition types

The first two transition types both continue the backward-looking center (CB ≈ topic). The difference between the two is that in case of Retain there is a change of CB predicted in the subsequent utterance, given that the current CP differs from the current CB. In case of Continue the prediction is also keeping the CB. The last two transitions both change the CB. The difference is that at Smooth-shift the prediction is that this new CB will be kept [$CB(U_i) = CP(U_i)$], while at Rough-shift, it is not the case [$CB(U_i) \neq CP(U_i)$]. Various proposals are made before to capture transitions between utterances where one (or both) of them has no CB. Kameyama (1986) adds CB-Establishment, a transition from a CB-less utterance to one with a CB.

The opposite of that, where a CB-less utterance follows one with a CB, can be considered as a Zero transition, and when a CB-less utterance follows another CB-less utterance it can be considered a Null transition (Poesio et al. 2004). In our analysis, we follow the definitions given by WJP (1998), and take transitions from a CB-less utterance to one with a CB under Continue and Retain. Hence we do not consider CB-Establishment. Furthermore, we take the transitions where the second utterance has no CB, whether or not the first utterance has one, as one case, and indicate them as Null.

3 Centering analysis

In this study, we investigated 12 Hungarian spoken narratives acquired by guided elicitations based on the picture books known as the ‘Frog Stories’ (Mayer 1967; 1969; Mayer & Mayer 1971). These books each tell a different story using exclusively illustrations, but no words. The 12 stories are narrated by 7 different consultants, each story is told by 4 different persons, all monolingual native speakers of Hungarian between age 22 and 53. Their style and ways of story-telling showed considerable differences, which provides us a diverse set of data. The 12 recordings contain 602 utterances that form our target data for the investigation. The core data in this study contain naturally occurring narratives, which primarily represent language production, and as such they are significant for any analysis and explanation of morphosyntactic choices. The data are morphosyntactically annotated and segmented, both carried out by 2 different annotators.

3.1 Predictions and main questions

The starting point of our analysis is based on earlier approaches to Hungarian structural topic marking and zero coding. Both target morphosyntactic strategies are related to the relative *salience* of the given referents and to their *topicality* in terms of *aboutness topic*.

The first prediction concerns the morphosyntactic realization of topicality and the most salient entity. Both notions, the CB and the referent of the expression in the Hungarian topic position, are considered to be (roughly) equivalent to ‘aboutness topic’ (Reinhart 1981). This predicts that the filled topic position should express the CB of the utterance.[5]

[5]Note that Hungarian allows multiple topic positions, however, such constructions are less frequent and raise further issues that go beyond the scope of the paper. We restrict our

> The BACKWARD-LOOKING CENTER, Cb(U_i, D) is a special member of the Cf, which represents the discourse entity that the utterance U_i, most centrally concerns, similar to what is elsewhere called the 'topic' (Walker, Joshi & Prince 1998: 3)

> The topic foregrounds an individual (a person, an object, or a group of them) from among those present in the universe of discourse as the subject of the subsequent predication. (É. Kiss 2004: 8)

> (...) the landing site of topic movement is assumed to be the specifier position of a functional projection called TopP. (É. Kiss 2004: 12)

The other prediction is based on the generalizations by Comrie (1999: 342): "*(...) in the extended domain, the expectation is for referential continuity, or, as it is often called in the literature, topic continuity*", and by Van Valin (2005), who similarly argues that a zero morpheme is the most unmarked topic and as such it marks continuing topics.

These predict that although the two strategies in Hungarian are both related to topicality, they differ in the discourse processes underlying them. This claim is supported by the different uses of zero coding and structural topic marking, as illustrated in (7) below. Our expectation is that this pattern is verifiable on a larger amount of data.

(7) *A kisfiú kergette a béká-t,* The boy was chasing the frog,

a. *aztán ∅ / #(a kisfiú) el-ugrott egy faág-ra.*
and.then ∅ / the boy PRT-jumped[3SG] a branch-SUB
'and then he$_{=\text{boy}}$ / #the boy jumped away to a branch.' (continue)

b. *aztán a béka / az / ő el-ugrott egy faág-ra.*
and.then the frog / that / he PRT-jumped[3SG] a branch-SUB
'and then the frog / that / he$_{=\text{frog}}$ jumped away to a branch.' (shift)

In order to check the above predictions on a larger scale, we investigate data from Hungarian narratives and provide a centering analysis. In our analysis, we investigate the use of structural topic marking and zero coding with respect to (i) the relative salience of the centers (i.e., referents) and (ii) the established local coherence between the utterances (i.e., the respective transition types). The analysis is driven by the following core questions:

study to a single topic position, and leave multiple structural topics for further work.

(1) What is the distribution of the transitions?
(2) Which center (CB, CP, none) is realized by { structural topic / zero }?
(3) What are the correspondences between the expression of the CB and the transition type? In particular: (a) When the CB is realized by { structural topic / zero }, what is the transition? and (b) For a given transition type how is the CB expressed?

3.2 Parameters for Hungarian

Centering Theory is parametric and therefore the analysis is dependent on the ways these parameters are set (Poesio et al. 2004). The application of Centering Theory to Hungarian data is novel, as no comparable analysis has been proposed before.[6] Therefore, we first need to discuss how to set the different parameters for Hungarian. In our analysis, we follow as close as possible to the standard practices within Centering Theory, and propose only necessary changes, for example, which language-specific features are determinant for ranking, or how to implement the 'realize-relation'.

3.2.1 Segmenting

One of the crucial questions for any centering analysis is how to segment the given text into utterances. In the initial proposal (e.g., GJW 1995), utterances are simply identified with sentences. Kameyama (1998) considers intrasentential local coherence, and she proposes a segmenting of complex sentences and takes tensed clauses as the basic discourse units (i.e., utterances) in English. Following this approach, we take each coordinated clause and tensed adverbial clause as a separate utterance. We do not segment inifinitival complements, complement clauses and relative clauses.

3.2.2 The realize-relation

In each utterance, we need to determine the centers, i.e., the referents that are evoked/talked about at that point in the discourse. Referential expressions evoke referents to entities as usual. In Hungarian, we must consider zeros (or zero pronouns) as well, which realize arguments in subject or object

[6] Very few works on Hungarian mention Centering Theory in connection with particular phenomena (temporal relations (Fretheim & Vaskó 1996), anaphora resolution (Lejtovicz & Kardkovács 2007)), but none of these works can be considered to be a strict application of Centering Theory to Hungarian data. Furthermore, no texts were analyzed, and the language-specific settings of the theory were not investigated beforehand.

functions[7] (8) and the possessor (9). Zero pronouns occur both in main and embedded clauses.

(8) *Aztán lát-ják, hogy a tav-on van egy béka. Ott üldögél. És*
then see-3PL that the lake-SUP is a frog there sit.around[3SG] and
meg-próbál-ják el-kap-ni.
PRT-try-3PL.D PRT-catch-INF
'Then they see that there is a frog at the lake. He is sitting around there. And they try to catch him.'

(9) He thought to go to them following the footsteps of the boy and the dog.
Meg is érkezett a lakás-uk-ba.
PRT also arrived the flat-PS.3PL-ILL
'And he arrived in their flat.'

There are special constructions that also realize entity referents, although the surface linguistic expressions are not referential. Such expressions are, for example, elliptical noun phrases, where the head-noun is missing in the adjective+noun combination, and the adjective carries the case marking (10b). Note that similar constructions appear in other languages as well.

(10) a. *a vidám béká-t*
the happy frog-ACC
'the happy frog'

b. *a vidám-at*
the happy-ACC
'the happy one'

Adverbials with person/number marking, e.g., *mellé-m* (next-1SG) 'next to me' also occur regularly. Such adverbials express the same as the referential phrases like *én mellém* (I next-1SG), and thus we analyze them as realizing entity referents. We also list event referents but reduced to the minimum necessary. Referents to events/states are naturally evoked within each utterance. Nevertheless, we do not add all of these event referents to our analysis; rather we only consider them when they are (also) realized by an anaphoric device in a subsequent clause. In case the text contains such linguistic expressions, we consider the event referent they evoke, as well as their antecedents. In all other cases, we leave out event referents.

A large number of plural referents (e.g., *they, the dog and the boy*) occur in our data, and the way they are captured can affect our analysis. We take

[7] Although, in most cases, the zero marked argument is the subject.

such plural referents as sets of referents, following the treatment of plural reference in DRT (Kamp & Reyle 1993). We assign them to plural pronouns and to zero elements next to plural verb forms (e.g., 3PL).

(11) u_1: *fogt-a a vödr-é-t*
took-3SG.D the bucket-PS.3SG-ACC
'he$_{=\text{boy}}$ took his bucket' CF-list: $\text{r}_{\text{boy}} > \text{r}_{\text{bucket}}$

u_2: *és meg-fenyegett-e a béká-t*
and PRT-threatened-3SG.D the frog-ACC
'and he$_{=\text{boy}}$ threatened the frog' CF-list: $\text{r}_{\text{boy}} > \text{r}_{\text{frog}}$

u_3: *és ez-zel el-ment-ek*
and this-INS PRT-went-3PL
'and then they$_{=\text{boy,dog}}$ went away' CF-list: $\{\text{r}_{\text{boy}}, \text{r}_{\text{dog}}\}$

In u_1 above, the verb is inflected for 3rd person singular, the zero pronoun of the subject and the zero pronoun of the possessor of the object both realize the center/referent r_{boy} (referring to the boy). In u_2, there are two referents realized: r_{boy} by the zero pronoun as before and r_{frog} by the noun phrase *a békát* 'the frog.ACC'. In u_3, the subject is zero and the verb is inflected for third person plural, which realizes the plural referent (a set of referents), including the referents of the boy (r_{boy}) and the dog (r_{dog}). In the first analysis, we take each plural referents as a distinct one. An alternative approach will be discussed in Section 4.

3.2.3 Ranking in Hungarian

One of the most important parameters in a centering analysis is the ranking of the CF-set in each utterance. It is widely accepted that ranking is language specific, depending on the type and the specific properties of the given language, and the features that determine the ranking vary across languages (see also Section 2.1). Hungarian is a flexible word order language, where grammatical functions are not marked in the syntactic structure, but primarily marked by a rich system of case morphemes (there are approximately 20 cases in Hungarian). Word order variations are rather related to information structure, i.e., to the discourse-semantic functions of *topic* and *focus*. We argue that grammatical function as the major determining feature for ranking is not the most appropriate one for Hungarian. Given the similarities in the use of zero coding and overt topicalization, we could consider a similar ranking as proposed for Japanese. However, we do not follow this suggestion. The main aim of our study is to investigate the discourse functions of our target morphosyntactic strategies. Since ranking is a crucial aspect in determining the transition type, and eventually the discourse function, considering structural topic marking and zero coding as a determining feature for ranking would interfere with the purpose of the analysis. We argue that the best ranking for our study on Hungarian is the one based on lexical conceptual structure as proposed by Cote (1998), and we refer to this parameter as the ‘LCS position’. As usual, we rank arguments higher than adjuncts, and adjuncts higher than possessors.

3.3 Methodology

The 12 texts were segmented into 602 utterances, following the instructions presented in Section 3.2.1. During the analysis, we registered the set of forward-looking centers (CF_1, ..., CF_n), ranked according to their LCS position determined by the given predicate. The first element of the ordered CF-set is also the preferred center (CF_1 = CP) of the utterance. Following the basic rules of Centering Theory (see Section 2), at each utterance, we determined the backward looking center (CB) and the transition type. For the CB, we also registered the following: (i) the type of expression (zero, overt NP, overt personal pronoun etc.), (ii) its surface position: whether it is in a postverbal position, in the clause-initial ‘topic position’, in the preverbal ‘focus position’ and so on, (iii) its LCS position determined by the predicate and (iv) its case. Surface position and case are only relevant in cases where the CB is overtly expressed. For an illustration, consider Figure 2 below. The transition type is indicated at the second utterance, e.g., the transition from utterance #3 to #4 is CON.

All 12 stories were examined in the way showed in Figure 2. In the analysis, we were looking at the correspondence of transitions and the ways the CB is expressed. In our evaluation, we focused on the use of structural topic marking and zero coding, and on the characterization of their behaviour in terms of local coherence in discourse.

#	predicate	properties of the CB				CB	Ranked CF-list			Trans
		type	pos	LCS	case		CP	CF2	CF3	Type
1	go						r_{boy}	r_{dog}	e_{fish}	NULL
2	believe	0		1		r_{boy}	r_{boy}	e_{fish}		CON
3	captured	ppro	top	1	nom	r_{boy}	r_{boy}	r_{frog}		CON
4	fall in	0		1		r_{boy}	r_{boy}	r_{wat}		CON
5	jump out						r_{frog}	r_{bra}		NULL
6	watch	0		1		r_{frog}	r_{frog}	r_{boy}	r_{dog}	CON

Figure 2 Centering analysis example

3.4 Findings

We investigated 602 utterances, hence 602 transitions. In total we identified 1295 centers, of which 353 (27,3%) are realized by a zero element, and 240 (18,5%) are expressed using structural topic. The rest of the centers are expressed overtly in a non-topic position. There are 448 backward-looking centers (CBs). First we have looked at the following: (i) the distribution of the transitions, (ii) What does the structural topic express: CB, CP or neither of the two? and (iii) What does the zero element express: CB, CP or neither of the two? Then, we looked at the correspondences between the expression of the CB and the transition from two directions: (i) In case the CB is expressed by { structural topic / zero }, what is the transition? and (ii) For a given transition type how is the CB expressed?

As for the distribution of the transitions, out of the 602 transitions there were 194 Continue, 105 Retain, 105 Smooth-shift, 44 Rough-shift and 154 Null. The first two transition types reflect a continuation of the CB, which occurred 299 times (49,7%, thus almost the half of it). The second two show some kind of shift of the CB, which happened 149 times (24,8%) and the latter one corresponds to the beginning of a new discourse segment, which was the case 154 times (25,6%). These counts meet the expectation of a coherent discourse, where the preferred local transition is continuation, but there are significant number of changes, either at the local level (ssh/rsh) or on a higher level (null).

3.4.1 The use of the 'topic position'

With respect to structural topic and the related transitions, we have two leading issues: (i) What does the structural topic realize, i.e., whether it is the CB, the CP or neither of the two? and (ii) In case the CB is encoded by a structural topic, what is the transition?

As for the first question, we have found that the element in the 'topic position' (i.e., structural topic) tends to express a center that is not the CB. From all cases where a constituent occurred in the topic position (240 in total), 176 times (73,3%) it realizes a center that is not the CB, and merely 64 times (26,7%) the CB. This strongly indicates that structural topic marking generally does not correspond to the CB of the utterance. This finding is crucial in our discussion, as it contradicts our first prediction (Section 3.1). Both the CB and the Hungarian clause-initial 'topic position' are characterized in terms of 'aboutness' and a classical understanding of 'aboutness topic' (e.g., WJP (1998) and É. Kiss (2004); Section 3.1). Our findings, however, suggest that structural topic marking in the clause-initial position and the CB of the utterance do not lead to the same (or similar) topic notion. We propose that the function of the structural topic in Hungarian must further be investigated, and it should be given a discourse-based characterization reflecting aspects of the local or global coherence beyond the 'classical' topic function in terms of aboutness. É. Kiss' (2004: p. 8) definition touches upon discourse related functions but essentially this characterization does not go beyond the sentence-level and beyond determining the subject of the predication. The discourse related aspects in her description are basically used to explain the referentiality and specificity requirements of the referent expressed by the element in the structural topic position.

Here we concentrate on determining the discourse function of the structural topic. As we saw above, the referent of the structural topic cannot simply be equated with the CB, i.e., the most salient or foregrounded center. Considering local coherence and the transitions, we need to investigate what relation we can infer between structural topic marking and transition types. The second question at the beginning of this section need to be revised. We have shown that structural topic tends to express a non-CB, hence the question of what transition is related to a CB realized by structural topic is not the appropriate one to begin with. If we look at the distribution of CPs and non-CPs realized by a structural topic, we see that there is an even stronger tendency that structural topic is related to the CP (= predicted next CB) of the utterance. 204 times (85%) the element in the topic position realizes the CP, while only 36 (15%) times a non-CP.

There are two ways to target the second question, i.e., which transition is related to structural topic marking. We can look at which transition we have in all cases where the utterance contains a filled topic position, and we can look at the transition where the CP is realized by a structural topic. These two counts are very similar in our data, given that 85% (204 out of 240) of the topic expressions realize the CP, and from the remaining 36, 13 are iterated topics, co-occurring with a CP expressed by a structural topic.

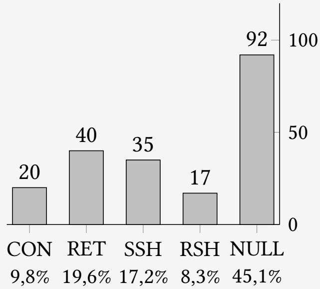

Figure 3 Distribution of transitions for sentences where the CP is realized with a structural topic

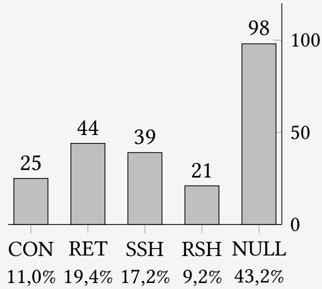

Figure 4 Distribution of transitions for sentences that contain a structural topic

Both counts show that structural topic marking in an utterance tends to correspond with some kind of shift ('topic shift') in the discourse. Looking at the second count in Figure 4, we see that in 43,2% the transition is NULL, while in 26,4% the transition is a SHIFT. These transitions both reflect some kind of change/shift in the discourse, SSH/RSH at the local-level, while NULL at the global-level. The latter transition is related to the beginning of a new discourse segment. Hence, in total, 69,6% of the structural topics are related to a shift-like transition, and only 30,4% are related to some kind of continuation. For the latter we must note that there are almost twice as many RET transitions than CON transitions. In the RET transition the predicted next CB (≈ topic) is different, hence at least there is a predicted shift (whether or not the shift actually takes place in the next utterance).

This finding, i.e., that structural topic tends to correspond to a shift, fits to the generalizations by Comrie (1999) and Van Valin (2005). A relatively large number of NULL transitions associated with the topic position further suggests that the syntactic topic marking in Hungarian corresponds to the marking of a new discourse segment, hence it is related to the global structure, i.e., the global coherence of the given text.

3.4.2 The use of zero coding

In our data, we see a correspondence between zero coding and the CB. This is supported in both ways: when we look at how the CB is expressed and also when we look at all zero elements and what these realize. As for the first aspect, we see a strong tendency to express the CB by a zero element. There are 448 CBs in our data, of which 287 (64,1%) are encoded by a zero element, while only 62 (13,8%) are encoded with a structural topic. From the rest, 94 (21,0%) are expressed by an overt element outside of the topic position, and 5 cases were unclear. The cases we classified as 'unclear' are the ones where the CB is a set referent, of which the elements, i.e., the individual referents, are expressed in different ways. See (12) for an illustration. In u_3, the CB is the set referent $\{r_{dog}, r_{turtle}\}$, while the referent of the turtle (r_{turtle}) is expressed using structural topic and the referent of the dog (r_{dog}) is expressed by a zero possessor.

(12) u_1: *és el-kezdt-e ugat-ni a teknőst*
and PRT-began-3SG.D bark-INF the turtle-ACC
'and he$_{=dog}$ began to bark at the turtle'

u_2: *hát komoly vitá-juk volt*
well serious argument-PS.3PL was
'well, they$_{=dog+turtle}$ had a serious argument'

u_3: *hiszen a teknős végülis be-rántott-a a gazdá-já-t a víz-be*
since the turtle after.all PRT-pulled-3SG.D the owner-PS.3SG-ACC the water-ILL
'since after all, the turtle pulled his owner into the water'

	CB	CP	ranked CF list	transition
u_1	r_{dog}	r_{dog}	$r_{dog} > r_{turtle}$	CON
u_2	r_{dog}	r_{arg}	$r_{arg} > \{r_{dog}, r_{turtle}\}$	RET
u_3	$\{r_{dog}, r_{turtle}\}$	r_{turtle}	$r_{turtle} > r_{boy} > r_{dog} > r_{water}$	RSH

Looking at the issue of the relation between zero coding and the CB from the other direction (from zero coding to CB/non-CB), we can conclude that out of all zero elements (353), 289 (81,9%) realize the CB and only 64 (18,1%) realize a center that is not the CB. These findings point to the direction that the semantic notion of 'aboutness topic' or "*the discourse entity that the utterance U_i, most centrally concerns*" (WJP 1998: 3) is associated with zero coding and not with the structural topic position in Hungarian.

To determine the function of zero coding in discourse, we look at the relation between a zero CB and the transition type. Out of the 287 cases, where the CB is realized by a zero element, we have found 215 times (74,9%) some kind of continuation (CON/RET) and only 72 times (25,1%) a shift of the CB (SSH/RSH). A zero-marked CB is never associated with the NULL transition.

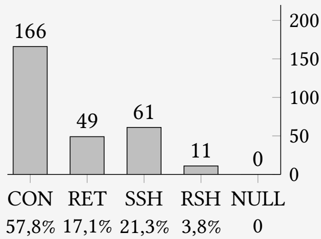

Figure 5 Distribution of transitions for sentences with a zero-marked CB

The exact distribution of the transitions is shown in Figure 5. This distribution indicates that there is a strong tendency that the use of zero coding establishes local coherence by continuation of the most salient center in consecutive utterances.

4 Set reference and Retain/Smooth-shift sub-types

Considering plural referents as 'different' centers needs some elaboration regarding the transition types that require a difference between the CB and the CP of the current utterance and/or between the CBs of the current and the previous utterance. Respectively, $\text{CB}(\text{U}_i) \neq \text{CP}(\text{U}_i)$ holds for Retain and Rough-shift and $\text{CB}(\text{U}_i) \neq \text{CB}(\text{U}_{i-1})$ holds for Smooth-shift and Rough-shift. The issue is how to apply this 'difference-requirement'. Given that plural referents occur in large number in a text in any language, this issue is significant for any centering analysis in general. A strict interpretation of the 'difference-requirement' takes plural referents (i.e., sets of referents) as strictly different ones, without considering which individual referents are included in the given set. A more concessive view makes a distinction between cases where the 'difference-requirement' is considered between a plural referent (a set) and a singular referent or between two plural referents, where the former includes the latter. For example, when the CB(U_i) = r_1 and CP(U_i) = {r_1, r_2} or CB(U_i) = {r_1, r_2} and CP(U_i) = {r_1, r_2, r_3}. This latter view leads to a more fine-grained distinction of transition types.

The second condition of Retain (see Figure 1) requires that the CB and the CP of the current utterance are different: CB(U_i) ≠ CP(U_i). Both the CB and the CP can either be a single referent or a set of referents. The difference between the two can be strict, CB(U_i) ≠ CP(U_i), meaning that they are either two different single referents, or one is a single referent that is not the element of the other plural referent, or they are two disjoint sets of referents. This strict difference means that the prediction is that in the next utterance, the most prominent center will be entirely new. The CB(U_i) and the CP(U_i) can also be overlapping, hence partly different (or partly the same). There are more possibilities:

(a) if one is a single referent and the other is a set, then either CB(U_i) ∈ CP(U_i), or CP(U_i) ∈ CB(U_i); and
(b) if they are both plural referents, then either CB(U_i) ⊂ CP(U_i), or CP(U_i) ⊂ CB(U_i).

These reduce to two relevant cases. When CB(U_i) includes CP(U_i), it predicts that the next topic is part of the current topic, i.e., it predicts that the speaker will partly go on with the same topic. Or, when the CP(U_i) includes CB(U_i), it indicates a prediction that the next topic includes the current topic, hence the prediction is that the speaker will go on with the same topic, but 'extends' it. Accordingly, we propose to make a distinction between different sub-types of Retain (RET) as: RET, RET$^-$ and RET$^+$.

RET	CB(U_i) = CB(U_{i-1}) or no CB(U_{i-1})	and	CB(U_i) ≠ CP(U_i)
RET$^-$			CP(U_i) ∈ CB(U_i) or CP(U_i) ⊂ CB(U_i)
RET$^+$			CB(U_i) ∈ CP(U_i) or CB(U_i) ⊂ CP(U_i)

Figure 6 Sub-types of Retain

The following two examples from our data illustrate the proposed transitions, RET^{-} (13) and RET^{+} (14):

(13)

u_1:	*ahol*	*valami-t*	*hall-anak*		
	where	something-ACC	hear-3PL		

‘where$_{=\text{lake}}$ they$_{=\text{boy+dog}}$ hear something’

u_2:	*fel-figyel-nek*	*ar-ra,*	*hogy*	*valami-t*	*hall-anak*
	PRT-notice-3PL	that-SUB	that	something-ACC	hear-3PL

‘they$_{=\text{boy+dog}}$ notice that they$_{=\text{boy+dog}}$ hear something’

u_3:	*a*	*kisfiú*	*csend-re*	*int-i*	*társ-á-t*
	the	boy	silence-SUB	wave-3SG.D	companion-PS.3SG-ACC

‘the boy silence his$_{=\text{boy}}$ companion’

	CB	CP	ranked CF list	transition
u_1	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\} > r_{lake}$	SSH
u_2	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\} > e_{hear}$	CON
u_3	$\{r_{boy}, r_{dog}\}$	r_{boy}	$r_{boy} > r_{dog}$	RET^{-}

In (13), the transition from u_2 to u_3 is RET^{-}, since the CP of u_3 is a single referent, r_{boy}, which is an element of the plural CB of u_3: = $\{r_{boy}, r_{dog}\}$.

(14)

u_1:	*Van*	*egy*	*kisfiú,*	*aki*	*halász-ni*	*megy*	*a*	*kutyá-já-val.*	
	is	a	boy	who	fish-INF	go[3SG]	the	dog-PS.3SG-INS	

‘There is a boy who goes fishing with his$_{=\text{boy}}$ dog.’

u_2:	*Éppen*	*meg-néz-i,*	*hogy*	*milyen*	*állapot-ban*	*van*	*a*	*tó.*	
	just	PRT-look-3SG.D	that	what	state-ILL	is	the	lake	

‘He$_{=\text{boy}}$ is just looking in what state the lake is.’

u_3:	*Aztán*	*lát-ják,*	*hogy*	*a*	*tav-on*	*van*	*egy*	*béka.*	
	then	see-3PL.D	that	the	lake-SUP	is	a	frog	

‘Then they$_{=\text{boy+dog}}$ see that there is a frog on the lake.’

	CB	CP	ranked CF list	transition
$u1$		r_{boy}	$r_{boy} > e_{fish} > r_{dog}$	NULL
$u2$	r_{boy}	r_{boy}	$r_{boy} > r_{lake}$	CON
$u3$	r_{boy}	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\} > r_{frog} > r_{lake}$	RET^{+}

In example (14), the transition from the second utterance to the third is

RET$^+$, since the CB of u_3 is a single referent, r_{boy}, which is an element of the plural CP = $\{r_{boy}, r_{dog}\}$.

Similar to the sub-types of RETAIN, we define sub-types of the SMOOTH-SHIFT (SSH) transition regarding its first condition that the CB of the current utterance and the CB of the previous utterance must be different: $CB(U_i) \neq CB(U_{i-1})$. When these two are strictly different, it means that an entirely new topic is chosen (topic is shifted). If the current CB includes the previous CB, then the current topic is extended, hence the topic is kept, but more is added to it. And finally, if the previous CB includes the current CB, it indicates that the current topic is part of the previous one, hence the topic is partially the same.

SSH	$CB(U_i) \neq CB(U_{i-1})$	and	$CP(U_i) = CB(U_i)$
SSH$^-$	$CB(U_i) \in CB(U_{i-1})$ or $CB(U_i) \subset CB(U_{i-1})$	and	
SSH$^+$	$CB(U_{i-1}) \in CB(U_i)$ or $CB(U_{i-1}) \subset CB(U_i)$	and	

Figure 7 Sub-types of SMOOTH-SHIFT

We find examples for both SSH$^-$ and SSH$^+$ transitions; see example (15).

(15) u_1: *az ablak-on ordibálva is kerest-ék a béká-t*
the window-SUP shouting also searched-3PL the frog-ACC
'they$_{=boy+dog}$ were also looking for the frog shouting in the window'

u_3: *de nem talált-ák*
but not found-3PL.D
'but they$_{=boy+dog}$ could not find him$_{=frog}$'

u_3: *a kiskutyus ki-esett az ablakpárkány-ról*
the doggy PRT-fell[3SG] the window.sill-DEL
'the doggy fell from the window sill'

	CB	CP	ranked CF list	transition
u_1	r_{dog}	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\} > r_{frog} > r_{win}$	RET$^+$
u_2	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\}$	$\{r_{boy}, r_{dog}\} > r_{frog}$	SSH$^+$
u_3	r_{dog}	r_{dog}	$r_{dog} > r_{win.sill}$	SSH$^-$

In the second utterance, the CB is "extended" from the single referent r_{dog} to the set referent $\{r_{boy}, r_{dog}\}$, hence the transition from u_1 to u_2 is SSH$^+$. In the third utterance, the CB is "reduced" from the set containing two referents, the boy and the dog, to the single referent of the dog. Hence, the transition from u_2 to u_3 is SSH$^-$.

In the following, we examine the effects of considering the above sub-types of RETAIN and SMOOTH-SHIFT in our analysis. Recall the sub-types we proposed before. The RET$^+$ transition predicts that the speaker will extend the current topic, and the RET$^-$ transition predicts that the speaker will reduce the topic in the subsequent utterance. Similarly, with the SSH$^+$ transition the topic is kept but extended, and with the SSH$^-$ transition the topic is reduced or partially maintained.

In our data, we identified 99 RETAIN transitions, of which only 2 are of sub-type RET$^-$, while there are 26 of sub-type RET$^+$ and 71 of sub-type RET. We observed that there is a clear difference in morphosyntactic coding between the RET$^+$ transition and the other two (RET/RET$^-$). The relevant aspect here is the morphosyntactic coding of the CP. In case we have a RET$^+$ transition, the CP is in 81% coded by zero, while in case of the RET transition, the CP is in 91,5% overt (50,7% realized by structural topic, 40,8% realized outside of the topic position). This difference in morphosyntactic coding of the sub-types supports the distinction between RET$^+$ and RET/RET$^-$. As for the distribution of the "special" SMOOTH-SHIFT transitions, SSH$^+$ and SSH$^-$, we see that both are significantly represented in our data, and their relative distribution is similar. Out of the 105 occurrences of a SMOOTH-SHIFT, 17 are SSH$^+$ (16,2%) and 21 are SSH$^-$ (20%). This is different from the distribution of RET$^+$ versus RET$^-$ above, where RET$^-$ is marginal. Based on the related morphosyntactic coding, we can argue again that distinguishing the sub-types of the SMOOTH-SHIFT transition is meaningful. Similar to the sub-types of RETAIN, there is a clear difference in corresponding morphosyntactic coding. For the SMOOTH-SHIFT transition type from U_{i-1} to U_i, the expression of the CB in U_i is the relevant factor. We see that in case of the SSH$^+$ transition the CB is almost exclusively zero marked: in the 17 occurrences of SSH$^+$, the CB was zero marked in 16 cases, while it was encoded overtly outside of the topic position only once. With SSH$^+$, the CB was never encoded with structural topic. For the SSH$^-$ transition, on the other hand, there is a tendency to mark the CB with structural topic. The picture is less clear in this case, as we see zero coded CBs as well. In the 21 occurrences of SSH$^-$, the CB was encoded by a structural topic in 13 cases, by a zero in 7 cases, and by an overt element in a non-topic position once. Nevertheless, the tendency for structural topic is clear. Given that in case of the "plain" SSH transition we also encounter various encodings of the CB, we suggest that a distinction between SSH$^+$ and SSH/SSH$^-$ can be of relevance.

We conclude from the above findings that the proposed sub-types, RET$^+$ and SSH$^+$, are indeed special. These are the transitions, where the predicted or actual next topic is continued, with something merely added to the set. Without considering the corresponding morphosyntactic coding, we argue that in these cases, the topic or the predicted topic is kept. In SSH$^+$, the CB(U_{i-1}) is fully preserved in CB(U_i), and in RET$^+$ the predicted topic CP(U_i) is fully preserved with respect to CB(U_i). Based on this argumentation, we propose to take RET$^+$ and SSH$^+$ as a continuation and count these cases under the CON transition. See below, in Figure 8, our proposed revision of determining the transition types accordingly.

Trans type	**relation between** CB(U_i) and CB(U_{i-1})		**relation between** CB(U_i) and CP(U_i)
CON	CB(U_i) = CB(U_{i-1}) or no CB(U_{i-1})	and	CB(U_i) = CP(U_i) or CB(U_i) ∈ CP(U_i) or CB(U_i) ⊊ CP(U_i)
	CB(U_{i-1}) ∈ CB(U_i) or CB(U_{i-1}) ⊂ CB(U_i)	and	CB(U_i) = CP(U_i)
RET	CB(U_i) = CB(U_{i-1}) or no CB(U_{i-1})	and	CB(U_i) ≠ CP(U_i) or CP(U_i) ∈ CB(U_i) or CP(U_i) ⊊ CB(U_i)
SSH	CB(U_i) ≠ CB(U_{i-1}) or CP(U_i) ∈ CB(U_{i-1}) or CP(U_i) ⊂ CB(U_{i-1})	and	CB(U_i) = CP(U_i)
RSH	CB(U_i) ≠ CB(U_{i-1})	and	CB(U_i) ≠ CP(U_i)

Figure 8 Revised transition types

This proposal is also supported by the corresponding morphosyntactic encodings as discussed before. Following our proposal, the distribution of transitions for sentences with a zero-marked CB is changed as shown in Figure 9, which shows the counts if we consider all RET$^+$ and SSH$^+$ transitions as CON. This revised distribution further strengthens our claims on the relation of zero marking and the transition types (see Section 3.4).

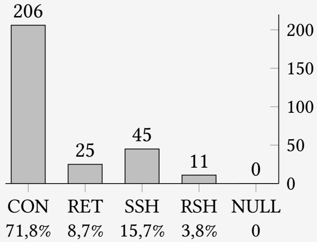

Figure 9 Revised distribution of transitions for sentences with a zero-marked CB (if RET+ = CON and SSH+ = CON)

Despite the convincing evidence from morpho-syntax, the above analysis is merely a first proposal. A more detailed investigation of the transitions and the corresponding morphosyntactic encoding is needed, and the validity of the proposed sub-types and their special treatment must be justified in a larger cross-linguistic setting. Furthermore, along the same line of argumentation, we can theoretically distinguish 9 sub-types of the Rough-shift transition. However, because of space limitations, we skip the discussion of these options in this paper and leave it for further investigation.

5 Conclusions

Both of our target morphosyntactic strategies are related to topicality. Structural topic marking is used to indicate what the sentence is about (É. Kiss 2004) and a zero argument is considered the most unmarked topic (Van Valin 2005). In Centering Theory, the backward-looking center (CB) is taken as an equivalent of 'aboutness topic' in other theories, while the preferred center (CP) is taken as the predicted next topic. Therefore, the goals of our study call for examining the expression of the CB and CP, as well as the corresponding transitions in a larger amount of text. We investigated 12 naturally occurring Hungarian narratives (see Section 3), containing 602 utterances. After analyzing our data within the framework of Centering Theory, we looked at the distribution and relation of given morphosyntactic codings and salient referents, as well as at the correspondences between the expression of the CB and the transition from different directions.

We found a clear correspondence between zero coding of the CB and the Continue transition, as well as an overtly topicalized CP and Shift transitions (Sections 3.4.1 and 3.4.2). Regarding structural topics, we have also found that they are very often associated with a null transition, which indicates the beginning of a new discourse segment. We conclude from this that there is a strong tendency to mark larger discourse units (discourse segments) by structural topics; hence this morphosyntactic strategy should also be considered at the level of global coherence. Our findings and final conclusions do not go entirely against the claims of, for example, É. Kiss (2004), on the analysis of structural topic in Hungarian. Rather, we offer a more elaborate characterization of the function of structural topic marking in discourse, which was merely given as "*the topic foregrounds an individual*" (É. Kiss 2004: 8), without specifying what 'foregrounding' means, i.e., what the exact process is behind it. In this paper, we provided an extension by investigating such processes within discourse. We also offered and explanation for zero elements along the same lines, and a comparison of the two different strategies. Regarding zero coding in Hungarian, we argue that it is crucial to look beyond the morphosyntactic licensing conditions, and we investigated the question: what is the function of the available zero coding within discourse and information exchange?

Our findings suggest that the view that 'topicality is marked structurally in Hungarian' is only partly accurate, and it should rather state that if there is a structural topic in Hungarian, it marks some kind of topicality, namely a *shifted topic*. This is seen as singling out a constituent for being the topic of the subsequent utterances. Topicality can also be marked by zero elements, which signals a *continuing topic*. Hence, we conclude that on the level of discourse coherence the two morphosyntactic strategies reflect the two-dimensional aspect of salience (Givón 1983; 2001) in discourse: zero argument coding has the backward-looking function, establishing local coherence by topic continuity, while structural topic marking has the forward-looking function, indicating a topic shift, which can operate both on the local or the global level of discourse coherence.

The findings in this study contradict our first prediction/hypothesis, which lead to a more elaborate characterization of topicality in Hungarian. On the other hand, our findings meet the second hypothesis based on Comrie (1999) and Van Valin (2005), of which we provided an experimental evidence. We claim that such experimantal studies, based on naturally occurring texts, are of great importance for any theoretical work. The formal analysis of any linguistic phenomenon requires that theoretical claims are verified by empirically valid studies.

Beyond our primary goal as explained before, we also discussed the issue of set referents and their proper treatment within Centering Theory. We proposed an extension to the rules of determining transition types by adding cases where there is an inclusion relation between two centers of which we need to determine whether they are different or the same. We introduced our first proposal on this issue in Section 4, that need further investigation, preferably in a cross-linguistic setting.

Despite the outcome and results of the study presented here, there are several further issues raised. First of all, our proposal needs to be evaluated by a comparative experiment in different languages that manifest some overt morphosyntactic topicalization strategy, as well as zero (argument) coding. Such a language is, for example, Japanese, in which a similar study is reported by Shimojo (2016). The results point in the same direction, however, the parameters in the two analyses are slightly different, which needs further investigation. Regarding the outcome for Hungarian, there are important questions we need to explore further. We need to look at cases that deviate from the tendencies we identified and find out the possible reasons behind it. With respect to this, we need to investigate the cases where a zero CB is associated with some kind of shift transition, and the cases where a structural topic cooccurs with a kind of continuation. The question is whether these cases are due to some 'mistake' or 'noise' (that is expected in a naturally occurring narrative), or whether there is another communicative or discourse function behind them, which we have not identified yet. These issues are left for further research and will be discussed in subsequent papers.

Abbreviations and glosses

1, 2, 3	1st, 2nd, 3rd person	FOC	focus	PS	possessive
ACC	accusative	ILL	illative	SG	singular
CT	contrastive topic	INF	infinitive	SUB	sublative
D	definite conjugation	INS	instrumental	SUP	superessive
DAT	dative	PL	plural	TOP	topic
DEL	delative	PRT	particle		

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Interpreting gradable adjectives: Rational reasoning or simple heuristics?

Alexandre Cremers

Abstract Gradable adjectives can be categorized into relative adjectives ('tall', 'far', 'happy'), which are vague and context-dependent, and absolute ones ('dry', 'dirty', 'full'), which are much less context-dependent and can receive a strict interpretation. Different explanations have been proposed in the literature to explain this split, most saliently: a lexical approach, where the category is determined by properties of the scale on which the adjectives measures entities (Kennedy & McNally 2005), and a pragmatic approach, which refers to properties of the distribution of measurements in the comparison class (Lassiter & Goodman 2013: a.o.). A related debate concerns the nature of the cognitive processes responsible for integrating contextual information: simple heuristics or sophisticated rational reasoning? Pragmatic approaches are split between theories which assume rationality at the speaker's level and evolutionary theories which instead focus on long-term optimality, while lexicalist approaches tend to rely on heuristics. The experimental literature has established an effect of the comparison class on the interpretation of relative adjectives, but it is still unclear whether it can determine an adjective's category, and rational models have not been directly compared with simpler heuristics. We present an experiment using nonce adjectives (to control for lexical information and world knowledge), in which the range of the scale is always closed. Comparison classes vary in the probability mass they place at scale boundaries, a factor which probabilistic pragmatic accounts take to be the determining factor. We found that simple heuristics perform as well as the best rational model, and that the degree distribution within the comparison class can lead to categorical distinctions in the interpretation of nonce adjectives, although it remains unclear whether the resulting categories constitute genuine absolute and relative meanings.

Keywords gradable adjectives · degree semantics · vagueness · probabilistic pragmatics

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1 Gradable adjectives, scales, and comparison classes

The class of gradable adjectives can be divided between *relative* adjectives, such as ‘tall’ or ‘far’, which are highly context-dependent and vague, and *absolute* adjectives, the meaning of which is much more rigid (Unger 1971; Bolinger 1972). Absolute adjectives are further divided between *minimum standard*, such as ‘dangerous’, and *maximum standard*, such as ‘dry’. Informally, the former conveys that an object presents at least some danger, while the latter conveys that an object is fully dry.

Kennedy & McNally (2005) argued that these distinctions stem from differences in the structure of the scales to which these adjectives refer. Relative adjectives map individuals onto *open* scales, with no definite boundaries, while absolute adjectives map individuals onto *closed* scales, with a strict minimum, maximum, or both. Whether the closed scale is upper- or lower-bound further distinguishes between minimum and maximum-standard absolute adjectives. Scales that are fully closed tend to give rise to maximum-standard adjectives.

For Kennedy & McNally (2005), these distinctions are a matter of lexical semantics, in that the adjective encodes the type of scale to which it maps entities (as the range of the measure function it denotes), thereby determining its class. The class, in turn, affects other lexical properties of the adjective, such as the modifiers it can combine with. For instance, only maximum-standard adjectives can combine with adverbs such as ‘completely’ or ‘almost’ (which make reference to an endpoint).

A point often raised against the lexical approach is that lexically-encoded scales do not always match the scale we would intuitively associate to an adjective. For instance, the cost scale associated with ‘cheap/expensive’ should have a clear minimum: free items. Yet, ‘completely cheap’ sounds deviant and, to the extent that we would accept it, would not intuitively mean ‘free’. This suggests that the underlying scale determined by the adjective is not our intuitive notion of cost, lower-bound by zero, but a more abstract scale with no lower end, e.g., a logarithmic scale (Kennedy 2007). While this observation can at first be seen as an argument in favor of the lexical semantics idea, it may actually threaten the whole enterprise. If apparent exceptions to the rule that scale boundaries determine the class of the adjective can be circumvented by postulating *ad hoc* scales, the whole proposal may become circular. Wellwood (2020) proposes to save the lexical semantics approach from unfalsifiability using a two-stage system of semantic interpretation, where linguistic interpretations are first mapped to non-linguistic thoughts, which in turn can be assigned truth-values. She argues that such non-linguistics representations are needed anyway, and can in principle be tested independently. In the case of 'expensive', the assumption that our (non-linguistic) concept of price excludes 0 could indeed be independently motivated (see 'zero-price effect', Shampanier & Mazar & Ariely 2007).

In the same vein, McNally (2011) proposes that the difference between relative and absolute adjectives corresponds to different ways of categorizing objects. Relative adjectives would cluster them according to similarity with one another (which requires a comparison class), while absolute adjectives would use rule-based categorization. In this view, the crucial feature is not the scale structure anymore, but background knowledge about the dimension encoded by the adjective, which decides whether a rule can be derived or whether a comparison class is needed.

Alternatively, recent Bayesian pragmatics accounts of gradable adjectives, while drawing much of their inspiration from Kennedy & McNally (2005) and subsequent work, offer a competing view in which the comparison class, rather than the lexical semantics of the adjective, fixes the properties of the scale, and thereby determines the class of the adjective (on a case-by-case basis). The central idea of Bayesian pragmatics is that listeners interpret utterances by updating their prior beliefs with the information provided by the speaker (Frank & Goodman 2012). Lassiter & Goodman (2013: henceforth L&G) propose to model scale boundaries with prior beliefs where significant probability mass is located at one or the other end of the range of degrees. The adjective only provides a measure function (i.e. a function from entities to degrees), and prior beliefs about these entities is what ultimately determines whether the resulting scale is open or closed. Coming back to the 'expensive/cheap' example, if we are discussing the purchase of a new fridge, we would typically consider the range of prices for new fridges, which clearly does not extend all the way down to the theoretical lowest price of zero. In this framework, theoretical boundaries on a scale (the range of the measure function denoted by the adjective) are irrelevant; what matters is the distribution of degrees in the comparison class (i.e. the image of the comparison class by the measure function). These accounts therefore claim to make lexical stipulations superfluous.

This debate raises about a secondary question about the exact nature of the process that maps comparison classes onto adjective thresholds. According to McNally (2011), this process is a general similarity-based clustering and only plays a role for relative adjectives. There is no consideration of whether the resulting classification is optimal for language use. On the other hand, L&G and Qing & Franke (2014a: henceforth Q&F) assume that a single process, highly specialized for linguistic purposes, is responsible for both relative and absolute interpretations. They differ in that L&G see this process as explicit pragmatic reasoning occurring every time a gradable adjective is uttered, whereas Q&F adopt an evolutionary approach, in which the optimization of the mapping from comparison class to threshold happens at the level of a linguistic community, not internally for each agent (at the level of agents it could have solidified into a simple heuristics).

Previous experimental work (Syrett et al. 2004; Schmidt et al. 2009; Solt & Gotzner 2012; Qing & Franke 2014b, a.o.) shows that the distribution of degrees within a comparison class does affect the threshold of adjectives, but the link between closed scales and absolute interpretations has not been explicitly tested and simple heuristics have not been directly compared with Bayesian models. Xiang et al. (2022) recently showed that existing Bayesian models offer a good fit of the communicative effect of relative and absolute gradable adjectives, but fail to capture truth-value judgments, unless supplemented with semantic conventions. Meanwhile, most modeling work follows L&G in assuming that the prior distribution alone determines the class of the adjective (Q&F; Tessler & Lopez-Brau & Goodman 2017; Bennett & Goodman 2018).

We therefore propose a new experiment with two main goals. The first is to adjudicate between the Bayesian pragmatics view, in which the distribution of degrees in the comparison class is sufficient to determine the class of an adjective, and the lexical semantics view, which stipulates that the theoretical boundaries of the scale are the deciding factor (even if the comparison class does not reach these boundaries). To do so, we strip all world knowledge and lexical information by using nonce adjectives and fictional measures, and observe whether a categorical distinction between relative and absolute adjectives can emerge nonetheless. The second goal is to test explicit quantitative accounts of gradable adjectives. Several different types of models have been proposed: simple heuristics (Schmidt et al. 2009; Schmidt 2009), rational reasoning (L&G), and evolutionary models (Q&F, Correia & Franke 2019). By collecting a large enough dataset, we will be able to systematically compare models from each category.

2 Experiment

2.1 Methods

We tested the interpretation of nonce adjectives in the presence of explicit comparison classes which each comprised 20 planets, for which we gave fictional measurements of the dimension measured by the adjectives. The use of nonce adjectives ensured that only information about the scale and the comparison class was available to determine whether an adjective is absolute or relative. All measurements were expressed in percentages (thereby fixing clear theoretical boundaries for all scales), and the 20 planets in the comparison class corresponded to the 21-quantiles of a beta-distribution with possible inflation in 0 or 1 to represent closed scales. The experiment was run on Alex Drummond's Ibex Farm.

After validating the consent form, participants received instructions which included the introduction text in (1) as well as three example items which drew their attention to the comparison class and the fact that sometimes a clearcut answer wasn't possible.

(1) An advanced alien civilization from a distant galaxy has explored all the planets in their star system as well as many planets orbiting neighboring stars. They have classified these planets into a number of categories and have measured different properties.

In this survey, you will see some of these measurements for some categories of planets, and we will ask you to tell us how much you agree with statements about individual planets.

After reading the instructions participants saw three training items similar to the examples to help them familiarize with the task. In each trial, they were asked to judge the applicability of a predicate containing an adjective to an element from the comparison class, using a continuous slider as shown in Figure 1. The slider followed the cursor and its position was recorded on the first click to make the task less tedious. For each participant, we created

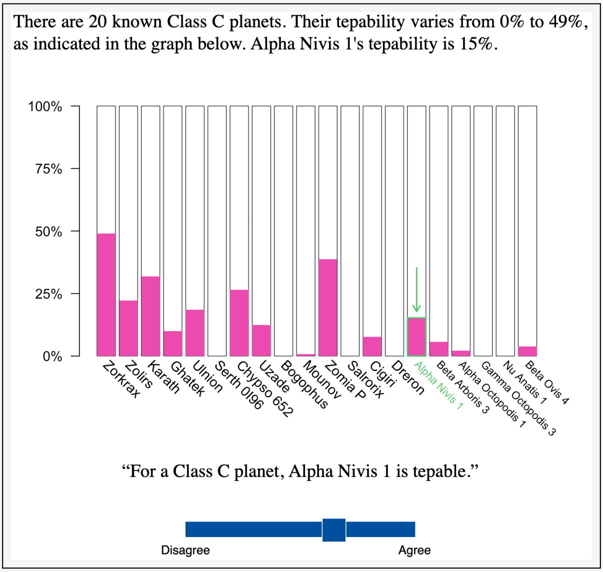


Figure 1 Example trial with a Lower-bound comparison class (many items are at or close to 0%).

8 comparison classes by sampling parameters from uniform distributions with ranges given in Table 1 (with probability distributions corresponding to lower-, upper-, double-bound and unbound scales in the Bayesian pragmatics literature). Each comparison class was paired with a nonce-adjectives from Table 2. For each comparison class, we tested the applicability of a predicate to half the elements, and the applicability of its negation for the other half (randomly selected as odd and even quantiles). Three comparison classes were paired with bare (positive form) adjectives and four featured adjectives modified by 'very', 'extremely', 'absolutely', and 'quite'. Each of these constructions could appear in affirmative of negated form. The last comparison class appeared with 'a bit' in affirmative sentences and 'at all' in negative sentences. The 8 comparison classes were broken down into 16 blocks of 10 trials (affirmative and negative forms separated to avoid confusion). The blocks were presented in random order, and items within each block were also randomized. The association between scales, adjectives, and constructions was randomized and balanced.

Distribution	p_0	p_1	a	b	Support
Unbound 1	0	0	[4, 40]		(0, 1)
Unbound 2	0	0	[3, 15]		
Lower-bound 1	[0.1, 0.7]	0	[0.7, 1]	[1, 6]	[0, 1)
Lower-bound 2	[0.2, 0.65]	0	[1, 2.5]	[1, 8]	
Upper-bound 1	0	[0.1, 0.7]	[1, 6]	[0.7, 1]	(0, 1]
Upper-bound 2	0	[0.2, 0.65]	[1, 8]	[1, 2.5]	
Double-bound 1	[0.1, 0.35]		[0.7, 1]		[0, 1]
Double-bound 2	[0.1, 0.25]		[1, 3.5]		

Table 1 Parameter ranges of the inflated beta distributions used to generate comparison classes. p_0 and p_1 are the discrete probability mass at 0 and 1 respectively. a and b parametrize the beta distribution. The last column indicates the support of the distributions (which align with their name).

Bare form	Noun	Comparative	Superlative
roagly	roagliness	roaglier	roagliest
vibble	vibbleness	vibbler	vibblest
drok	drokth	drokker	drokkest
scrop	scropth	scropper	scroppest
plard	plardity	plarder	plardest
hif	hifth	hiffer	hiffest
tepable	tepability	more tepable	most tepable
plawic	plawicity	more plawic	most plawic

Table 2 Nonce adjectives used in the experiment, together with the derived noun for the measurement. The comparative and superlative forms were only used in examples and training items. We varied the morphology across the 8 adjectives, as some suffixes may be biased towards specific categories. However, as discussed in the results section, we did not observe any difference between the 8 adjectives.

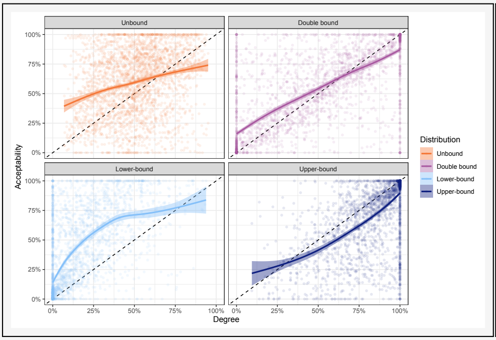
2.2 Participants

We recruited 222 participants on MTurk, paid \$2 each (the survey took about 10min). We removed participants whose median RT was below 1s, or who had more than 50% duplicated responses (i.e., didn't move the slider between subsequent trials). We fitted linear regressions of acceptability by degree (flipped for negative sentences) and removed blocks where the regression coefficients was more than 1SD below the mean (threshold: $-.36$), as well as participants who fell below the threshold on at least half of the blocks. The goal was to remove cases where participants missed a change of polarity between two blocks, which happened on 7% of affirmative blocks and 14% of negative blocks. In all, we filtered out 20% of the initial data set.

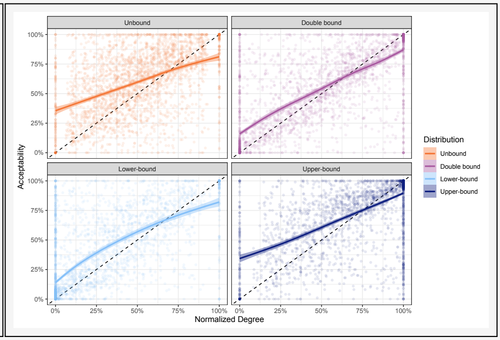
3 Results

The full data set and analysis scripts are available at `https://github.com/Alex-Cremers/nonce-gradable-adj`. We first tested how negation affected the results by fitting sigmoid functions with optional censoring at scale ends to each block, and compared the midpoints and steepness for pairs of affirmative and negative blocks (excluding the 'a bit/at all' cases). We found no significant differences (midpoint: $t(404) = -0.10$, $p = 0.92$; steepness: $t(456) = -0.85$, $p = 0.40$), confirming that negation does not shift the threshold for the adjective but only flips acceptability, in line with previous empirical findings (Hersh & Caramazza 1976; Leffel et al. 2019). In the rest of the analyses, we pool data from affirmative and negative blocks under the assumption that $\mathrm{Acc}(\neg S) = 1 - \mathrm{Acc}(S)$. From now on, we focus on the bare adjectives only.

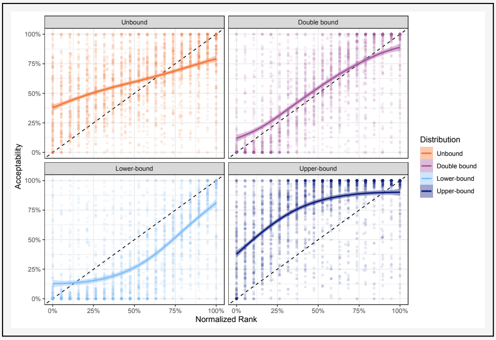
In order to diagnose absolute interpretations, we computed the slope of acceptability as a function of degree at both ends of each scale. Min. std. adjectives would have a sudden increase in acceptability at the bottom of the scale, since the threshold should most likely be located right above the minimum degree. For max. std. adjectives, we expect a steep increase at the top of the scale, as the threshold should sit right below the maximum of the scale. By contrast, relative adjectives should be flat at both extremities of their degree distribution, since their vague threshold should be situated slightly above the middle of the scale (their acceptability should form a sigmoid). The slopes were computed using linear regressions on the first and last 3 degrees on each scale. Figure 3 displays the measured slopes.



(a) Acceptability by raw degree.



(b) Acceptability by degree normalized to map the highest degree in each comparison class to 1 and the lowest to 0.



(c) Acceptability by rank of the item in the comparison class, normalized to [0,1].

Figure 2 Acceptability of the bare adjectives as a function of various possible predictors. Figure (a) illustrates the categorical difference between the different types of comparison classes. Figure (b) shows that normalizing degrees by the range of the comparison class explains most of the differences. By contrast, Figure (c) shows that rank in the comparison class alone cannot explain participants' judgments.

For statistical analysis, we applied an inverse hyperbolic sine (IHS) transform on slopes, which gives good results on right-skewed data with negative values (Burbidge & Magee & Robb 1988). We ran two mixed-effects regressions on these IHS-transformed slopes—one for slopes at the bottom of the comparison class and one for slopes at the top—with Distribution type as a predictor (treatment-coded with Unbound as the reference level) and random by-subject intercepts. The detailed results, in Table 3, confirm the differences which are visible in the graph: acceptability ratings vary significantly more dramatically near closed boundaries than open boundaries.

At this point, it is still unclear what drives the difference between the distributions, and whether participants are sensitive to fine-grained distributional differences within each type of comparison class. As a post-hoc analysis, we tested the effect of p_0 (the probability mass at 0) on bottom slopes and p_1 on top slopes by adding them as predictor to the mixed-effects models described above. We found no effect of p_0 for bottom slopes ($\beta = .098$, $\chi^2(1) = 1.4$, $p = .24$) and a small but *negative* effect of p_1 for top slopes ($\beta = -.18$, $\chi^2(1) = 5.4$, $p = .02$). This suggests that the presence of items from the comparison class at a scale boundary can shift the threshold to this boundary, but *how many* items are at the boundary does not actually matter, even though we varied this number dramatically, from 2 to 14.

Finally, one may wonder whether the eight nonce adjectives differed with respect to our measure. We tried to vary the morphology among them, and it is possible that some suffixes were biased towards a specific category of gradable adjectives. To test this possibility, we updated the mixed models with a fixed categorical factor of adjective. This didn't improve the fit on either top ($\chi^2(7) = 4.54$, $p = 0.72$) or bottom ($\chi^2(7) = 4.49$, $p = 0.72$) slopes, suggesting that there is no significant differences between the 8 adjectives.

	Distribution	β	t	p
Bottom	(unbound)	0.44	5.7	$< .001$
	double-bound	0.27	2.6	.011
	lower-bound	0.31	2.9	.004
	upper-bound	−0.03	−0.3	.77
Top	(unbound)	0.30	4.6	$< .001$
	double-bound	0.34	3.8	$< .001$
	lower-bound	0.08	0.9	.37
	upper-bound	0.35	3.9	$< .001$

Table 3 Results of the mixed-effects model on IHS-transformed slopes. Unbound is the reference level (intercept), other parameters correspond to the difference. The Double-bound distributions have higher slopes than Unbound at both ends. The Lower-bound distributions have a steeper slope at the bottom of the scale, but not at the top. The Upper-bound distributions exhibits the opposite pattern.

4 Modeling

Our results confirm that participants are sensitive to the distribution of degrees in the comparison class, and further demonstrate that their response

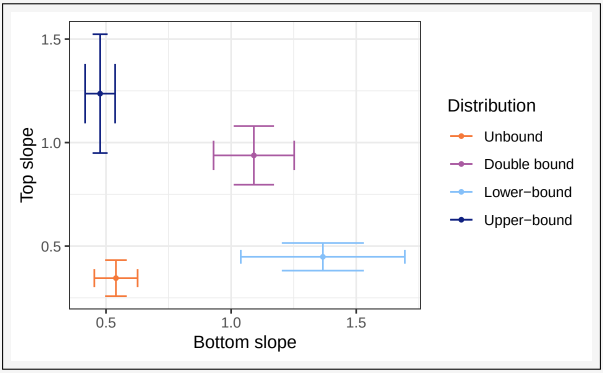


Figure 3 Slope computed on the three highest degrees as a function of slope on the three lowest degrees, by distribution type (mean and standard deviation).

patterns roughly fall into the usual categories of relative, min. std. and max. std. adjectives. However, the effect seems to come almost exclusively from the range of degrees in the comparison class, and whether this range reaches 0 or 1. This would suggest—against usual assumptions in the Bayesian pragmatic literature—that participants' behavior is not in fact sensitive to subtle distributional effects, and may be better described by a simple heuristic. Bayesian pragmatics is not out of the race yet however. For instance, the Speaker-Oriented Model (SOM) of Q&F allegedly switches to a minimum standard interpretation when the probability mass near the lower boundary reaches a tipping point. It would thus behave more categorically than the RSA model of L&G.

We now present quantitative models that have been proposed to capture effects of comparison class on adjectives and which we will test against our data. The first model is a very simple heuristic sensitive to the range of degrees only, while the second is a more complex one based on similarity-based clustering. We then present two implementations each of L&G's RSA model and Q&F's evolutionary SOM.

4.1 The RH-R model

Schmidt et al. (2009) tested 9 different descriptive models of gradable adjectives, which exploit various statistical properties of a discrete comparison class to predict the interpretation of an adjective. Of these 9, we will only consider the best two models. The first one, "Relative height by Range"

(RH-R), is a very simple model which assumes that the adjective is true of a fixed proportion of the degree range, with Gaussian noise around the degree that realizes this proportion. We allowed both parameters of the model (the proportion of degrees which validate the adjective and the fuzziness parameter) to vary independently by participant in a hierarchical model. For comparison with the Bayesian pragmatic models, we fitted the proportion of items for which the adjective is true as one minus the inverse logit of a "cost" parameter which was normally distributed among participants. The participants' fuzzyness parameters were sampled from a log-normal distribution. Each participant was also assigned a noise parameter (describing the error between the model predictions and the data), which was also log-normally distributed. For this model and all following models except CLUS, we also included a Gaussian random effect of nonce-adjective on cost.

4.2 The CLUS model

A second model proposed by Schmidt et al. (2009), CLUS, performed about as well as the RH-R on their data. It is a more sophisticated model based on a probabilistic clustering, and is therefore a good representative of what McNally (2011) assumes for relative adjectives. In detail, a Dirichlet process builds a probabilistic partition of the items in the comparison class, assuming that the degrees of items within the same cell follow the same normal distribution. In this model, the probability that an item counts as "tall" is the probability that it belongs to the same partition cell as the tallest item in the comparison class, conditional on the tallest and shortest items belonging to separate cells. Our detailed implementation of the model is given in Appendix A. The model has several free parameters governing the priors of the parameters of the Gaussian distribution for each cluster, and an α parameter tuning the model's bias towards few large clusters or many smaller clusters. A hierarchical fit was attempted, but turned out to be computationally too difficult. In the end, we fitted only the α parameter.

4.3 Lassiter and Goodman's RSA model

L&G build on the standard Rational Speech-Act model, where speakers are assumed to maximize the trade-off between informativity and cost for each utterance, but they assume that listeners also reason about which possible threshold θ could have led a speaker to use a gradable adjective. The literal listener L_0, parametrized by θ, is defined as:

(2) $L_0(d|\text{adj}, \theta) \propto \varphi(d)[\![\text{adj}]\!]^{\theta}(d)$ where φ is the prior on degrees

We adopt a non-strict semantics for gradable adjectives, except when $\theta = 0$. This means that $\theta = 0$ corresponds to a strict min. std. interpretation, and $\theta = 1$ to a strict max. std. interpretation:

(3) $[\![\text{adj}]\!]^{\theta,d} = 1 \quad \text{iff} \quad \big(d \geq \theta > 0 \quad \text{or} \quad d > \theta = 0\big)$

As usual in RSA, the utility function U_1 represents a trade-off between informativity and cost, here parametrized by θ. We only consider two messages (the bare positive-form adjective and the null message) so the function describing the pragmatic speaker S_1 remains very simple:

(4) $U_1(u|d, \theta) = \log L_0(d|u, \theta) - cost(u)$

(5) $S_1(\text{adj}|d, \theta) = \left| \begin{array}{ll} \dfrac{1}{1 + \mathrm{e}^{\lambda[\log \Phi^{c*}(\theta) + c_{\text{adj}}]}} & \text{if } [\![\text{adj}]\!]^{\theta}(d) = 1 \\ 0 & \text{otherwise} \end{array} \right.$

Where $\Phi^{c*}(\theta)$ is the probability that $[\![\text{adj}]\!]^{\theta}(d)$ is 1 given a fixed θ and the prior distribution φ on d (i.e., the complementary cumulative distribution function of d, modulo the strict/non-strict adjustment). Note that, as a function of d, S_1 is simply a step function.

The pragmatic listener infers both d and θ, using a prior $P(\theta)$ on the threshold:

(6) $L_1(d, \theta|\text{adj}) \propto \varphi(d)P(\theta)S_1(\text{adj}|d, \theta)$

In order to make predictions regarding the acceptability of the adjective, we need to compute the posterior cumulative distribution function of θ (Lassiter & Goodman 2015: Eq. 32). We first marginalize over d:[1]

[1]The move from the first line to the second is valid because $S_1 = 0$ for $d < \theta$. The move to the third line is possible because S_1 is constant for $d \geq \theta$ and can therefore be factored out of the sum.

(7)
$$\begin{aligned}
L_1(\theta|\text{adj}) &\propto \sum_d \varphi(d)P(\theta)S_1(\text{adj}|d,\theta)\\
&\propto \sum_{d\geq\theta} \varphi(d)P(\theta)S_1(\text{adj}|d,\theta)\\
&\propto \left(\sum_{d\geq\theta}\varphi(d)\right)P(\theta)S_1(\text{adj}|d\geq\theta,\theta)\\
&\propto \frac{\Phi^{c*}(\theta)P(\theta)}{1+\mathrm{e}^{\lambda[\log\Phi^{c*}(\theta)+c_{\text{adj}}]}}
\end{aligned}$$

We can then derive the predicted acceptability. The normalizing constant is simply the integral up to the highest degree in the comparison class:

(8)
$$\text{Acc}(\text{adj}|d_i) \propto \int_0^{d_i} \frac{\Phi^{c*}(\theta)P(\theta)}{1+\mathrm{e}^{\lambda[\log\Phi^{c*}(\theta)+c_{\text{adj}}]}}\mathrm{d}\theta$$

We tested two priors on θ: a continuous uniform prior on [0,1], and recycling the discrete degree prior. The first option is what L&G proposed; the second corresponds to sampling the threshold from the comparison class. In the rest of the paper, we name these two models RSA-U and RSA-I (for **U**niform and **I**nformed priors, respectively).

An interesting property of the RSA model is that it cannot ever predict less than 100% acceptability on the maximal element in a comparison class. Indeed, the acceptability is meant to track posterior probability of θ after hearing an utterance of the adjective in its positive form. Since the adjective must be true of some degree to have been uttered truthfully, θ cannot exceed the highest degree in the comparison class. By contrast, the model does not necessarily prevent the adjective from receiving a tautologous interpretation, which would make even the lowest degree acceptable. The possible values for θ are further restricted by the prior however (in particular, our priors do not allow $\theta < 0$, so a degree of 0 is always unacceptable in our implementation).

The participants' rationality parameters followed a log-normal distribution while the costs followed a normal distribution. As with the RH-R model, participants were also assigned a noise parameter from a log-normal distribution.

4.4 Qing and Franke's SOM

The SOM proposed in Q&F is superficially similar to the RSA, in that it also works around a trade-off between communication success and cost. Conceptually, it is very different however: the threshold is assumed to be a convention among a community of language users, and the trade-off is optimized in the long term rather than for an isolated utterance.

Formally, the model assumes that there is a convention on a probabilistic distribution for θ, $\Pr(\theta)$, and that this distribution is an approximation of the threshold which would optimize a trade-off between expected success (the probability that communication is successful) and expected cost (which increases with the frequency of use of the adjective). For a discrete prior, the two components are defined as follow:

(9) Expected success:

$$\begin{aligned} ES(\theta) &= \sum_{u_1(d)=0} \varphi(d)\varphi(d|u_0,\theta) + \sum_{u_1(d)=1} \varphi(d)\varphi(d|u_1,\theta) \\ &= \sum_{d<\theta} \varphi(d)^2 + \sum_{d\geq\theta} \frac{\varphi(d)^2}{P(d\geq\theta)} \\ &= \sum \varphi^2 + \frac{P(d<\theta)}{P(d\geq\theta)} \sum_{d\geq\theta} \varphi(d)^2 \end{aligned}$$

To understand the definition of expected success, one first needs to consider that there is a $\varphi(d)$ probability that a speaker may want to communicate the degree d. If d is below the threshold, the speaker cannot use the adjective, and so the listener also has a probability $\varphi(d)$ to guess the correct degree (hence the $\varphi(d)^2$). If d is above θ, the speaker can and will use the adjective, so the listener can conditionalize on the information that $d \geq \theta$, therefore they will guess d with probability $\frac{\varphi(d)}{P(d\geq\theta)}$.

The expected cost is simply the cost of the adjective multiplied by the probability that the adjective will be used given θ:

(10) Expected cost:

$$EC(\theta) = c_{\text{adj}} \times P(d \geq \theta)$$

The utility of a fixed threshold θ is then defined as the difference between expected success and expected cost, and the conventional distribution of θ

is assumed to be a softmax over possible thresholds:

(11)
$$\begin{aligned}\Pr(\theta) &\propto \exp(\lambda[ES(\theta) - EC(\theta)]) \\ &\propto \exp\left(\lambda\left[\frac{P(d<\theta)}{P(d\geq\theta)} \sum_{d\geq\theta} \varphi(d)^2 - c_{\mathrm{adj}} P(d \geq \theta)\right]\right)\end{aligned}$$

In this case, the softmax is not meant to encode sub-rationality (as we're talking about optimization at the level of a whole community), but to represent various sources of noise (in particular uncertainty on the prior distribution) which lead to vagueness.

Unlike the RSA, the SOM does not impose any restriction on θ, and in particular does not exclude thresholds outside the comparison class (which would make the adjective trivially true or false). For comparison with the RSA model, we assume that θ can fall under the smallest degree if it is positive, but cannot exceed the highest degree in the comparison class (i.e., the adjective can be trivial, but it cannot be contradictory). The second difference is that the SOM is not sensitive to the actual degrees, only to the probability distribution over them. This means that if the comparison class comprises of n degrees, there are at most $n + 1$ thresholds to consider (in practice, we'll only consider n or $n - 1$, given the previous point).[2]

The model uses the same parameters as the RSA, so we adopted the same distributions. However, due to difficulty fitting the model, we adopted more restrictive priors on the variance of the random effects.

4.5 An update on the SOM

The notion of expected success in the SOM is only properly defined for discrete priors[3] and has some problematic mathematical properties. For instance, given a discrete comparison class where elements are equiprobable, the model always predicts the maximum-standard interpretation to be

[2]Things would be different if we considered all possible values of θ in [0,1] and decided to integrate $\exp \lambda U(\theta)$ (see fn. 5), but this would require picking a prior on θ, which goes contrary to the spirit of the SOM.

[3]Q&F propose a continuous generalization with $\int \varphi^2$ where φ is the density of a continuous prior, but with some continuous priors, this integral is not finite, so the distribution of θ is not defined. Even when finite, this quantity is not scale independent, while the expected cost is. As a result, the model predictions depend on the unit of measurement (i.e., the prediction for 'tall' are qualitatively different if heights are measured in cm or in).

optimal, unless the cost of the adjective is negative.[4]

For these reasons, we propose an update to the SOM to give it a better-behaved expression by replacing the problematic notion of expected success with expected informativity (in line with the RSA). We refer to this model as "SOM-EI" in what follows.

(12) Expected informativity:

$$\begin{aligned} EI(\theta) &= \sum_{u_1(d)=0} \varphi(d) \log \varphi(d|u_0,\theta) + \sum_{u_1(d)=1} \varphi(d) \log \varphi(d|u_1,\theta) \\ &= \sum_{d<\theta} \varphi(d) \log \varphi(d) + \sum_{d\geq\theta} \varphi(d) \left[\log \varphi(d) - \log(1-\Phi(\theta))\right] \\ &= \sum \varphi \log \varphi - P(d \geq \theta) \log P(d \geq \theta) \\ &= -H(\varphi) - P(d \geq \theta) \log P(d \geq \theta) \end{aligned}$$

Where $H(\varphi)$ is the entropy of the prior. This notion of expected informativity can be generalized to the continuous case using the notion of differential entropy ($h(X) = E[\log X]$). While differential entropy is not scale independent, it only appears as an additive constant in the utility function $U(\theta)$, and therefore does not affect the predictions of the model:

(13) $U(\theta) = -h(\varphi) - P(d \geq \theta) \left[\log P(d \geq \theta) + c_{\text{adj}}\right]$

As this expressions makes clear, this version of the SOM is only sensitive to the proportion of elements in the comparison class that end up below or above the threshold. For instance, with $c_{\text{adj}} = 0$, the optimal θ is the value that makes the adjective applicable to $e^{-1} \approx 37\%$ of the elements. In this regard, this model is similar to the PN "Percent Number" model of Schmidt et al. (2009), which also focuses on the proportion of items counting as "tall". The two models differ on the shape of the distribution around this mode however, since the PN is always Gaussian while the SOM can take more exotic forms and may have a different mean.[5]

The parametrization of the SOM-EI was identical to that of the SOM.

[4]Proof: if there are N items in the comparison class, of which k are at or above θ, utility reduces to $\frac{1}{N} + \frac{N-k}{N^2} - \frac{k}{N}c_{\text{adj}}$. Assuming that c_{adj} is positive or null, this is a strictly decreasing function of k, which means that θ should be as high as possible.

[5]Looking at equation (8), one might think that this is also true of the RSA-U, since the comparison class only shows up through the function Φ^{c*}, which encodes the probability

4.6 Methods and Results

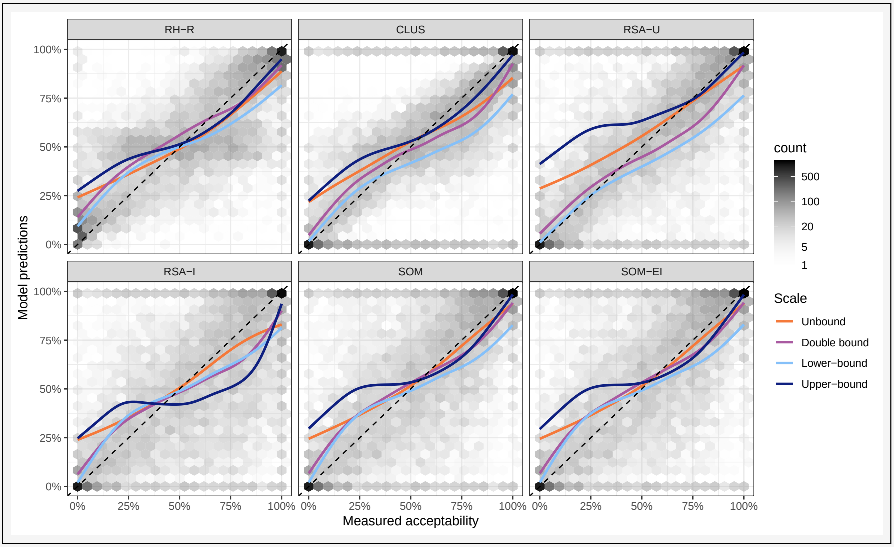


Figure 4 Model predictions against data for each of the models, with shade indicating the concentration of points in a given hex cell. The predictions of the best models fall along the diagonal since they tightly follow the data. The colored lines indicate the shape of predictions for each type of scale.

The models were fitted using Stan (Carpenter et al. 2017) on all data from bare adjectives. Participants' responses on sliders were assumed to follow a Gaussian censored at 0 and 1 (as in a tobit regression, Tobin 1958). Figure 4 presents each models predictions against the data.

We evaluated and compared the models through leave-one-out cross-validation (LOO-CV), using the PSIS technique from Vehtari & Gelman & Gabry (2017), as implemented in the package loo in R. LOO-CV consists in repeatedly removing one data point and refitting the model to generate predictions for the missing data point in order to evaluate the accuracy of a model's predictions. For complex models with a lot of data, this quickly

that the adjective is true (i.e. the proportion of the comparison class which falls above the threshold). Counterintuitively however, the distribution of degrees creeps back through the continuous prior on θ: because we need to integrate this continuous prior, the distance between the different degrees in the comparison class becomes relevant, and not just the proportion of items which falls below or above θ.

becomes impractical. The idea behind PSIS is to approximate the result of LOO-CV from the individual terms of the log-likelihood without having to refit the model for each data point. We treated each pair of participant and comparison class as a single data point for the cross-validation.

As the detailed results in Table 4 indicate, the RH-R, CLUS and RSA-U models best fitted the data (without significant difference between themselves). Surprisingly, sampling the threshold from the comparison class in the RSA-I model, leads to the worst predictions, in stark contrast with the RSA-U. The two versions of the SOM did not differ significantly, but were both much lower than the RSA-U.

Model	elpd_{loo}	Δ_{elpd}	$SE_{\Delta\text{elpd}}$	p_{loo}	SE_p
RH-R	−1701	0	0	1287	44.2
CLUS	−1737	−35.8	160.8	1272	56.3
RSA-U	−1805	−103.5	178.0	1184	44.9
SOM-EI	−2612	−910.7	159.0	1011	45.6
SOM	−2696	−995.4	155.8	1267	70.8
RSA-I	−3774	−2073.3	161.4	1209	63.2

Table 4 Comparison of the different models using PSIS LOO-CV (Vehtari & Gelman & Gabry 2017). The first column indicates the *expected log pointwise predictive density*, which measures how well the model can generalize to unseen data. The next two columns, Δ_{elpd} and $SE_{\Delta\text{elpd}}$, indicate the difference in elpd with the best model (RH-R in this case) and the estimated error on this difference. p_{loo} is the estimated effective number of parameters and SE_p the estimated error on this number.

We now turn to the posterior parameter estimates for each model, which are listed in Table 5. We first note that the RSA-U gives very reasonable parameters, with a median rationality of 2.4 and a mean cost of 1.6. In line with the results on top- and bottom-slopes which showed no differences between the nonce adjectives, the RSA-U also assigns the lowest variance of all models to by-adjective random effects.

By contrast, the SOM and SOM-EI require very negative costs of −2.8 and −4.9 respectively. As discussed above, the SOM is strongly biased towards maximum standard interpretations, and this bias can only be overcome by a negative cost or a large probability mass at the bottom of the scale. The SOM-EI does not usually place the mode of the distribution at the top of the scale, but it still puts more probability mass on high values, and no matter the distribution, it cannot predict the adjective to apply to more than 37% of the comparison class without a negative cost. To compensate for these large costs, the two models must assign very low rationality to the participants, with median 0.28 and 0.14 respectively.

5 Discussion

First of all, our results confirm the long-established effect of comparison class on the interpretation of gradable adjectives (Syrett et al. 2004; Schmidt et al. 2009; Syrett & Kennedy & Lidz 2010; Solt & Gotzner 2012; Qing & Franke 2014b; Xiang et al. 2022). They further establish that the distribution of degrees in the comparison class not only affects the interpretation of gradable adjectives, but is sufficient to see categorical contrasts reminiscent of the absolute/relative distinction emerge even in the absence of any world-knowledge or lexical information. On the face of it, one could think that this is enough to discard approaches which ground the absolute/relative distinction in lexical semantics (Kennedy 2007) or properties of the real-world scales denoted by the adjective (McNally 2011), but some limitations of the empirical design prevent us from drawing such a strong conclusion. Most importantly, all test sentences included a ‘for’-phrase (e.g., “for a class B planet”), which has been argued to be incompatible with absolute adjectives (Siegel 1976: p155). This has led accounts which argue that absolute interpretations require more than a very biased comparison class (rule-based categorization for McNally 2011, a specific morpheme for Qing 2021) to assume that ‘for’-phrases are incompatible with the source of absolute interpretations, and thus force a relative interpretation. McNally would further argue that information about the underlying real-world dimension is necessary to derive an absolute interpretations, as these are rule-based rather than similarity-based. Because our design intentionally stripped all pre-existing world-knowledge, it would prevent absolute interpretations. Participants may nevertheless be able to postulate simple rules by treating the 0 and 100% degrees as categorically different from the rest of the scale when some items reach them. This could in fact explain why we see categorical effects of distribution type but no dependency on the actual probability mass at scale ends. Note in passing that Qing's account of minimum-standard as zero-standard for the adjective 'profitable' may simply fall under McNally's account as a particular case of rule-based categorization.

Another potential limitation of the experiment concerns the use of percentages. The goal of the experiment was to make clear that all scales were closed on both sides, so that the comparison classes only varied in which part of these closed scales they populated. Percentages do not necessarily impose closed scales however. They can be used with dimensions we know to be associated with adjectives that encode open scales, as in (14) (Chris Kennedy, p.c.). Some scales also use percentages but can exceed 100%, as in (15), or even negative percentages (e.g., in a deflation situation). Conversely, a scale expressed in percentages may not actually reach its boundary, making it an open scale. For instance, the brightness of stars is defined in reference to the brightness of Vega.[6] A star can be arbitrarily faint, but it cannot reach 0% of the brightness of Vega, since all stars emit light.

(14) An optimum length is 50 percent of the length of the core

(15) In November 1923, inflation in Germany reached 29,525%

That being said, interpreting percentages as comparison with a reference, without the reference mentioned, does not seem very likely out of the blue, and the use fixed rectangles filled to various degrees in the images shown to participants reinforced the idea that the percentages were bound to 0–100%. The last point remains however: for comparison classes where no item reached 0% and/or 100%, it was entirely possible for participants to assume that these extreme values are physically impossible on the scale described by the nonce words. Note that for the results to remain compatible with a strict interpretation of Interpretive Economy, this would have to be the default assumption, otherwise we would have observed absolute interpretations for unbound comparison classes. On the other hand, if we accept that participants interpreted all nonce adjectives as denoting the same closed scale, our results would definitively establish that a closed scale can still give rise to a relative interpretation when the comparison class stays away from the boundaries. This would immediately capture the observation

[6]In practice, astronomers use the log of this ratio, but percentages are sometimes given for visible stars.

that ‘expensive/cheap’ are relative despite having a scale that includes 0.

Next, we must address the occasional ambiguity observed for lexicalized closed-scale adjectives between a min. std. and a max. std. interpretation. Kennedy (2007) cites in particular the case of ‘transparent’ which can alternatively mean “fully transparent” or “not fully opaque”. While these adjectives tend to favor a max. std. interpretation (see ‘full, closed’), McNally (2011) cites ‘familiar’ as a counter-example, which can receive a relative interpretation despite the availability of a “completely familiar” interpretation (see also debates around ‘likely’ in Lassiter 2011; Klecha 2012). Such examples would be prime targets for Bayesian pragmatic accounts: the variability may indicate sensitivity to a prior distribution which sometimes places more mass towards the top of the scale, sometimes towards the bottom. There is however good evidence against this probabilistic explanation in our data: for Double-bound distributions, not only did we not observe the usual max. std. interpretation that closed-scales adjectives such as ‘full’ typically receive, but we didn’t see any negative correlation between the top and bottom slopes (linear regression on IHS-transformed slopes: $\beta = 0.070, t = 0.94, p = .35$). If participants were split between min. std. and max. std. interpretations, we would expect such a correlation (they would place the threshold at one or another end of the scale). Instead, they all seem to assign a somewhat linear acceptability curve to the Double-bound cases. This would correspond to a uniform distribution for θ, as if they decided to remain fully agnostic on where the threshold might fall. This result suggests that when both scale ends are available, the distribution of degrees in the comparison class is not immediately relevant, and an external source is needed to disambiguate between relative, min. and max. std. interpretations. This could come from pure lexical idiosyncrasy, or—as McNally (2011) suggested—background knowledge about the physical dimension denoted by the adjective, which happens to be lacking here.

Given these potential caveats, in particular the point about for-phrases, our experiment likely did not reveal any genuine absolute interpretation, but only “absolute-like” relative interpretations. Remarkably, an important point of Q&F in favor of the SOM and against the RSA model was that the RSA failed to derive true absolute interpretations from extreme priors. Ironically, this inability to derive the true relative/absolute distinction from priors alone may be a strength of the model if these interpretations actually require more than probability mass near scale end. The SOM, on the other hand, is biased towards absolute interpretations—in particular maximum standard ones—, and may fare poorly on our dataset precisely because such extreme interpretations simply don't arise from priors alone. By contrast, the SOM outperforms the RSA in Xiang et al. (2022), who tested real English adjectives.[7] In short, the initial project of the probabilistic approach—to derive the absolute/relative distinction from distributional properties of the comparison class instead of stipulating it lexically—may have been doomed from the start because as soon as a comparison class is involved, we are dealing with a relative interpretation.

Our modeling results, together with those of Xiang et al. (2022), suggest that the RSA is a good model of relative interpretations, including "absolute-like" relative interpretations when the comparison class is concentrated at a scale end, but needs to be complemented with something else in order to capture actual absolute adjectives. We see two ways this could be done. The first is to accept Qing (2021)'s proposal that absolute interpretations involve a morpheme distinct from Kennedy and McNally's POS. We could even generalize this to include all rule-based interpretations, following McNally (2011). The second option would be to encode lexical knowledge in the θ-prior of the RSA. Indeed, the usual implementation of the RSA—the RSA-U which performed so well on our data—assumes a uniform prior on θ. This implies that the listener has no expectations whatsoever regarding the threshold before hearing a specific use of the adjective. Q&F already pointed out that this seems implausible. In practice, especially for frequent adjectives, the listener likely has quite specific expectations regarding where the threshold will fall. This effect would be particularly marked for absolute adjectives, since one can build more stable expectations regarding their threshold. It could even explain the idiosyncrasy of double-closed scale adjectives: over time, the prior on θ would concentrate on the side of the scale where comparison classes are most often concentrated, which can vary arbitrarily from one adjective to the next.

To conclude, we would like to come back to the debate between heuristics and explicit rational reasoning when it comes to computing the threshold

[7] It still struggled with min. std. adjectives though (presumably because of its bias towards max. std. interpretations).

of an adjective. We showed that the RSA and heuristics such as the RH-R and CLUS models were approximately equal when it comes to capturing participants' behavior in our experiment. However, our implementation of the RSA and modeling choices do not make it a great model of rational behavior either. First of all, affirmative and negative sentences clearly mirror each other in terms of acceptability, but in a model like the RSA, the negative sentence should be more costly, and therefore more informative. In other words, its threshold should be much lower. We avoided this problematic prediction of the model, and directly applied its prediction for an affirmative sentence to its negation by simply flipping the acceptability in $[0, 1]$. Second, the predictions for the affirmative sentence were computed based on only two messages: the bare form of the adjective and the null message. This ignores a lot of other messages a speaker might want to use to convey a given degree. In short, our implementation of the RSA makes it look more like an encapsulated heuristic than actual rational pragmatic reasoning. This actually seems like a better option when it comes to the computation of gradable adjectives thresholds, which doesn't seem to involve a lot of effort or conscious reasoning, appears to take place locally (e.g., within the scope of negation), and is acquired very early (Syrett & Kennedy & Lidz 2010), especially in comparison with implicatures. The relatively simple formula derived from the RSA-U model would only be a frozen heuristic, and the fact that it can be derived from a pragmatic model (reduced to its simplest form) could be a mere coincidence, or—more plausibly—would indicate that this heuristic mimics rational reasoning in bare positive uses of the adjective. As discussed in the introduction, there are two conceivable kinds of heuristics: the first would be the result of non-linguistic cognitive faculties clustering stimuli into categories which gradable adjectives can pick up. Such heuristics of non-linguistic origin would likely rely on categorizations useful for general cognition rather than specifically optimized for language use, and may not even be human-specific. The second kind would result from evolutionary processes shaping an optimal language (in terms of informativity, cost, learnability...), and would be specifically optimized for linguistic purposes.

Finally, the reliance on heuristics for the determination of the threshold would not mean, of course, that gradable adjectives cannot be involved in complex pragmatic reasoning. Leffel et al. (2019) present a puzzling example of interaction between vagueness and implicatures, and Cremers (2022) proposes an RSA model which explains this puzzle, but assumes that the distribution of the threshold has already been computed before genuine pragmatic reasoning can take place.

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Model	Parameter	Mean	CI_{low}	CI_{high}
RH-R	mean_cost	−0.46	−0.59	−0.31
	sigma_cost_adj	0.11	0.05	0.20
	sigma_cost_subj	0.71	0.61	0.81
	mean_log_eps	−0.70	−0.86	−0.56
	sigma_eps_subj	1.11	0.96	1.26
CLUS	alpha	1.18	1.17	1.20
RSA-U	mean_cost	1.63	1.27	2.00
	sigma_cost_adj	0.07	0.02	0.14
	sigma_cost_subj	1.79	1.42	2.18
	mean_log_lambda	0.87	0.74	0.99
	sigma_lambda_subj	0.68	0.57	0.80
RSA-I	mean_cost	−0.02	−3.37	3.15
	sigma_cost_adj	4.69	3.28	6.19
	sigma_cost_subj	12.53	9.92	15.27
	mean_log_lambda	0.10	0.00	0.20
	sigma_lambda_subj	0.37	0.29	0.46
SOM	mean_cost	−2.79	−4.47	−1.23
	sigma_cost_adj	1.74	0.86	2.89
	sigma_cost_subj	3.17	1.88	4.58
	mean_log_lambda	−1.29	−1.76	−0.82
	sigma_lambda_subj	2.03	1.69	2.38
SOM-EI	mean_cost	−4.91	−7.21	−2.73
	sigma_cost_adj	2.89	1.73	4.09
	sigma_cost_subj	6.10	4.52	7.70
	mean_log_lambda	−2.00	−2.37	−1.63
	sigma_lambda_subj	1.96	1.63	2.29

Table 5 Posterior parameters of the Stan models (mean posterior and 95% HDI confidence interval). The "mean_" parameters corresponds to fixed effects, the "sigma_" parameters correspond to the sd of random effects around these mean values (by subject or by adjective).

A Implementation of the CLUS model

The CLUS model assumes that the degrees of items in the comparison class were generated by an unknown number of normal distributions, and draws inferences about which items are likely to have their degrees likely coming from the same distribution. In practice, since the degrees in my experiment are bound to $[0, 1]$, I assume that the *arcsine transformed* degrees (Sokal & Rohlf 1969) follow an infinite Gaussian mixture.

For the details about the Dirichlet Process and the original implementation of the CLUS, see Schmidt (2009). My implementation follows the stick-breaking interpretation of the Dirichlet process, as described in Lui (2021). In practice, I set a cap at 10 clusters (exploration showed that the weights drop below 1% from the 7th cluster already).

Given Q the maximum number of clusters and $d_1, \dots d_K$ the arcsine-transformed degrees in a given comparison, we can write the model:

$$
\begin{array}{rcll}
\alpha & \sim & \text{Gamma}(2, 4) & \\
v_q|\alpha & \sim & \text{Beta}(1, \alpha) & \\
w_1 & = & v_1 & w \text{ are the weights for the clusters} \\
w_q & = & v_q \prod_{r=1}^{q-1}(1 - v_r) & (1 < q < Q) \\
w_Q & = & \prod_{r=1}^{Q-1}(1 - v_r) & \\
z|w & \sim & \text{Categorical}_Q(w) & \text{indicative vector of length K} \\
\mu & \sim & \mathcal{N}(\frac{\pi}{4}, 0.5) & \text{vector of means of Gaussians (length } Q) \\
\sigma & \sim & \text{Gamma}(1.5, 4) & \text{vector of sd of Gaussians (length } Q) \\
d_k|z_k, \mu, \sigma & \sim & \mathcal{N}(\mu_{z_k}, \sigma_{z_k}) & \text{likelihood of each component} \\
d_k|w, \mu, \sigma & \sim & \sum_{q=1}^{Q} w_q \mathcal{N}(\mu_q, \sigma_q) & \text{marginal likelihood}
\end{array}
$$

We can already write the log-likelihood of the clustering (for a given scale):

$$\ell_{\text{cluster}} = \sum_k \underset{q}{\text{LSE}} \left(\log w_q + \log f(d_k|\mu_q, \sigma_q)\right)$$

where LSE is the log-sum-exp operation.

For the participants' judgment, we assume that the acceptability tracks the probability of an item being in the same cluster as the largest item in the comparison class, conditional on the smallest and largest being in different clusters:

$$P(z_i = z_K | z_1 \neq z_K) = \left| \begin{array}{cl} 0 & \text{if } i = 1 \\ 1 & \text{if } i = K \\ \frac{P(z_i = z_K \neq z_1)}{P(z_K \neq z_1)} & \text{otherwise} \end{array} \right.$$

Let's decompose the numerator in cases where i is neither 1 nor K. The degrees of the different elements are assumed to be independent, so:

$$\begin{aligned} P(z_i = z_K \neq z_1) &= \textstyle\sum_q \frac{w_q f(d_i|\mu_q,\sigma_q)}{f(d_i|\mu,\sigma,w)} \frac{w_q f(d_K|\mu_q,\sigma_q)}{f(d_K|\mu,\sigma,w)} \left(1 - \frac{w_q f(d_1|\mu_q,\sigma_q)}{f(d_1|\mu,\sigma,w)}\right) \\ &= \frac{1}{f(d_i|\mu,\sigma,w) f(d_K|\mu,\sigma,w)} \textstyle\sum_q \exp a_{i,q} \end{aligned}$$

$$a_{i,q} = 2 \log w_q + \log f(d_i|\mu, \sigma, w) + \log f(d_K|\mu_q, \sigma_q) + \mathrm{log1m}\, \frac{w_q f(d_1|\mu_q, \sigma_q)}{f(d_1|\mu, \sigma, w)}$$

Similarly for the denominator:

$$P(z_K \neq z_1) = \frac{1}{f(d_K|\mu,\sigma,w)} \textstyle\sum_q \exp b_q$$

$$b_q = \log w_q + \log f(d_K|\mu_q, \sigma_q) + \mathrm{log1m}\, \frac{w_q f(d_1|\mu_q, \sigma_q)}{f(d_1|\mu, \sigma, w)}$$

Finally, we can write the predicted acceptability from which we can derive the likelihood of participant n's response y_i:

$$\log \mathrm{Acc}(d_i) = \operatorname*{LSE}_q a_{i,q} - \operatorname*{LSE}_q b_q - \log f(d_i|\mu, \sigma, w)$$

$$y_i \sim \mathcal{N}^{[0,1]}(\mathrm{Acc}(d_i), \epsilon_n)$$

ϵ_n is specific to participant n, and (μ, σ, w) are specific to n and a particular comparison class.

Parasitic licensing in uncertainty

Julie Goncharov • Hedde Zeijlstra

Abstract This paper discusses a phenomenon known as 'parasitic licensing', in which strong Negative Polarity Items (NPIs), such as English *in weeks*, become acceptable in downward-entailing but non-anti-additive contexts in the presence of a weak NPI, such as English *any*. We show that *in weeks* is not special in the sense that it has some particular requirement that restricts it to anti-additive contexts only, rather *in weeks* is actually a weak NPI whose presuppositional requirements are such that they are in conflict with the presuppositional requirements of non-anti-additive NPI-licensers. We argue that the conflict between the presuppositional requirements of *in weeks*-type NPIs and non-anti-additive licensers can be resolved in the presence of a quantificational expression introducing contextual uncertainty, including *any*. We implement our solution by extending Stalnaker's diagonalization to presuppositional content (Stalnaker 1978; 2004) and claim that this mechanism is at the heart of the parasitic licensing phenomenon.

Keywords Negative Polarity Items · strength of negation · presupposition · context

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1 Parasitic licensing

Parasitic licensing is the phenomenon where weak Negative Polarity Items (NPIs) can intermediate in the licensing of strong NPIs that would otherwise remain unlicensed (see Klima 1964; den Dikken 2006; Hoeksema 2007). Take the apparently strong NPI *in weeks* that is only licensed in anti-additive environments like *nobody*, and not in non-anti-additive, Strawson downward-entailing contexts like *only*, see (1).

(1) a. Nobody has read the *New York Times* in weeks.
b. *Only Mary has read the *New York Times* in weeks.

Strikingly, inclusion of a weak NPI such as *any* renders the licensing of *in weeks* by *only* fine again, as in (2).

(2) Only Mary has read any newspaper in weeks.

Parasitic licensing is not possible for every strong NPI, though. Take punctual *until*. Even though punctual *until* is a strong NPI, see (3a-b), it cannot be rescued by means of parasitic licensing, as in (3c).

(3) a. Nobody left the house until 7pm.
b. *Only Mary left the house until 7pm.
c. *Only Mary gave any student a call until 7pm.

In the literature, such cases of parasitic licensing have been discussed, though not yet fully understood (see den Dikken 2006; Hoeksema 2007). In this paper, we address the following questions: why is it that some apparently strong NPIs, such as *in weeks*, can be rescued by means of parasitic licensing? And why does this not hold for every strong NPI?

Our explanation will have two components. First, we show that there are two types of NPIs that are usually described as strong NPIs: true strong NPIs and illusory strong NPIs. True strong NPIs are NPIs whose NPI-triggering properties restrict them to anti-additive contexts. We take punctual *until* to be such a true strong NPI. Illusory strong NPIs are NPIs that are actually weak NPIs, but that have additional presuppositions (or other non-truth-conditional inferences) that further ban them from weak-licensing contexts (i.e., contexts that are Strawson downward-entailing but not anti-additive, like *only*). This makes illusory strong NPIs appear to have the same distribution as true strong NPIs. We argue that *in weeks*-type NPIs are illusory strong NPIs. We will see that only illusory strong NPIs can be involved in parasitic licensing.

Second, we say that NPIs like *any* (and some other expressions) are inherently uncertain, in a sense to be specified later. The presence of an inherently uncertain expression, such as *any*, allows for different presuppositions to be met in different possible worlds that constitute the Context Set, i.e., the set of possible worlds compatible with what is mutually believed by the participants of the conversation in the world in which the utterance takes place (Stalnaker 1978: et seq.). This flexibility permits the offensive presupposition of illusory strong NPIs to be satisfiable in weak-licensing contexts giving rise to the parasitic licensing configuration. To formalize the proposal, we extend the notion of diagonal propositions (Stalnaker 1978; 1999; 2004) to presuppositions.

The flow of the paper is as follows: In Section 2, we discuss the difference between true and illusory strong NPIs and the diagnostics to tell them apart. Section 3 provides some background on the idea of diagonalization in Stalnaker (1978; 1999; 2004). In Section 4, we show how Stalnaker's diagonalization can be extended to presuppositions and applied to explain parasitic licensing of illusory strong NPIs. In this section, we use licensing under *only* as our base example. In Section 5, we show that the same mechanism can be applied to other non-anti-additive, downward-entailing environments where parasitic licensing has also been attested. Section 6 discusses some cases of parasitic licensing beyond *in weeks* and *any*. Section 7 concludes the paper.

2 Two types of strong NPIs

Traditionally weak NPIs are distinguished from strong NPIs in the sense that weak NPIs are, in principle, licensed in all Strawson downward-entailing (DE) contexts and strong NPIs are licensed in anti-additive (AA) contexts only. Given that every anti-additive context is also downward-entailing, the set of possible licensing contexts for weak NPIs then forms a superset of the set of possible licensing contexts for strong NPIs. At the same time, it is known that there are contexts where strong NPIs are better than weak NPIs. Sedivy (1990) shows that there are at least two contexts where strong but not weak NPIs may appear. These are clauses with contrastively used auxiliaries, as in (4), and environments under the scope of modals with a counterfactual inference, as in (5).[1]

(4) a. I DO give a damn.
    b. *Bill DID ever kiss Marilyn Monroe.

(5) a. You should have given a damn.
    b. *You should have eaten any healthful tofu.

An additional context where strong NPIs may appear but weak ones may not are questions that lack an interrogative clause-type, as shown by Sailer (2021), see (6).

[1]The status of *give a damn* as a strong NPI is debatable, given that it can be used in *if*-clauses and under *wish*, see Giannakidou (2011).

(6) a. And, Alexia has given a damn?
b. *And, Alexia has ever been to France?

Strikingly, while these tests work well for a strong NPI like punctual *until* (albeit not every speaker of English likes them, which we mark with %), for *in weeks*, even though it is often considered a prototypical strong NPI, these examples are systematically rejected, as shown in (7)-(9). Note that the relevant examples do involve punctual *until* and not polarity-insensitive durative *until*, given that they appear with the perfective while durative *until* can only appear with the imperfective.

(7) a. %I DID leave until 7pm.
b. *Bill HAS been there in weeks.

(8) a. %You should have left until 7pm.
b. *You should have been there in weeks.

(9) a. %And, you left until 7pm?
b. *And, you have been there in weeks?

As Sedivy (1990) has shown, most minimizing NPIs (e.g., *give a damn*, *lift a finger*) also align with strong NPIs. Strikingly, those minimizer NPIs are also degraded in parasitic licensing constructions.

(10) a. *Only Mary ever gave a damn.
b. *Only Mary has ever lifted a finger.

Now we have arrived at a paradox. Against these diagnostics, it appears that *in weeks* behaves like a weak NPI rather than like a strong NPI. At the same time, it is still restricted to anti-additive contexts. We use *in weeks* as an example here, but the same observations apply to all *in* + timespan NPIs, such as *in days, in years, in ages,* and so on. It is to be understood that when discussing *in weeks*, we discuss all *in weeks*-type NPIs.

In order to resolve the above paradox, we propose that *in weeks* is actually a weak NPI, but it comes along with additional inferences that prevent it from appearing under the scope of non-anti-additive, downward-entailing operators like *only*. As an informal illustration, let us consider the example in (11).

(11) *Only John has read the *New York Times* in weeks.

According to the standard analysis of *only*, it comes with the positive inference for (11) that there was a relevant reading event (by John) weeks from now. As shown in Iatridou & Zeijlstra (2019), *in weeks* also comes with a number of additional inferences. One of these inferences is the change-of-state inference that can be represented as the requirement that all relevant events happen either before the timespan set by *in weeks* or within that timespan. *In weeks* also triggers an actuality inference (AI), that is, the inference that there was a relevant event at the Left Boundary (LB) of the contextual timespan. The actuality inference combined with the assertive meaning of (11) requires there to be a relevant reading event before the LB but not after. These inferences taken together form an inconsistent set, as shown in Figure 1, which explains the unacceptability of *in weeks* in weak-licensing contexts, such as in (11).

	?	LB	?
only:			some relevant event
in weeks:	all relevant events	∨	all relevant events
assertion+AI:	some relevant event		

Figure 1 Inconsistent inferences of *in weeks* under *only*

Before formalizing our proposal, we want to point out that this new way of looking at *in weeks*-type NPIs gives us another perspective on parasitic licensing. Strictly speaking, the grammaticality of (2) is no longer surprising because *in weeks* is a weak NPI. The surprising fact is that the inclusion of *any* allows us to dissolve the inconsistencies shown in Figure 1 making *in weeks* acceptable under *only*.

In order to explain illusory strong NPIs and parasitic licensing, we then need to understand what it means for a presupposition to be satisfied in a particular context and whether there are ways of weakening the satisfiability condition under certain circumstances. To this end, we turn to the two-dimensional semantics and the use of diagonalization in Stalnaker (1978; 1999; 2004: et seq).

3 Background: Stalnaker (1978: et seq.)

According to Stalnaker, the role of an assertion is to reduce a Context Set CS_c (Stalnaker 1978: et seq.). That is to say, we have the statement in (12) that holds for Assertions:

(12) When a sentence S translatable as ϕ is asserted in context c, the context set CS_c is updated with ϕ, i.e., $CS_c \subseteq \{w \in W \mid \phi \text{ is true in } w\}$.

There are three principles that govern CS_c updates:

(P1) A proposition asserted is always true in some but not all of the possible worlds in the context set.
(P2) Any assertive utterance should express a proposition, relative to each possible world in the context set, and that proposition should have truth-value in each possible world in the context set.
(P3) The same proposition is expressed relative to each possible world in the context set (see Stalnaker 1978: 80).

To model this, Stalnaker has developed a two-dimensional framework that allows us to account for the communicative value of utterances when participants of conversation are partially ignorant (or mistaken) about the semantic value of what is said. This framework is based on the intuition that possible worlds play a double role with respect to an utterance. First, they determine the truth-value of the proposition expressed by the utterance (i.e., the standard semantic value). Second, they determine the truth-value of what is expressed by the utterance (i.e., what is being said).

To see this, take Stalnaker's own example. Suppose CS_c consists of three worlds i, j, k in which the speaker truthfully utters *You are a fool* addressing O'Leary. O'Leary, who correctly understands the utterance as addressing him, disagrees with the facts as he believes that he is not a fool. But O'Leary falsely believes that Daniels, another participant of the conversation, is a fool. Daniels, who is not a fool and knows this, misunderstands the utterance as addressing him rather than O'Leary.

In this scenario, i can be said to be the actual world, j the world O'Leary believes we are in, and k the world Daniels believes we are in. We can represent the proposition *You are a fool* in a two-dimensional matrix, as in Figure 2 which uses possible worlds not only in their role as valuation functions (the horizontal axis), but also in their role as contexts that determine what is being said (the vertical axis). The rows following *i* and *j* have the same truth-values since they represent the same proposition, namely *O'Leary is a fool*. The row following *k* represents the proposition that Daniels erroneously assigns to the utterance, namely 'Daniels is a fool'.

	i:	j:	k:
i:	T	F	T
j:	T	F	T
k:	F	T	F

Figure 2 Propositional concept for *You are a fool*

The matrix in Figure 2 is called *a propositional concept*, which is defined as a function from possible worlds to propositions or equivalently from a pair of possible worlds to a truth-value.

Propositional concepts are useful, for instance, to resolve the tension between the semantic analysis of identity statements as necessary truths or necessary falsehoods and our general intuition that such statements can be uttered informatively.

As an illustration, consider O'Leary's assertion in (13).[2] Let us say this time that $CS_c = \{i, j\}$, where *i* is the actual world in which the astronomical facts are the way they actually are, that is, Hesperus and Mars are distinct planets, and *j* is a counterfactual world in which the astronomical facts are the way O'Leary believes they are, that is, Hesperus and Mars are the same planet. Intuitively, O'Leary seems to be asserting a contingent proposition that is false in *i* and true in *j*.

(13) O'Leary: Hesperus is Mars.

Now, let us assume that proper names are rigid designators (e.g., Kripke 1980) and that *is* expresses identity. Then, *Hesperus is Mars* is necessarily false, i.e., false in all possible worlds including *j*. In other words, our semantic rules do not derive a contingent proposition which we intuitively assign to O'Leary's assertion.

This tension can be resolved (Stalnaker argues) if we look not just at the

[2]From Stalnaker (1999).

horizontal proposition but at the propositional concept for (13), see Figure 3. Here, we look not only at truth-values the sentence has as it is uttered in the actual world, but at truth-values the sentence has as it is uttered in different possible worlds.

	i:	j:
i:	F	F
j:	T	T

Figure 3 Propositional concept for *Hesperus is Mars*

Our intuition that O'Leary's assertion expresses a contingent statement can be captured if we say that the content of the assertion is determined by the *diagonal proposition* of the propositional concept.

A diagonal proposition is a proposition ϕ that is true in w for each w only if ϕ expressed in w is true in w, that is to say $\phi\ := \{w \in W \mid \phi_w \text{ is true in } w\}$. Thus, we have (14) instead of (12).

(14) When a sentence *S with uncertain meaning* translatable as ϕ is asserted in context c, the context set CS_c is updated with the diagonal proposition of ϕ, i.e., $CS_c \subseteq \{w \in W \mid \phi_w \text{ is true in } w\}$.

In cases with identity statements, the diagonal proposition resolves the tension between the principles (P1) and (P3).

4 Polarity licensing and uncertainty

Now, we will apply diagonalization to understand the discussed cases of illusory strong NPIs and parasitic licensing. For this, we first discuss some properties of *any* and how it can be combined with a non-AA NPI licenser like *only*. Then, we look at how *only* and *in weeks* interact highlighting *in weeks*' behaviour as an illusory strong NPI. Finally, we focus on the combination of *only*, *any*, and *in weeks*, that is, the parasitic licensing configuration.

4.1 Weak NPIs: the case of *any* and *only*

That *any* is a weak NPI goes without saying. We follow the standard analysis by Chierchia (2013) in accounting for its restriction to Strawson downward-entailing context as the result of exhaustification of its domain alternatives. However, there is more to say about *any*.

We first note that, unlike NPI minimizers like *a red cent*, the domain of *any* does not have to be the widest in the given context. This is supported by the co-occurrence of *any* with exceptives, see (15), and also its acceptability in non-exhaustive contexts, see (16).

(15) a. Johnny didn't get any pocket money this week, except for $5 for ice-cream on Friday.
b. #Johnny didn't get a red cent this week, except for $5 for ice-cream on Friday.

(16) Context: You go to a mall with your friend Mary. Mary sees a new coffee machine which she has been looking for. Mary asks you to borrow $200 to buy the machine. You have $2 on you to pay for public transportation to go home, but nothing else.
a. You: I don't have any money on me.
b. You: #I don't have a red cent on me.

The fact that *any* does not have to range over the widest domain allows it to have varied interpretations in the same context. We call this property of *any* 'uncertainty'. The uncertainty of *any* is different from the implicit domain restriction that all natural language quantifiers are assumed to come with.

To clarify this distinction, let us first sketch how it can be described in theoretical terms using Stalnaker's framework again (Stalnaker 2002; 2014). As mentioned above, in this framework, it is assumed that to understand the content of an assertion is to know what possibilities it rules out. Let us say that an utterance event is presumed to be taking place in a Common Ground context (CG-context), which can be viewed as a set of (uncentered) possible worlds compatible with beliefs of the participants of conversation. That is, the utterance event is presumed to be taking place in each element of the CG-context. The utterance event determines a set of centered possible worlds (K-contexts, for Kaplan-style contexts), each of which contains non-shiftable information about a particular conversation (speaker, addressee, time of utterance, place of utterance, world of utterance) and is used to determine the truth-value of the proposition expressed by the utterance. That is, a CG-context can be seen as a set of K-contexts (i.e., a set of centered possible worlds), rather than a set of uncentered possible worlds compatible with participants' beliefs. Crucially, the information that can distinguish between the various K-contexts compatible with the common ground does not have to be commonly believed. That is, according to this picture, the content of the utterance relative to one K-context does not have to be the same as the content of that utterance relative to a different K-context.

Returning now to domains of quantification, we can say that the implicit domain restriction of natural language quantifiers (as in *Every student passed the exam*) comes from common ground beliefs and is associated with the CG-context. Thus, the implicit domain restriction does not vary across different K-contexts. (Note that this is not to say that the implicit domain restriction cannot be unsettled in the common ground, in which case accommodation mechanisms will be called for.) In the case of *any money* and *a red cent*, the implicit domain restriction is also set by the common ground. For example, in the context of everyday shopping of a middle-class individual in North America in 2022 as in (16), the implicit domain restriction can be set as ranging from one cent to $1,500. The difference between *any money* and *a red cent* is that for *any money* the domain of quantification is not fixed as the widest range which allows it to vary across different K-contexts.

As an illustration, consider a scenario similar to the O'Leary situation above, where the mistake in the addressee results in different domain restrictions rather than different values for indexicals. The scenario in (17) is similar to that in (16) but now we have two addressees, each of whom takes your utterance as responding to their respective requests for money.

(17) Context: You go to a mall with your friends Mary and Peter. Peter immediately goes to the food court area to buy all three of you coffee and sandwiches. While waiting for him, Mary sees a new coffee machine which she has been looking for. Mary asks you to borrow $200 to buy the machine. At this point, Peter returns and hands you your coffee and sandwich worth $10 expecting you to give him the money. You have $2 on you to pay for public transportation to go home, but nothing else.
You: I don't have any money on me.

In the scenario in (17), Mary, Peter, and you share same common beliefs about the conversation including the implicit domain restriction for *any money* as ranging from one cent to $1,500. The information that is not shared is whether you mean that you don't have enough money for a coffee machine or for the food. In this sense, Peter and Mary understand different propositions in which *any money* has varied domains. Note that cases of the mistaken or confused addressee as in the Peter example in (17) or the O'Leary example in Section 3 are used for illustration. Following Stalnaker, we take them to be examples of a more general case of uncertainty of speaker-meaning.

This shows that sentences with (licensed) *any* are inherently uncertain, in the sense that they can have different interpretations in different possible worlds (or K-contexts).[3] For example, if $CS_c = \{i, j, k\}$ and the domain of *any* $D = \{a, b, c\}$, when uttered in i, the domain of *any* can be the widest, i.e., $D_i = \{a, b, c\}$, but when uttered in j or k, the domains can be restricted differently, e.g., $D_j = \{a, b\}$ and $D_k = \{c\}$. Participants of the conversation are not certain which is the actual world.

This means that sentences with (licensed) *any* as in (18a) may trigger diagonalization to avoid violating the no-ambiguity principle (P3) above, see Figure 4.

(18) a. John didn't read anything.

b. Assertion (Asr): $\neg\exists x \in \{a, b, c\}[thing(x) \wedge read(j, x)]$
abbreviated as $\neg(a_1 \vee b_1 \vee c_1)$ where 1 = john

	i: $\neg(a_1 \vee b_1 \vee c_1)$	j: $\neg(a_1 \vee b_1)$	k: $\neg c_1$
i: $\neg(a_1 \vee b_1 \vee c_1)$	T	F	F
j: $\neg(a_1 \vee b_1)$	T	T	F
k: $\neg c_1$	T	F	T

Figure 4 Propositional concept for the assertion in (18)

[3]There is an additional assumption here that there is a one-to-one correspondence between a K-context and an uncentered world in the CG-context (which we represent as the context set CS_c in a particular context c), see Stalnaker (2014). In this paper, we simplify the discussion to two-dimensional semantics without involving K-contexts. The difference between a CG-context and a K-context was invoked only in order to explain the conceptual difference between an implicit domain of quantification and uncertainty of *any*.

As a next step, we propose to extend Stalnaker's conjecture that assertions can be identified as diagonal propositions to presuppositions. In simple cases like *Only John read the New York Times*, (P2) above is satisfied when 'John read the NYT' is entailed by the context set, given (19).

(19) When a sentence S translatable as ϕ has a presupposition ψ, S is felicitously uttered in context c only if the context set CS_c entails ψ, i.e., $CS_c \subseteq \{w \in W \mid \psi \text{ is true in } w\}$.

Moreover, we propose that presuppositions can also give rise to uncertainty (either due to ignorance or indifference). In such cases, we say that (P2) is satisfied when the diagonal proposition of the presupposition is entailed by the context set, as in (20).

(20) When a sentence S translatable as ϕ has *an uncertain presupposition* ψ, S is felicitously uttered in context c only if the context set CS_c entails the diagonal proposition of ψ, i.e., $CS_c \subseteq \{w \in W \mid \psi_w \text{ is true in } w\}$.

Now, let us look at the behaviour of weak NPIs like *any* under Strawson downward-entailing elements like *only*. That *any* is an NPI licensed in a Strawson downward-entailing context, we take to be the result of exhaustification of its domain alternatives, following the standard analysis by Chierchia (2013). In addition, we adopt the standard analysis for *only* (see Horn 1969; von Fintel 1999), which takes *only* to presuppose its prejacent. Hence, when *any* with $D = \{a, b, c\}$ appears in the scope of *only* as in (21a), the sentence is defined only if 'John read $a \vee$ John read $b \vee$ John read c'. When defined, (21a) is true only if 'Nobody but John read $a \vee b \vee c$'.

(21) a. Only John read anything.
b. Presupposition (Psp): $\exists x \in \{a, b, c\}[read(j, x)]$;
abbreviated as $a_1 \vee b_1 \vee c_1$ where 1 = john
c. Asr: $\neg\exists y \neq j\ [\exists x \in \{a, b, c\}[read(y, x)]]$;
abbreviated as $\neg(a_{2<} \vee b_{2<} \vee c_{2<})$ where $2<$ stands for 'everyone but john'

Since the domain of *any* does not have to be the widest and can have varied interpretations in the same context, the presupposition of *only* with *any* in its scope is also uncertain: in different possible worlds - say $i,\ j,\ k$,

- the domain of *any* may be restricted differently. To see this, assume that in i the domain is the widest, i.e., $D_i = D = \{a, b, c\}$, but that in j and k, the domains are restricted as follows: $D_j = \{a, b\}$ and $D_k = \{c\}$. Now, the presupposition of (21a) is different across i, j, k. It is $a_1 \vee b_1 \vee c_1$ in i, $a_1 \vee b_1$ in j and c_1 in k. The participants of the conversation are uncertain (or it is irrelevant for the purpose of conversation) which interpretation of *any* is meant. We take such uncertain presuppositions to be satisfied if their diagonal is entailed by the context set, as in the matrix in Figure 5. The matrix in Figure 5 shows that *Only John read anything* is felicitous in the context set that consists of i, j, k.

	i: $a_1 \vee b_1 \vee c_1$	j: $a_1 \vee b_1$	k: c_1
i: $a_1 \vee b_1 \vee c_1$	T	T	T
j: $a_1 \vee b_1$	F	T	F
k: c_1	F	F	T

Figure 5 Propositional concept for the presupposition of *only* in (21a)

4.2 Illusory strong NPIs: the case of *only* and *in weeks*

As a next step, we assume that illusory strong NPIs like *in weeks* are not special in the sense that they have some particular requirement that restricts them to anti-additive contexts only, but are actually weak NPIs whose presuppositional requirements are such that they are in conflict with the presuppositional requirements of non-anti-additive NPI-licensers such as *only*. This idea can be thought of as an alternative version of Gajewski (2011), who argues that strong NPI-hood does not involve an inherent distributional restriction to anti-additive contexts, but rather argues that strong NPIs are like weak NPIs sensitive to Strawson downward entailment only, but require the overall meaning contribution and not only the assertion to be Strawson downward-entailing.

Here, we illustrate our proposal for *only* and *in weeks*. First, we follow the essence of Iatridou & Zeijlstra (2019) in assuming that *in* + timespan NPIs like *in weeks* presuppose the presence of a Perfect Time Span (PTS) whose Left Boundary (LB) must be set by the relevant event, and presuppose a change of state, i.e., either before or after PTS' LB no event of the kind may take place. In other words, we assume that (22a) has the presupposition in (22b) and the assertion in (22c) (where RB = Right Boundary of PTS, UT = Utterance Time, $\tau(e)$ = event run time, μ = measurement of time intervals).[4]

(22) a. John hasn't read the *New York Times* in weeks.

b. Psp: $\exists$ PTS [PTS = [LB,RB] $\wedge$ RB = UT $\wedge$ LB $\prec$ UT $\wedge$ ($\exists$e [john-read-NYT(e) $\wedge$ τ(e) $\subset$ PTS] $\vee$ $\exists$e [john-read-NYT(e) $\wedge$ τ(e) $\prec$ PTS])]
abbreviated as $(x \ll n) \vee (n \ll x)$ where n = john's reading the NYT event, x = any other relevant event, $\ll$ marks two pieces of information: (i) temporal precedence ($u \ll v = u < v$ = event u precedes event v) and (ii) the placement of LB on the timeline (the events following $\ll$ occur after the LB, and the events preceding $\ll$ occur before the LB)

c. Asr: $\neg\exists$e [john-read-NYT(e) $\wedge$ τ(e) $\subset$ PTS $\wedge$ μ(PTS) = week]
abbreviated as $\neg(x \ll n)$

In addition, we follow Chierchia (2013); Iatridou & Zeijlstra (2019) in assuming that since *in weeks* introduces subdomain alternatives of the PTS that are obligatorily exhaustified, *in weeks* is an NPI.

Now, assume that there are three types of reading events: m = John read *Le Monde*, n = John read the *New York Times*, and t = John read the *Toronto Star*. Also assume that there are three worlds i, j, k as below, where the events are ordered on the time scale shown as for example: $m < n \ll t$, where $\ll$ marks that events after $\ll$ happen within the PTS and not before. Now, the presupposition in (22b) is satisfied when, next to there being an n-event at the LB of the PTS, there is an n-event either on the left or on the right of $\ll$. As shown in (23), worlds i and j satisfy the presupposition of *in weeks* in (22b) and among them only i renders the assertion in (22c) true. Since the assertion contains a downward-entailing operator (*n't*), (22a) is grammatical.

[4]The change of state presupposition of *in weeks* together with the assertion leads to the Actuality Inference (AI) not made explicit here. That the LB is set at the relevant event (see Iatridou & Zeijlstra 2019) is achieved by saying that PTS is the maximal interval. This point is omitted here to simplify the representation of the presupposition. Nothing is lost by this simplification for the purpose of this paper.

(23) Presupposition and assertion of licensed *in weeks*

	i: $m < n \ll t$	j: $m \ll n < t$	k: $m \ll t$
Psp: $(n \ll x) \vee (x \ll n)$	T	T	F
Asr: $\neg(x \ll n)$	T	F	T

Let us focus next on the question as to why *in weeks* may not appear under *only*. As we show below, (24a) is ungrammatical because it is impossible to construct a context set that entails both the presupposition of *only* in (24b) and the disjunct of the presupposition of *in weeks* in (24c) that is compatible with the assertion (i.e., $n_N \ll x$). This is shown in (25) for a context set with two worlds *i* and *j* that have states of affairs similar to what we saw in (23). (We use the following abbreviations: 1 = john, 2< = everyone but john, N = everyone.)

(24) a. *Only John has read the *New York Times* in weeks.
b. Psp of *only*: $x \ll n_1$
c. Psp of *in weeks*: $(x \ll n_N) \vee (n_N \ll x)$
d. Asr: $\neg(x \ll n_{2<})$

(25) Incompatible requirements of *only* and *in weeks*

	i: $m < n_1 \ll t$	j: $m \ll n_1 < t$
Psp of *only*: $x \ll n_1$	F	T
Psp of *in weeks*: $n_N \ll x$	T	F

As the reader can see in (25), the presuppositions of *only* and of *in weeks* trigger a conflict. This is because in terms of events, the presupposition of *in weeks* encompasses all relevant reading events including John's reading events and everybody-else's reading events. We assume this is due to the fact that modification by *in weeks* happens before the subject is merged, given that *in weeks* is a so-called VP adverbial (see Iatridou & Zeijlstra 2019; Rouillard 2020), which enters the structure prior to the head introducing the external argument. That is to say, the presupposition of *in weeks* requires there to be a relevant reading event by everybody, including John, either before or after the LB.

Now, the presupposition of *only* requires John to have read the NYT at some point after the LB, which is only compatible with the $x \ll n_N$ disjunct of the presupposition of *in weeks*. At the same time, the assertion is only compatible with the $n_N \ll x$ disjunct of the presupposition of *in weeks*. But as the disjunction here must be exclusive, we have incompatible requirements. Hence, the two presuppositional requirements and the assertion in (24b-d) cannot be satisfied at the same time, and (24a) is out.

4.3 Parasitic licensing: the case of *only*, *any*, and *in weeks*

To continue, let us see what happens when both *any* and *in weeks* are used in a negative clause, as in (26a), where $(a_1 \vee b_1 \vee c_1)$ stands for 'John read $a \vee b \vee c$'. Because of *any*'s uncertainty, the presupposition of *in weeks* has become uncertain and is now satisfied when the diagonal proposition of the presupposition is entailed by CS_c. This situation is illustrated in Figure 6 (where for expository purposes we present only the presuppositional disjunct compatible with the assertion).

(26) a. John hasn't read anything in weeks.
 b. Psp: $((a_1 \vee b_1 \vee c_1) \ll x) \vee (x \ll (a_1 \vee b_1 \vee c_1))$
 c. Asr: $\neg(x \ll (a_1 \vee b_1 \vee c_1))$

	i: $(a_1 \vee b_1 \vee c_1) \ll x$	j: $(a_1 \vee b_1) \ll x$	k: $c_1 \ll x$
i: $(a_1 \vee b_1 \vee c_1) \ll x$	T	T	T
j: $(a_1 \vee b_1) \ll x$	F	T	F
k: $c_1 \ll x$	F	F	T

Figure 6 Propositional concept of the psp of *John hasn't read anything in weeks*

Since the presupposition of *in weeks* is now met and since both *any* and *in weeks* are in a downward-entailing context, the sentence is correctly predicted to be fine.

Now, we can make the final step in the analysis. Strikingly, the uncertainty of *any* can rescue the co-occurrence of *only* and *in weeks* in non-negative sentences. The reason is that given *any*'s uncertainty, now both presuppositions can be satisfied, albeit not simultaneously. However, as long as the presupposition diagonal is satisfied, all usage conditions are fulfilled.

(27) a. Only John has read anything in weeks.
b. Psp of *only*: $x \ll (a_1 \vee b_1 \vee c_1)$
c. Psp of *in weeks*: $(x \ll (a_N \vee b_N \vee c_N)) \vee ((a_N \vee b_N \vee c_N) \ll x)$
d. Asr: $\neg(x \ll (a_{2<} \vee b_{2<} \vee c_{2<}))$

As we can see in Figure 7, for any two disjoint interpretations of the presupposition of *only* (top line in each cell) and the presupposition of *in weeks* (bottom line in each cell), we can have a world that satisfies both. This means that (27a) is grammatical, which explains the phenomenon of parasitic licensing.

	i: $x \ll (a_1 \vee b_1 \vee c_1)$	j: $x \ll (a_1 \vee b_1)$	k: $x \ll c_1$
i: $x \ll (a_1 \vee b_1 \vee c_1)$	T	T	T
any interpr.	F	F	F
j: $x \ll (a_1 \vee b_1)$	F	T	F
$c_N \ll x$	F	T	F
k: $x \ll c_1$	F	F	T
$(a_N \vee b_N) \ll x$	F	F	T

Figure 7 Parasitic licensing: *only* and *in weeks*

For instance, in world *j*, both the presupposition of *only* is met (as John read *a* or *b* in the PTS in *j*), and the presupposition of *in weeks* is met, as everybody read *c* before the PTS and nobody afterwards. The same applies to world *k*, where both presuppositions are met as well (John read *c* within the PTS and everybody read *a* or *b* before it). Since the uncertainty of *any* triggers diagonalization, the two presuppositions can be satisfied with respect to different interpretations of the domain of *any*, rendering the context set consistent and the sentence grammatical.[5]

In the next section, we show that other contexts such as emotive factives, *at most*, and the restrictor of *every*, which disallow *in weeks* but are improved in parasitic licensing configurations, can receive an explanation similar to

[5] It is worth mentioning here that when we talk about diagonalization for the purpose of parasitic licensing, we do not assume that this process necessarily triggers diagonalization for all elements sensitive to it. Whether this is so or not depends on the structure of the context (flat vs. multi-dimensional or even hierarchical). We remain open to different possibilities here, which ultimately depend on empirical facts.

that developed for *only* above.

5 Other instances of parasitic licensing of *in* + timespan NPIs

The general recipe for the infelicity of *in weeks* in non-anti-additive (non-AA) contexts is as follows: the presupposition (or any other inference of a non-AA operator) requires there to be a relevant event after the LB; the presupposition of *in weeks* operates on all relevant events and requires them to occur either before or after LB; the assertive meaning of the non-AA operator plus the Actuality Inference (AI) (i.e., the inference that there is a relevant event at LB, see fn. 4 and Iatridou & Zeijlstra 2019) requires there to be a relevant event before LB. These requirements cannot be met simultaneously, thus, ungrammaticality. This can be schematized as in Figure 8.

	?	LB	?
non-AA:			some relevant event
in weeks:	all relevant events	∨	all relevant events
assertion+AI:	some relevant event		

Figure 8 General recipe for ungrammaticality of illusory strong NPIs in non-AA contexts

Uncertainty helps because it triggers diagonalization which in turn allows conflicting requirements to be satisfied with respect to disjoint interpretations of the element carrying uncertainty. Let's now see how this works for other non-AA NPI licernsers, such as emotive factives like *surprise*, quantificational DPs like *at most N*, and the restrictor of the universal quantifier *every*.

5.1 *Surprise*

Emotive factives like *surprise* do not license *in weeks* (e.g., von Fintel 1999), see (28). This fact can also be explained in our system as a result of the inconsistency of a context set that entails both the factive presupposition of *surprise* and the presupposition of *in weeks*, see (29).

(28) a. ??I'm surprised John has been here in weeks.
b. Psp of *surprise*: x ≪ j in the actual world
c. Psp of *in weeks*: (j ≪ x) in all speaker's belief-worlds including the actual world ∨ (x ≪ j) in all speaker's belief-worlds including the actual world
d. Asr: ¬(x ≪ j) in all previous belief-worlds of the speaker

		i: $j \ll x$	j: $x \ll j$
(29) a.	Psp of *surprise*: $x \ll j$	F	T
b.	Psp of *in weeks*: $j \ll x$	T	F

Note that we need to assume that the presupposition of *in weeks* cannot be satisfied by different disjuncts when speaker's beliefs are updated. The presupposition is global in Stalnaker's sense.

Parasitic licensing in case of *surprise* is explained similarly to the case with *only*: the diagonal propositions of the factive presupposition of *surprise* and the presupposition of *in weeks* are satisfied by any disjoint set of interpretations of *any*.

(30) a. I'm surprised anybody has been here in weeks.
b. Psp of *surprise*: x ≪ (a ∨ b ∨ c) in the actual world
c. Psp of *in weeks*: ((a ∨ b ∨ c) ≪ x) in all speaker's belief-worlds including the actual world ∨ (x ≪ (a ∨ b ∨ c)) in all speaker's belief-worlds including the actual world
d. Asr: ¬(x ≪ (a ∨ b ∨ c)) in all previous belief-worlds of the speaker,

	i: $x \ll (a \vee b \vee c)$	j: $x \ll (a \vee b)$	k: $x \ll c$
i: $x \ll (a \vee b \vee c)$	T	T	T
any interpr.	F	F	F
j: $x \ll (a \vee b)$	F	T	F
$c \ll x$	F	T	F
k: $x \ll c$	F	F	T
$(a \vee b) \ll x$	F	F	T

Figure 9 Parasitic licensing: *surprise* and *in weeks*

5.2 *At most*

At most is a downward-entailing, non-AA weak licenser which does not license *in weeks* but can participate in parasitic licensing.

(31) a. *At most 5 students have been here in weeks.
b. At most 5 students have talked to anybody in weeks.

The conflicting inferences for (31a) are shown below in (32). They follow the general recipe. The non-empty set implicature can be satisfied only by a *CS* that entails the first disjunct of the presupposition of *in weeks*. But in such a *CS*, the assertion is false. Note again that we need to assume that the relevant domain of students exceeds 5.

(32) a. Implicature (Impl) of *at most*: $x \ll$ some student' being here event
b. Psp of *in weeks*: ($x \ll$ all students' being here events) $\vee$ (all students' being here events $\ll x$)
c. Asr: $\neg$($x \ll$ 6 or more students' being here events)

Diagonalization helps because, as above, the conflicting inferences can be satisfied with respect to disjoint interpretations of the uncertain element:

(33) a. Impl of *at most*: $x \ll$ some student' event $a \vee b \vee c$
b. Psp of *in weeks*: ($x \ll$ all students' event $a \vee b \vee c$) $\vee$ (all students' event $a \vee b \vee c \ll x$)
c. Asr: $\neg$($x \ll$ 6 or more students' event $a \vee b \vee c$)

5.3 *Every*

The restrictor of *every* is AA, yet strong NPIs are not licensed there presumably because of the upward-entailing non-empty set presupposition brought in by the relative clause (Gajewski 2011; Chierchia 2013). But in the parasitic licensing configuration acceptability improves.

(34) a. *Every student who has been here in weeks is asked to stay home.
b. Every student who has talked to anybody in weeks is asked to stay home.

As above, the inconsistency of *CS* arises only if we assume that the events in the presupposition of *in weeks* form a superset of events quantified over in the assertion. That is to say, the assertion is felicitous in *CS* where some student's being here event $\ll x$.

(35) a. Psp of relative clause: $x \ll$ some student being here event
b. Psp of *in weeks*: ($x \ll$ all students' being here events) $\vee$ (all students' being here events $\ll x$)
c. Asr: all students are such that if $x \ll$ students' being here event, then …

As before, diagonalization can do the job:

(36) a. Psp of rel.cl: $x \ll$ some student' event $a \vee b \vee c$
b. Psp of *in weeks*: ($x \ll$ all students' event $a \vee b \vee c$) $\vee$ (all students' event $a \vee b \vee c \ll x$)
c. Asr: all students are such that if $x \ll$ students' event $a \vee b \vee c$, then …

6 Beyond *in weeks* and *any*

6.1 Beyond *in weeks*

As Sedivy (1990) has shown, most minimizing NPIs (e.g., *give a damn*, *lift a finger*) align with strong NPIs, see (37a). Interestingly, these minimizers are also degraded in parasitic licensing constructions, see (37b).

(37) a. *Only Mary ever gave a damn.
b. *Only Mary has ever lifted a finger.

If the Sedivy-Sailer tests distinguish between true strong NPIs and weak NPIs, the unavailability of parasitic licensing with minimizers is expected. This is because minimizers as presumably true strong NPIs (including punctual *until*) have licensing conditions that restrict them to anti-additive contexts (e.g., Gajewski 2011).

A more interesting line of investigation can be developed if we try to connect Sedivy-Sailer tests with parasitic licensing. The hypothesis then will be that the property that disallows true strong NPIs from parasitic licensing is exactly what allows them in Sedivy-Sailer contexts.

6.2 Beyond *any*

Our account of parasitic licensing builds on the observation that *any* is inherently uncertain. It does not depend on the NPI-hood of *any* as such. This predicts that non-NPI elements that give rise to uncertainty (and do not give rise to additional intervening inferences) can participate in parasitic licensing.[6]

This prediction is borne out (at least) for the following cases (Kenyon Branan, p.c.):[7]

(38) a. Only John has talked to Mary, Sue or God knows who in weeks.
  b. Only John has talked to Mary, Sue or whoever he wanted to in weeks.

7 Conclusions

To conclude, we have seen that apparently strong NPIs like *in weeks* are not special in the sense that they have some particular requirement that restricts them to anti-additive contexts only, but are actually weak NPIs whose presuppositional requirements are such that they are in conflict with the presuppositional requirements of non-anti-additive NPI-licensers. Given our implementation of Stalnaker's diagonal for presuppositions, the inclusion of uncertain NPIs like *any* in clauses where *in weeks*-type NPIs

[6]The parenthetical remark that a quantifier that gives rise to uncertainty can be part of a parasitic licensing construction only if it does not have additional inferences is important. An anonymous reviewer asks why quantifiers like *every, many, some*, assuming they can be uncertain, do not improve the acceptability of sentences with *in weeks*, e.g., **Only John talked to someone/some student(s)/many/few students in weeks*. We take this to be a simple case of intervention similar to **Only John said many words to anybody*, where a positive inference generated by the intervening quantifier disrupts the downward-entailing environment necessary for the licensing of *any*, thus, rendering the sentence trivial (e.g., Chierchia 2013).

[7]An anonymous reviewer correctly points out that *God knows who* and *whoever he wanted to* are akin to free choice items. We believe that the fact that free choice items participate in parasitic licensing agrees with our proposal as free choice items have epistemic uncertainty hard-wired in their meaning. Our proposal, however, is that a weaker property of giving rise to pragmatic uncertainty due to a non-widest-domain requirement (as it is the case with *any*) is enough to participate in parasitic licensing. Evidence for the weaker pragmatic uncertainty comes from the fact that NPIs that do not have a connection to free choice items like English *ever* and Dutch *ooit* 'ever' can participate in parasitic licensing.

appear in non-anti-additive, downward-entailing contexts ensures that the apparent conflicting presuppositional requirements of the *in weeks*-type NPI and the weak NPI-licenser can still be met.

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Ways to sidestep Minimality (and how to diagnose them)

Fabian Heck

Abstract In this paper, I argue that leapfrogging and late Merger, two strategies that have been proposed to be involved in apparent violations of Minimality, can be distinguished wrt. the effects they have on reconstruction: leapfrogging across the intervener leads to reconstruction, late Merger of the intervener to the lack thereof. The argument is concerned with reconstruction asymmetries in scrambling.

Keywords Minimality · reconstruction · derivation · leapfrogging · scrambling

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1 Introduction

Various proposals have been made to account for apparent violations of Minimality (in the sense of Rizzi 1990, Chomsky 1995). One strategy involves removal of the intervener (Rizzi 1986, McGinnis 1998, Anagnostopoulou 2003, Holmberg & Hróarsdóttir 2003), another 'leapfrogging' over the intervener (Bobaljik 1995b, Ura 1996, McGinnis 1998, Doggett 2004), yet another late Merger of the intervener (Stepanov 2001a;b). The main claim of the present paper is that the difference between leapfrogging and late Merger can be correlated with (and thus be diagnosed by) a difference in reconstruction behavior of the moved category.[1]

1.1 A reconstruction asymmetry

The empirical domain that the discussion focuses on is an asymmetry with respect to reconstruction between *intermediate* scrambling of the direct object (DObj) or indirect object (IObj) to a position preceding the subject (Subj)

[1] Collins (2005) proposes that Minimality may be voided by derivations involving so-called Smuggling. In principle, Smuggling makes the same predictions with respect to reconstruction as leapfrogging. However, it potentially violates the Freezing Principle of Ross (1967) (cf. also Wexler & Culicover 1980). Smuggling will not be discussed in this paper.

on the one hand and *short* scrambling of the DObj to a position preceding the IObj (but following the Subj) on the other. While the former often shows reconstruction for Principles A, C or for variable binding the latter usually lacks such effects.[2] This has been reported for Korean (Lee & Santorini 1994, Lee 2020), Japanese (Saito 1992, Tada 1993, Miyagawa 1997), German (Frey 1993, Haider 1993, Lee & Santorini 1994, Lechner 1998; 2019), and Hindi (Mahajan 1990; 1994, Bhatt & Anagnostopoulou 1996).

(1a-c) from Mahajan (1990) illustrate reconstruction of short scrambling (the scrambled category in red) vs. intermediate scrambling (scrambled category in blue) in Hindi for Principle A:

(1) a. *raam-ne*$_i$ *mohan-ko*$_j$ *apnii*$_{i/j}$ *kitaab* *lOTaaii*
Ram-ERG Mohan-DAT SELF's book.FEM.ABS return.PERF.FEM
'Ram$_i$ returned self's$_{i/j}$ book to Mohan$_j$.'

b. *raam-ne*$_i$ *apnii*$_{i/*j}$ *kitaab* *mohan-ko*$_j$ __ *lOTaaii*
Ram-ERG SELF's book.FEM.ABS Mohan-DAT return.PERF.FEM
'Ram$_i$ returned self's$_{i/*j}$ book to Mohan$_j$.'

c. *apnii*$_i$ *kitaab* *raam-ne*$_i$ *mohan-ko*$_j$ __ *lOTaaii*
SELF's book.FEM.ABS Ram-ERG Mohan-DAT return.PERF.FEM
'Ram$_i$ returned self's$_i$ book to Mohan$_j$.'

In (1a), the DObj, which contains a reflexive, remains in situ. Accordingly, the reflexive can be bound by the IObj or the Subj, which both c-command the DObj. In (1b), short scrambling of the DObj across the IObj has applied. In this context, the IObj loses its capacity to function as an antecedent for the reflexive, i.e., short scrambling does not reconstruct for Principle A. (1c) involves intermediate scrambling of the DObj across the Subj. Although the DObj has left the c-command domain of the Subj, the latter may function as the antecedent of the reflexive contained within the former, thereby satisfying Principle A. In other words, intermediate scrambling reconstructs for Principle A in Hindi.

[2]For the moment, the notion of reconstruction is to be understood as referring to the phenomenon as such; see section 1.4 and 2.4, where the theoretical analysis of reconstruction that underlies the present proposal is clarified.

The examples in (2) and (3) illustrate reconstruction of short vs. intermediate scrambling in Hindi for Principle C ((2a,b) are from Mahajan 1990; (3a,b) are from Keine 2016):

(2) a. **mE-ne use$_i$ raam$_i$-ki kitaab dii*
I-ERG him.DAT Ram-GEN book.FEM give.PERF.FEM
lit. 'I gave to him$_i$ Ram$_i$'s book.'

b. *mE-ne raam-$_i$ki kitaab use$_i$ _ dii.*
I-ERG Ram-GEN book.FEM him.DAT give.PERF.FEM

(2a) serves as the base line: A DObj containing an R-expression (a proper name) cannot be c-commanded by an IObj pronoun that is interpreted as co-referential with the R-expression: a violation of Principle C. If the DObj is displaced by short scrambling across the IObj as in (2b), the Principle C violation vanishes: short scrambling does not reconstruct for Principle C.

(3) a. **us-ne$_i$ mohan-ki$_i$ behin-ko dekhaa*
he-ERG Mohan-GEN sister-ACC saw
'*He$_i$ saw Mohan$_i$'s sister.'

b. **mohan-ki$_i$ behin-ko us-ne$_i$ _ dekhaa*
Mohan-GEN sister-ACC he-ERG saw

(3a) is similar to (2a), the difference being that this time the R-expression in the DObj is bound by a Subj pronoun, resulting in a Principle C violation. (3b) illustrates that this violation cannot be avoided by displacing the DObj to the left of the Subj by intermediate scrambling, again suggesting reconstruction for Principle C.

1.2 Minimal vs. total reconstruction

An additional complication is due to the fact that for some speakers (referred to as group A in what follows), reconstruction of intermediate scrambling by the DObj must target a position between the Subj and the IObj. It may not target the base position of the DObj (below the IObj). In other words: For speakers of group A, intermediate scrambling may not reconstruct with respect to the IObj but only with respect to the Subj. In this sense, reconstruction is minimal. This has been reported for Hindi (Mahajan 1990; 1994, Bhatt & Anagnostopoulou 1996), Korean (Lee & Santorini 1994) and German (Frey 1993, Lee & Santorini 1994, Lechner 1998). However, there is also another group of speakers (group B), who do allow total reconstruction of intermediate scrambling, i.e., for those speakers reconstruction may target the base position of the DObj; see Lee (2020) on Korean.

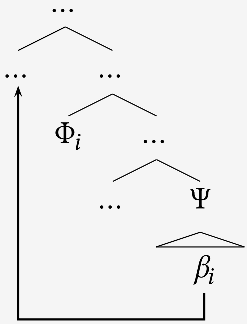
The example in (4a) (from Mahajan 1990) illustrates minimal reconstruction of intermediate scrambling in Hindi for Principle A. (4b) illustrates total reconstruction of intermediate scrambling in Korean for variable binding (taken from Lee 2020).

(4) a. *apnii*$_{i/*j}$ *kitaab* *raam-ne*$_i$ *mohan-ko*$_j$ __ *lOTaaii*
SELF's book.FEM.ABS Ram-ERG Mohan-DAT return.PERF.FEM
'Ram$_i$ returned self's$_{i/*j}$ book to Mohan$_j$.'

b. *Ku-*$_i$*uy* *koyangi-lul* *Suzi-ka* *motun* *salam*$_i$*-eykey* __ *sokayhaysste.*
he-GEN cats-ACC Suzi-NOM every person-DAT introduced
'Suzi introduced his$_i$ cats to everyone$_i$.'

1.3 A puzzle and some previous accounts

Assuming that both short and intermediate scrambling involve movement, the results of these transformations are representationally identical with respect to the Merge-positions of binder Φ and the moved constituent Ψ containing the bindee β. In both cases, Ψ begins the derivation in a position c-commanded by Φ, see (5).

(5)


If this were a necessary and sufficient condition for reconstruction, then one would expect reconstruction to be either applicable to both types of scrambling or to none of them, contrary to fact.

Various proposals have been made in the literature as to how the asymmetry for reconstruction should be accounted for. The first type of approach, presumably the dominant view in the literature, has it that there is a distinction between A- and Ā-scrambling (Mahajan 1990; 1994; Tada 1993). The assumption then is that A-scrambling (= short scrambling) must not reconstruct while Ā-scrambling (= intermediate scrambling) must reconstruct. Frey (1993) presents an approach where binding is mediated by agreement features, thus distinguishing the Subj from the IObj. Lee & Santorini (1994) develop a theory of the asymmetry that is based on the elaborate notions of binding-domain and argument-domain. Miyagawa (1997), concentrating on Japanese, proposes that scrambling may involve base generation (≈ short scrambling) or movement (= intermediate scrambling). Lechner (2019) proposes to approach the lack of reconstruction with short scrambling by making reference to late Merger (in the sense of Takahashi 2006, Takahashi & Hulsey 2009). Finally, Lee (2020) argues that the asymmetry follows from an anti-locality requirement that is sensitive for binding.

A thorough assessment of these approaches is beyond the scope of this article. Here, I simply would like to remark that it seems to me that while all these approaches successfully capture the asymmetry, they do so either by invoking otherwise non-motivated concepts (Frey 1993, Lee & Santorini 1994, Lechner 2019, Lee 2020) or by analyzing scrambling as a heterogeneous phenomenon (Mahajan 1990; 1994, Tada 1993, Miyagawa 1997). In contrast, in what follows, I argue that an approach to the reconstruction asymmetry is possible that a) is based on a set of independently motivated assumptions and b) treats scrambling in a unified manner.

1.4 The proposal in a nutshell

The underlying idea of the proposal is that short and intermediate scrambling differ *derivationally* in some dimension that goes beyond the difference in landing sites. Namely, due to Minimality short scrambling of the DObj is only possible if at the point of the derivation where such scrambling applies there is no IObj (and thus no binder) present. Rather, the IObj enters the picture only later – too late for binding to apply (a case of opacity, i.e., counter-feeding, in the sense of Kiparsky 1973). This results in a lack of 'reconstruction.' In contrast, intermediate scrambling of the DObj can apply in the presence of the Subj because the Subj is not in the c-command domain of the attracting head (Bobaljik 1995b's leapfrogging configuration). Thus, the binder is present before movement applies, which thus enables 'reconstruction' to arise.

Under this view, and opposed to the tradition (going back to Bierwisch 1965, Ross 1967), scrambling one argument across another is, in principle, restricted by Minimality. As such, its application requires special conditions. This assimilates scrambling (in Hindi, German, Japanese, etc.) to Scandinavian object shift and also to Dutch scrambling, where Minimality effects show up in a more transparent manner (Vikner 1989, Neeleman 1994, Collins & Thráinsson 1996, Thráinsson 2001).

2 Background assumptions

Before presenting the analysis in detail, I specify the theoretical assumptions that it is based on.

2.1 Minimality

To begin with, I assume that the following locality principle holds (Ferguson 1993, Chomsky 1995; cf. also Rizzi 1990, Fanselow 1991).

(6) *Minimal Link Condition (MLC):*
If in a structure
… H … [… Φ … [… Ψ …] …] …
a. H c-commands Φ, Φ asymmetrically c-commands Ψ, and
b. Φ and Ψ can both, in principle, establish a relation R with H,
then H can establish R only with Φ (but not with Ψ).

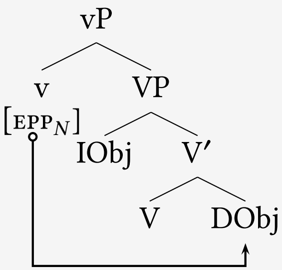
The relation R between H and Ψ blocked by the MLC that is relevant here is the 'probing' of Ψ by H (in the sense of Chomsky 2000; 2001): H is a functional head bearing some feature [F] (the 'probe') that scans its c-command domain in search of an appropriate 'goal' (Φ or Ψ in (6)) that may satisfy the needs of [F]. One such need may be the creation of a specifier of H, which then results in movement of the goal to SpecH.

2.2 Scrambling

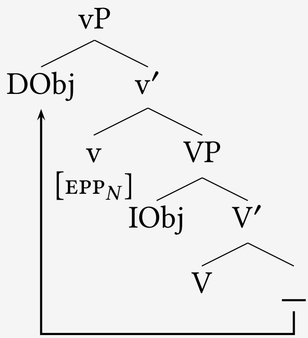
By assumption, scrambling is movement. As such, it is triggered by a probe. Following Miyagawa (2001), I assume that the probe in question is an EPP-feature that is relativized to nominal categories (comprising NP, and, presupposing some abstraction, possibly PP and CP): [EPP$_N$]. This is supposed to reflect the fact that scrambling typically targets nominal categories. In scrambling languages, the EPP-probe may be instantiated on the head introducing the external argument: v (Chomsky 1995, Koizumi 1995, Kratzer 1996).

Assuming that the IObj is merged in SpecV, it asymmetrically c-commands the DObj, which occupies the complement position of the verb. The assumptions about Minimality and scrambling together then imply that an IObj will block probing of the DObj by [EPP$_N$] on v (7a), and, consequently, will ban direct scrambling of the DObj across the IObj, see (7b).

(7) a. *



b. *



2.3 Strict cyclicity

I assume that syntactic derivations obey the Extension Condition (EC, Chomsky 1993; 1995) in (8) (cf. the Strict Cycle Condition of Chomsky 1973).

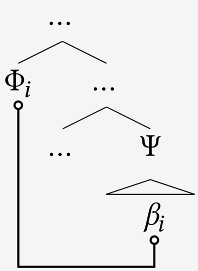
(8) *Extension Condition*:
Merge must apply to the root node of the current tree.

The EC blocks derivations where Merge does *not* apply to the root of the current tree Φ but targets a position internal to Φ instead. Note that the EC also constrains movement, the latter being, essentially, just another instance of Merge, called ‘internal’ Merge (as opposed to ‘external’ Merge).

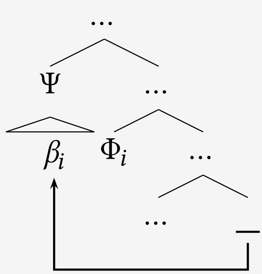
2.4 Reconstruction

While much of current syntactic theorizing is based on the assumption that reconstruction effects are a consequence of the copy theory of movement (e.g., Chomsky 1995, Fox 1999, Takahashi & Hulsey 2009) I assume here that reconstruction for binding principles (such as Principle A and C, and the binding of variables) is due to these principles being computed during the derivation (Burzio 1986, Belletti & Rizzi 1988, Lebeaux 1988; 2009, Heycock 1995, Sabel 1995; 1998):

(9) a.



b.



As (9a) illustrates, reconstruction effects may arise because Principle A is satisfied through syntactic binding of a reflexive β by its antecedent Φ (or Principle C is violated through binding of an R-expression β by a co-indexed pronoun Φ, or a variable β is semantically bound by a quantifier Φ) before movement of the category Ψ containing β applies (see (9b)).

Note that not only does the present approach abstain from making use of the copy theory of movement to account for reconstruction effects. In fact, the approach does not seem to combine easily with the copy theory of movement. The reason is that the lack of reconstruction as it shows up with short scrambling is based on the idea that the IObj enters the derivation too late to c-command the DObj because the latter has been displaced already. If displacement of the DObj left a copy, the IObj would still c-command this copy, thus leading to reconstruction.[3]

[3] A way to maintain the option of combining the present approach with the copy theory would be to assume that a copy left behind by movement does not bear all the features of the displaced category (an assumption that is sometimes made in order to to explain why copies left by Ā-movement do not trigger A-Minimality violations (e.g., Chomsky 2000, Anagnostopoulou 2003).

2.5 Phases

According to Chomsky (2000; 2001), (agentive) vP and CP constitute designated categories that are called ‘phases.’ As such, they are subject to the Phase Impenetrability Condition (PIC, Chomsky 2001) in (10).

(10) *Phase Impenetrability Condition*:
In a phase Ψ with head H, the complement (‘domain’) of H is not accessible for operations that involve a position outside Ψ. Only H and its specifier(s) (‘edge’) are accessible.

Deviating from Chomsky (2000; 2001), I assume that non-agentive vP (unaccusatives, passives, etc.) is also a phase (see Legate 2003, Sauerland 2003, Richards 2005, Deal 2009, Heck 2016).

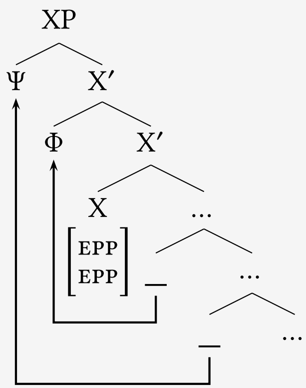
Due to the PIC, movement out of a phase must pass successive cyclically via the specifier of the phase. Such successive cyclic movement of NP to Specv is triggered by an edge feature [EF_N] (Chomsky 2008). A difference between [EF_N] and [EPP_N] is that a category that was attracted by [EF_N] may not remain at its landing site (witness (11)) while a category attracted by [EPP_N] may.

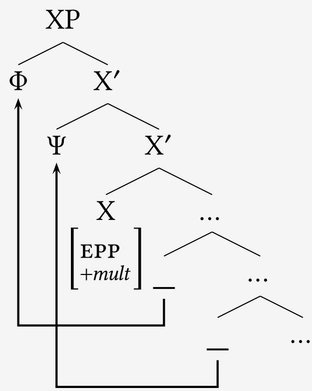
(11) *Who [$_{vP}$ what bought __]?

Edge features are added to the derivation when needed. In particular, I assume that each head taken from the lexicon has its probe features [π_i] ordered in an array determining the order of operations that the head triggers: [π_1] > … > [π_n]. By assumption, a probe [π_i] cannot be accessed before the probe [π_{i-1}] that directly precedes it in the array has been satisfied in a previous step (Koizumi 1994, Sabel 1998, Heck & Müller 2007, Müller 2010, Georgi 2014, Amato 2021). Edge features are added to the beginning of the feature array of a head H before H is merged: [EF] > [π_1] > … > [π_n].

2.6 Multiple specifiers

Multiple movement to the same specifier domain triggered by different features (also multiple instances of the same feature) creates nested paths (12a). In contrast, multiple movement to the same specifier domain triggered by a single feature (e.g. [EPP_{+mult}], a feature that is able to attract multiple categories) creates crossing paths (12b) (McGinnis 1998’ generalization).

(12) a.


b.


Note that (12a) involves leapfrogging: After Φ has been attracted to SpecX by the first EPP-feature on X, it is located outside the c-command domain of the second EPP-feature, which is supposed to attract Ψ. Therefore, Φ does not intervene and Ψ can be attracted in the next step. Of course, Φ could as well reach SpecX via (external) Merge and then be leapfrogged over by Ψ.

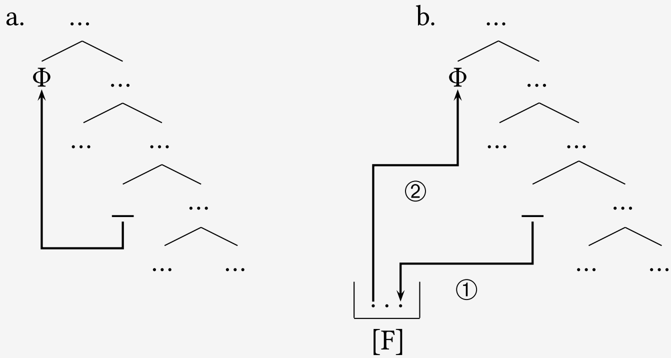
2.7 Workspaces

Finally, every theory in which syntactic structure building proceeds in a derivational fashion needs to make use of different workspaces (WSPs) in order to generate complex syntactic objects (see Uriagereka 1999). Moreover, WSPs have proven useful for a strictly cyclic account of head-movement (Bobaljik 1995a, Bobaljik & Brown 1996) and for a strictly cyclic analysis of order-preservation in multiple movement constructions (Doggett 2004, Stroik 2009, Heck & Himmelreich 2016; cf. (12b), which would otherwise violate the EC or the MLC).

Here, I will assume, following Heck (2016), that syntactic derivations can make use of various WSPs in a generalized way, hosting categories that participate in the derivation (often resulting in what is called a 'non-monotonic' derivation in Heck 2016). In particular, the idea is that any garden-variety type of movement of a category Φ as in (13a) may actually be decomposed into two operations. First, removal of Φ applies (cf. Müller 2017; 2018, Pesetsky 2016) to another WSP (step ① in (13b)).[4] Second, Φ is remerged from the WSP to the current tree (② in (13b)).

[4]This looks like sideward movement (in the sense of Nunes 2001). However, I am assuming here (following Heck 2016) the standard condition on movement to the effect that the movement trigger (the probe) c-commands the goal at the point of the derivation where the goal is attracted, which excludes typical analyses of sideward movement.

(13)



(Note in passing that the feature [F] that attracts Φ acts as a pointer to the WSP that Φ is temporarily moved; here and in what follows, this is indicated by displaying the feature below the WSP.) If no other operation is interspersed between the steps ① and ②, movement applies in the ordinary way (giving the impression of (13a)). The more interesting case is one where such interspersion applies.

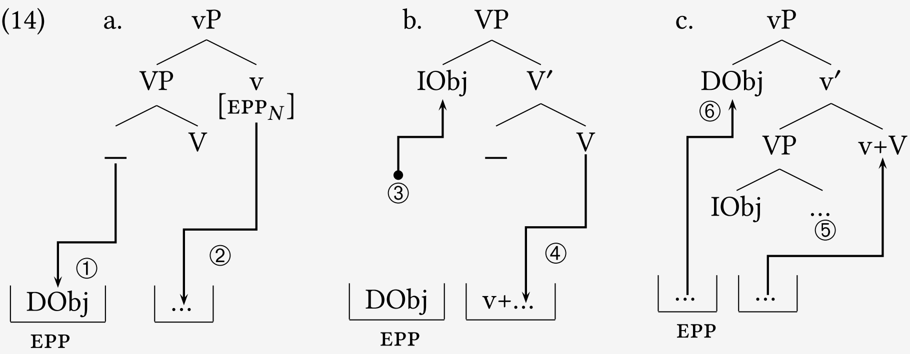
3 Analysis

3.1 Short scrambling

I begin with short scrambling (Subj > DObj > IObj), which does not reconstruct. As already illustrated in section 2.5, short scrambling cannot be triggered by [EF_N] as this would force the DObj to move on, deriving the order DObj > Subj (cf. the derivations in (15) and (16) discussed below). Therefore v must bear [EPP_N]. As discussed in section 2.2, the DObj cannot move directly across the IObj because of the MLC. I would like to suggest that the solution to this problem consists in delaying Merge of the IObj. This means that the DObj is attracted by [EPP_N] on v to a WSP before the IObj is even merged (see step ① in (14)).

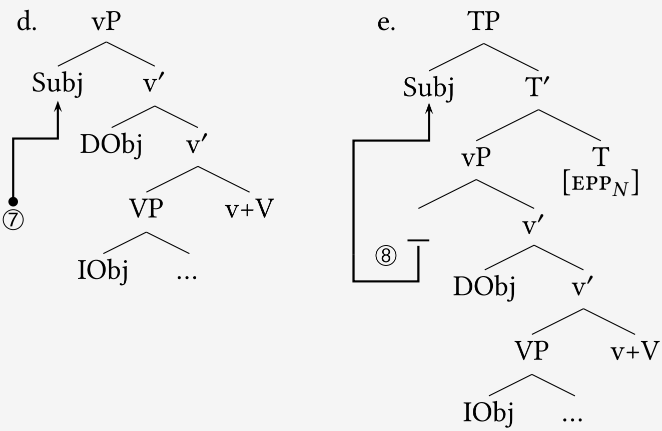
In order for V-to-v movement to be able to apply in agreement with the EC, the v-head is first removed and stored in a separate WSP (step ②) (cf. Bobaljik 1995a, Bobaljik & Brown 1996). Since v has been removed, and since there are no specifiers requiring vP to be maintained, vP ceases to exist (cf. Heycock & Kroch 1993, Takano 2000). What remains is a VP. Consequently, late Merger of the IObj to SpecV can now apply in conformity with the EC (see step ③). Next, V joins v in the WSP to form a complex head, and head-movement is completed by remerging the v+V complex to the current tree (steps ④, ⑤), thereby re-establishing a vP.

(14)



Finally, the DObj is remerged in Specv (step ⑥ in (14c)), and the Subj is merged in an outer Specv and, possibly, moves to SpecT (see ⑦, ⑧ in (14d,e)).

(14)



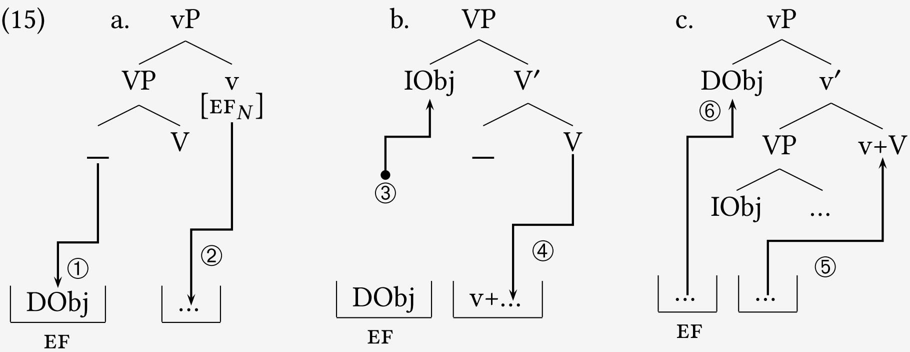
Crucially, at no point of the derivation in (14a-e) does the IObj c-command the DObj. Therefore, there is no reconstruction effect with short scrambling of the DObj relative to the IObj. Note that it must not be the case that v bears two instances of [EPP$_N$], each attracting one of the objects: this would lead to the order DObj > IObj via leapfrogging at the vP level (recall (12a)), wrongly avoiding a violation of the MLC without deriving the lack of reconstruction.

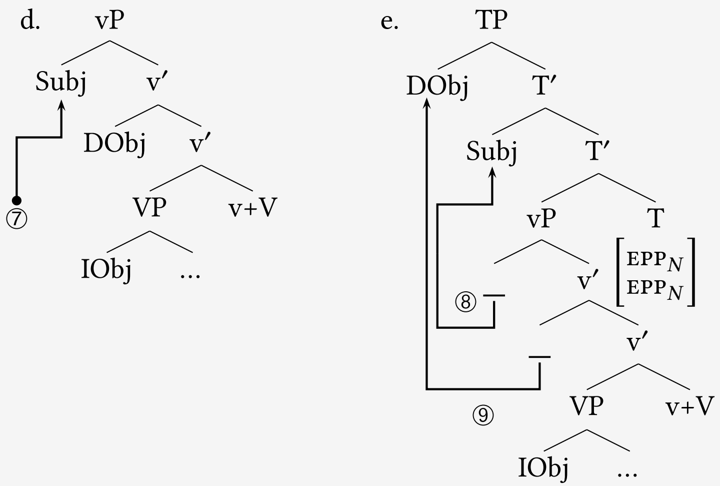
3.2 Intermediate Scrambling

I turn to intermediate scrambling (DObj > Subj > IObj). There are two groups of speakers: group A (minimal reconstruction) and group B (total reconstruction).

3.2.1 First derivation: minimal reconstruction

The DObj must reach a position to the left of the Subj. As before (cf. section 2.2 and section 3.1), it cannot move directly across the IObj because of the MLC. Therefore, Merge of the IObj is delayed. The derivation proceeds almost exactly as in (14), the only differences being a) that both DObj and Subj ultimately undergo multiple scrambling to SpecT, triggered by two instances of [EPP$_N$] on T (leapfrogging steps ⑧, ⑨ in (15e)), and b) that the DObj is attracted by an EF in (15a).[5]

(15)


(15)


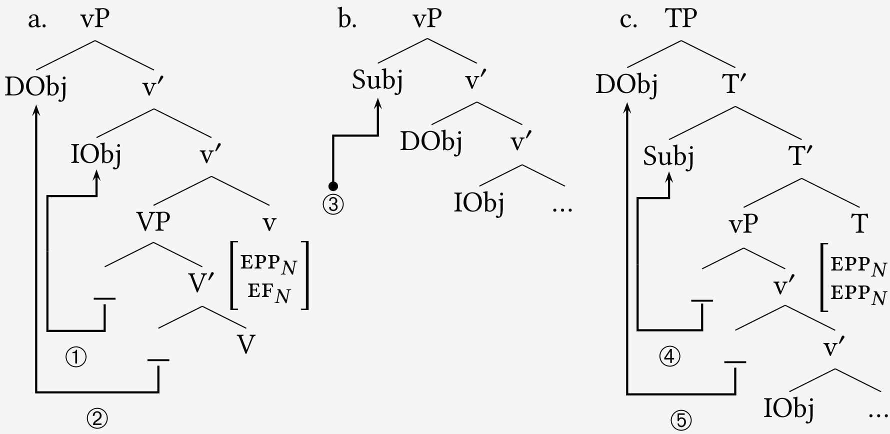
Note that since there is a point in the derivation (15a-e) where the Subj c-commands the DObj (namely before both move to SpecT, see (15d)), binding into the DObj by

[5] In fact, the DObj could be attracted by an EPP-feature instead (unless one assumes so-called Criterial Freezing in the sense of Rizzi 2006). Thus, the distinction between EF and EPP is irrelevant in this case, but cf. section 3.2.2.

the Subj (reconstruction of the DObj relative to the Subj) is derived. Moreover, since the IObj is merged only after the DObj has already been moved, there is no point in (15a-e) where the IObj c-commands the DObj. Thus, there is no reconstruction of the DObj relative to the IObj: reconstruction is minimal (group A).

3.2.2 Second derivation: total reconstruction

Again, the DObj must get past the IObj (and the Subj), which is not directly possible due to the MLC. Suppose now that speakers of group B do not delay Merge of the IObj. Rather, the IObj first scrambles to Specv, triggered by an [EPP$_N$]-feature on v (see step ①). Next, the DObj undergoes successive-cyclic movement to Specv triggered by an [EF$_N$] on v (see step ②).[6] This results in a change of the relative order of the objects (leapfrogging). In what follows, the Subj is merged to the outermost Specv (step ③). Finally, both the DObj and the Subj undergo multiple scrambling to SpecT, triggered by two instances of [EPP$_N$] on T (steps ④, ⑤), again involving leapfrogging.

(16)


Since there is a point in the derivation (16a-c) where the IObj c-commands the DObj (namely before both move to Specv, see (16a)), binding into the DObj by the IObj (reconstruction) with intermediate scrambling is possible. In this way, the derivation accounts for speakers of group B, for whom reconstruction may be total. Of course, speakers of group B also allow for minimal reconstruction because at point (16b) of the derivation the Subj c-commands the DObj.

[6] As noted in section 3.1, the desired derivation for short scrambling requires that v must not bear two independent EPP-features. This forces an analysis as the one in (16), where the DObj moves to Specv by means of an [EF$_N$].

Note that the derivation in (16) requires the option of adding [EF_N] to the beginning of v's feature array *after* its [EPP_N] has been eliminated (i.e. after v has entered the syntax). This is reflected in (16a) (somewhat opaquely) by the fact that [EPP_N] shows up preceding [EF_N] in the feature array (in (16a): on top of the feature structure). I assume that this is an option only for speakers of group B, and therefore is exactly the parameter that sets apart group B from group A.

4 Floating Quantifiers in Japanese

As already mentioned in section 1, Japanese also shows the reconstruction asymmetry between short and intermediate scrambling. The following examples (from Miyagawa 1997) illustrate. (17a) shows reconstruction for Principle C with intermediate scrambling. (Miyagawa 1997 himself analyzes (17a) involving a violation of Rizzi 1986's Chain Condition.) (17b) illustrates that Principle C is not violated if the necessary c-command is lacking (because the reciprocal is embedded).

(17) a. ??? *John-to Mary-o$_i$ otagai$_i$-ga ___ mita.*
John-and Mary-ACC$_i$ each other$_i$-NOM saw
lit. 'John and Mary, each other saw.'

b. *John-to Mary-o$_i$ otagai$_i$-no sensei-ga ___ mita.*
John-and Mary-ACC$_i$ each other$_i$-GEN teachers-NOM ___ saw
'John and Mary, each other's teachers saw.'

Next, (18a) shows that short scrambling does not reconstruct for Principle A. Furthermore, (18b) illustrates that short scrambling also does not reconstruct for Principle C.

(18) a. ??? *John-ga otagai$_i$-no tomodati-o$_j$ Hanako-to Mary$_i$-ni ___ syookaisita.*
John-NOM each other$_i$-GEN friends-ACC$_j$ Hanako-and Mary$_i$-DAT introduced
'John introduced each other's friends to Hanako and Mary.'

b. *John-ga Hanako-to Mary$_i$-o (paatii-de) otagai$_i$-ni ___ syookaisita.*
John-NOM Hanako-and Mary$_i$-ACC (party-at) each other$_i$-DAT introduced
'John introduced Hanako and Mary to each other at the party.'

4.1 Floating quantifiers and reconstruction

Japanese shows an interesting complication to the overall pattern: A DObj that undergoes short scrambling suddenly does show reconstruction effects (here: for Principle C) if it associates with a floating quantifier (19a). (Floating quantifiers are indicated by amber.) (19b), where the reflexive pronoun is embedded and thus does not c-command the base position of the R-expression, shows that the problem with (19a) arguably is a Principle C effect.

(19) a. **John-ga gakusei-tati$_i$-o karera-zisini$_i$-ni __ futa-ri miseta.*
John-NOM students$_i$-ACC they-SELF$_i$-DAT 2-CL showed.
'John showed two students to themselves.'

b. *John-ga gakusei-tati$_i$-o karera-zisini$_i$-no sensei-ni __ futa-ri syookaisita.*
John-NOM students$_i$-ACC they-SELF$_i$-GEN teachers-DAT 2-CL introduced
'John introduced two students to their own teachers.'

Miyagawa (1997), who analyzes the lack of reconstruction with short scrambling illustrated in (17) and (18) as a consequence of the idea that the order DObj > IObj may be base generated in Japanese, explains the surprising emergence of reconstruction effects with short scrambling in the context of floating quantifiers by assuming that the dissociated position of the floating quantifier enforces a movement analysis of the order DObj > IObj (which may then show the common reconstruction behavior of movement).

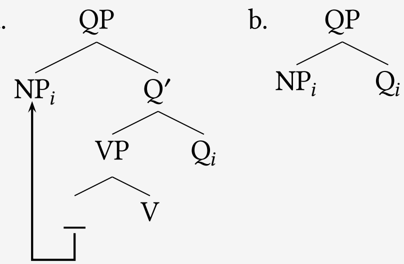
The question is: Can one also account for the fact that floating quantifiers in Japanese create a reconstruction effect with short scrambling within the present approach? As I will argue in the following section, this is indeed the case.

4.2 Analysis

I begin with my assumptions about floating quantifiers in Japanese. First, I assume that the quantifier is a head Q that takes VP (20) or NP (21) as its complement.

Second, if an NP is supposed to associate with a quantifier (here indicated by co-indexation), it must, at some point, be merged within its projection. This is achieved either by movement to SpecQ (which means that Q may bear [EPP$_N$]), see (20a), or by merging directly with the quantifier, see (20b).

(20) a. b.



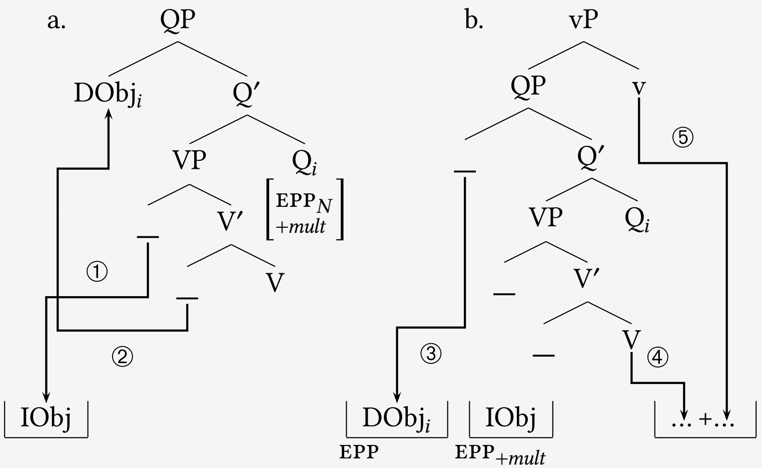
The first assumption is supposed to generate floating quantifiers that are dissociated from their antecedent (as in (19)), the latter assumption is used to generate cases such as (21), where the quantifier moves together with its antecedent:

(21) *John-ga gakusei-tati$_i$-o futa-ri otagai$_i$-ni* _ *syookaisita.*
John-NOM students$_i$-acc 2-CL each other$_i$-DAT introduced
'John introduced two students to each other.'

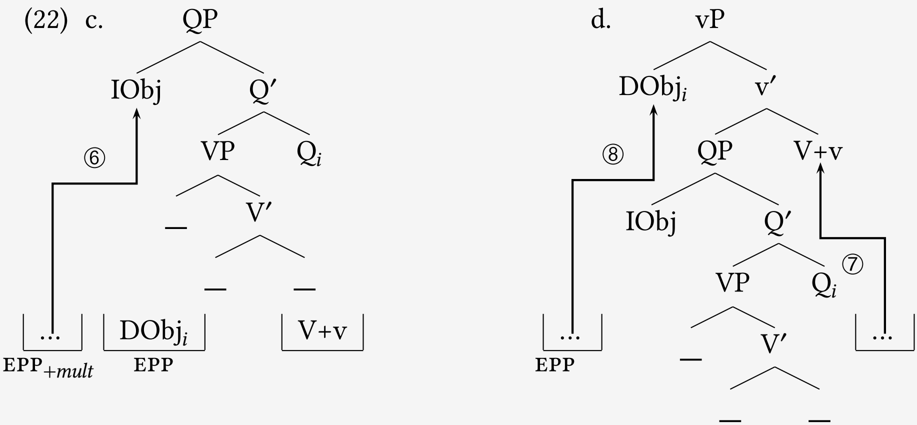
A way to generate (19b) is by moving both objects to SpecQ via leapfrogging (Q bearing two [EPP$_N$]). However, then the IObj is closer to Q than the DObj within QP, possibly generating a reading where the IObj associates with the quantifier.

To avoid this issue, suppose Q bears [EPP$_{N/+mult}$], a feature able to attract multiple NPs. It first attracts the IObj to some WSP (step ① in (22a)), and then the DObj to SpecQ (step ②). From there, the DObj gets attracted by v (by a simple [EPP$_N$], step ③ in (22b)) after the v-head is merged.

(22) a. b.

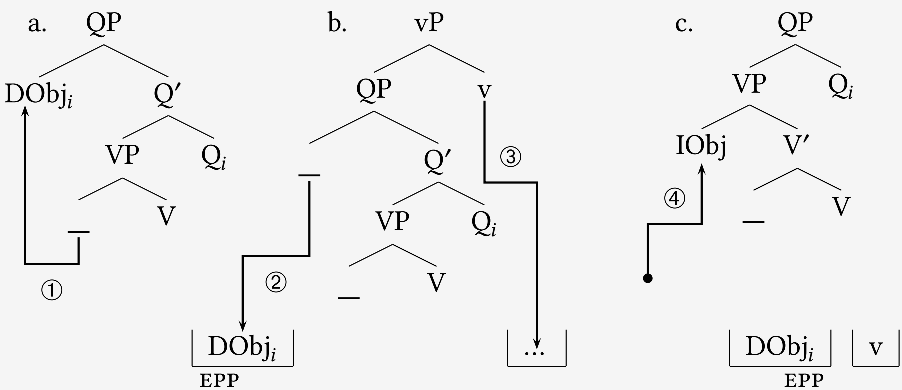


After v is removed (step ⑤) the IObj moves to SpecQ (⑥ in (22c)). Head-movement is completed, and the DObj is remerged in Specv (steps ⑦, ⑧ in (22d)), from where it can bind a reflexive within the IObj, satisfying Principle A.

(22)


The same derivation cannot make use of two different EPP-features. The reason is that the EPP-feature that attracts the IObj occupies the beginning of Q's feature array. It is not removed unless the IObj is merged. This means that the EPP-feature attracting the DObj does not become active while the IObj remains in the WSP.

In order to derive the ban on (19a), every derivation generating it must be blocked. If (19a) is generated along the lines of (19b), then it incurs a Principle C violation: There is a point in (22a-d) where the IObj c-commands the DObj, namely at the very beginning (see (22a)); recall in this context that in contrast to (19b), the reflexive in (19a) is not embedded within the IObj, it *is* the IObj. Moreover, maneuvering the DObj past the IObj by merging the IObj late fails because the QP cannot be removed as it does not participate in head-movement. This is shown in (23):

(23)


In (23b), v joins a WSP in order to participate in head-movement. This leads to the temporary disappearance of the vP-shell (see (23c)). Next, the IObj is remerged in SpecV (step ④ in (23c)). However, as the QP-shell is still present (due to its not participating in head-movement) , this derivation violates the EC. Assuming that these are the only options to generate (19a), its ungrammaticality is derived.

To briefly summarize, the re-emergence of reconstruction effects with respect to Principle C in the context of floating quantifiers in Japanese is reduced to the idea that the only way that a violation of Principle C could be avoided in this context is blocked by the EC, due to the presence of the floating quantifier. Reconstruction with respect to Principle A arises due to the quantifier's ability to attract multiple categories with a single feature.

5 Beyond scrambling: Topicalization in German

It is generally assumed that Ā-movement obligatorily reconstructs while A-movement does not (Mahajan 1990, Fox 1999, Takahashi & Hulsey 2009). So far, it was assumed that late Merger of the IObj is generally available, at least in some languages. This predicts anti-reconstruction of Ā-movement of the DObj with respect to the IObj .

Interestingly, Lechner (2019) observes the following contrasts, which suggest that the prediction is borne out for movement to the initial position of a V2 clause in German, so-called 'topicalization'. (Topicalization is usually analyzed as movement to SpecC, a bona fide instance of Ā-movement.)

(24) a. **Ich brauchte ihm*$_i$ *diesen alten Freund von Karl*$_i$ *nicht vorzustellen.*
I needed him.DAT this old friend.ACC of Karl not to introduce
'I didn't need to introduce this old friend of Karl$_i$'s to him$_i$.

b. *Diesen alten Freund von Karl*$_i$ *brauchte ich ihm*$_i$ _ *nicht vorzustellen.*
this old friend.ACC of Karl needed I him.DAT not to introduce

(25) a. **Er*$_i$ *brauchte uns diesen alten Freund von Karl*$_i$ *nicht vorzustellen.*
he needed us.DAT this old friend.ACC of Karl not to introduce
lit. 'He$_i$ did not need to introduce to us this old friend of Karl$_i$'s.

b. **Diesen alten Freund von Karl*$_i$ *brauchte er*$_i$ *uns* __ *nicht*
this old friend.ACC of Karl needed he us.DAT not
vorzustellen.
to introduce

(24a) and (25a) are base lines. They show the expected Principle C effects arising when an IObj pronoun (24a) or a Subj pronoun (25a) c-commands a DObj containing an R-expression interpreted as co-referential with the pronoun. Both (24b) and (25b) involve topicalization of the DObj. According to Lechner (2019), (24b) is acceptable (but see Frey 1993 for an opposing view), meaning that topicalization of the DObj does not reconstruct below the IObj for Principle C. This contrasts with the ungrammatical (25b), suggesting that topicalization of the DObj does reconstruct below the Subj for Principle C. (Comparable facts appear to hold for *wh*-movement.)

In order to account for (24b), one may just assume in the present approach that successive-cyclic movement via Specv ending up in SpecC is triggered by the same feature that triggers successive-cyclic movement ending up in SpecT: [EF$_N$]. This assumption forces late Merger of the IObj in (24b) in order for the DObj to be able to move to Specv (and thus to remain PIC-accessible), thereby accounting for the lack of reconstruction of the DObj relative to the IObj.

Until now, the option of late Merger was envisaged only with respect to the IObj. However, it is, in principle, imaginable that late Merger also applies to the Subj. Therefore, the question arises whether one could not generate the string in (25b) by merging the Subj late, resulting in a lack of reconstruction of the DObj with respect to the Subj (contrary to fact, witness (25b)). As it turns out, there is a way that such a derivation could proceed, but only under the premise that there is also V(+v)-to-T movement taking place. In what follows, I will illustrate this in some detail.[7]

I begin with attempts that fail. First, if the Subj is merged to Specv before the DObj gets attracted by v, the former c-commands the latter, and reconstruction of the DObj with respect to the Subj arises. Second, if the DObj is attracted first and merged to (what ends up to be an inner) Specv right away, then the Subj is merged

[7] Somewhat simplifying, Lechner (2019)'s theory accounts for (24b)/(25b) (and for the asymmetry between short and intermediate scrambling with respect to reconstruction) by assuming a) that late Merger of the complement of the determiner of the DObj (containing the R-expression) is possible, and b) that such late Merger must not apply before the DObj has undergone short scrambling (if it scrambles).

to an outer Specv, a position from where it c-commands the DObj, again leading to reconstruction. Third, one may think of the following derivation: the DObj is attracted first by an [EF] on v and put into some WSP; next the Subj is merged to Specv, and finally, the DObj is remerged from the WSP to an outer Specv. If this were a viable derivation, then it could ultimately lead to the string in (25b) without implying a single representation where the Subj c-commands the DObj, hence falsely deriving a lack of reconstruction. However, such a derivation is blocked because the [EF] that attracts the DObj will not be removed from the beginning of v's feature array unless it has been fully satisfied, i.e., unless the DObj has been remerged to Specv. Assuming that external Merge is also feature-driven (see, e.g., Svenonius 1994, Collins 2002, Lechner 2004, Kobele 2006, Müller 2017, Stabler 2013, among others), it follows that the structure building feature which triggers external Merge of the Subj, and which is also part of v's feature array, cannot be accessed by the derivation as long as the DObj remains in the WSP.[8]

There is, however, one derivation of (25b) that merges the Subj late and thereby falsely predicts the lack of reconstruction. It runs as follows. Suppose the v-head was just merged with VP. In what follows, the DObj is first attracted by an [EF] on v and merged to Specv. Next, V-to-v movement applies in the usual manner. Instead of merging the Subj in the following step, the T-head is merged. Assuming that T bears [EPP$_N$], this feature attracts the DObj, putting it into some WSP. The T-head is removed, joining some WSP in order to participate in head-movement with the V+v complex. This makes the current tree, a TP, shrink and become a vP, again. Consequently, the Subj can now be merged into Specv, in agreement with the EC. The V+v-complex joins T in its WSP and the newly generated complex head V+v+T remerges with vP, restoring the current tree as a TP. Finally, the DObj is remerged from its WSP into SpecT (from where it will ultimately undergo Ā-movement). At no point of this derivation does the Subj c-command the DObj. Hence, there is no reconstruction effect of the DObj with respect to Subj.

In fact, if the DObj does not undergo further Ā-movement, the above derivation derives a case of intermediate scrambling where reconstruction with respect to the Subj is not enforced. This, however, would predict the lack for reconstruction for Principle C with intermediate scrambling, contrary to fact (recall, e.g., the examples (3b) and (17) from Hindi and Japanese, respectively). For these reasons, this type of derivation must be blocked.

One can think of different ways to achieve this. First, one may simply stipulate that late Merger of the Subj (in contrast to late Merger of the IObj) is generally

[8]Cf. already section 4.2 for the same type of argument.

impossible. Second, as the above derivation is based on the application of V-to-T movement, one may prevent it by dropping this assumption (see, e.g., Haider 1993; 2010 for German). Third, if the language in question exhibits obligatory raising of the Subj to SpecT (not the case for German, cf. Grewendorf 1989, Diesing 1992, Haider 1993; 2010), then either a) the word order generated by the above derivation (Subj > DObj) does not instantiate a case of intermediate scrambling (DObj > Subj), or b) if the DObj undergoes a further movement step (deriving DObj > Subj after all), the obligatory reconstruction effect with respect to Principle C is reached at the TP-cycle. Finally, and perhaps most interestingly, one may assume that late Merger is a last resort strategy of the grammar, i.e., a repair that is only available if the way for a category to reach a certain position is blocked by an intervener. In the case of successive cyclic movement of a DObj across an IObj to Specv, the only way for the DObj to reach Specv is by merging the IObj late. In contrast, no such measure is required if the DObj crosses the Subj on its way to Specv, simply because the Subj (not being in the c-command domain of v) can be leapfrogged over. For now, I leave the question as to which way one should proceed for future research.[9]

6 Conclusion

It has been proposed in the literature that apparent violations of Minimality can be explained by different processes, among them a) leapfrogging or b) late Merger. In the present paper, I proposed that these processes can be distinguished by the effects they have on reconstruction. The empirical focus of the argument involved reconstruction asymmetries as they show up with scrambling in different languages (Hindi, German, Japanese, Korean).

The argument went as follows. Due to Minimality, short scrambling is not easily available (cf. Scandinavian object shift): It requires late Merger of the intervener (= IObj) at the vP-level. This derives the lack of reconstruction effects with respect

[9]Note that the present theory predicts a pattern for reflexivization (and variable binding) that is the mirror image of (24b)/(25b). Relevant examples involving reflexivization from German are given in (ia,b):

(i) a. **Diesen alten Freund von sich*$_i$ *brauchte ich ihm*$_i$ __ *nicht vorzustellen.*
this old friend.ACC of SELF needed I him.DAT not to introduce

b. *Diesen alten Freund von sich*$_i$ *brauchte er*$_i$ *uns* __ *nicht vorzustellen.*
this old friend.ACC of SELF needed he us.DAT not to introduce

At first sight, the prediction seems to go into the right direction (with similar results for variable binding).

to the IObj. In contrast, intermediate scrambling can be generated more directly by leapfrogging over the intervener (= Subj). To be precise, I proposed that intermediate scrambling involves late Merger at the vP-level and leapfrogging at the TP-level for group A speakers, resulting in minimal reconstruction, and leapfrogging at both the vP-level and TP-level for group B speakers, resulting in total reconstruction. The presence/absence of reconstruction effects may thus serve as a diagnostic to distinguish different ways to side step Minimality.

Next, I addressed floating quantifiers in Japanese, a context where a) a leapfrogging derivation is possible and b) late Merger of the intervener may not apply due to the Extension Condition. Both a) and b) are tied to the presence of a QP-shell, which is headed by the floating quantifier. As a result, obligatory reconstruction effects with short scrambling exceptionally show up with floating quantifiers in Japanese. Finally, I briefly addressed the case of reconstruction with respect to topicalization in German, also alluding to the possibility that late Merger may be a (language specific) repair operation (subject to further restrictions), which is only available if Minimality would otherwise prevent a certain movement from applying.

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Two types of subjunctive in Korean: Interaction between inquisitiveness and nonveridicality

Arum Kang • Suwon Yoon

Abstract The goal of the current work is to identify a novel type of subjunctive mood in Korean. We address the following questions: First, what are the semantic functions of two types of modalized questions in Korean? Second, what do they tell us about the universality and variation of the subjunctive phenomena across Korean and other languages? Given these questions, we want to explore the empirical dimension and show the crosslinguistically extended paradigm of the subjunctive mood. Specifically, we argue first that the Korean subjunctive can be formally marked at the level of an inquisitive subordinator C. Second, it exhibits flexible distributions with respect to the selection by attitude predicates. Third, subjunctive marking has the semantic contribution of epistemic/buletic weakening rather than merely reflecting the modal properties of the context in which it occurs. Assuming that the inquisitive subjunctive in Korean expresses the relation between the speaker/subject's attitude and the potential answers of the interrogative complements in the partitioned modal base, we propose a unified analysis of subjunctive mood in Korean within the framework of nonveridicality.

Keywords subjunctive · inquisitiveness · nonveridicality · modalized questions

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1 Introduction

The goal of this study is to investigate a novel paradigm of subjunctive mood in Korean. Subjunctive mood selection refers to the linguistic phenomenon in which the complement of certain propositional attitude verbs appears in a subjunctive form. In many Indo-European languages, attitude predicates require the subjunctive mood to be reflected as overt verbal inflection in embedded clauses. As shown below, the desire verb *veut* 'wants' in French in (1b) obligatorily selects for the subjunctive verbal form in an embedded clause, whereas the factive verb *sait* 'knows' selects for the indicative in (1a) (Giannakidou & Mari 2021: 11, (17a-b)).

(1) a. *Marc sait que le printemps {*soit/est} arrivé.*
Marc knows that the spring be.SBJV.3SG/be.IND.3SG arrived
'Marc knows that spring has arrived.'
b. *Marc veut que le printemps {soit/*est } long.*
Marc wants that the spring be.SBJV.3SG/be.IND.3SG long
'Marc wants spring to be long.' [French]

While languages exhibit some variation with regard to subjunctive-selecting predicates that trigger this mood with distinct marking strategies (Marques 2004; Porter & Rubinstein 2020, a.o.), these grammatical mood selection patterns share the following properties: (i) they show complementary distribution between indicative and subjunctive; (ii) a mood marker mostly appears in a declarative complement; and (iii) subjunctive marking itself does not have any additional semantic contribution but merely reflects modal properties of the context in which it occurs.

To capture cross-linguistic facts beyond European languages, however, we suggest adopting an extended spectrum of the notional mood (à la Giorgi & Pianesi 1996), rather than the traditional grammatical mood. The advantage of the notional mood includes the following: First, unlike the traditional view, the subjunctive can be also marked on subordinate complementizers in modern Greek and Balkan languages (Farkas 1992), as illustrated in (2) for Greek (Giannakidou & Mari 2021: 13, (22)).

(2) *Thelo {**na/*oti**} kerdisi o Janis.*
want.1SG that.SBJV/that.IND win.NONPAST.3SG the John
'I want John to win.' [Greek]

Second, mood is shown to be variable. In Italian, the doxastic verb *crede* 'believe' in (3) allows flexibility in mood selection between the indicative with stronger belief and the subjunctive with weaker belief (Farkas 1985; Quer 1998; Villalta 2008; Anand & Hacquard 2013; Mari 2016; Mari & Portner 2021: 2, (2)).

(3) *Piero crede che Maria {**é/sia**} malata.*
Peter believe.IND.3SG that Mary be.IND.3SG/be.SBJV.3SG ill
'Peter believes that Mary is ill.' [Italian]

Third, subjunctive mood selection occurs not only in declarative clauses, but also in interrogative clauses where rogative predicates can be a mood trigger, as illustrated in (4) for Italian. A predicate of inquiry such as 'ask' in (4a) selects for the indicative, whereas a predicate of inquisitive such as 'wonder' in (4b) selects for the subjunctive. Portner suggests that the inquiry 'ask' is the interrogative counterpart of a verb of assertion (i.e., 'want to be told') whereas the inquisitive 'wonder' is the interrogative counterpart of a verb of belief/knowledge (i.e., 'want to know').

(4) Rogative predicates can be mood governors (Portner 2018: 237, (9)):

a.

Gli	*avevo*	*chiesto*	*se*	*ci*	***sono***	*corsi*	*d'inglese.*
him	have.1SG	asked	if	there	be.IND.3PL	courses	of.English

'I asked him whether there are English courses.'

b.

Mi	*chiedo*	*se*	*ci*	***siano***	*corsi*	*d'inglese.*
me	wonder.1SG	if	there	be.SBJV.3PL	courses	of.English

'I wonder whether there are English courses.' [Italian]

Compared to the extensive research conducted in Indo-European languages, the precise nature of the Korean subjunctive has yet to be systematically explained, except for some preliminary works (Yoon 2011; Yoon 2013; Kang & Yoon 2019a; Kang & Yoon 2019b; Kang & Yoon 2020). Just as has been done for Indo-European languages, we will show that the Korean subjunctive exhibits the three aspects of extended spectrum mentioned above: First, Korean subjunctive mood can be marked on the subordinator C position. Second, the Korean subjunctive exhibits mood flexibility, along with Italian. Third, the subjunctive in Korean is sensitive to inquisitiveness.

In this work, our main data are based on three different types of question markers (Q-markers): *(n)ci*, *nka* and *lkka*. As shown below, the criteria of question markers in Korean are subdivided into two parts, i.e. the ordinary question marker *(n)ci* vs. the modalized question markers (MQ-markers) *nka* and *lkka* (Kang & Yoon 2019a; Kang & Yoon 2019b; Kang & Yoon 2020).[1] The question marked *(n)ci* forms a typical yes-no question in (5a), whereas the questions marked *nka* in (5b) and *lkka* in (5c) report on the speaker's consideration of a set of possibilities of the given proposition. Just like an epistemic modal, they specify the degree of certainty about the proposition

[1] The modalized questions are glossed as 'MQ'.

in question.

(5) a. *Inho-ka pathi-ey o-**ci**?*
Inho-NOM party-LOC come-Q
'Is Inho coming to the party?'
b. *Inho-ka pathi-ey o.nu-**nka**?*
Inho-NOM party-LOC come-MQ
'Maybe Inho is coming to the party, maybe not? (I don't know which)'
c. *Inho-ka pathi-ey o-**lkka**?*
Inho-NOM party-LOC come-MQ
'Might Inho come to the party?'
≈ 'I conjecture (the possibility) that Inho is coming to the party.'

The meaning of epistemic uncertainty expressed by *nka* and *lkka* is revealed in the following examples. As a Q-marker, when *(n)ci*, *nka* and *lkka* are affixed on the embedded verbs in (6), they all occur in the complement clause of the verb *kwungkumha* 'wonder' (Kim 2016). Unlike the ordinary Q-marker *(n)ci*, the MQ-markers *nka* and *lkka* cannot combine with the verb *a(l)* 'know' in (7).

(6) a. *Mina-nun Inho-ka pathi-ey o-nu.**nci** kwungkumha-ta.*
Mina-TOP Inho-NOM party-LOC come-Q wonder-DECL
'Mina wonders whether Inho is coming to the party.'
b. *Mina-nun Inho-ka pathi-ey {o-nu.**nka**/o-**lkka**}*
Mina-TOP Inho-NOM party-LOC come-MQ/come-MQ
kwungkumha-ta.
wonder-DECL
'Mina wonders if Inho might come to the party.'

(7) *Mina-nun Inho-ka pathi-ey {o-nu.**nci**/#o-nu.**nka**/#o-**lkka**}*
Mina-TOP Inho-NOM party-LOC come-Q/come-MQ/come-MQ
an-ta.
know-DECL
'Mina knows whether Inho is coming to the party.'

Given this, we will show that the function of *nka* and *lkka* involves modal exponents and they bring about a subjunctive effect in that they yield a weaker commitment interpretation (Schlenker 2003; Portner & Rubinstein 2012; Giannakidou & Mari 2021).

Our main research questions are as follows: First, what are the semantic functions of the two types of modalized question markers in an embedded clause? Second, what does it tell us about the universality and variation of the subjunctive phenomena across Korean and other languages? Given these questions, we want to explore the empirical dimension and show the crosslinguistically extended paradigm of the subjunctive mood. In particular, we argue first that Korean employs distinct types of Q-markers in an embedded clause: As an ordinary Q-marker, *(n)ci* forms a typical interrogative. As MQ-markers, which can be analyzed as an instance of inquisitive disjunction as shown in Section 3, *nka* and *lkka* give rise to an inquisitive subjunctive.

(8) Subtypes of the Korean Q-marker in an embedded clause:
   a. Typical interrogative: *(n)ci*
   b. Inquisitive subjunctive: *nka, lkka*

Second, as clarified in Section 2, assuming that inquisitive subjunctive markers combine with nonveridical predicates (Lahiri 2002; Égré & Spector 2007; Uegaki 2015; Theiler & Roelofsen & Aloni 2018), we show how the semantic role of inquisitive subjunctive in Korean can be captured under the general theory of nonveridicality.

The paper proceeds as follows: In Section 2, we discuss the core properties of *nka* and *lkka* by observing what types of attitude predicates they take. In Section 3, to show the status of inquisitive subjunctive, we offer a critical review on theories of modalized questions. In Section 4, we present the interaction between inquisitiveness and nonveridicality. We conclude in Section 5 with theoretical implications.

2 Empirical observation: Distributional restriction on attitude predicates in Korean

Before jumping into the main discussion, we briefly discuss the types of attitude predicates that subjunctive complementizers take. Building on Lahiri (2002), we assume a classification of embedding predicates into rogative and responsive predicates as shown in (9).

(9) Predicates that take embedded complements

- Rogative
  wonder, ask, investigate
- Responsive
  - Veridical
    know, remember, forget
  - Nonveridical
    be certain, conjecture about

A rogative verb only takes an interrogative complement, whereas a responsive verb takes both declarative and interrogative complements. The responsive predicates are further subcategorized into veridical responsive and nonveridical responsive. The following examples show the case of veridical responsive 'know' (10) and nonveridical responsive 'be certain' (11):

(10) a. John knows who called.
b. John knows that Mary called.

(11) a. John is certain who called.
b. John is certain that Mary called.

Following Spector & Égré (2015) and Theiler & Roelofsen & Aloni (2018), we assume that responsive predicates express a relation between an attitude holder and a proposition which is an answer to the embedded question. In other words, veridical responsive predicates express a relation between the attitude holder and the proposition that is the actual answer to the embedded question. On the other hand, nonveridical responsive predicates express a relation between an attitude holder and a proposition that is simply a potential answer to the embedded question. Accordingly, the sentence (10a) is true if and only if John knows who called (i.e., 'Mary called'), which is the true answer of the declarative complement in (10b). On the other hand, for the case of the nonveridical predicate in (11a), the same inference cannot be applied. The sentence is true in those worlds in which the attitude holder considers it possible that Mary called. Accordingly, the sentence (11a) is true if and only if John is certain who called, where 'Mary called' was one possibility. As a result, (10a) entails that John's knowledge corresponds to actuality as to who called, whereas (11a) is true even if John believes that Mary called while in fact it was not the case.

Now let us examine Korean data. Traditionally, the declarative suffix *tako* and the interrogative suffix *(n)ci* on the embedded verb have been known to form a split morpho-syntactic system corresponding to English *that* and *whether*, respectively. Just like English complementizers, *tako* and *(n)ci* exhibit complementary distribution with regard to matrix predicates in terms of Lahiri's typology. As shown below, *tako* can take the anti-rogative predicate *mit* 'believe' in (12), whereas it cannot combine with the rogative predicate *kwungkumha* 'wonder' in (13):

(12) Anti-rogative: 'believe'

a. *Mina-nun Inho-ka pathi-ey o-n.**tako** mit-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-that believe-PST-DECL
'Mina believed that Inho is coming to the party.'

b. #*Mina-nun Inho-ka pathi-ey o-nu.**nci** mit-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-Q believe-PST-DECL
'(lit.) #Mina believed whether Inho would come to the party.'

(13) Rogative (inquisitive): 'wonder'

a. #*Mina-nun Inho-ka pathi-ey o-n.**tako***
Mina-TOP Inho-NOM party-LOC come-Q
kwungkumhay-hayss-ta.
wonder-PST-DECL
'(lit.) #Mina wondered that Inho would come to the party.'

b. *Mina-nun Inho-ka pathi-ey o-nu.**nci***
Mina-TOP Inho-NOM party-LOC come-Q
kwungkumhay-hayss-ta.
wonder-PST-DECL
'Mina wondered whether Inho would come to the party.'

Likewise, in (15), the MQ-marker *nka/lkka* can appear with the rogative verb *kwungkumha* 'wonder' whereas they exhibit distributional restriction in that they never co-occur with the anti-rogative verb in (14):

(14) Anti-rogative: 'believe'

a. #*Mina-nun Inho-ka pathi-ey o-nu.**nka** mit-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ believe-PST-DECL
'(lit.) #Mina believed if Inho might come to the party.'

b. *#Mina-nun Inho-ka pathi-ey o-**lkka** mit-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ believe-PST-DECL
'(lit.) #Mina believed if Inho might come to the party.'

(15) Rogative (inquisitive): 'wonder'

a. *Mina-nun Inho-ka pathi-ey o-nu.**nka***
Mina-TOP Inho-NOM party-LOC come-MQ
kwungkumhy-hayss-ta.
wonder-PST-DECL
'Mina wondered if Inho might come to the party.'

b. *Mina-nun Inho-ka pathi-ey o-**lkka***
Mina-TOP Inho-NOM party-LKKA come-MQ
kwungkumhy-hayss-ta.
wonder-PST-DECL
'Mina wondered if Inho might come to the party.'

However, *nka* and *lkka* reveal a huge contrast in the distributional restriction of responsive verbs from the typical interrogative *(n)ci*. First, *(n)ci* and *nka/lkka* exhibit distinct distributional restrictions in crucial aspects in the sense that, unlike *(n)ci*, *nka* and *lkka* never co-occur with factive verbs and epistemic certainty-inducing verbs. They thus never combine with veridical responsive predicates such as *a(l)* 'know' and nonveridical epistemic *hwaksinha* 'be certain.' Accordingly, *tako* and *(n)ci* co-occur with the veridical responsive factive verb *a(l)* 'know' in (16a-b), which implies that the subject Mina knows the true answer to 'is Inho coming to the party?'. On the other hand, *lkka* or *nka* cannot take veridical responsive predicates, as in (16c-d).

(16) Veridical responsive: 'know'

a. *Mina-nun Inho-ka pathi-ey o-n.**tako** al-ko.iss-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-Q know-ASP-DECL
'Mina knew that Inho would come to the party.'

b. *Mina-nun Inho-ka pathi-ey o-nu.**nci** al-ko.iss-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-Q know-ASP-DECL
'Mina knew whether Inho would come to the party.'

c. *#Mina-nun Inho-ka pathi-ey o-nu.**nka** al-ko.iss-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ know-PST-DECL

‘(lit.) Mina knew if Inho might come to the party.’

d. #*Mina-nun Inho-ka pathi-ey o-**lkka** al-ko.iss-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ know-PST-DECL
‘(lit.) Mina knew if Inho might come to the party.’

Likewise, *tako* in (17a) and *(n)ci* in (17b) are compatible with the nonveridical responsive predicate *hwaksinha* ‘be certain’. On the other hand, the *nka/lkka*-clause cannot take the nonveridical responsive predicate in (17c-d).[2]

(17) Nonveridical responsive (epistemic): ‘be certain’

a. *Mina-nun Inho-ka pathi-ey o-n.**tako** hwaksinha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q be.certain-ASP-DECL
‘Mina was certain that Inho would come to the party.’

b. ?*Mina-nun Inho-ka pathi-ey o-nu.**nci** hwaksinha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q be.certain-ASP-DECL
‘(lit.) Mina was certain whether Inho would come to the party.’

c. #*Mina-nun Inho-ka pathi-ey o-nu.**nka***
Mina-TOP Inho-NOM party-LOC come-MQ
hwaksinha-ess-ta.
be.certain-PST-DECL
‘(lit.) Mina was certain if Inho might come to the party.’

d. #*Mina-nun Inho-ka pathi-ey o-**lkka***
Mina-TOP Inho-NOM party-LOC come-MQ
hwaksinha-ess-ta.
be.certain-PST-DECL
‘(lit.) Mina was certain if Inho might come to the party.’

Another important feature in combining with nonveridical responsive predicates is that *nka* and *lkka* exhibit mood flexibility. The most interesting property of *nka* and *lkka* is shown in the case where they co-occur with polysemous verbs such as *siph*, which has four different meanings, namely ‘want, believe, hope, intend’, as illustrated in (18).

[2] As a reviewer pointed out, the occurrence of *(n)ci* with *hwaksinha* ‘be certain’ is felicitous if the sentence is negative, as in “Mary was not certain (or uncertain) whether Inho would come to the party.” Even in the negative sentence, *nka* and *lkka* cannot combine with *hwaksinha* ‘be certain.’

(18) Nonveridical responsive: *siph* 'want; believe; hope; intend'

a. *ppang-ul mek-ko siph-ta.*
bread-ACC eat-that want-DECL
'I want to eat bread.'

b. *Inho-ka o-lkka siph-ta.*
Inho-NOM come-MQ think/believe-DECL
'I am doubt if Inho might come.'
≈ 'I am uncertain whether Inho will com to the party (although it is unlikely to happen).'

c. *ilccik ca-ss-umeyn siph-ta.*
early sleep-PST-if hope-DECL
'I hope to sleep early.'

d. *cip-ey ka-lkka siph-ta.*
home-LOC go-MQ intend-DECL
'I intend to go home.'

Tako and *(n)ci* are not compatible with *siph*, as shown in (19a-b). When *nka* and *lkka* combine with the polysemous verb *siph* that has four potential interpretations, a doxastic meaning is chosen; a conjectural reading (i.e., 'believe but not know') arises with *nka* in (19c) while a dubitative reading arises with *lkka* in (19d). Here the dubitative meaning is achieved by the addition of presupposition of unlikelihood on the conjectural interpretation. In so doing, the speaker expresses her non-commitment to the truth of the propositional content, which is the main function of the subjunctive.

(19) Context: Kim asks Mina if Inho is coming to the party. With uncertainty, Mina says:

a. *#Mina-nun Inho-ka pathi-ey o-n.**tako** siph-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-that believe-PST-DECL
'(intended) Mina was uncertain that Inho would come to the party.'

b. *#Mina-nun Inho-ka pathi-ey o-nu.**nci** siph-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-Q believe-PST-DECL
'(intended) Mina was uncertain whether Inho would come to the party.'

c. *Mina-nun Inho-ka pathi-ey o-nu.**nka** siph-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ believe-PST-DECL
'Mina was **uncertain** if Inho would come to the party.'

d. *Mina-nun Inho-ka pathi-ey o-**lkka** siph-ess-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ believe-PST-DECL
'Mina **doubt** that Inho would come to the party.'
≈ 'Mina was **uncertain** if Inho would come to the party (although it is unlikely to happen).'

Further empirical evidence to support this comes from the fact that the emotive and desire reading is only available for *lkka*. In (20), by combining with *twulyewoha* 'fear', *lkka* manifests an unfortunate possibility which will be realized.

(20) Emotive: 'fear'

a. *#Mina-nun Inho-ka pathi-ey o-n.**tako** twulyewohay-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q fear-PST-DECL
'(lit.) #Mina feared that Inho will come to the party.'

b. *#Mina-nun Inho-ka pathi-ey o-nu.**nci** twulyewohay-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q fear-PST-DECL
'(lit.) #Mina feared whether Inho will come to the party.'

c. *#Mina-nun Inho-ka pathi-ey o-nu.**nka***
Mina-TOP Inho-NOM party-LOC come-MQ
twulyewohay-ss-ta.
fear-PST-DECL
'(lit.) #Mina feared whether Inho will come to the party.'

d. *Mina-nun Inho-ka pathi-ey o-**lkka** twulyewohay-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ fear-PST-DECL
'Mina feared if Inho might come to the party.'

In (21), by combing with *kitayha* 'hope', *lkka* also manifests a fortunate possibility which will be realized.

(21) Desire: 'hope'

a. *#Mina-nun Inho-ka pathi-ey o-n.**tako** kitayha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q hope-PST-DECL
'(lit.) #Mina hoped that Inho will come to the party.'

b. #*Mina-nun Inho-ka pathi-ey o-nu.**nci** kitayha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-Q hope-PST-DECL
'(lit.) #Mina hoped whether Inho will come to the party.'

c. #*Mina-nun Inho-ka pathi-ey o-nu.**nka** kitayha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ hope-PST-DECL
'(lit.) #Mina hoped whether Inho will come to the party.'

d. *Mina-nun Inho-ka pathi-ey o-**lkka** kitayha-ss-ta.*
Mina-TOP Inho-NOM party-LOC come-MQ hope-PST-DECL
'Mina hoped if Inho might come to the party.'

Table 1 below summarizes the co-occurrence patterns of the various types of attitude predicates and different types of affixes we observed above.

Attitude predicates		*tako*	*(n)ci*	*nka*	*lkka*
Anti-rogative	*mit* 'believe'		*	*	*
Rogative	*kwungkumha* 'wonder'	*			
Veridical responsive	*al* 'know'			*	*
Nonveridical responsive	*hwaksinha* 'be certain'		?	*	*
	siph 'want/believe/ hope/intend'	'want'	*	'conjecture'	'doubt'
Emotive	*twulyewoha* 'fear'	*	*	*	
Desire	*kitayha* 'hope'	*	*	*	

Table 1 The co-occurrence patterns of attitude predicates and clausal affixes

Summing up, the inquisitive subjunctive in Korean makes the following crucial distinctions. First, *(n)ci*, *nka* and *lkka* all share the property that they do not combine with anti-rogative predicates. Second, as markers of the inquisitive subjunctive, *nka* and *lkka* cannot co-occur with veridical responsive predicates. Third, when combining with a nonveridical responsive (epistemic uncertainty), *nka* yields a conjecture reading whereas *lkka* gives rise to a doubt reading. Fourth, emotive and desire verbs such as the verb 'fear' and 'hope' select for *lkka* only. In the next section, we will see the behavior of *nka* and *lkka* when they are in an unembedded clause.

3 Modalized Question: The role of the inquisitive subjunctive in an unembedded clause

In unembedded clauses, the main role of *lkka* and *nka* is to mark a modalized question (MQ). In this section, we briefly introduce the core properties of MQs as proposed in Kang & Yoon (2019, 2020).

3.1 Epistemic modality

The first characteristic of a MQ is that it has the flavor of an epistemic modal. Kang & Yoon (2019a, 2019b, 2020) took the MQ as a question about the possibility of the proposition.[3] Unlike the ordinary information-seeking questions whose goal is to receive a true answer from the hearer (Hamblin 1973; Karttunen 1977; Groenendijk & Stokhof 1984), MQs are used to express the speaker's epistemic uncertainty or conjecture on the given propositional content. The examples in (22) show the meaning difference between MQs and regular questions. In (22a-b), we can infer from the MQ-markers *nka* and *lkka* that the speaker, John, considers that 'today is Friday' has a good possibility of being true, while considering the possibility that it is false at the same time. It contrasts with the ordinary question marker *ni* in (22c) which lacks such a conjecture:

(22) Context: John is not sure whether today is Friday or not. With uncertainty, John says (to himself):

a. *onul-i* *kumyoil-i-**nka**?*
today-NOM Friday-be-MQ
'Maybe today is Friday, maybe not?' [MQ]

b. *onul-i* *kumyoil-i-**lkka**?*
today-NOM Friday-be-MQ
'Might today be Friday? (although it is unlikely to be).' [MQ]

c. #*onul-i* *kumyoil-i-**ni**?*
today-NOM Friday-be-Q
'Is today Friday?' [Regular Q]

A MQ questions the speaker's belief and knowledge, and reports on the

[3] Previous studies have examined this type of question under various labels; they are *self-addressing questions* (Hara & Davis 2013), *conjectural questions* (Matthewson 2010; Eckardt 2020), *subjunctive questions* (Giannakidou 2016).

consideration of a set of alternatives. By uttering MQs, the speaker expresses her weak commitment to the possibility of propositional content (Kang & Yoon 2020: 233, (51)):

(23) $[\![\text{MQ}]\!] = [\![\text{that it is possible that } p]\!] \cap [\![\text{that it is not possible that } p]\!]$

The semantic meaning proposed above in (23) shows how a MQ expresses the speaker's perspective towards *p* by achieving a medium possibility in the modal base characterized as an equipoised epistemic space (i.e., *nonveridical equilibrium* in Kang & Yoon 2020).

3.2 Inquisitive disjunction

The second characteristic of *nka* and *lkka* is that they are instances of inquisitive disjunction. Under the framework of Inquisitive Semantics (Groenendijk & Roelofsen 2009; Ciardelli & Groenendijk & Roelofsen 2019, a.o.), the core function of questions and disjunctions is to contribute issues to discourse. When interlocutors engage in conversation, the conversational effect of informativeness and inquisitiveness arises. The declarative sentence yields informativeness, whereas interrogatives or declaratives with disjunctions give rise to inquisitiveness. When the speaker utters an informative sentence, she provides the information that at least one of the states in *p* must be compatible with the actual state. When the speaker utters an inquisitive sentence, the proposition embodies a proposal to update the common ground in one or more ways. In other words, disjunction and questions share the property of inquisitiveness in that they both raise an issue by presenting a set of alternatives and demanding that one of them be chosen. The common ground should be enhanced where one of these states is reached. The definition of inquisitiveness and informativeness is as follows:

(24) Inquisitiveness in terms of possibilities (Groenendijk & Roelofsen 2009: Definition 9):
   a. φ is inquisitive in σ iff there are at least two possibilities of ϕ in σ;
   b. φ is informative in σ iff there is a possibility for φ in σ and a possibility is excluded by φ in σ.

The notion of inquisitiveness provides a fundamental explanation of the interrogative-disjunctive affinity in natural languages (AnderBois 2012; Slade 2011; Szabolcsi 2015, a.o.). Likewise, in Korean, the MQ markers *nka* and *lkka* exhibit an interrogative-disjunction affinity as illustrated in (25).

(25) Context: John knows there is a possibility that today is Friday or Thursday, but he is very uncertain about his inference. John says (to himself):

a. *onul-un mokyoil-**inka** kumyoil-i-ta*
today-TOP Thursday-DISJ Friday-be-DECL
'Today is maybe Thursday or Friday (I don't know which).'

b. *onul-i kumyoil-i-**nka**/**lkka**? mokyoil-**nka**/**lkka**?*
today-NOM Thursday-be-MQ Friday-be-MQ
'Maybe today is Friday, or maybe Thursday? (I don't know which)'

Given that the function of (*i*)*nka* in (25a) is that of a disjunction marker without overt modals (Zimmerman 2001; Geurts 2005) and the function of *nka* in (25b) is that of a MQ marker, they are inquisitive operators. In terms of Inquisitive Semantics, the semantico-pragmatic contribution of *nka* in (25a) and (25b) is the same in that it functions as a join operation of two alternatives. Similarly, *lkka* in (25b) gives rise to an inquisitive interpretation because it is inherently treated as an inquisitive component. Accordingly, MQs in Korean can be analyzed as inquisitive disjunctions, which predicts the common semantic denominator of the disjunction and the questions.

4 Interaction between inquisitiveness and nonveridicality

We propose that the addition of *nka* or *lkka* in an embedded clause produces a weakening, nonveridicality effect, which specifies the degree of certainty about the proposition in the embedded question and gives rise to epistemic uncertainty or doubt interpretation. The inquisitive subjunctive in Korean expresses the speaker's perspective towards *p* by achieving a partition in the modal base, as defined in (26).

(26) Licensing condition for the subjunctive mood in Korean:
The subjunctive is licensed in the complement of attitude predicates that express a relation to *the potential answers.*

Given that the semantics of embedded questions comprises all potential answers, the employment of an inquisitive subjunctive introduces both positive and negative possibilities of p or $\neg p$. If the speaker chooses *nka* or *lkka*, she expresses her weak commitment to the possibility of propositional content, as illustrated in (27).

(27) a. *Mina-nun Inho-ka pathi-ey o.nu-**nka**/o-**lkka***
Mina-TOP Inho-NOM party-LOC come-MQ
siph-ess-ta.
believe-PST-DECL
'Mina is uncertain whether Inho might come to the party.'

b. (27a) is true iff Mina believes p, where p is a potential answer to 'will Inho come to the party?' & Mina is undecided as to where the actual world is on the possible answer sets (epistemic uncertainty)

Despite their overall similarities as MQ markers, *nka* and *lkka* differ from each other since the latter involves a strong irrealis mood with the non-actualizations (i.e. the realm of the unrealized), which makes two crucial differences.

The examples in (28) show significant meaning differences between hypothetical and counterfactual MQs. As shown below, while we can infer from the hypothetical MQ-marker *nka* in (28a) that the speaker, John, considers that 'today is Friday' has an equal possibility of being true and false at the same time, the counterfactual MQ-marker *lkka* in (28b) marks a low possibility.

(28) Context: John is not sure whether today is Friday or not. With uncertainty, John says (to himself):

a. *onul-i kumyoil-i-**nka**?*
today-NOM Friday-be-MQ
'Maybe today is Friday, maybe not? (I don't know which)'

b. *onul-i kumyoil-i-**lkka**?*
today-NOM Friday-be-MQ
'Might today be Friday? (although it is unlikely to be)'

Further, unlike *nka* (29a), *lkka* can presuppose a counterfactual possibility in an unembedded clause as in (29b).

(29) Context: Although John is aware that Santa Clause does not exist in the real world, he wonders how old Santa would be if he exists. John says (to himself):

a. #*Santa-ka issta-myen, myech-sal-i-**nka**?*
Santa-NOM exist-if what-age-be-MQ
'How old might Santa Clause be if he exists?'

b. *Santa-ka issta-myen, myech-sal-i-**lkka**?*
Santa-NOM exist-if what-age-be-MQ
'How old might Santa Clause be if he exists?'

In the counterfactual context in which Santa exists, only *lkka* in (29b) can be felicitously uttered. This shows that only *lkka* can form a counterfactual inquiry.

Another crucial difference between *nka* and *lkka* comes from the fact that only *lkka* is compatible with expletive negation (EN, a.k.a. evaluative negation, pleonastic negation, vacuous negation) while *nka* is not (Yoon 2011, 2013), as illustrated in (30). When combined with EN, the meaning of *lkka* in emotive predicates is akin to *lest* in English.

(30) a. *Inho-ka pathi-ey*
Inho-NOM party-LOC
*{*o-ci-anh-nu.**nka**/o-ci-anh-u.**lkka**}*
come-COMP-EXPL.NEG-MQ/come-COMP-EXPL.NEG-MQ
siph-e.
believe-DECL
'I conjecture that Inho might come to the party (although it is unlikely to happen).'

b. *Inho-ka pathi-ey*
Inho-NOM party-LOC
*{*o-ci-anh-nu.**nka**/o-ci-anh-u.**lkka**}*
come-COMP-EXPL.NEG-MQ/come-COMP-EXPL.NEG-MQ
twulyewo-e.
fear-DECL
'I fear lest Inho might come to the party (although it is undesir-

able to happen).'

Yoon (2011, 2013) suggests a unified analysis of EN at the pragmatic-semantic interface that can capture the nature of EN across linguistic contexts and languages. In particular, she argues that the main contribution of EN is to mark a scalar meaning of undesirability or unlikelihood, and the modal base of scale varies depending on the context or the epistemic subject's emotional state, which can be reflected in the tone of voice, for example.

Given this meaning of EN, we can understand why only the low-likelihood or counterfactual *lkka* is compatible with EN, while the medium-likelihood or pure hypothetical *nka* is odd. The dual marking of the low-likelihood or counterfactuality by the combination of *lkka* and EN seems to have a strengthening effect on the undesirability or unlikelihood.

5 Conclusion and implications

In this paper, we showed that there are three distinct mechanisms within Korean and Indo-European subjunctive marking: First, Korean subjunctive can be formally marked at the level of an inquisitive subordinator C. Second, it exhibits rather flexible distributions with respect to the selection by attitude predicates. Third, subjunctive marking has the semantic contribution of commitment weakening rather than merely reflecting modal properties.

Theoretical implication of the current analysis includes the fact that we identify a novel type of subjunctive mood markers that falls under the realm of inquisitiveness. Our empirical findings imply that the tight connection between inquisitiveness, subjunctive, and polarity can be incorporated within a unified perspective of nonveridicality.

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Reverse Sobel sequences: What is being cancelled here?

David Krassnig

Abstract In this paper, we show that an account centred around modal subordination and contrastive topic may account for most if not all of the known data on reverse Sobel sequence felicity. We show that contrastive stress in rSSs often targets the auxiliary verb and that, in doing so, we actually target the tense-aspect-mood information that is encoded by it. By treating tense-aspect-mood as a type of bound pro-form, adopting the pro-form semantics of Jacobson (2000; 2004), we show that, in doing so, we are actually trying to contrast the two conditionals' domains of quantification. As such, the contrastive topic is successful iff the two domains are disjoint, preventing a modally subordinate reading, allowing for the possibility of reverse Sobel sequence felicity.

Keywords conditionals · reverse Sobel sequence · contrastive stress · topic

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1 Introduction

Sobel sequences (SS) and reverse SS (rSS) play a pivotal role in the debate on how the meaning of conditionals should be modelled. Attributed to Sobel (1970), SSs refer to conditional sequences that adhere to the pattern of 'If φ, χ; but if φ and ψ, not χ'. Their standard example is provided in (1).

(1) If the USA threw its weapons into the sea tomorrow, there would be war; but if the USA and the other nuclear powers all threw their weapons into the sea tomorrow, there would be peace. (D. K. Lewis 1973: 10)

For (1), φ refers to the US throwing its weapons into the sea, and ψ refers to all other nuclear powers throwing their weapons into the sea, thereby covertly adhering to the form of SSs despite of its seeming overt deviance.

The variably-strict approach to conditionals, as started off by Stalnaker (1968) and D. K. Lewis (1973), argues that the validity of such SSs rules out the possibility of the conservative strict approach to conditionals, as it was originally put forth by C. I. Lewis (1912; 1914; 1918): He argued that 'If φ, χ' was true iff the respective material implicature holds true for all possible worlds, as defined in (2) using the modal logic semantics of Kripke (1963):

(2) $[\![\text{If } \varphi, \chi.]\!]^g = \Box(\phi \rightarrow \chi)$

Using (2), we would predict SSs to be contradictory, as we make two opposing claims regarding χ for all φ∧ψ-worlds: The φ-conditional claims that all φ-world are χ-worlds (which incldudes all φ∧ψ-worlds). The subsequent φ∧ψ-conditional then claims that all φ∧ψ-worlds are, in fact, not χ-worlds.

Instead of quantifying over all possible worlds, D. K. Lewis (1973) argued that conditionals only quantify over a subset of worlds: Specifically, he argued that 'If φ, χ' is true iff the consequent χ is true in all antecedent worlds that are maximally close to the evaluation world. World closeness is defined via world similarity: The more deviances are introduced to some world w in comparison to some evaluation world w_0, the less similar and therefore less close w is considered to be to w_0. This way, a world similarity ordering is created where all worlds are ranked in accordance to their respective world similarity values in relation to the central evaluation world. This ordering is visualised in Figure 1.

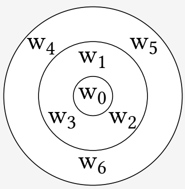

Figure 1 Similarity ordering with respect to some evaluation world w_0, where the worlds are ordered as follows: $w_0 < w_1, w_2, w_3 < w_4, w_5, w_6$.

This variably-strict definition is formalised in (3), where the accessibility function $f_{\leqslant}(\phi, w_0)$ returns the set of φ-worlds that are closest to w_0.

(3) $[\![\text{If } \varphi, \chi]\!]^g = [\lambda w_s.\forall v : v \in f_{\leqslant}([\lambda w'_s.\phi(w')], w)[\chi(v)]]$

Using (3), a SS would no longer result in contradictory claims: Assuming that φ and ψ each introduce a change to their respective worlds in comparison to w_0, the φ-conditional and the φ∧ψ-conditional quantify over two sets of worlds that are unequal in world closeness and therefore disjoint to one another. This is visualised in Figure 2.

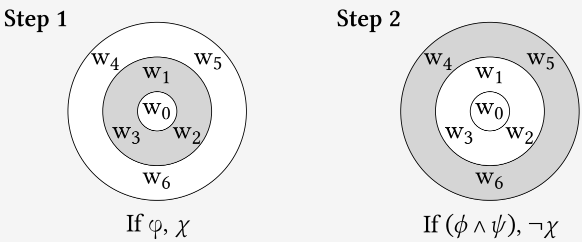

Figure 2 Domains of quantification according to a variably-strict semantics.

As the variably-strict semantics is insensitive to discourse order, the traditional variably-strict approach would predict that SSs should be fundamentally reversible. However, Heim (1994) noted that rSSs are actually infelicitous by default, as exemplified by (4).

(4) If the USA and the other nuclear powers all threw their weapons into the sea tomorrow, there would be peace; #but if the USA threw its weapons into the sea tomorrow, there would be war. (Heim 1994)

The infelicity of rSSs is so prevalent that it gave rise to the (semi-)dynamic strict approach to conditionals (von Fintel 2001; Gillies 2007) which was designed such that SSs are optionally felicitous and rSSs obligatorily infelicitous. However, the discovery of felicitous rSSs by Moss (2012), such as the one in (5), caused a return to the more permissive variably-strict approach.

(5) *Holding up a dry match, with no water around.*
If I had struck this match and it had been soaked, it would not have lit. But if I had struck this match, it would have lit.
(adapted from Stalnaker (1968: 106) by K. Lewis (2018: 487))

To then account for the infelicity of the majority of rSSs, pragmatic components were added on top of the conditional semantics such that they selectively rule out some but not all rSSs. Moss (2012) proposed that said additional pragmatic mechanism corresponds to the principle of epistemic irresponsibility. Later, other possible mechanisms were proposed, such as: imprecision and precisification (Klecha 2015; Krassnig 2020), modal subordination between conditionals (Klecha 2015; Krassnig 2020), the need for contrastive stress in the second antecedent (Klecha 2015; Krassnig 2020), a relevance-based dynamic world closeness ordering (K. Lewis 2018), and a specificity-constraint-based approach (Ippolito 2020).

In this paper, we formalise the contrast-based account briefly sketched out by Krassnig (2020), providing a unified explanation for the infelicity of rSSs via the interaction between contrastive stress, modal subordination, and the world closeness ordering—and how the latter is impacted by a number of factors. To this end, we detail the empirical factors that influence the felicity of rSS in Section 2, using this information to incrementally build up a formal account in the same section, starting in Section 2.1.2.

2 Creating a model for (reverse) Sobel sequences

The current main issue surrounding rSSs is which factors actually influence rSS (in)felicity. To this end, multiple factors have been identified: (i) contrastive stress in the antecedent of the φ-conditional is one of the main sources of rSS felicity (Klecha 2015; Krassnig 2020); (ii) contrastive stress is often placed on the auxiliary verb when no other suitably contrastable item is present (Krassnig 2020); (iii) causal links between φ and ψ typically reduce the acceptability of rSS (Klecha 2014; 2015); (iv) non-counterfactuality reduces the acceptability of rSS; and (v) rSS are generally felicitous whenever the possibility of ψ is sufficiently dismissible (Moss 2012)—either by context or by an interjection in between the rSS's conditionals. We provide empirical data for each data point in subsequent subsections.

The typical felicity distribution for (r)SS is summarised in Table 1. In this

Table 1 Felicity distribution for (r)SSs, broken down by causality, counterfactuality, and whether or not the possibility of ψ was dismissed. Contrastive stress is assumed on the auxiliary verb for all sequences.

	Acausal				Causal			
	Non-Counterfactual		Counterfactual		Non-Counterfactual		Counterfactual	
	Not Dismissed	Dismissed	Not Dismissed	Dismissed	Not Dismissed	Dismissed	Not Dismissed	Dismissed
SS	✓	N/A	✓	N/A	✓	N/A	✓	N/A
rSS	#	✓	✓	✓	#	✓	#	✓

section, we successively deal with each felicity factor on an empirical as well as on a model-theoretical level. To this end, we start off with contrastive stress in Section 2.1, using the insights gained here to construct the fundamentals of our rSS model, using acausal counterfactual rSS as a basis. We then show in Section 2.3 how a causal link between φ and ψ degrades the acceptability of rSS and how our model can naturally account for this effect. In Section 2.4, we then show how non-counterfactuality has essentially the same effect as causal links in the antecedent, and extend our account from Section 2.3 to account for these cases as well. Finally, in Section 2.5, we show how the (responsible) dismissal of ψ as an epistemic possibility virtually ensures rSS felicity regardless of causality or non-counterfactuality and show that this naturally follows from our account.

2.1 Contrastive stress in the antecedent

Klecha (2015: 134) has argued that rSSs may only be felicitous if their respective antecedents are contrastively stressed against one another. To exemplify this, he put forth and contrasted the two examples (6) and (7).

(6) *On a construction site, a steel beam fell to a spot close to Daryl, who was not wearing a helmet and who is being addressed by Ida and Aaron.*
  a. *Ida:* If you had been standing there and wearing a helmet, you wouldn't have been killed.
  b. *Aaron:* #But if you had been standing there, you would have been killed. (Klecha 2015: 133)

(7) *Karlos is known for being fun at parties, but his house is small & smelly.*
  a. *Ben:* If Karlos had hosted the party, it would not have been a good time.
  b. *Martina:* But if Karlos had COME to the party, it would have been a good time. (Klecha 2015: 134)

Klecha (2015) argued that (6) may be infelicitous because the antecedent of the φ-conditional is a syntactic subset of the preceding φ∧ψ-conditional: It therefore does not have an overtly different lexical item in its antecedent to contrastively stress. He argued that (7) is felicitous partly because *come* can be contrastively stressed against *hosted*.[1]

While we agree with Klecha (2015) that contrastive stress is generally a

[1]It should be noted that (7) is a rSS in a manner similar to the nuclear powers example in (4); i.e., it covertly adheres to the rSS pattern. In this case, Klecha (2014: 151) argued that *to host a party* entails *to come to a party*. Therefore, the ψ-conditional is also a *ϕ∧ψ*-conditional.

felicity-enabling factor, there appears to be more to the story: Von Fintel (2001) has already pointed out examples where there is an overtly different lexical item in the second antecedent, but where contrastive stress does not yield a felicitous rSS, as shown in (8).

(8) a. If I ran really fast to the store, it might still be open.
b. #But if I WENT to the store, it would be closed by the time I got there. (von Fintel 2001: 146)

Furthermore, Krassnig (2017: 328) pointed out that some rSSs such as (5) serve as a counterexample to the assumption of Klecha (2015) that contrastive stress requires an overtly different lexical item in the second antecedent. In fact, Krassnig (2020: 459ff) pointed out that the contrastive stress typically falls upon the auxiliary verb for all felicitous rSSs that do not carry an overtly different lexical item in the second antecedent—though the required force of the contrastive stress as well as an optional emphatic stress on *would*[2] appears to be subject to speaker variance. We show such a contrastively stressed rSS in (9), where we modified (5) to show which item is actually contrastively stressed.

(9) *Holding up a dry match, with no water around.*
If I had struck this match and it had been soaked, it would not have lit.
a. #But if I had struck this match, it would have lit.
b. But if I HAD struck this match, it would have lit.

Here, the majority (n=7) of native speakers we have consulted (n=12) considered (9a) to be infelicitous when pronounced entirely without any contrastive inflection whatsoever, but considered the conditional in (9b) to be felicitous (though with varying degrees of acceptability). However, a minority of the native speakers we consulted considered both variants to be similarly degraded (n=3). Opposite to this, another minority considered some rSSs to be felicitous even without (self-reported) contrastive stress (n=2). These rSSs, however, required other atypical properties such as interjections in between the rSS's conditionals, like the ones we show in Section 2.5.

[2] As this appears to be an optional stress, we do not take this further into account in this paper. We leave that open to future research.

The general intuitive effect of contrastive stress in rSS appears to be as follows: By contrastively stressing an overtly different lexical item or the auxiliary verb in the second antecedent, we indicate that ψ no longer needs to be taken into account. In other words, we indicate that, given our world knowledge at this time, ψ should not follow from the assumption of φ and that ψ is not anticipated to occur independent of φ. Using (9b) as an example, the speaker uses contrastive stress to indicate that we can dismiss the possibility of the match being wet because we can currently observe the fact that the match being held up is, in fact, dry.[3]

But why would this need to be actively indicated? After all, the variably-strict approach itself is not affected by order and the disjoint nature of the worlds considered should be self-evident, as previously shown in Figure 2. We provide an explanation for this in Section 2.1.1, where we show why rSSs without contrastive stress are routinely infelicitous. This is followed by Section 2.1.2, where we explain why contrastive stress is typically required and how it helps us escape the infelicity-deriving mechanism shown in S 2.1.1. Finally, in S 2.1.3 we show why contrastive stress may be placed upon the auxiliary verb, what effect this has, and which factors determine its success in rendering the rSS felicitous.

2.1.1 Why are rSSs routinely infelicitous?

It is a well-known fact that *would* is sensitive to modal subordination, as demonstrated by (10), where the speaker's family's driving through Ontario is anchored to the preceding sentence's context of going to Albion.

(10) My family used to go to Albion. We would drive through Ontario. (Klecha 2011: 378)

This would naturally extend to conditionals that make use of *would* as well. However, not all conditionals make use of modal subordination. We show this in (11), where most people would not use modal subordination.

(11) If John had killed his boss, he would've spent his summer in prison; but if John had won the lottery, he would've gone on a cruise around the world.

[3]Here, we wish to note that this intuitive effect of the contrastive stress has been confirmed by a number of native speakers—with whom we share this intuition.

However, many conditionals are read with modal subordination such that the antecedental content of a preceding φ-conditional is covertly adjoined to a subsequent ψ-conditional. This way, the latter is interpreted as a $\varphi\wedge\psi$-conditional, as shown in (12a). Crucially, this is done even when modal subordination would actively render an otherwise felicitous sequence infelicitous, as shown in (12b).

(12) *John is married to Mary. He is a good liar and a flirt. Mary always suspected him of cheating and once contemplated hiring a very competent private investigator but ultimately decided against it. However, John has never actually cheated on Mary, unbeknownst to her.*

a. If John had cheated on Mary, she would've never found out about it; but if she had hired the private investigator, he would have brought her evidence of John's cheating.

b. If John had cheated on Mary, she would've never found out about it; ??but if she had hired the private investigator, he would have told her that John didn't cheat on her.

We argue that this is the main source of rSS infelicity: rSSs are especially prone to being subjected to modal subordination and the φ-conditionals of rSSs thereby routinely become covert $\varphi\wedge\psi$-conditionals. This results in contradictory claims with regards to the status of χ in the closest $\varphi\wedge\psi$-worlds, leading to infelicity. It should be noted that this occurs even if the closest φ-worlds would have been a disjoint set of worlds from the closest $\varphi\wedge\psi$-worlds according to a variably-strict semantics (Klecha 2015: 134).

But why are rSSs especially prone to modal subordination? To motivate this, we need to determine when conditionals become modally subordinate and when they do not—and why rSSs always seem to satisfy the conditions required for modal subordination. Here, we would argue that conditionals are modally subordinated to a preceding conditional's antecedent whenever the two antecedents can be construed to be topically related: E.g., in (11), there is no clear reason why killing one's boss and winning the lottery would be part of a single discourse topic centred around the first conditional: killing ones boss and winning the lottery are seldom connected by our world knowledge and expectations.

In (12), however, this topical connection is far more easily established. The antecedents of conditionals typically establish the current aboutness topic of their sentence (Ebert & Ebert & Hinterwimmer 2014). We would argue that this established aboutness topic may survive the end of its associated sentence. The subsequent conditional antecedents are then analysed as sub-specifying the established aboutness topic whenever it is contextually sensible to do so. This causes the subsequent conditional to become modally subordinated in the process: E.g., "What if John killed his boss?" would be contextually unexpected to be sub-specified to "What if John killed his boss and won the lottery?", but it is less of a stretch to relate "What if John cheated?" to "What if John cheated and Mary hired a PI?". This is, of course, subject to a degree of subjective speaker variance.

For rSSs, we would argue that this connection is essentially guaranteed to be available—after all, for rSSs, the two antecedents are in a propositional subset relationship such that $\varphi \wedge \psi \subseteq \varphi$. As such, there should be no difficulties to consider the two antecedents topically related. This would cause the aboutness topic established by the preceding $\varphi \wedge \psi$-conditional (i.e., "What if $\varphi \wedge \psi$?") to extend to the subsequent φ-conditional, causing the latter to become modally subordinated to the former in its reading, thereby causing the conditionals to become contradictory by nature.

As such, rSSs would be predicted to be typically infelicitous. The only way for a rSS to be rendered felicitously is to escape modal subordination. The only ways to accomplish this would be: (i) If its two topics were not considered to be topically related in the first place, or (ii) if the topic of the $\varphi \wedge \psi$-conditional is somehow cancelled before the φ-conditional is evaluated. The former seems generally unlikely, but we do not wish to exclude the possibility that a more permissive minority of speakers might have gone this route. The latter, on the other hand, is where the observed contrastive stress comes into place.

2.1.2 Why is contrastive stress necessary?

One of the methods to indicate that two topics are clearly distinct and demarcated from one another is the use of a contrastive topic (cf. Krifka 2007; Lee 2017; Van Rooij & Schulz 2017; Yabushita 2017), which is standardly realised via a form of emphatic stress. Krifka (2007: 44ff), specifically, covers the use of contrastive topic for aboutness topics. An example of this is shown in (13), where it should be noted that Krifka (2007) equates focus within topic to contrastive topic.

(13) a. What do your siblings do?
b. [My [SIster]$_{\text{Focus}}$]$_{\text{Topic}}$ [studies MEDicine]$_{\text{Focus}}$, and [my [BROther]$_{\text{Focus}}$]$_{\text{Topic}}$ is [working on a FREIGHT ship]$_{\text{Focus}}$.
(adapted from Krifka 2007: 44)

Here, the contrastive stress—or, more specifically, the contrastive topic—indicates that we first talk about what my sister does and then talk about what my brother does and that the two topics are independent and delineated from one another (i.e., they are non-overlapping in their partition of logical space).

We would argue that contrastive stress in the antecedent of rSSs serves exactly the same purpose and that clearly demarcating the two topics as independent from one another prevents the modal subordinate reading of the φ-conditional. In (7), repeated below, we attempt to contrast *hosted* and *come* against one another.

(7) *Karlos is known for being fun at parties, but his house is small & smelly.*
a. *Ben:* If Karlos had hosted the party, it would not have been a good time.
b. *Martina:* But if Karlos had COME to the party, it would have been a good time. (Klecha 2015: 134)

In order for this contrast to be successful, we need to establish *hosting the party* and *coming to the party* to be disparate topics. This may be accomplished by covertly strengthening *come* to *come-but-not-host*—a possibility proposed by Klecha (2015: 134). However, this would not yet explain why the example of von Fintel (2001) in (8), repeated below, remains infelicitous.

(8) a. If I ran really fast to the store, it might still be open.
b. #But if I WENT to the store, it would be closed by the time I got there. (von Fintel 2001: 146)

One possibility could be that the speed component of meaning of *to go* is too weak or too undefined for it to properly contrast against *to run*, failing to change the aboutness topic and thereby failing to avert modal subordination. However, pinning down the exact felicity conditions of rSSs with contrastively stressed overtly different lexical items is beyond the scope of this paper, and we make no definitive commitment to an analysis here. We merely provide a tentative explanation for as to why (7) is felicitous but (8) is not.

We would argue that contrastive topic on the auxiliary verb accomplishes the same thing: We demarcate the two possible topics to be distinct from one another and thereby prevent a modally subordinate reading. The difference would be that, in the case of auxiliary verbs, it is not intuitively obvious what exactly is being contrasted and thereby delineated.

In fact, we can see that contrastive topic on the auxiliary verb does cancel modal subordinate readings, as evidenced by (14). There the contrastive stress on the auxiliary verb reverses the felicity distribution previously shown in (12)—which would suggest a lack of modal subordination.

(14) *John is married to Mary. He is a good liar and a flirt. Mary always suspected him of cheating and once contemplated hiring a very competent private investigator but ultimately decided against it. However, John has never actually cheated on Mary, unbeknownst to her.*

  a. If John had cheated on Mary, she would've never found out about it; ??but if she HAD hired the private investigator, he would have brought her evidence of John's cheating.
  b. If John had cheated on Mary, she would've never found out about it; but if she HAD hired the private investigator, he would have told her that John didn't cheat on her.

This would indicate that there is a shift in aboutness topic in between the two conditionals—the requirement for escaping modal subordination.

2.1.3 Why the auxiliary verb?

But how does the contrastive topic on the auxiliary verb accomplish this shift in aboutness topic? To answer this we must first determine which part of meaning of the auxiliary verb is actually contrasted. This part of meaning must differ between conditionals for it to be contrastively stressable. We argue that the contrasted part of meaning are actually the domains of quantification of the two conditionals. But how do we get from the auxiliary verbs to the domains of quantification? Our answer is to treat auxiliary verbs in conditional antecedents as pro-forms that are bound by their conditional's domain of quantification via the Tense-aspect-mood (TAM) morphology that they encode. We explain and motivate this reasoning in this section.

Why do we believe that the auxiliary verb in the antecedent of conditionals should be treated as a pro-form? TAM morphology has been argued to be a type of bound pro-form (e.g. Partee 1973; Kratzer 1998). Crucially to us, the auxiliary verb in conditional antecedents—when present—carries the TAM morphology of its clause. As such, we would argue, the contrastive stress that is placed upon the auxiliary verb actually targets the TAM morphology it encodes (Goodhue 2018: 12, Footnote 3).

The next pertinent question is why the TAM morphology of the antecedents is contrastively stressed: In order for the two items to contrast against one another, they must possess some differing semantic values. To this end, we must consider what this bound pro-form—that is, the antecedent's TAM morphology—is actually bound to. Here, we argue that antecedental TAM morphology is bound to the world selection function of its conditional—or rather to the domain of quantification that this selection function produces. We argue this because antecedental TAM morphology has long since been considered linked to the world variable of its conditional and it is known to (partially) encode which properties this world variable must possess (see, amongst others, Palmer 1986; Iatridou 2000; Arregui 2009; Romero 2014; Schulz 2014): E.g., it encodes whether or not we are looking for counterfactual or non-counterfactual worlds. Thus, there is a direct connection between TAM morphology and the selection of worlds that are being quantified over by its conditional.

As such, by putting stress on the auxiliary verb, we actually attempt to contrastively stress the two domains of quantification for each conditional, as this is the only semantic value in which the two auxiliary verbs differ (or rather in which the TAM morphology between conditionals differs).

The hypothesis that we are attempting to stress the two differing domains of quantification is given further credibility by the following two facts from the pre-existing literature: First, the TAM morphology acts as a kind of proform (Partee 1973; Kratzer 1998). Second, it has been shown elsewhere that two bound pro-forms that are contrastively stressed against one another are actually trying to contrast the domains that they are bound to. Specifically, this was shown to be the case for contrastively stressed bound pro-nouns (Sauerland 1998; 1999; Jacobson 2000; 2004).

As Sauerland (1998; 1999) and Jacobson (2000; 2004) have noted, when we contrastively stress two bound pronouns against one another, it appears that we are actually contrasting the two domains which bind them, mandating them to be disjoint to one another. This is typically demonstrated by the difference in felicity between (15) and (16).

(15) Every boy$_i$ called his$_i$ father and every TEAcher$_j$ called HIS$_j$ father. (Sauerland 1998: 204)

(16) *I expected every student$_i$ to call his$_i$ father, but only every YOUNG student$_j$ called HIS$_j$ father. (Sauerland 1998: 206)

In (15), the two contrasting domains are the domain of *boys* and the domain of *teachers*. These are typically considered disjoint to one another, which, as Sauerland (1998; 1999) and Jacobson (2000; 2004) propose, renders the contrast licit. In (16), on the other hand, the contrasting domains are the domain of *students* and the domain of *young students*. Since the latter necessarily is a subset of the former, the two domains are obviously not disjoint and the contrast is therefore illicit, rendering the entire expression infelicitous.

To formally account for this, we adopt a variant of Jacobson (2000; 2004): We treat bound pronouns as partial identity functions whose range is restricted to the domain that binds them, as defined in (17), where $\textsc{id}_R$ is the partial identity function restricted in range to the binding domain R.

(17) a. $[\![\text{his}_\text{i}]\!]^{g,c} = \textsc{id}_\text{R}(g(i))$
b. $[\![\text{his}_\text{i}]\!]^{f,g,c} = \{\textsc{id}_{\text{R'}}(g(1)) \mid \textsc{id}_{\text{R'}} \subseteq \textsc{id}_{\langle e,e\rangle}\}$

This way, for the sequence (15), we may contrast the two semantically different items $\textsc{id}_{\textsc{boy}}$ and $\textsc{id}_{\textsc{teacher}}$ by putting contrastive stress on the two respective pronouns. The two respective LFs for (15) are shown in (18) to better illustrate which part in meaning is contrastively stressed, indicating the actually contrasted part of meaning via the use of boldface.

(18) a. every boy $[\lambda x.\textsc{call}(x, \textsc{the-father-of}(\mathbf{ID_{BOYS}}(x)))]$
b. every teacher $[\lambda x.\textsc{call}(x, \textsc{the-father-of}(\mathbf{ID_{TEACHERS}}(x)))]$

This contrast is, as previously mentioned, licit iff $\textsc{id}_{\textsc{boy}} \cap \textsc{id}_{\textsc{teacher}} = \emptyset$.

For the analysis of contrastively stressed TAM morphology, we extend this account to other types of pro-forms: In our case, we extend it such that the TAM-morphology carried by the auxiliary verb inside of a conditional antecedent is equal to a partial pro-world identity function that is restricted in its range to the domain that binds them: the output of the world closeness function. As such, we would define the auxiliary verb (or, more specifically its TAM component) as shown in (19).[4]

(19) a. $[\![\textsc{aux}_\mathrm{i}]\!]^{g,c} = [\![\textsc{tam}_\mathrm{i}]\!]^{g,c} = \textsc{id}_{\textsc{domain}}(g(i))$
b. $[\![\textsc{aux}_\mathrm{i}]\!]^{f,g,c} = [\![\textsc{tam}_\mathrm{i}]\!]^{f,g,c} = \{\textsc{id}_{\textsc{domain}'}(g(i)) \mid \textsc{id}_{\textsc{domain}'} \subseteq \textsc{id}_{\langle s,s \rangle}\}$

Here, as previously mentioned, the domain of the identity function would end up equal to the domain of its binder: the output of the world closeness function (i.e., the conditional's domain of quantification). The partial identity function of a φ-conditional's antecedent would therefore be equal to $\textsc{id}_{\textsc{closest-}\varphi}(g(i))$, the partial identity function of a φ∧ψ-conditional's antecedent would be equal to $\textsc{id}_{\textsc{closest-}\varphi\wedge\psi}(g(i))$, and so on.

As such, a rSS where the auxiliary verb is contrastively stressed could be rendered as contrasting the two boldfaced identity functions in (20).

(20) a. If $[\lambda w_s.\phi(\mathbf{ID_{CLOSEST\text{-}\varphi\wedge\psi}}(w)) \wedge \psi(\textsc{id}_{\textsc{closest-}\varphi\wedge\psi}(w))]$,
(then) would $\neg\chi$.
b. If $[\lambda w_s.\phi(\mathbf{ID_{CLOSEST\text{-}\varphi}}(w))]$, (then) would χ.

Whether the contrastive stress is licit would then, again, be determined by whether or not $\textsc{id}_{\textsc{closest-}\varphi\wedge\psi} \cap \textsc{id}_{\textsc{closest-}\varphi} = \emptyset$. If the two domains are disjoint,

[4]Treating TAM-morphology as pro-worlds with restricted domains is uncontroversial. See, e.g., Schlenker (2005), who treated mood the same way, as defined in (ia), which is functionally equivalent to (ib).

(i) a. $[\![\textsc{indicative}_\mathrm{I}]\!]^{g,c}$ is defined only if $g(i) \in \textsc{dox}_{\textsc{speaker}}$, where $\textsc{dox}_{\textsc{speaker}}$ is the speaker's doxastic set of possible worlds. If defined, $[\![\textsc{indicative}_\mathrm{I}]\!]^{g,c} = g(i)$
b. $[\![\textsc{indicative}_\mathrm{I}]\!]^{g,c} = \textsc{id}_{\textsc{dox}_{\textsc{speaker}}}(g(i))$

the contrastive stress would be licit. If not, it would be illicit.[5]

To grasp the importance of this criterion, we must remind ourselves that the contrastive stress on the auxiliary verb is actually an instance of contrastive topic. As such, the success of the contrastive topic is inherently bound to whether or not the two contrasting domains are disjoint. If they are, the contrastive topic establishes that the two conditionals' aboutness topics are clearly demarcated and independent from one another. For rSSs, this would entail that the modal subordinate reading is prevented, as modal subordination is caused via a shared aboutness topic, and that the φ-conditional is analysed purely with respect to the content of its antecedent.

If on the other hand, the contrast was illicit, the contrastive topic fails to establish a new aboutness topic for the rSS's φ-conditional. This would mean that the aboutness topic of 'What if $\varphi \wedge \psi$?' persists and that the φ-conditional is thereby covertly strengthened to be another $\varphi \wedge \psi$-conditional via modal subordination. This would render the entire expression infelicitous due to the contradictory nature of the conditionals' claims.

At this point it is also important to recall that we have argued that, without outside intervention, all rSS are virtually guaranteed to make use of modal subordination. That is because the underlying pattern of this construct makes it excessively easy to interpret the φ-conditional to be topically related to the preceding $\varphi \wedge \psi$-conditional, extending the latter's aboutness topic to cover the former conditional as well. As such, all rSS are infelicitous unless some indication is given that the φ-conditional's antecedent is not actually topically related to the preceding $\varphi \wedge \psi$-conditional's antecedent. With the implementation of contrastive topic on the auxiliary verb sketched out above, we now have such a way to indicate this to be the case. By contrastively stressing the auxiliary verb, we attempt to point out that the two topics are actually entirely distinct from one another by pointing out that there is no overlap in their domains of quantification.

With this we have the two criteria upon which rSS felicity rests. First, whether or not we have a clear indication that we want to analyse the two conditionals as topically unrelated. And second, if this was indicated via

[5]Naturally, the check of whether or not the two domains in question are actually disjoint would be executed while the modal subordination is suspended for the sake of evaluation. Otherwise, the contrast could never succeed and the use of contrastive stress would be a pointless exercise.

contrastive stress on the auxiliary verb, whether or not their domains of quantification without modal subordination would be disjoint to one another. If either condition is not given, the rSS would be rendered infelicitous via modal subordination.

2.2 Acausal Counterfactual Conditionals

With this basic model and a standard variably-strict semantics in place, we would already be able to explain why acausal counterfactual rSSs, such as (9b), repeated below, are typically felicitous when contrastively stressed.

(9b) *Holding up a dry match, with no water around.*
If I had struck this match and it had been soaked, it would not have lit. But if I HAD struck this match, it would have lit.

It is the height of orthodoxy to claim that any cause-initial meaningful deviance of a counterfactual world w away from w_0 decreases the world similarity of w in relation to the evaluation world w_0. As world closeness is determined by world similarity, and φ and ψ each represent a causally independent deviance from w_0, it follows that the closest φ-worlds are closer to w_0 than the closest φ∧ψ-worlds are.

A variably-strict conditional semantics would then make a claim only with regard to the closest antecedent worlds—and we have already established that the closest φ-worlds and the closest φ∧ψ-worlds are unequal in world similarity and therefore unequal in world closeness. Since a variably-strict conditional semantics never quantifies over two different levels of world closeness at the same time, the two domains of quantification would therefore necessarily be disjoint. We visualise this in Figure 3.

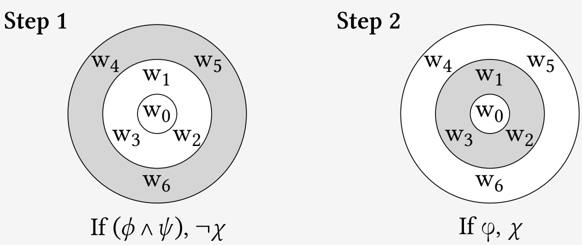

Figure 3 Domains of quantification according to a variably-strict semantics for an acausal counterfactual rSS.

As such, so long as we can clearly identify that the two antecedental propositions φ and ψ are counterfactual and causally unrelated, we can ensure that $\text{ID}_{\text{CLOSEST-}\varphi\wedge\psi}\cap\text{ID}_{\text{CLOSEST-}\varphi}=\emptyset$ must necessarily be the case. This would render the contrastive topic licit, cancelling modal subordination, and thereby saving the rSS in question.

2.3 Causal Links in the Antecedent

With this, we may turn our attention to another felicity factor of rSS: causality. Klecha (2015) observed that causality negatively impacts the felicity of rSSs: If φ causally precedes ψ on some chain of events, then the corresponding rSS is infelicitous. Here, it should be noted that *causally precedes* does not equate a strict cause-and-effect relationship: It suffices if φ started a causal chain which created the necessary conditions for ψ to possibly happen. We can illustrate this by comparing (9b), repeated below as (21a), where the match being wet is causally independent of the speaker striking the match, against its minimal pair (21b).

(21) *Holding up a dry match, with no water around.*

a. If I had struck this match and it had been soaked, it would not have lit. But if I HAD struck this match, it would have lit.

b. If I had struck this match and it had snapped, it would not have lit. #But if I HAD struck this match, it would have lit.

While striking the match is causally independent of it being wet, as the match can be wet regardless of whether or not anyone is going to strike it, snapping the match by accident must be causally preceded by striking the match for the former to even be logically possible.

In addition to this, Klecha (2015) noted that causal (r)SSs exhibit a number of traits not shared by their acausal counterparts.[6] Namely, causal SSs exhibit the possible trait of pedantry and the possibility for partial concessions between discourse participants. Here, Klecha (2015: 139) defined pedantry as an intuition of mild uncooperativity that may arise when another discourse

[6]Note that Klecha (2015) considered causal and acausal (r)SSs to be independent semantic phenomena that coincidentally have the same surface structure. He referred to causal SSs as *Lewis sequences* and acausal SSs as *True SS* in Klecha (2015). We do not share this opinion, and therefore merely refer to them as causal and acausal SSs, which also increases terminological clarity.

participant raises the level of discourse precision unnecessarily high to invalidate the utterance of the original speaker—who used a contextually valid form of loose talk. An example of this is shown in (22), example due Klecha (2015: 138), where most would interpret Lelia's contribution to the discourse to be needlessly uncooperative.

(22) *Katie and Lelia stand around a table made by humans.*

a. *Katie:* This table is flat. LOOSE CLAIM

b. *Lelia:* Not really. Nothing made by humans is actually flat. REBUTTAL

c. *Katie:* Well, you're technically right, but you get my drift. CONCESSION

Klecha (2015: 139) showed with (23a) and (23b) that causal SSs may evoke the same feeling of pedantry if ψ is suitably unlikely or outlandish:[7]

(23) a. *Aaron:* Daryl, if you had been standing there, you would have been killed.

b. *Ida:* But if he had been standing there and he saw a the shadow of the falling beam and managed to jump out of the way in time, he would not have.

c. *Aaron:* Well, okay, technically that's true, but you get my drift.

Partial concessions, Klecha (2015) defines as signals that the speaker is assimilating to the opposing understanding of the context while not acknowledging any factual incorrectness to their original statement. Rather, the speaker maintains the underlying truth of the proposition they intended to assert. Partial concessions are a common trait for loose talk: In (22c), Katie maintains that the table is flat for all relevant intents and proposes, though she concedes that Lelia is technically correct. Similarly, in (23c),

[7] Here, it should be noted that Aaron can make his conditional claim even when he has already internally considered Ida's claim and dismissed it as too unlikely to be taken seriously. As such, Aaron can be aware of the fact that his conditional is technically false when he utters it. While possible, it does not have to be the case that Aaron simply didn't consider the possibility pointed out by Ida. In this, too, (23a) behaves akin to (22a), as Katie can truly believe the table to be flat up until she is reminded of the fact that humans are unable of creating something perfectly flat.

Aaron maintains his original point that Daryl most likely would have died.

2.3.1 Retrodiction

How can we account for these observations using the model we have developed in Section 2.1? We would argue that all of Klecha's observations follow naturally if we adopt the view on world similarity of Bennett (2003) and Arregui (2009): They argue that only cause-initial deviances to the evaluation world w_0 decrease the similarity of any given world w.

In other worlds, if some deviance ψ follows a cause-initial deviance φ on some causal chain of events, then ψ does not further decrease the similarity of a φ-world in relation to w_0. In such a situation, the closest φ∧ψ-worlds and the closest φ∧¬ψ-worlds would be equal in similarity to w_0.[8]

It is easy to see how this would interact with the requirements we place upon contrastive topic: If ψ does not further decrease the world closeness of any φ-worlds, then the closest φ∧ψ-worlds would necessarily be a subset of the closest φ-worlds. As such, causal rSSs would partially quantify over the same worlds, as visualised in Figure 4.

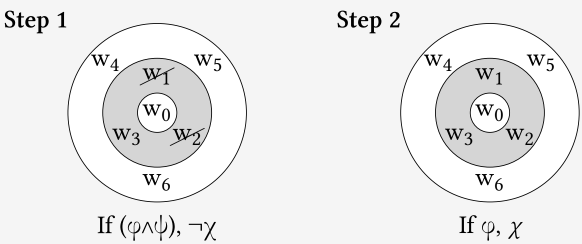

Figure 4 Domains of quantification according to a variably-strict semantics for a causal rSS, where w_1, w_2, w_3 are φ-worlds and where w_3 is also a ψ-world.

Since φ causally preceding ψ on some chain of events would therefore entail $\text{ID}_{\text{CLOSEST-}\varphi\wedge\psi} \subseteq \text{ID}_{\text{CLOSEST-}\varphi}$, there is no way to satisfy the constraints placed upon contrastive topic: Since the two necessarily non-empty domains are in a subset relation to one another, they may never be disjoint. Therefore, contrastive topic could never succeed and modal subordination persists. In addition, even if modal subordination were to be otherwise cancelled, the two conditionals would still make contradictory claims and therefore still

[8]Unfortunately, for reasons of space, we cannot provide a detailed account for how they independently motivate this assumption. We refer to their papers for details.

be infelicitous.

This also has a very important implication for regularly ordered SSs: Since the closest $\varphi\wedge\psi$-worlds are a subset of the closest φ-worlds, the $\varphi\wedge\psi$-conditional would at least partially contradict the claims made by the preceding φ-conditional. To circumvent this issue, we adopt the imprecision and precisification-based account proposed by Klecha (2015). He argued that causal SSs actually make use of a type of loose talk: The preceding φ-conditional is only considered true enough with respect to the initial degree of discourse precision. When we then evaluate the subsequent $\varphi\wedge\psi$-conditional, we raise the standard of precision via precisification and have to take the $\varphi\wedge\psi$-worlds into account as well. As such, the issue here is not rooted in contradiction but in the increase of evaluative precision.

The reverse, however, does not work: Discourse precision typically does not decrease without effort. In this way, the unidirectionality of the shift in precision in causal SSs is equal to the unidirectional precisification of other forms of loose talk (Lasersohn 1999; Lauer 2012), as exemplified by (24):

(24) *The facts: Julian arrived at 2:59; Gallagher arrived at 2:58.*
Julian arrived at 2:59 and #Gallagher arrived at three.

This would ensure that causal rSS remain infelicitous, as they are unable to take advantage of lower levels of precision.

As Klecha (2015) further notes, this would also account for why causal SSs may exhibit the traits of pedantry and partial concessions: If the level of precision must be raised to an unreasonably useless degree, such as in (22b) or (23b) in Section 2.3, the responsible discourse participant is evaluated to be needlessly uncooperative, leading to a sense of pedantry. For partial concession, such as in (22c) or (23b), the discourse participant who originally uttered the φ-conditional agrees that the other speaker's $\varphi\wedge\psi$-conditional is true, given an elevated level of precision, but maintains the general true-enough value of his original utterance given the previous and contextually sufficient level of imprecision. Acausal SSs, on the other hand, do not make use of precisification and imprecision (since they have disjoint domains) and therefore do not exhibit these traits.

2.4 Non-counterfactuality

Non-counterfactuality appears to have a very similar effect on rSSs as causal links in the antecedent do. Consider the felicitous counterfactual rSS in (9b) again, repeated below as (25).

(25) *Holding up a dry match, with no water around.*
If I had struck this match and it had been soaked, it would not have lit. But if I HAD struck this match, it would have lit.

If we convert (25) into a conditional concerning some possible future event, the rSS becomes infelicitous, as shown in (26). It also appears to make no difference in felicity whether or not we make use of indicative conditionals or future-less-vivid conditionals, as shown in (26a) and (26b), respectively.

(26) *Holding up a dry match, with no water around.*
  a. If I strike this match tomorrow and it is soaked, it will not light. #But if I DO strike this match tomorrow, it will light.
  b. If I struck this match tomorrow and it was soaked, it wouldn't light. #But if I WERE to strike this match tomorrow, it would light.

Additionally, non-counterfactual SSs also exhibit the same pragmatic traits as causal SSs, as demonstrated by the acausal non-counterfactual SS in (27).

(27) *John and Henry discuss whether their daughter Mary should go to a party. Mary hates Nicole and vice versa. John and Henry have no way of knowing whether Nicole will go to any specific party, but they do know that she rarely attends any—she only attended two in ten years.*
  a. *John:* If Mary went to the party tomorrow, she'd have a good time.
  b. *Henry:* But if Mary went to the party tomorrow and Nicole was there, too, she'd have a terrible time!
  c. *John:* Well, okay, technically that's true. But you get my drift: She'd probably have a good time, so she should go.

Here, (27b) evokes a sense of pedantry in the same manner as (22b) and (23b): As Nicole is unlikely to attend any party—though not with absolute certainty—most would evaluate Nicole's rebuttal as mildly uncooperative though technically true. Likewise, the non-counterfactual sequence in (27) allows for John to partially concede to Henry in (27c) while maintaining his original point from (27a), similarly to the partial concession shown in (23c).

Acausal counterfactual rSSs crucially do not share these two properties, as demonstrated by (28), which is a counterfactual variant of the acausal non-counterfactual SS in (27).

(28) *John and Henry are in full possession of the facts: Now that the party is over and Mary did not go, it turns out that Nicole didn't go to the party either.*

a. *John:* If Mary had gone to the party, she would've had a good time.

b. *Henry:* But if Mary had gone to the party and Nicole had been there, too, she would've had a terrible time!

c. *John:* #Well, okay, technically that's true. But you get my drift: She probably would've had a good time, so she should've gone.

Here, Henry's interjection does not serve as a pedantic rebuttal to John's point: Rather, it seems that Henry is making a point that is somewhat unrelated to John's.[9] Similarly, John cannot make a partial concession that limits the truth value of his original assertion: Since Nicole wasn't there, Mary would've had a good time, rendering Henry's rebuttal irrelevant.

2.4.1 Retrodiction

As we have just shown, standard non-counterfactual rSSs are not only infelicitous, but non-counterfactual SS also exhibit the same possible sense of pedantry as causal SSs and causal rSSs also allow for partial concessions. As such, rather than make predictions from standard assumptions, our account would rather impose a restriction on non-counterfactual conditional semantics: In order to derive equal predictions for non-counterfactual (r)SSs and causal (r)SSs, non-counterfactual (r)SSs would have to quantify over a single degree of world closeness—as this is the driving factor behind the

[9] At best, this can be interpreted as Henry justifying why he was originally against Mary going: because he was unsure whether or not Nicole would've been there, too. It does not contradict that Mary would've had a good time, however.

special properties exhibited by causal (r)SS, as shown in Section 2.3. This requirement is functionally equivalent to claiming that non-counterfactual conditionals actually make use of a kind of strict semantics: Rather than quantifying over different levels of world closeness, non-counterfactual would simply quantify over all non-counterfactual possible worlds.

This is not an altogether uncontroversial imposition: The debate of whether non-counterfactual conditionals should be analysed with a strict or with a variably-strict semantics is an ongoing issue: While some argue in favour of a variably-strict semantics across the board (e.g. Stalnaker 1975), others argue in favour of a strict conditional semantics for non-counterfactual conditionals even if they assume a variably-strict semantics for counterfactual ones (e.g. D. K. Lewis 1973). As this would exceed the bounds of this paper's topic, we do not further get involved in this particular debate and merely note that our account speaks in favour of (quasi-)strict accounts for non-counterfactual conditionals. For an interesting paper on this particular subject, see Willer (2017), who also discusses some issues that non-counterfactual SS cause for variably-strict accounts of conditionals.

Given this assumption, a non-counterfactual rSS would at least partially quantify over the same worlds, as visualised in Figure 5.

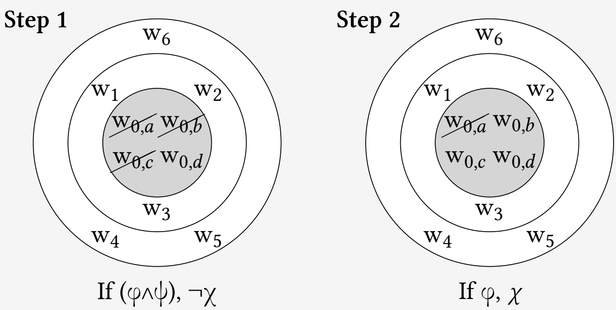

Figure 5 Domains of quantification according to a variably-strict semantics for a causal rSS, where w_0 are non-counterfactual worlds, and where $w_{n>0}$ are counterfactual ones. $w_{0,b}$, $w_{0,c}$, $w_{0,d}$ are φ-worlds and $w_{0,d}$ is also a ψ-world.

This way, the analysis of non-counterfactual (r)SSs would be perfectly equal to the analysis of causal (r)SSs. Not only would $\text{ID}_{\text{CLOSEST-}\phi\wedge\psi}$ being a subset of $\text{ID}_{\text{CLOSEST-}\varphi}$ preclude the possibility of their domains being disjoint, thereby eliminating all hopes for a successful contrastive topic, but it would also explain why non-counterfactual SSs also exhibit the traits of pedantry and allow for partial concessions: We would merely have to extend the account of Klecha (2015) to non-counterfactuals as well, using imprecision and precisification to explain why causal SS may be felicitous despite of overlapping quantificational domains. We refer back to Section 2.3 for our explanation of causal (r)SS for a more in-depth explanation of how the particulars would be derived in this case, as a reiteration of that particular analysis would be needlessly repetitive.

2.5 Responsible epistemic dismissal of possibility

Finally, we turn to the last felicity factor of rSS: the responsible epistemic dismissal of ψ as a possibility: When we actively dismiss the possibility of ψ, any contrastively stressed rSS may be rescued and achieve felicity: even causal or non-counterfactual rSSs. This dismissal of ψ may happen either overtly by dismissing the possibility of ψ in between rSS conditionals or covertly via an appropriate context.

To demonstrate how the overt dismissal of ψ as a possibility may rescue any rSS, we provide a causal non-counterfactual variant of (21b) in (29), showing that this overt dismissal is able to save even causal non-counterfactual rSSs.

(29) If I struck this match and it snapped, it would not light. But, of course, since I am world champion at striking matches, there's little chance of THAT happening. So, if I WERE to strike this match, it would light.

Here, the majority of asked native speakers judged (21b) to be felicitous. Furthermore, as mentioned in Section 2.1, a minority is even able to drop the contrastive stress in such overt dismissal rSS without a loss in acceptability. However, this ability appears to be tendentially restricted to rSS that are constructed by multiple discourse participants, such as the one in (30).[10]

[10] On a preliminary note, due to the hereto small number of native speakers available to us for this particular point, we would like to note that this ability to omit the contrastive stress might somewhat correlate to the ease with which ψ can be dismissed: e.g., some speakers were able to omit the stress in acausal counterfactual rSS such as (30) but not in similar causal or non-counterfactual rSS. Very few were able to do so for any rSS uttered by a single person.

(30) a. *John:* If I had struck this match and it was soaked, it would not have lit.
b. *Mary:* Come on! If you had struck this match, it would have lit.

Similarly, a strong enough context may allow for the dismissal of ψ as a possibility without overt intervention. The prototypical example of this was provided by Moss (2012: 577), shown below in (31).

(31) *John and Mary are our mutual friends. John was going to ask Mary to marry him, but chickened out. I know Mary much better than you do, and you ask me whether Mary might have said yes to John's proposal. I tell you that I swore to Mary that I would never tell anyone that information, which means that strictly speaking, I cannot answer your question. But I say that I will go so far as to tell you two facts:*
a. If John had proposed to Mary and she had said yes, he would have been really happy.
b. But if John HAD proposed, he would have been really unhappy. (adapted from Moss 2012: 577)

Here, the possibility of ψ can be dismissed without an interjection because the discourse context makes it clear that the speaker has superior knowledge regarding the feasibility of ψ. This inference allows for the causal counterfactual rSS to be rescued.

2.5.1 Retrodiction

Here, we would argue that our account requires no further additions or assumptions to account for these cases. We would argue that the (overt or covert) dismissal of ψ-worlds removes all ψ-worlds from the domain of any subsequent quantification so long as this elimination of ψ-worlds does not yield an empty domain of quantification. In the context of rSS, this would mean that $\varphi\wedge\psi$-conditionals would still target the closest $\varphi\wedge\psi$-worlds—as they would otherwise quantify over nothing—but that φ-conditionals can exclude all ψ-worlds from their domain of quantification so long as φ does not entail ψ (which would render such sequences (r)SS infelicitous for a different reason anyhow).

Their exclusion would then be a simple example of context/relevance-based restriction of the domain of quantification, as it has previously and extensively been argued for in the literature (see von Fintel 1994; Reimer 1998; Stanley & Gendler Szabó 2000: amongst many others).[11]

This would guarantee that contrastive topic always succeeds for rSS that involve the epistemically responsible dismissal of ψ as a possibility: Since $D_{\text{closest-}\phi\wedge\psi} \cap (D_{\text{closest-}\phi} \setminus D_{\psi}) = \emptyset$ is a set theoretical tautology, the disjointness of the domains in question is ensured under all reasonable circumstances, ensuring both that the modal subordination is cancelled and that no contradictory reading is otherwise derived via the standard variably-strict semantics.

We would also argue that our account may explain why some speakers are able to omit contrastive stress in cases such as (30), where the possibility of ψ is overtly dismissed in between conditionals. Here, we would say that our account only requires there to be some reasonably obvious indication that the conditionals of a rSS should be taken to be topically unrelated, as mentioned in Section 2.1. One of the main ways to do this is to make use of contrastive topic, as we have extensively covered up until this point. However, it is perfectly reasonable to assume that such dismissive interjections could suffice for some people to achieve the same end: By telling the other person to be more realistic in their assumptions, we indicate that we do not believe that ψ-worlds should be given any further consideration. As such, an aboutness topic that explicitly revolves around the possibility of ψ would have to be terminated for subsequent conditionals (so long as the interjection is not rejected by the other discourse participants). In fact, some very agreeable speakers might already take the covert dismissal of ψ to be enough to achieve this—though, as this is the least clear indicator of topical unrelatedness, this is also the least widespread speaker property.

3 Conclusion

With this, we have shown in Section 2 that our contrastive-topic-based account is able to account for all currently available empirical data regarding the felicity distribution of rSSs—and that it does so by adopting mostly

[11] Another possible view to take is that the dismissal of ψ marks said proposition as requiring an additional deviance from the evaluation world, effectively suspending any direct causal relation between φ and ψ (if such a relation existed) and marking all ψ-worlds as counterfactual worlds (if they were not marked as such already) for the purpose of the current discourse.

uncontroversial and independently motivated tools from the literature: For counterfactuals, we predict that contrastive topic should always succeed so long as φ and ψ are causally independent from one another, as shown in Section 2.2. For causal rSSs, we predict that they are generally infelicitous, as contrastive topic cannot succeed without the possibility of ψ being dismissed, as shown in Section 2.3. Also shown in Section 2.3, we predict that a causal SS's φ-conditional is actually technically false, but considered true enough via the use of loose talk, because the closest φ∧ψ-worlds are just a subset of the closest φ-worlds, explaining why causal (r)SS exhibit some special pragmatic characteristics. For non-counterfactual (r)SSs, who behave perfectly alike to causal (r)SSs, our account would mandate that all non-counterfactual conditionals quantify over the same degree of world closeness, rendering their analysis equal in all aspects to the analysis of causal (r)SSs, as shown in Section 2.4. Finally, the dismissal of ψ as a possibility renders all rSSs felicitous, which our account may explain by assuming that this active dismissal excludes ψ from all domains of quantification that are thereby not rendered equal to the empty set. In doing this, the success conditions for contrastive topic amount to a set theoretical tautology, ensuring that such rSSs are always felicitous.

Our account is also able to account for the speaker variance we encountered in our preliminary native speaker consultations: Speakers simply vary with respect to what they deem sufficiently obvious indicators of topical unrelatedness. E.g., very strict discourse participants require an overt dismissal of ψ and the use of contrastive topic, most discourse participants seem content with the use of contrastive topic on the auxiliary verb, and some less strict discourse participants do not even require the use of contrastive topic if the possibility of ψ is sufficiently dismissed in other ways.

For future research, we would propose to further delve into what happens when we contrastively stress two overtly different lexical items in rSSs, and also that an experiment is conducted to test the veracity of our account.

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Symmetric but non-complementary: Gradient paradigmatic opposition in binding

Suzanne Lesage • Olivier Bonami

Abstract This paper relies on experimental data on the interpretation of Estonian proforms to argue for an overhaul of Binding Theory. First, we show that classical binding principles are unable to capture the distribution of nonreflexive proforms, which must be locally free in finite clauses but may be bound in embedded infinitives. Second, we provide evidence that possessives exhibit a symmetrical distribution: while the proportion of local antecedents for possessive reflexives varies depending on the syntactic context, it matches the proportion of nonlocal antecedents for antireflexives. This is strong evidence for the existence of substantial grammatical constraints on binding of a gradient nature. Third, we propose a 2×2 typology of systems of binding constraints, which can be symmetric or asymmetric and categorical or gradient. We provide empirical evidence that all four types are attested.

Keywords Binding Theory · reflexive · possessive · experimental · Estonian

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1 Introduction: possessives and binding theory

Reflexive proforms are anaphoric expressions with an affinity towards local antecedents: for instance, *herself* in (1a) needs to be bound by the subject of the embedded clause. They contrast with what we call antireflexive proforms, which have the opposite affinity: witness the binding potential of *her* in (1b).[1]

[1]Generative literature since Chomsky (1981) uses anaphor as a cover term for reflexives and reciprocals, and pronominal for what we call antireflexives, a reassignment of traditional grammatical labels leading to much confusion. As we will have nothing to say on reciprocals in this paper, we adopt from Heine (2005); González et al. (2020) the term antireflexive as a name for those proforms with binding properties opposite to those of reflexives.

(1) a. Mary$_i$ was surprised that Eva$_j$ was blaming herself$_{*i/j/*k}$ for the accident.
b. Mary$_i$ was surprised that Eva$_j$ was blaming her$_{i/*j/k}$ for the accident.

Classical binding theory (Chomsky 1981) regulates the distribution of reflexives and antireflexives through the separate but complementary principles A and B: reflexives must be bound by a commanding expression in their binding domains, while antireflexives can't. An appropriate definition of binding domains that captures the whole distribution of each proform is thus a crucial ingredient of the theory. For English, the relevant binding domain for reflexives is taken to be what Büring (2005) calls the SUBJECT DOMAIN, i.e. the smallest constituent containing the reflexive and either a subject or a possessive. This makes the correct predictions about the binding of *herself* in the following examples, where the binding domain is indicated in square brackets.

(2) a. [Jane$_i$ washes herself$_i$].
b. [Jane$_i$ saw a picture of herself$_i$].
c. [Jane$_i$'s picture of herself$_i$] is beautiful.

One of the main challenges facing classical binding theory is to account for situations of noncomplementarity in the distribution of reflexives and antireflexives.[2] Standard accounts (Chomsky 1981; Kuno 1987; Hestvik 1991) rely on the idea that different proforms have qualitatively different binding domains. In particular, English antireflexives rely on the COARGUMENT DOMAIN, the smallest constituent containing the head assigning a semantic role to the proform and its arguments. As the coargument domain is, in some configurations, smaller than the subject domain, this correctly predicts an overlap between the distribution of English reflexives and antireflexives. This is the case in example (3), where *around* assigns a semantic role to its object but does not have a subject.

[2]Other challenges not discussed in this paper include what we call neutral proforms, i.e. proforms that can be either free or bound (Zribi-Hertz 1995), exempt reflexives (Pollard & Sag 1992), long-distance reflexives (Dalrymple 1993), logophors (Reuland 2001) as well as non-subject oriented forms such as Norwegian *ham selv* (Hellan 1980; 1988; Jakubowicz 1984).

(3) [$_{SD}$ John$_i$ looked [$_{CD}$ around himself$_i$/him$_i$]]

In this paper, we focus on *possessive* reflexives and antireflexives, which raise important challenges for classical binding theory. Estonian is an example of a language with such types of proforms. In simple clauses, they exhibit the expected complementary distribution: reflexive *oma* must be bound by the local subject, while adnominal genitive pronouns such as the first-person singular *minu* and second-person singular *sinu*, as antireflexives, can't (Erelt et al. 1993; Metslang 2013), as we can see in (4).[3]

(4) a. *Ma loe-n oma raamatut.*
1SG.NOM read-1SG REFL.POSS book.PART
'I read my book.'

b. *Ma loe-n sinu raamatut.*
1SG.NOM read-1SG 2SG.GEN book.PART
'I read your book.'

c. **Ma loe-n minu raamatut.*
1SG.NOM read-1SG 1SG.GEN book.PART

In infinitive complement clauses, both reflexives and antireflexives may be bound by either the implicit embedded subject or the subject of the embedding clause.

(5) a. *Ma$_i$ luba-n sind$_j$ PRO$_j$ oma$_{i/j}$ kredikaarti kasuta-da.*
1SG.NOM authorize-1SG 2SG.PART REFL.POSS credit_card.PART use-INF
'I give you permission to use my/your credit card.'

b. *Ma$_i$ luba-n sind$_j$ PRO$_j$ minu$_i$*
1SG.NOM authorize-1SG 2SG.PART 1SG.GEN

[3] Some authors (Reuland 2011; Despić 2015) call *reflexive possessive* any possessive that is required to be bound, whether or not they contrast with an antireflexive. This leads to lumping together Estonian *oma*, which in most contexts is in complementary distribution with genitive proforms, and e.g. Mandarin Chinese *ziji-de*, which can always be replaced by the binding-agnostic possessive *ta-de*. We adopt a narrower usage, and will qualify a possessive as reflexive only when it contrasts with an antireflexice counterpart.

kredikaarti *kasuta-da.*
credit_card.PART use-INF
'I give you permission to use my credit card.'

c. *Ma$_i$* *luba-n* *sind$_j$* *PRO$_j$* *sinu$_j$*
1SG.NOM authorize-1SG 2SG.PART 2SG.GEN
kredikaarti *kasuta-da.*
credit_card.PART use-INF
'I give you permission to use your credit card.'

The data so far is consistent with postulating that reflexive *oma* must be bound in the TENSE DOMAIN, as has been proposed for its Norwegian counterpart (Hellan 1988). However, there is no possible specification of a binding domain that will account for the distribution of antireflexives in both (4) and (5): the antireflexive can be bound by the local subject in an infinitive complement clause, but not in a finite clause.[4] The classical formulation of binding principles, which are supposed to be valid across constructions, cannot capture this distribution. In the next section we further argue that, in situations like (5) where there is no categorical constraint on the use of a reflexive or antireflexive, there are still gradient preferences going in the direction of the binding principles.

2 Symmetric binding

This section describes the results of two experiments and analyses their results. These experiments document the interpretation of the Estonian reflexive and antireflexive possessives in contexts other than prototypical simple finite clauses. We propose a post hoc analysis, as the experiments were run with a different purpose. In both cases, participants read sentences and then answered a question eliciting the referent of the possessive form, with two semantically and morphologically plausible choices. We refer the reader to Lesage & Bonami (2021) and Lesage (2022b) respectively for a full description of experimental designs.

[4]The same pattern is found in other languages with reflexive possessives, including Czech (Lesage 2022a), Danish (Lundquist 2014) and Swedish (Tingsell 2007).

2.1 Experiment 1: Binding in embedded infinitives

Seventy-six native speakers of Estonian recruited on social media took part in the first experiment. They were asked to first read a sentence or a pair of sentences, and then fill a gap in second sentence rephrasing the sentence they had read (see 1). The experiment contained twenty-four items and thirty-six fillers. The experiment had six conditions. Three ways of expressing the possessor were possible: reflexive, antireflexive, or no overt expression. There were also two syntactic contexts: the proform was either in an independent clause preceded by another clause containing a possible antecedent (6a), or in an embedded infinitive clause where the main clause contained a possible antecedent (6b). Conditions with unexpressed possessors are irrelevant to the present argument, and will thus be omitted. Sample materials are shown in Table 1.

(6) a. ***Paul*** *on* *kõik läbi* *mõel-nud.* ***Katrin***
Paul.NOM be.3SG.PRS all through think-PPAST Katrin
jätab *oma/tema* *dokumend-id* *registratuuri.*
leave3SG.PRS POSS document-PL.NOM reception.ILL
'Paul made arrangements. Katrin will leave his/her documents at the reception.'

b. ***Paul*** *lase-b* ***Katrini-l*** *oma/tema* *dokumendi-d*
Paul.NOM let-3SG.PRS Katrin-ADE POSS document-PL.NOM
registratuuri *jät-ta.*
reception.ILL leave-INF
'Paul allowed Katrin to leave his/her documents at the reception.'

We expect reflexives and antireflexives to be in complementary distribution in simple clauses, as we have seen in (4): the reflexive must be interpreted as having the local subject (*Katrin*) as an antecedent and the antireflexive cannot be given this interpretation. In the experimental configuration, the only available antecedent for the antireflexive is the subject of the sentence preceding the sentence containing the possessive form (*Paul*). In nonfinite clauses, we expect the distribution of possessives not to be complementary, as we have seen in examples (5). More precisely, we hypothesize that the reflexive still has a preference for the local subject (*Katrin*), and the antireflexive has a preference for the non-local subject (*Paul*).

Clause type	Proform	Example
Independent	Reflexive	*Paul on kõik läbi mõelnud. Katrin jätab oma dokumendid registratuuri.*
	Antirefl.	*Paul on kõik läbi mõelnud. Katrin jätab tema dokumendid registratuuri.* 'Paul made arrangements. Katrin will leave his/her documents at the reception.'
Infinitive	Reflexive	*Paul laseb Katrinil oma dokumendid registratuuri jätta.*
	Antirefl.	*Paul laseb Katrinil tema dokumendid registratuuri jätta.* 'Paul allowed Katrin to leave his/her documents at the reception.'
Sentence to fill		______ *dokumendid jäetakse registratuuri.* 'Someone left _____'s documents at the reception.'

Table 1 Materials for experiment 1

Experimental results shown in Figure 1 confirm our assumptions. In simple clauses, reflexives and antireflexives are in complementary distribution. In infinitive complement clauses, the distribution is not complementary, but the proportion of local antecedents is still higher for reflexives than for antireflexives.[5] A generalized linear mixed model [6] trained only on possessives in infinitive clauses confirmed the statistical significance of the effect. Note that, as Figure 1 makes clear, most participants exhibit variation in their responses for infinitive clauses. Hence the effect is not driven by different subpopulations having different categorical preferences. Although this is not shown in the figure, we likewise observe that most items do not give rise to uniform responses across participants.

[5] A similar experiment on Czech gives rise to the same pattern (Lesage 2022a).

[6] This model had participants' answer as the dependent variable. Fixed effects were the clause type, the possessive proform, as well as their interactions. Random intercepts were included for participant and item.

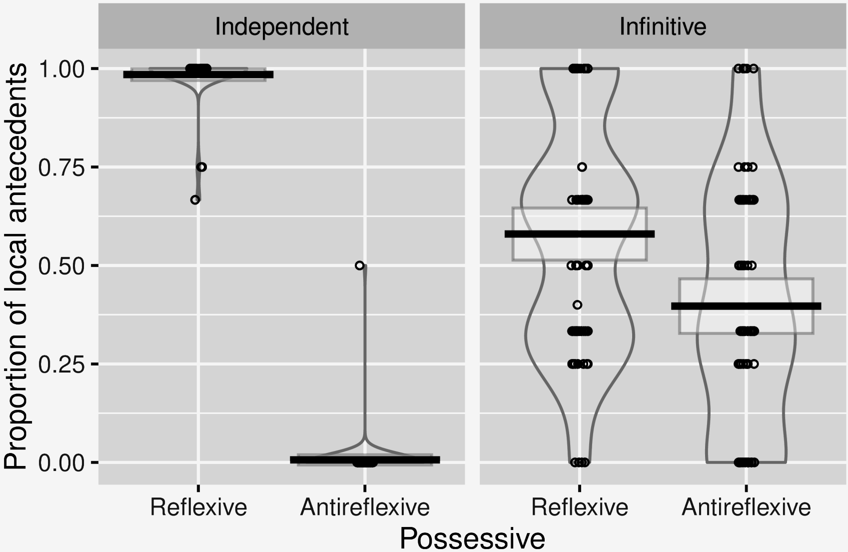

Figure 1 Main results of experiment 1. The horizontal line is the global mean, with the box around it specifying the 95% confidence intervals assuming a normal sampling distribution. Individual points indicate by-participant averages.

2.2 Experiment 2: Binding with non-canonical argument structure constructions

The second experiment focused on binding in a noncanonical argument structure construction, where a nominative argument realizes the stimulus and an allative argument realizes the the experiencer (7). This construction is of particular interest in terms of binding, as both arguments can bind either a reflexive or antireflexive possessive.[7]

(7) ***Katrin*** *meeldi-s* ***Pauli-le*** *[oma/tema õnnetuse-ks].*
Katrin.NOM appeal-3SG.PST Paul-ALL POSS misfortune-TR
'Paul loved Katrin for his/her great misfortune.'

[7]There are other non-canonical constructions in Estonian in which the possessive's binding is atypical (i.e. the reflexive possessive is bound by the oblique argument), but in those constructions the reflexive possessive cannot be bound by the subject and the antireflexive possessive cannot be bound by the oblique argument (Lesage 2022b). They are not relevant for our point.

This unusual behavior is certainly linked to the fact that this construction leads to an unusual mix of properties for the two arguments. Although the nominative argument is clearly the syntactic subject (it is the agreement trigger, the raised argument in a raising construction, and the deleted argument in impersonal constructions), the allative has some properties associated with subjecthood in canonical constructions: it codes the most agentive semantic role, and is most often realized in preverbal position (88% of the time in Metslang's (2013) study), a position associated with topicality in Estonian and otherwise generally occupied by subjects.

In the experiment, we compared this construction to two different baselines: sentences with a transitive verb and an allative argument expressing a beneficiary (8a), and sentences with a transitive psych verb, with a nominative argument expressing the experiencer and a partitive expressing the stimulus (8b). Note that the first baseline is parallel to the construction of interest in terms of the morphosyntactic case of the potential binders, while the second is parallel in terms of semantic roles.

(8) a. ***Paul*** *laena-s* ***Jaani-le*** *ülikonna [oma/tema*
Paul.NOM lend-3SG.PST Jaan-ALL suit POSS
õe pulma-de jaoks].
sister.GEN wedding-PL.GEN for
'Paul lent a suit to Jaan for his sister's wedding.'

b. ***Katrin*** *põlga-s* ***Pauli*** *[oma/tema sotsiaalse*
Katrin.NOM despise-3SG.PST Paul.PART POSS social.GEN
päritolu tõttu].
origine.GEN because
'Katrin despised Paul because of his/her social class.'

In addition to the construction type, we manipulated word order. In Estonian, word order is free but correlates strongly with information structure (Tael 1988), with the preverbal constituent normally constituting a topic. Thus word order preferences could be shifted in the non-canonical argument structure condition of interest, where the oblique argument is a natural candidate for topicality. [8]

[8] Note that the postverbal subject is even more unusual in canonical constructions that the preverbal suject in a non-canonical construction.

ARG-ST	Order	Example
NOM agent,	SX	*Paul laenas Jaanile ülikonna oma/tema õe pulmade jaoks.*
ALL beneficiary	XS	*Jaanile laenas Paul ülikonna oma/tema õe pulmade jaoks.*
(BenAll)		'Paul lent a suit to Jaan for his sister's wedding.'
Question		*Kelle õe pulmadest on juttu?*
		Whose marriage is it about?
NOM experiencer,	SX	*Katrin põlgas Pauli oma/tema sotsiaalse päritolu tõttu.*
NOM stimulus	XS	*Pauli põlgas Katrin oma/tema sotsiaalse päritolu tõttu.*
(ExpNom)		'Katrin despised Paul because of his/her social class.'
Question		*Kelle sotsiaalse päritolust on juttu?*
		Whose social condition is in question?
PART stimulus,	SX	*Katrin meeldis Paulile oma/tema õnnetuseks.*
ALL experiencer	XS	*Paulile meeldis Katrin oma/tema õnnetuseks.*
(ExpAll)		'Paul loved Katrin for her/his great misfortune.'
Question		*Kelle õnnetusest on juttu?*
		Whose misfortune are we talking about?

Table 2 Materials for experiment 2

Each item sentence in the experiment contained a possessive embedded in an oblique dependent of the verb, indicated by brackets in (7) and (8). Two arguments, indicated in boldface, are potential binders for the possessive. For each construction, type of possessive (reflexive vs. antireflexive) and word order (preverbal vs. postverbal subject) were manipulated. Sample materials are shown in Table 2.

Our assumptions were the following.

- Reflexives and antireflexives are in strict complementary distribution in canonical constructions (BenAll and ExpNom) regardless of word order.
- Reflexives and antireflexives are not in complementary distribution in non-canonical constructions (ExpAll). In this type of construction, word order plays a role: the reflexive favors a preverbal antecedent while the antireflexive favors a postverbal antecedent.

Ninety-five native speakers of Estonian recruited on social media took part in a second experiment that focused on simple finite clauses. They were asked to read a sentence and to answer a question about the sentence they had read. This experiment contained twenty-four experimental items and twenty-five fillers.[9]

As the descriptive statistics in Figure 2 illustrate, part of our assumptions are confirmed. We found a nearly complementary distribution in conditions where both the argument structure construction and the word order are canonical. If either argument structure or word order departs from the canon, the categorical distinction becomes a mere tendency. No difference of behavior between the two types of possessives is found when the sentence is noncanonical in both dimensions. A generalized mixed effects model confirmed the significance of the effect.[10]

Note that the proportions of local subject antecedent in canonical configurations are more extreme in the first experiment than in the second one. It does not seem to us that this difference is attributable (only) to the type

[9]As explained above, we take the nominative argument to be the subject in the non-canonical construction.

[10]The model we used had participants' answer as a dependent variable. Fixed effects were the construction type, the possessive proform, the word order as well as their interactions. Random intercepts were included for participant and item.

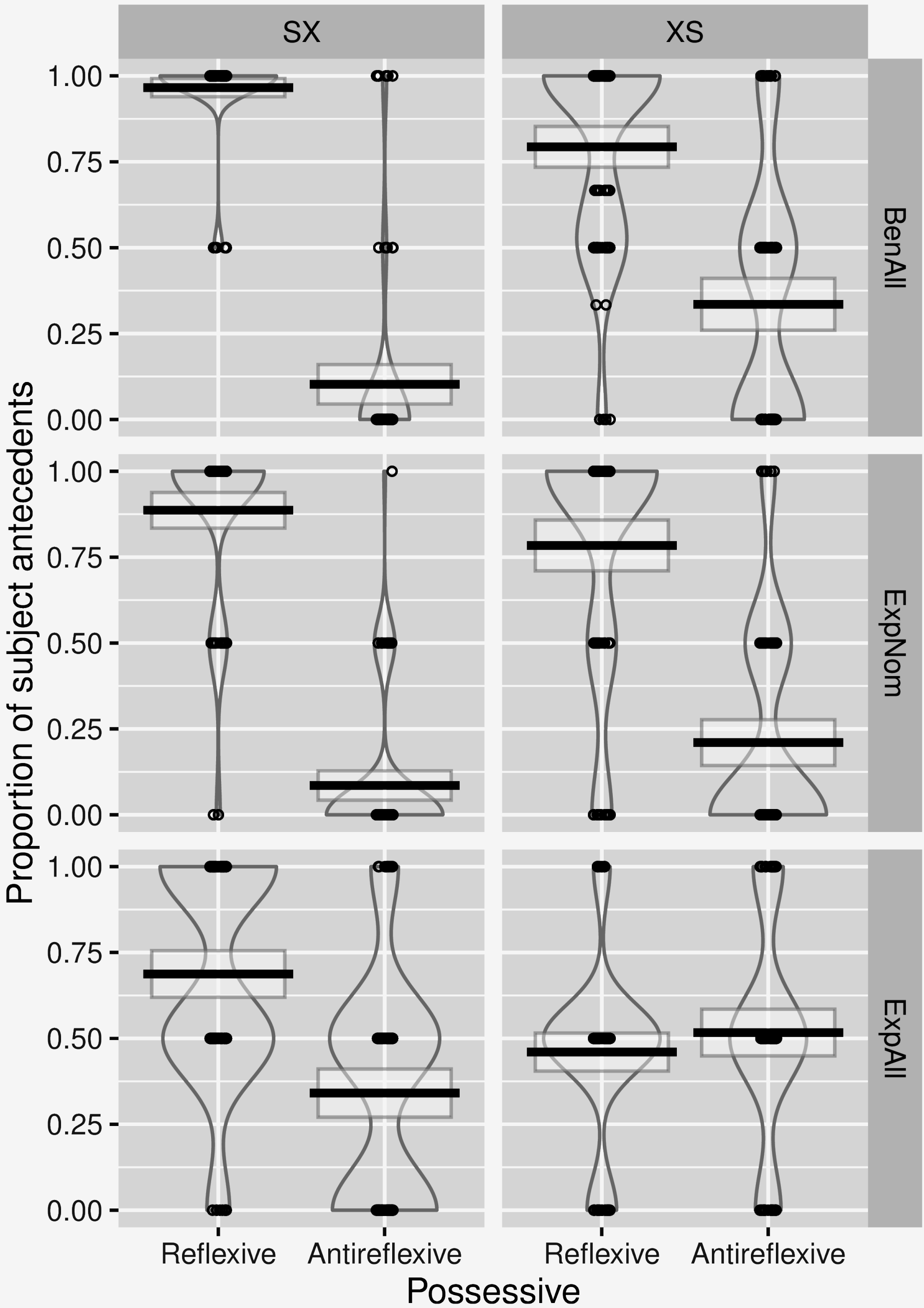

Figure 2 Main results of experiment 2.

of constructions under scrutiny, but rather we think that the nature of the experimental task (answering an open question with a freeform response in experiment 1 and selecting an answer in a list in experiment 2) could lead to this difference.

2.3 Gradient paradigmatic opposition

The experimental results above lead to two striking generalizations. First, while the binding preferences of reflexives and antireflexives do not always lead to a complementary distribution, they are always symmetric: the proportion of choice of one antecedent for the reflexive matches the proportion of choice of the other for the antireflexive. The pattern in the results of experiment 1 or 2 could be the result of chance, but the fact that this pattern is repeated in different constructions of Estonian suggests that it is likely not accidental. In fact, a third experiment on Czech reflexive possessives found the same pattern again (Lesage 2022b). Second, the strength of these preferences varies with the typicality of the syntactic configuration: preferences are maximal in simple finite clauses with a canonical word order and in canonical argument structure constructions; they are weaker for less typical clause types (nonfinite), argument structure constructions, or word orders; these preferences are even unperceivable if the configuration is atypical in more than one dimension.

We take it that these observations must be handled by binding theory, since the same constraints that are categorical and attributed to binding theory in some contexts apply in a gradient manner in other contexts. Our argument is similar to that of Bresnan & Dingare & Manning (2001), who point out a categorical vs. gradient effect of the person hierarchy in passive constructions in Lummi and English. Moreover, as noted above, classical binding theory fails to account for even the categorical aspects of the distribution of antireflexive possessives (see Section 1); hence it needs to be amended anyway, independently of the gradient effects documented above.

To account for the data presented thus far, we appeal to the logic of paradigmatic opposition. We start from the many studies (Bouchard 1983; Yadurajan 1987; Burzio 1996; 1998; Kiparsky 2002; Rooryck & Vanden Wyngaerd 2011) arguing that the symmetric behavior of reflexive and antireflexive expressions should be accounted for with a single mechanism, rather than two independent principles. To this end they posit that the distribution of antireflexives is due to a blocking effect attributable to the ELSEWHERE PRINCIPLE familiar from phonology and morphology (Kiparsky 1973; Anderson 1992): antireflexive forms are used where reflexives forms are not available.

As elegant as it is, this formulation cannot deal with the present data, as it is crucially dependent on reflexives and antireflexives being not only paradigmatically opposed but in complementary distribution. Instead, we submit that an adequate account of binding constraints for Estonian possessives requires replacing binding principles with four ingredients:

(9) a. A characterization of the BINDING DOMAIN for each reflexive proform. In any sentence, we call REFLEXIVE BINDING TARGETS (RBTs) all commanding referential expressions within the binding domain.
b. A statement of the strength of reflexive binding preferences in different syntactic configurations.
c. A paradigmatic pairing of each (collection of) reflexive proforms with matching antireflexive proforms.
d. The SYMMETRIC BINDING PRINCIPLE (SBP), stating that:
In any syntactic configuration, reflexives and antireflexives display symmetric preferences for the binding of RBTs.

The SBP is readily interpreted in probabilistic terms. In a situation where there is a single RBT e that is a reflexive binding target, as with Estonian *oma*, given some sentence frame with a slot containing a proform, the probability of choosing e as an antecedent if the proform is reflexive is the complement of the probability of choosing e if the proform is antireflexive:

(10) $P(e|\text{reflexive}) = 1 - P(e|\text{antireflexive})$

In our two experiments, the experimental items provide two reflexive binding targets e and e' inside the sentence. In the absence of a context, participants are unlikely to consider an extra-sentential antecedent. Hence most of the probability mass will be assigned to the two intra-sentential candidate antecedents. This then leads to the symmetric distribution:

(11) $P(e|\text{refl.}) = 1 - P(e|\text{antirefl.}) \approx P(e'|\text{antirefl.}) = 1 - P(e'|\text{refl.})$

Together these four ingredients provide a general account of gradient binding preferences in the Estonian data. Note that the theory as developed so far accommodates the challenging observations on binding domains for antireflexive possessives discussed in Section 1. Antireflexives do not have a binding domain per se, but have binding preferences matching those of the corresponding reflexive. Hence the behavior of antireflexive possessives follows from that of reflexives: in (4), there is a single reflexive binding target, and hence no possibility for an antireflexive to be bound; in (5), there are two reflexive binding targets splitting the probability mass, hence we correctly predict that antireflexives should be bindable by either.

Finally, while it is designed to account for gradient binding preferences, the theory also encompasses as a special case familiar classical binding theory effects, where the distribution between reflexive and antireflexive is complementary and the reflexive has only one possible antecedent. Consider the case of French object reflexive *se*, which takes the local subject as antecedent in all contexts (unlike what happens in Estonian, English, and many other languages), and antireflexive *le*, which never does. In such a situation, the Symmetric Binding Principle makes exactly the same predictions as Rooryck & Vanden Wyngaerd's account: if $P(e|\text{reflexive}) = 1$, then $P(e|\text{antireflexive}) = 0$.

(12) a. *Paul*$_i$ *se*$_{i/*j}$ *lave.*
Paul REFL wash.PRS.3SG
'Paul washes.'

b. *Paul*$_i$ *le*$_{*i/j}$ *lave.*
Paul 3SG.M wash.PRS.3SG
'Paul washes him.'

c. *Paul*$_i$ *demande à Pierre*$_j$ *de se*$_{j/*i}$ *présenter.*
Paul ask.PRS.3SG to Pierre REFL introduce.INF
'Paul asks Pierre to introduce himself.'

d. *Paul*$_i$ *demande à Pierre*$_j$ *de le*$_{i/*j}$ *présenter.*
Paul ask.PRS.3SG to Pierre 3SG.M introduce.INF
'Paul asks Pierre to introduce him.'

3 Toward a typology of binding constraints

3.1 Not all binding is symmetric

In the last section we argued that a principle of symmetric binding captures both the gradient binding properties of Estonian possessives and the categorical distribution of some reflexive/antireflexive pairs. Importantly though, not all reflexive/antireflexive pairs conform to the principle in all contexts. As a case in point, English reflexives and antireflexives do obey the principle in direct object position, but not when the pronoun occurs in the last of a series of complements, as in (13) (see Pollard & Sag 1992: 266 or Van Valin & LaPolla 1997: 398; for a semantic explanation, see Jackendoff 1972). Here the antireflexive can't refer to the subject, hence $P(\mathit{John}|\mathit{him}) = 0$, but the reflexive has two possible binders. As a consequence, $P(\mathit{John}|\mathit{himself}) < 1$.

(13) John$_i$ talks to Peter$_j$ about himself$_{i/j/*k}$/him$_{k/*i/*j}$.

Likewise, pronouns in adjuncts do not conform to symmetric binding, as we already saw in (3). This time, the subject is the only possible antecedent for the reflexive, so that $P(\mathit{John}|\mathit{himself}) = 1$, but the antireflexive is not barred from taking the subject as an antecedent, so that $P(\mathit{John}|\mathit{him}) > 0$.

These cases clearly indicate that, while symmetric binding needs to be recognized as one type of binding constraint configuration, it does not account for the distribution of all reflexive/antireflexive pairs, and, in fact, fails to account for well-known cases correctly covered by classical binding theory.

3.2 Laying out a typology of binding constraints

At this point, we have witnessed pairs of proforms having three types of distributions. In the first type, exemplified by French *se* and *le*, reflexive and antireflexive are in full complementary distribution. In the second type, exemplified by Estonian possessives, the two proforms satisfy symmetric binding, with the rate of reference to RBTs not lower than 50%, depending on the construction. In the third type, exemplified by English *him* and *himself*, binding constraints are categorical but not symmetric. As a consequence, the two proforms are in complementary distribution in some contexts, but in others one of the two forms has a more constrained distribution than the other.

	Categorical	Gradient
symmetric	French *le* and *se*	Estonian possessives
asymmetric	English *him* and *himself*	?

Table 3 Four configurations of binding constraints for pairs of proforms. 'Categorical' means that at least one of the two proforms under consideration either must or can't be bound by the local subject in some syntactic context.

As Table 3 illustrates, comparison on the three types of systems suggests that two dimensions have to be taken into account to describe the distribution of a pair of proforms: the symmetry of constraints (symmetric for French object pronouns and Estonian possessives, assymetric for English pronouns), and the strength of the constraints (gradient in Estonian, categorical in French and English). This leaves an empty slot for a system that is neither categorical nor symmetric. In the next section we provide evidence that Estonian non-possessive pronouns fill that slot.

3.3 Experiment 3: Gradient asymmetric binding

We ran a third experiment about the interpretation of non-possessive pronouns in simple finite clauses and infinitive complement clauses. We decided to investigate this situation on the basis of informally collected speaker judgements. According to these, we have the expected complementary distribution in simple finite clauses: in (14), reflexive *endast* needs to be bound by the local subject, while antireflexive *temast* can't. On the other hand, in infinitive complement clauses, judgements are different: in (15), reflexive *endast* can readily be bound either by the local subject (*Paul*) or the matrix subject (*Katrin*), but speakers disagree on whether the local subject can bind antireflexive *temast*. This leads us to expect to find nonsymmetric binding constraints in infinitive complement clauses.

(14) a. ***Katrin***$_i$ *avalda-s* *oma* *arvamus-t.* ***Paul***$_j$
Katrin.NOM open-3SG.PST REFL.POSS opinion-PART Paul.NOM
rääki-s *enda-st*$_{*i/j}$ *liiga palju.*
talk-3SG-PST REFL-ELA too much
'Katrin gave her opinion. Paul talked too much about himself.'

b. ***Katrin***$_i$ *avalda-s* *oma* *arvamus-t.* ***Paul***$_j$
Katrin.NOM open-3SG.PST REFL.POSS opinion-PART Paul.NOM
rääki-s *tema-st*$_{i/*j}$ *liiga palju.*
talk-3SG-PST 3SG-ELA too much
'Katrin gave her opinion. Paul talked too much about her.'

(15) a. ***Katrin***$_i$ *soovita-b* ***Pauli-l***$_j$ *töövestluse*
Katrin.NOM advice-3SG.PRS Paul-ADE job.interview.GEN
jooksul mitte liiga palju *enda-st*$_{i/j}$ *rääki-da.*
during NEG too much REFL-ELA talk-INF2
'Katrin advises Paul not to talk too much about her/himself during the job interview.'

b. ***Katrin***$_i$ *soovita-b* ***Pauli-l***$_j$ *töövestluse*
Katrin.NOM advice-3SG.PRS Paul-ADE job.interview.GEN
jooksul mitte liiga palju *tema-st*$_{i/??j}$ *rääki-da.*
during NEG too much 3SG-ELA talk-INF2
'Katrin advises Paul not to talk too much about her/??himself during the job interview.'

Sixty native speakers of Estonian recruited on Prolific[11] (mean age: 26,5 years, median age: 25) took part in this third experiment. They were paid 4€ and the experiment lasted 20 minutes on average. We manipulated two variables: the finiteness of the embedded clause (finite vs. infinitive) and the type of proform (reflexive vs. antireflexive). The experiment had four conditions, shown in Table 4. The experiment contained 20 experimental items and 43 fillers. The fillers consisted of pairs of sentences. The second sentence contained a proform referring to one element mentioned in the previous sentence. In some sentences, there were two semantically and morphologically possible antecedents for the proform (as exemplified in (16a)). For some other fillers, the proform in the second sentence had only one semantically possible antecedent (as exemplified in (16b)). The experiment started with three training items to allow participants to get used to the task. The sentence was followed by a question eliciting the referent of the proform. As in experiment 1, participants had to write the answer in a freeform text box.

[11] `prolific.co`

Clause type	Proform	Example
Independent	Reflexive	*Katrin avaldas oma arvamust. Paul rääkis endast liiga palju.*
	Antirefl.	*Katrin avaldas oma arvamust. Paul rääkis temast liiga palju.* 'Katrin gave her opinion. Paul talked too much about her/himself.'
Infinitive	Reflexive	*Katrin soovitab Paulil töövestluse jooksul mitte liiga palju endast rääkida.*
	Antirefl.	*Katrin soovitab Paulil töövestluse jooksul mitte liiga palju temast rääkida.* 'Katrin advises Paul not to talk too much about her/himself during the job interview.'
Question		*Kellest räägitakse/räägiti?* 'Who is being talked about?'

Table 4 Materials for experiment ”

(16) a. ***Andrus*** *peit-is* ***Jaani****.* *To-l* *aja-l*
Andrus.NOM hide-3SG.PST Jaan.GEN this-ADE time-ADE
ol-i ***ta*** *sõdur.*
be-3SG.PST 3SG.NOM soldier
'Andrus hid Jaan. At this time, he was soldier.'

b. *Ma* *võt-s-in* *looma-de* *varjupaiga-st* ***kassi****,*
1SG.NOM take-PST-1SG animal-GEN.PL shelter-ELA cat.GEN
mitte ***koera****.* ***Tema*** *eest tule-b* *hoolitse-da.*
NEG dog.PART 3SG.GEN of need-3SG.PRS take_care-INF
'I took from an animal shelter a cat, not a dog. It needs to take care of it.'

Figure 3 confirms informal judgements. In simple finite clauses, reflexives and antireflexives are roughly in complementary distribution in simple clauses, although the reflexive was interpreted as free in a nontrivial number of cases (5%).[12] In infinitive complement clauses, the proportion of local

[12]Surprisingly, this proportion is higher than what we found for reflexive possessive in experiment 1 (see Figure 1). This is unexpected, as binding constraints on non-possessives

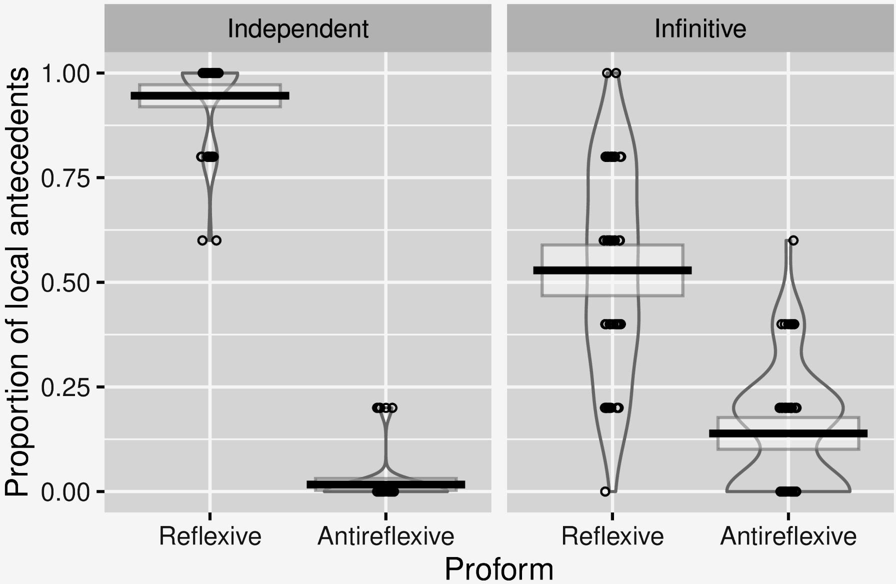

Figure 3 Main results of Experiment 3.

antecedents is higher for reflexives than for antireflexives, as it was for possessives in Experiment 1. However the distribution is not symmetric: only 51% of reflexives are bound by the local subject, whereas 86% of antireflexives are bound by the matrix subject.

We have thus provided clear empirical evidence that binding constraints can be asymmetric and gradient at the same time, filling the last slot of the typology in Table 3.

4 Conclusion

In this paper, we first showed that classical binding theory fails to describe the use of some proforms. More precisely, principle B does not capture the distribution of antireflexives in infinitive complement clauses in Estonian.

We then showed that Estonian possessives are subject to gradient constraints in some contexts. Our observations here contrast with previous work on the role of non-categorical preferences in binding. For example,

are generally stricter than those on possessives. Be that as it may, this does not affect the point at hand.

Keller (2000) observes gradient effects of factors orthogonal to those that classical binding theory focuses on (lexical semantics and definiteness). We on the other hand document gradient effects of the locality of the syntactic relationship between proform and binder, the bread and butter of binding theory.

We furthermore showed that, although the strength of binding constraints on Estonian possessives vary across constructions, they always exhibit symmetric binding: reflexive and antireflexive possessives exhibit complementary binding preferences. We sketched a version of binding theory encompassing a probabilistic symmetric binding principle, and accounting for all three observations.

Finally, we outlined a typology of systems of pairs of proforms on the basis of the kinds of binding constraints they fulfill: these can be symmetric or asymmetric, categorical or gradient. Classical binding theory focuses on categorical constraint alone, and reduces the symmetric/asymmetric distinction to whether the reflexive and antireflexive have the same binding domain. We provided empirical evidence from Estonian that the two kinds of systems of gradient binding constraints are attested, which calls for an overhaul of binding theory.

The present study opens up at least two avenues for future research. First, we need to better understand the interplay between gradient binding constraints in production and comprehension. Because of its categorical nature, classical binding theory is agnostic to production and comprehension: the same constraints are readily interpreted as dictating what form can be used to express the intended coreference, and which antecedents are available for a given form. As soon as we recognize gradient constraints, agnosticism is not warranted anymore: $P(\mathit{form}|\mathit{meaning})$ need not be the same as $P(\mathit{meaning}|\mathit{form})$. Production studies parallel to the comprehension experiments reported in this paper would be needed to find out whether production binding constraints match their comprehension counterparts. The corpus study reported in Lesage & Bonami (2019) suggests that they don't: that study found that speakers seldom use an antireflexive bound by an allative experiencer, while the second experiment in the present paper found that the corresponding interpretation was more common.

Second, the relative strength of binding constraints warrants a more detailed look. Experiments 1 and 2 suggested that the more ordinary the syntactic context is, the stronger binding constraints are: simple finite clauses lead to stronger constraints than embedded infinitives; canonical transitive constructions lead to stronger constraints than noncanonical constructions with mixed subject properties; and default SX word order leads to stronger constraints than marked XS order. These binding preferences may be a consequence of the familiarity of speakers with different construction types: in the same way as more familiar items, like canonical simple clauses, lead to sharper acceptability judgements (Divjak 2017), more familiar syntactic configurations lead to stronger preferences for binding.

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Pragmatic filtering and presupposition projection

Jon Ander Mendia

Abstract The so-called satisfaction theories of presupposition propose weak presuppositions that are then pragmatically strengthened under to-be-determined conditions. The opposite view, pioneered by Gazdar (1979) and van der Sandt (1988), contends instead that presuppositions are semantically strong but can nevertheless be also canceled under to-be-determined conditions. This paper explores two ideas: (*i*) one such case of cancellation can be restated in terms of pragmatic weaking, in the sense that presuppositions do not project if, in doing so, the speaker would declare that they hold an inconsistent epistemic state; (*ii*) presuppositions that fail to be inherited wholesale by the sentence may nevertheless project conditionally—as suggested by satisfaction theories—provided certain contextual conditions are met.

Keywords presupposition · projection · proviso problem · pragmatics

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1 Introduction

Presuppositions project: they have the ability to "escape" unaffected from the scope of a variety of operators, including negation, modal verbs, conditionals, questions, etc.

(1) a. Kipchoge has not stopped running.
b. It is possible that / Perhaps Kipchoge has stopped running.
c. Sam believes/thinks that Kipchoge has stopped running.
d. If Kipchoge has stopped running, he must be really tired.
e. If Kipchoge is tired, he will stop running.
f. Has Kipchoge stopped running?
$\rightsquigarrow$ *Kipchoge was running.*

All the examples in (1) have in common that the sentence as a whole has somehow inherited the meaning that *Kipchoge was running*, "triggered" by the verb *stop*, an ability that *stop* shares with a rich variety of lexical expressions, such as some aspectual as well as factive verbs, definite and possessive

DPs, particles such as *too* and *again* among many others. Such pervasive behavior inspired the well-established conception of presuppositions as propositional content whose truth the speaker takes for granted for the purposes of the conversation (Stalnaker 1973; 1974).

The main complication to provide a general account of presupposition projection is that presuppositions of compound sentences do not follow a homogeneous projection pattern (Langendoen & Savin 1971). Most notably, presuppositions triggered in the consequent of a conditional or the second disjunct of a disjunction—among others—are varyingly inherited by the complex sentence: none of the sentences in (2) carry the presupposition that *Kigchoge was running* anymore, despite containing the same proposition that triggered it in (1):

(2) a. If Kipchoge is participating, he will stop running.
b. Either Kipchoge isn't running, or he has stopped running.
$\not\rightsquigarrow$ *Kipchoge was running.*

In such cases, instead of being inherited wholesale by the full sentence, the "failed" presupposition is assumed to adopt a weaker, "conditionalized" form: e.g. for a proposition of the form $A \rightarrow B_p$, where p is the presupposition carried by the consequent B, the perceived presupposition is not p itself but $A \rightarrow p$.

(3) If Kipchoge is participating, then he was running.

The challenge is, thus, "to predict the presuppositions of complex sentences in a compositional fashion from the presuppositions of their parts" (Heim 1983: 114). This challenge is yet to be fully met. The majority of theories—with the possible exception of DRT-based theories such as van der Sandt (1992) and Krahmer (1996)—make the wrong predictions when dealing with this lack of homogeneity in presupposition projection patterns. These include so-called satisfaction theories like Stalnaker (1973; 1974); Karttunen (1974); Heim (1982; 1983); Beaver (2001); von Fintel (2008), plugs, holes and filters (Karttunen 1973), multivalent theories (van Fraassen 1969; Karttunen & Peters 1979; George 2008; Fox 2012), cancellation theories (Gazdar 1979; Soames 1982; van der Sandt 1988) and others (Schlenker 2008; Chemla 2008).

This paper presents an investigation of the idea that there are general, construction independent principles acting against presupposition projection. This is an essentially contextualist view on projection, supporting the notion, exposed at length below, that one cannot determine the presuppositions that project in a vacuum, out of context—in line with recent work on presupposition, and projection in general; see e.g. Simons et al. (2011) et seq. More concretely, the main goal is to explore the idea that existing general pragmatic pressures towards preserving the speaker's epistemic coherence act against presupposition projection in cases that, otherwise, would lead the speaker to declare that they hold an inconsistent epistemic state. This general principle, which we will refer to as *Epistemic Defensibility*, helps in turn define a particular set of "inadmissibility" conditions on presupposition projection.[1]

The plan for the rest of the paper is the following. Section 2 provides some background discussion, with a focus on the main pragmatic reactions to the projection problem, and introduces the main conceptual underpinnings of the paper. These are based on the Stalnakerian notion of assertion as update of the common ground and the Stalnaker/Karttunen treatment of presuppositions as constraints on the common ground.[2] Section 3 revisits and quickly comments on Karttunen (1974)'s observation that the presuppositions of compound sentences are not fixed, but instead depend on properties of the context in which they are uttered (a discussion that is based mostly on Francez 2018). Section 4 introduces Epistemic Defensibility as a general pragmatic principle sanctioning (at least some of) presupposition projection in a framework where, all else equal, presuppositions are expected to project by default. Section 5 discusses the fate of those presuppositions that failed to project and argue as well as discuss some seemingly problematic cases for

[1] In this sense, the paper fits naturally within the body of literature that has been trying to identify factors that regulate presupposition projection. Unlike much recent experimental work, however, the proposal presented here has nothing to say about the factors that modulate the "strength" of projection; see Tonhauser & Beaver & Degen (2018) for an overview of such factors. In this paper we limit the discussion to the contextual (local or global) conditions that allow projection in the first place, and to the factors leading to the weakening of global projection there where it is not found.

[2] What matters here is that Stalnaker and Karttunen both think of presuppositions as pre-conditions on input contexts. They do not share exactly the same view, but here and throughout the paper I will ignore such differences.

Epistemic Defensibility. Section 6 discusses outstanding empirical problems that remain and briefly concludes by assessing the resulting state of affairs.

2 When and how to project

2.1 Weakening vs. strengthening

Simplifying somewhat, there have been two general types of reactions to the issue of presupposition projection, taking opposing views on what the semantic "strength" of presuppositions is supposed to be, and then supplementing such semantic conceptions with additional pragmatic constraints on projection. For the sake of the argument, we may summarized them as follows:

(4) a. **Weakening**
Presuppositions project by default, may then be pragmatically weakened (or canceled).

b. **Strengthening**
Presuppositions do not project by default, then may be pragmatically strengthened.

A position like (4a) is endorsed most notably by Gazdar (1979) and van der Sandt (1988). According to this strand of theories, presuppositions project by default, unless they encounter some pragmatic principle acting against them and effectively blocking them from projecting wholesale. The assumption that presuppositions project by default is often referred to as the *Cumulative Hypothesis*. For instance, according to Gazdar (1979), the reason why neither sentence in (2) presupposes that Kipchoge was running has to do with the fact that such presuppositions are not compatible with general conversational assumptions necessary for the sentences to be felicitous utterances. And, in fact, it would be rather odd to utter e.g. (2a) in the eventuality that the speaker knew that Kipchoge was running.

These types of accounts are appealing because the cancellation of presuppositions is dictated by general conversational principles aiming at maintaining consistency and thus do not rely on idiosyncratic construction-specific properties of particular constructions, such as conditional statements in this case. Nevertheless, such approaches have been heavily criticized on the basis of data like the following (from Heim 1983):

(5) a. If John has children, then Mary will not like his twins.
b. If John has twins, then Mary will not like his children.

(6) a. If John used to smoke (heavily), then John stopped smoking.
b. Either John didn't use to smoke (heavily), or he stopped smoking.

A sentence like (5a) is a bit odd out of context. Intuitively, or so it has been claimed in the literature, at the source of this oddness lies a clash between two seemingly inconsistent implications: the speaker is both taking for granted (i.e presupposing) that John has twins while at the same time calling into question (through the ignorance implicature of the antecedent of the conditional), that John has children. A cancellation account of presupposition projection like Gazdar (1979)'s predicts therefore that (5a) presupposes nothing, since there is indeed a general conversational principle being violated. Similarly, (5b) is felt to presuppose nothing, but since the sentence is in violation of no general conversational principle, cancellation accounts such as (4a) predict that indeed (5b) presupposes that John has children.

Examples like those in (6) provide a second type of challenge for cancellation accounts (first noted by Soames 1982). The variants without the modifier *heavily* are not felt to presuppose that John used to smoke and this is correctly captured by these theories, since doing so would lead to the conclusion that the speaker is implicating and presupposing inconsistently. These inconsistencies are removed by the presence of the modifier *heavily*, and so these variants are expected to presuppose that John used to smoke. The presuppositions, however, do not suddenly reappear.

Partly because of issues such as these, the most prominent response to the projection problem aligns with the second option (4b), which takes the opposite view to that of cancellation theories: presuppositions are predicted to convey weak "conditionalized" presuppositions that, under certain circumstances, may be strengthened so as to be inherited wholesale by the full sentence. This strand of theories are typically referred to as (local) *satisfaction* theories (see discussions in Beaver 2001; von Fintel 2008). For instance, these theories explain why the presupposition of the consequent does not project in (2a): the presupposition that Kipchoge is running triggered by the factive verb *stop* in the consequent is *locally* entailed by the antecedent Kipchoge is participating, whereas this relation does not obtain in say (1e). For these theories, presuppositions must be satisfied in their local contexts:

(7) **Local satisfaction**
A presupposes whatever is required to ensure that A's constituents have their presuppositions locally entailed in C.[3]

For satisfaction theories presuppositions do not project by default because they are semantically weak. For the sake of illustration, suppose we have a conditional statement of the form $A \rightarrow B_p$ where p is a presupposition carried by B. The global context of the whole statement is C, but the *local* context of the consequent B_p is indeed the result of adding the antecedent to C, $C \cup \{A\}$.[4] The requirement for a context to satisfy a presupposition is thus that $C \cup \{A\} \vDash p$. But since $C \cup \{A\} \vDash p \equiv C \vDash A \rightarrow p$, satisfaction theories effectively predict that *any* conditional statement, all else equal, will carry a conditional presupposition.

It is not rare however to find discrepancies between the presuppositions carried by some sentence and the conditional presuppositions predicted by satisfaction theories. This is the so-called *Proviso Problem*: "the satisfaction theory often predicts presuppositions of the form $A \rightarrow p$, where the intuitively perceived presupposition is simply p" (Geurts 1996: 260). For instance, in a context where the global context C does not entail that John has a sister, (8a) below is predicted to presuppose the conditional (8b), instead of the simple presupposition in (8c):

(8) a. If John has free time this afternoon, he'll pick up his sister at the airport.
b. If John has free time this afternoon, he has a sister.
c. John has a sister.

The proposed solution in these cases is again opposite to that of cancellation theories: a theory of pragmatic strengthening is invoked that, in addition to the conditionalized presupposition, permits the sentence to inherit the simple, unconditionalized presupposition. The main line of reasoning goes as follows: a conditional such as (8a) is strange in the sense that there seems to be little connection (either logical, causal, etc.) between antecedent

[3]For discussion of what counts as local entailment, see Schlenker (2009), Rothschild (2015) a.o.

[4]This feature makes such theories dynamic and thus the meanings of the sentential connectives requires of some special non-classical treatment.

and consequent. It is then plausible, on general grounds based on world knowledge, that if a speaker is assuming (8a), it must be because they are also presupposing the truth of some stronger statement that entails it, like (8c) in the case of (8a). The exact justification for why such strengthening processes should appear varies from author to author, but they typically follow a similar schema: if the presupposed content p relates *in the relevant way* to the antecedent A, then the conditional presupposition $A \rightarrow p$ is left untouched and no strengthening is expected. If, on the contrary, A and p are not related in the relevant way, strengthening from $A \rightarrow p$ to p is both possible and expected. The critical relation that must hold between the antecedent A and the presupposed content p has been suggested to be one of likelihood (i.e. that A increases the likelihood of p), plausibility, relevance, etc.[5]

The two approaches we have sketched above share the core assumption that pragmatic processes must be invoked in order to fully capture projection patterns of presupposition; on their own neither the Cumulative Hypothesis nor satisfaction theory provide empirically correct semantic presuppositions. Nevertheless, they differ in the fundamental, default nature of presuppositional content and thus on the pragmatic processes involved in each case: while cancellation theories require pragmatic weakening, satisfaction theories require strengthening. These differences come with important conceptual distinctions as well. For one, the main idea behind cancellation theories is remarkably simple and does not require any additional assumptions, other than identifying the correct pragmatic agents sanctioning presupposition projection. On the other hand, satisfaction theories have been criticized for providing a treatment of sentential connectives that is not explanatory (see Soames 1982, Schlenker 2008); for instance, in the particular account of Heim (1983) the projection properties of connectives must be stipulated and hardwired for each binary connective on a case-by-case basis. Instead, cancellation theories use over-arching principles of well-formedness and felicity in conversation, as Gazdar (1979).

It is in the context of this state of affairs that the present contribution must be framed. It is not the mission of this paper to provide a theory of presupposition, nor is it the plan to attempt an all encompassing account for all

[5] For discussion see Beaver 2001, Singh 2007; 2009 Schlenker 2011, Lassiter 2012, a.o.

cases of projection, including a solution to the proviso problem. Instead, the focus here is on identifying and understanding the overarching factors—if any—that enter into consideration when a presupposition fails to project; i.e. to identify general construction- and trigger-independent constraints against presupposition projection. If we manage to identify such factors external to the theory of presupposition, we may help remove some explanatory onus from the theory of presupposition itself, leading to a more comprehensive understanding of the phenomenon. With this general research program in mind, the specific goal of this paper is to explore how pragmatic pressures, in particular the pragmatic pressure towards conserving the speaker's epistemic coherence, affect the projection of presuppositions carried by compound sentences.

2.2 Common ground, presupposition and context

Here is a very general and widespread characterization of the role of presuppositional content in discourse. Assume with Stalnaker (1973; 1974) that to presuppose something is to hold a propositional attitude with respect to the content that is being presupposed:

> "[a] proposition is presupposed if the speaker is disposed to act as if he assumes or believes that the proposition is true, and as if he assumes or believes that his audience assumes or believes that it is true as well." (Stalnaker 1978: 328)

This is a speaker oriented notion of presupposition. In presupposing a proposition ϕ, speakers act as though hearers believed ϕ, irrespective of whether ϕ was indeed part of the speaker's context set—the set of worlds where all propositions in the context are true according to the speaker. In this respect, we may say that the utterance of some proposition ϕ presupposes p if the felicity of such an utterance requires a context in which the mutual assumptions of the agents partaking in the conversation—i.e. the *common ground*—already include p. In other words, presuppositions are constraints on input contexts.

In this framework, the problem of presupposition projection involves figuring out what propositions must be present in the context that precedes the utterance of the proposition (or discursive exchange) carrying the presupposition triggers under consideration. This amounts to the so-called *Stalnaker's bridge* (von Fintel 2008):

(9) **Stalnaker's bridge**
If A presupposes p in C, then A can only be felicitously asserted in C if C entails p.

If we factor in considerations of compositionality, finding a solution to the projection problem requires determining the conditions that compound sentences impose on the common ground as a function of the conditions that their parts do.

3 On satisfying presuppositions

Generally speaking, Karttunen (1974) agreed with the general view presented above in that he took presuppositions to impose some form of precondition on the interpretability of a sentence. But he did something else too: he connected this view that presuppositions impose preconditions on interpretability to the problem of projection by highlighting that what (at least some) compound sentences presuppose is not fixed, but depends instead on properties of the context in which they are uttered. His critical examples are the following:[6]

(10) a. If Dean told the truth, Nixon is guilty too.
$\rightsquigarrow$ *Someone other than Nixon is guilty*
b. If Haldeman is guilty, Nixon is guilty too.
$\not\rightsquigarrow$ *Someone other than Nixon is guilty*

(11) If Miss Woods destroyed the missing tapes, Nixon is guilty too.

(12) Someone other than Nixon is guilty…
a. $\rightsquigarrow$ *if* destroying tapes is a crime
b. $\not\rightsquigarrow$ *if* destroying tapes is **not** a crime

What is remarkable about this is that Karttunen (1974) managed to show how it is possible to determine when a context might satisfy the presuppositions of a conditional without actually committing to what exactly those

[6]The relevant context here lies in the details of the investigation concerning the Watergate scandal that lead to U.S. president Richard Nixon's resignation in 1974.

presuppositions are. This is an important observation, since it opens the door to the possibility of accounting for the empirical observations about projection without actually having to state a theory of projection, i.e. without having to commit ourselves to a theory where the presuppositions of a compound sentence can be predicted *only* on the basis of the presuppositions of its parts. The corollary is that one should not commit oneself to a theory of presuppositions that predicts what projects out of compound sentences independently of context. For instance, for conditional statements Karttunen summarized his insight in the following notion of satisfaction:

(13) **Satisfaction**
Context X satisfies-the-presuppositions-of $A \rightarrow B$ just in case (i) X satisfies the presuppositions of A, and (ii) $X \cup A$ satisfies-the-presuppositions-of B.

The burden is now shifted from predicting what some expression ϕ presupposes to predicting what it takes for a context to satisfy an expression ϕ carrying such-and-such presuppositions. In the case of the conditional above, a context C satisfies the presuppositions of conditional $A \rightarrow B_p$ in exactly the following kinds of contexts:

(14) a. $C \vDash p$
b. $C \nvDash p$ but $C \cup A \vDash p$
c. $C \vDash A \rightarrow p$

These are the *miniminal conditions* for a context to satisfy the presuppositions in the consequent of a conditional statement; i.e. they are the *admisibility conditions* of $A \rightarrow B_p$. But it is important to note that saying that presuppositions are admissibility conditions does not merit the conclusion that e.g. $A \rightarrow p$ in (14c) *is the* presupposition of $A \rightarrow B_p$. What counts as the actual presupposition of a conditional is itself context dependent, as illustrated above in (10)/(11). The bottom line is that we should be able to state when presuppositions are satisfied without making any context independent predictions about what exact form those presuppositions take.

The question of when a conditional requires a context of type $C \vDash p$ or type $C \nvDash p$ but $C \cup A \vDash p$ is a related but not identical question to the projection problem. It is the problem of accounting for the ways in which the context, in its most wide conception, determines (at least partly) what an expression presupposes.[7] That is precisely what this paper attempts to do. Rather than asking what explains the lack of presupposition projection (e.g. in cases like (2)), in this paper we ask the following question: Are there "inadmissibility" conditions that we can identify that regulate presupposition projection from complex sentences?

The rest of the paper is devoted to show that there are reasons to believe that the answer is affirmative. In particular, we explore the idea that the result of the update process with respect to some context C must be *epistemically defensible*: if the speaker uttered some sentence ϕ, the presupposition p of ϕ may not project if in doing so the speaker would declare that they hold an inconsistent epistemic state.

4 Epistemic Defensibility

In this section we shall explore a view of the variable projection of presuppositions from compound sentences that takes the unconditional presupposition as basic. The conceptual underpinnings of such an approach have already been mentioned in Section 1 and Section 2. Refining a Gazdar (1979)-style Cumulative Hypothesis, we follow the intuition that presuppositions fail to project because of general, all purpose and presupposition-independent conversational principles: echoing Beaver & Geurts & Denlinger (2021)'s words, presuppositions project globally unless they "cause pragmatic embarrassment."

For the purposes of this paper we focus solely on one such case of pragmatic embarrassment: that where speakers, by virtue of admitting that a certain presupposition is known, declare that their epistemic state is inconsistent. The gist of the idea is the following: if speaker S is ignorant about proposition ϕ, a complex sentence will not presuppose ϕ, since, if it did, the speaker would have to be assumed to hold an inconsistent epistemic state.[8]

[7]Accounts that have attempted to answer this question rely typically on pragmatic considerations related to e.g. the conditional independence of p relative to A (van Rooij 2007), plausibility (Beaver 2001), likelihood (Lassiter 2012), etc.

[8]Beyond Gazdar (1979) and other canceling accounts, the idea that ignorance attributed to the speaker may bleed global projection is also explicitly mentioned by Abusch (2010), who already noted that presuppositions in the consequent of a conditional may be cancelable by "a discourse context which explicitly expresses ignorance." (Abusch 2010: 39).

The only ancillary assumption required is that speakers may not declare themselves to hold inconsistent epistemic states (cf. Moore's paradox). We shall call such pragmatic condition *Epistemic Defensibility*:

(15) **Epistemic Defensibility**
A context cannot satisfy a presupposition if it leads to an inference that the speaker holds an inconsistent epistemic state.

I discuss here conditional statements, an environment where we can identify the effect of inconsistent epistemic states in presupposition projection.

In order to advance our understanding of the projection problem, a theory of presupposition projection relying on default global projection patterns that may nevertheless be pragmatically weakened must propose at least two things: (*i*) when exactly presuppositions fail to project globally, and (*ii*) what happens to those presuppositions that fail to project. This section is concerned with the first of these questions, the second is addressed in Section 5. I begin first by introducing some background assumptions.

As was pointed out earlier, we may say that *semantic* presuppositions (i.e. conventionally associated to certain lexical items) are *pragmatically* constrained: a conversational context C is understood as the set of possible worlds compatible with the common ground CG, the set of propositions presumed to be known among all participants in a conversation. Assume thus that Stalnaker's bridge in (9) holds. Failing to obey this principle by *overtly* presupposing a proposition p not entailed by C threatens to make the context defective in the sense that the speaker presupposes something that others do not—assuming we are dealing with an informative statement by a cooperative speaker, etc. Given the make-up of CG it is only natural to assume that the set of worlds compatible with the knowledge (or beliefs) of any one speaker S in the conversation, ES_S, is strictly greater than CG, and thus $p \in C \wedge p \notin ES_S$ is inconsistent. I use the epistemic operator K (Hintikka 1962) to represent speakers' epistemic states: $\mathsf{K}_S[\phi]$ stands for *speaker S knows that* ϕ.[9] Thus, if $\mathsf{K}_S[p]$, then $p \in ES_S$—but whether $p \in CG$ is a mere contingency. A speaker is said to hold an inconsistent epistemic state if for some set of propositions $\{\phi_1, \ldots, \phi_n\}$, $\mathsf{K}_S[\phi_1 \wedge \ldots \wedge \phi_n]$ is inconsistent.

[9]The proposal is presented in terms of a speaker's epistemic rather than doxastic states, but nothing goes wrong by appealing to the latter.

Speakers uttering (non-counterfactual) conditionals $A \rightarrow B$ often convey that A is a mere *supposition*, and thus they signal that they cannot settle whether A is the case: either because they are uncertain, $\neg\mathsf{K}_S[A]$, or ignorant of A, $\neg\mathsf{K}_S\neg[A] \wedge \neg\mathsf{K}_S[A]$. A proposition A is settled for S *iff* the epistemic state of S, ES_S, is such that it either entails A (and thus $\mathsf{K}_S[A]$) or $\neg A$ (and thus $\mathsf{K}_S\neg[A]$). Thus, by uttering $A \rightarrow B$ the speaker signals that both A and $\neg A$ are compatible with their epistemic state.

In what follows I consider systematically a number of case studies with different relations between the antecedent and a presupposition in the consequent of conditional statements. I show that the account defended here in terms of epistemically admissible states makes a good number of successful predictions.[10] Moreover, the most problematic cases we encounter, as discussed below in Section 6, turn out to be problematic also for theories of presupposition like (4b) above, relying on weak conditionalized presuppositions supplemented with pragmatic strengthening processes.

4.1 Case 1: $A \rightarrow B_p$ and $A \nVdash\nvDash p$

Before dealing with more interesting cases,[11] notice that the seemingly problematic cases for local satisfaction theories relying on pragmatic weakening follow naturally and without further assumptions from the approach defended here. We repeat from above:

(16) If John has free time this afternoon, he'll pick up his sister at the airport.

Here no epistemic clash exists between the antecedent in that *John has time this afternoon* and the presupposition in the consequent that *John has a sister*. This is to say that the set $\mathsf{K}_S(\{A, p\})$ for antecedent A and presupposition p is epistemically defensible given their logical independence. Thus, lacking a good pragmatic reason not to do so, such presuppositions invariably project globally.

[10] To be clear, these need not be either problematic or even necessarily pose an argument against satisfaction-style theories.

[11] The doublesided turnstile symbol '$\nVdash\nvDash$' expresses that neither A entails p nor p entails A.

4.2 Case 2: $A \to B_p$ and $p \vDash A$

Suppose that a speaker S uttered a sentence of the form $A \to B_p$ where p is a presupposition carried by B and $p \vDash A$. Since by assumption $p \in CG$ and $CG \subseteq ES_S$, it follows that $\mathsf{K}_S[p]$. Moreover, since $p \vDash A$, it follows that $\mathsf{K}_S[A]$. But $\mathsf{K}_S[A]$ contradicts the ignorance of A conveyed by S's uttering of $A \to B_p$: $\neg\mathsf{K}_S[A] \wedge \mathsf{K}_S[A] = \bot$. Thus, uttering $A \to B_p$ where $p \vDash A$ is epistemically indefensible, and so p must not project. We illustrate this the contrast between (1e) and (2a), repeated below:

(17) a. If Kipchoge is tired, he will stop running.
b. If Kipchoge is participating, he will stop running.

In the case of (17b) above, the speaker conveys that they lack knowledge about the truth of the antecedent, $\neg\mathsf{K}_S[\textit{Kipchoge is participating}]$, and the consequent presupposes that *Kipchoge is running*, $\mathsf{K}_S[\textit{Kipchoge is running}]$. Since $\mathsf{K}_S[\textit{Kipchoge is running}] \subseteq \mathsf{K}_S[\textit{Kipchoge is participating}]$ and moreover $\neg\mathsf{K}_S[\textit{Kipchoge is participating}] \wedge \mathsf{K}_S[\textit{Kipchoge is participating}] = \bot$, the prediction is that the presupposition should not project. In contrast, this is not a problem for (17a), where the descriptive content of the presupposition is merely contingent with the speaker's epistemic state. In other words, the urge to preserve the speaker's epistemic state consistent trumps the possibility of taking the speaker to presuppose p in the context. Presuppositions do not fail to project because they are entailed in their local context, but because they lead to indefensible epistemic states. (I discuss what happens to p in Section 5.)

Above we mentioned a problematic instance of this case for so-called cancellation theories, (5a) repeated below:

(5a) If John has children, then Mary will not like his twins.

The consensus seems to be that the oddness of (5a) results from the clash between the presupposition p that *John has twins* and the implication that the speakers does not know whether John has children. Clearly, this is *prima facie* problematic for Epistemic Defensibility which, all else equal, would predict that p should not project.[12] Where did Epistemic Defensibility go wrong?

[12]In fact, an anonymous reviewer suggests that the same is true of (17b), as long as they consider a context where Kipchoge may be biking instead of running.

In order to understand the issue posed by (5a) and rescue Epistemic Defensibility from failure we must consider first whether we are dealing with a context where (5a) is plain odd (as Heim (1983) suggested for out of the blue contexts) or whether instead it is taken to convey the conditionalized presupposition that *If John has children, then he has twins* (as argued by e.g. Abusch (2010)).[13] It is key to realize that the contexts where (5a) is odd are exactly those contexts where the unconditional presupposition itself is odd: In contexts where settling whether John has children entails that John has twins, (5a) is indeed felicitous, and the presupposition that *John has twins* is conditional on him having children. In the absence of such supporting contexts, i.e. in contexts where the conditionalized presupposition of the form $A \rightarrow p$ is itself odd out of the blue, there is no way of rescuing (5a) and oddness results—since the unconditional presupposition that p is independently ruled out by Epistemic Defensibility.

4.3 Case 3: $A \rightarrow B_p$ and $\mathsf{K}_s[A]$

By appealing to belief states we can make sense of certain contrasts. So far, sentences of the form $A \rightarrow B_p$ have been shown to not project p if its descriptive content is inconsistent with the epistemic state of the speaker. This allows us to readily capture otherwise difficult cases for local satisfaction. We saw above that the presupposition *Kipchoge is running* of (17b) does not project because that would render the speaker's epistemic state inconsistent. Crucial to obtain this result was the speaker's ignorance with respect to the truth of the antecedent, a property of conditional statements that we took to be the general case. Nevertheless, some occurrences of indicative conditionals are such that their antecedent is known to the speaker, and thus, for an antecedent A, $\mathsf{K}_s[A]$ is the case, instead of $\neg\mathsf{K}_s[A] \wedge \neg\mathsf{K}_s\neg[A]$. For these cases, our approach correctly predicts that presuppositions in the consequent project globally:

(18) a. Kipchoge is finally participating!
b. Well, if Kipchoge is participating, he will stop running soon.
$\rightsquigarrow$ *Kipchoge is running*

[13] We explain below in Section 5 a way to achieve conditionalized presuppositions pragmatically without relinquishing neither default projection nor Epistemic Defensibility.

Note that this is precisely what we would expect if, as argued in Section 3, presuppositions are not the type of content that can be fixed in isolation from the rest of the contextually available information. What the contrast between (17b) and (18b) shows is that a sentence like (17b)/(18b) carries a presupposition trigger whose presupposed content, all else equal, shall be inherited wholesale by the full sentence; however, in (17b) not all else is equal.

4.4 Case 4: $A \to B_p$ and $A \equiv p$

If A and p are logically equivalent, the fact that the speaker's epistemic state must be compatible with both A and $\neg A$ is in conflict with $\mathsf{K}_S[p]$, $\neg\mathsf{K}_S[A] \wedge \mathsf{K}_S[p] = \bot$. Thus, p is predicted not to project:

(19) If Kipchoge is running, he will stop running
$\not\rightsquigarrow$ *Kigpchoge is running.*

4.5 Case 5: $A \to B_p$ and $A \vDash p$

In this case p does not entail neither A nor $\neg A$, and thus p projects by default. For instance, assuming the speaker knows that Berlin is in Europe, this is a case where A logically entails p; this is not in conflict with the speaker's epistemic state, and thus p is predicted to project out of the blue:

(20) If Liz is in Berlin, Bill will discover that she is visiting Europe.
$\rightsquigarrow$ *Liz is visiting Europe*

Echoing Gazdar (1979), we might say that this is the most commonly occurring configuration when it comes to presuppositonal content in the consequent of a conditional statement. Wholesale projection is thus the most expected behavior in these cases with no additional contextual information available. Nevertheless, as an anonymous reviewers points out, judgments may change quickly in contexts where the speaker is more ignorant about Liz's whereabouts than suggested by (20) alone (example by the same anonymous reviewer):

(21) I don't know whether Liz is visiting Europe. But if Liz is in Berlin, Bill will discover that she is visiting Europe.
$\not\rightsquigarrow$ *Liz is visiting Europe*

The conditions that lead to such discovery by Bill may be contrived but are not implausible. The lack of projection is now correctly sanctioned by Epistemic Defensibility, too: the speaker cannot be taken to assume the p that *Liz is visiting Europe* given their earlier declaration of ignorance.

With this discussion in mind, we can return now to the problematic case in (5b), repeated below:

(5b) If John has twins, then Mary will not like his children.

The issue is clear: a proposition like *John has twins* in the antecedent asymmetrically entails the presupposition p in the consequent that *John has children* and so, all else equal, p is predicted to project globally, contra the general consensus that (5b) does not presuppose p. This prediction however is not expected by Epistemic Defensibility since, lacking any trouble from a consistency standpoint, it cannot rule out the global projection of p.

Our suggestion on this point is that the reason for the lack of projection in (5b) resides in the fact that, on its most natural interpretation out of the blue, (5b) is in fact a case where $A \equiv p$. In other words, the most natural out of the blue interpretation of (5b) can be paraphrased as in (22) below:

(22) If John has twins, then Mary will not like {them / his twins}.
$\not\rightsquigarrow$ *John has children*

For the same reasons laid out above in Section 4.4, (22) is not problematic for Epistemic Defensibility since the projection of p would clash with the ignorance about John's progeny conveyed by the antecedent of the conditional. Thus, under this interpretation, lack of projection in (5b) would also be accounted for by general consistency preserving principles.

Of course, (22) is not the only possible state of affairs regarding (5b); it is plausible that John has more children besides the twins, and thus $A \not\equiv p$. However, in our own assessment, interpretations where *his children* in (5b) may include children other than the twins are not easily accessible without any previous knowledge about John. We can access them by overtly stating what we know, but doing so does not reveal any surprising projection pattern.

(23) a. I don't know whether John has any children. But if he has twins, Mary will not like his children.
$\not\rightsquigarrow$ *John has children*

b. John had a daughter some years ago and we heard that he might have been a second-time dad. If he has twins, Mary will not like his children.
$\rightsquigarrow$ *John has children*

In sum, cases like (5b) behave exactly as expected by Epistemic Defensibility both in out of the blue contexts (due to the preferred interpretation of (5b) in terms of $A \equiv p$ instead of $A \rightarrow p$) and in cases where there is relevant and accessible knowledge, as in (23).

5 Presupposition conditionalization

5.1 The fate of presuppositions that do not project globally

We have focused so far on showing how a simple assumption about conversational felicity such as Epistemic Defensibility may help understand what presuppositions project. Moreover, this is done in accordance to Karttunen (1974)'s dictum that presuppositions shall not be regarded as fixed contents, but must instead be assessed always with respect to the contextual assumptions in place in each case. In this sense, Epistemic Defensibility contributes one (of the plausibly various) factors explaining the admisibility conditions on presuppositions.

A major question for accounts where presuppositions are taken to be default is: what happens to a presupposition p in cases where it is not felt to project globally? Satisfaction theory has an immediate answer to this question, as they take basic, default presuppositions to be conditionalized: if the truth of the antecedent A cannot be settled, the truth of p is interpreted as being contingent on the truth of A, and thus the expected presupposition is of the form $A \rightarrow p$. This is, moreover, in accordance to intuitions in cases we have already seen; e.g. (17b) and the trivial case of (19). But such explanations are not readily available for approaches like the one pursued here. It is one thing to determine conditions that presuppositions must meet in order to project globally; it is another to explain the fate of presuppositions that were not admisible in context.

We already explained the lack of projection in e.g. (17b) in Section 4.2.

But this is not to say that p in (17b) plays no role in the presuppositional content of the statement as a whole. Intuitively at least, satisfaction theorists got this right: there is ample consensus that the felt presupposition in cases where they fail to project globally is one where p is conditionalized to the truth of the antecedent, hence is of the form $A \rightarrow p$. But what can a defender of presuppositions-as-default say about the processes responsible for this weakening effect from p to $A \rightarrow p$? We suggest that we can make sense of this weakening by recruiting an additional pragmatic process, one that provides results similar to the "perfected" interpretation of the conditionalized presupposition. We elaborate below by discussing an additional case, that of contextual entailment.

5.2 Case 6: $A \rightarrow B_p$ and $A \vDash_c p$

The current proposal makes the same predictions for cases where p is independent of A or A asymmetrically entails p: all else equal, p is expected to project in both cases. There is however an additional set of cases, not relying on logical entailment, where it is not just the antecedent A, but A together with some contextual premises that entail p. These are cases such as (24) below:

(24) If Tom doesn't exercise, he will regret getting a bypass.
$\not\rightsquigarrow$ *Tom will get a bypass*

In cases like this the listener could safely assume that, given some fairly common-sense contextual premises—e.g. that exercising would significantly improve Tom's heart condition so as to avoid getting a bypass—the antecedent does indeed contextually entail the presupposition p that *Tom will get a bypass*. The issue for the pragmatic weakening account proposed here is that (*i*) since p entails neither A nor $\neg A$, no clash between $\mathsf{K}_S[p]$ and $\neg\mathsf{K}_S[A]$ (or $\neg\mathsf{K}_S\neg[A]$) arises, which in turn leads to a contingent epistemic state that should not preempt the projection of p (unlike what we saw in case 2 and 4); and (*ii*) A together with additional contextual premises entails p. If so, p is also expected to project. But this is not what we observe above.

That is only the first part of the problem however. Descriptively at least there is some reason why being unable to settle the truth of the antecedent A has the effect to take p as being contingent on the truth of A. Thus, the second part of the problem is that the felt presupposition of (24) is conditionalized to the antecedent:

(25) If Toms doesn't exercise, he will get a bypass.

This conditionalized presupposition corresponds to Karttunen (1974)'s minimal admissibility conditions that contexts require of presuppositional sentences ($C \vDash A \rightarrow p$). The task is to identify what makes this admissibility condition be weaker in (24).

As we mentioned earlier in Section 3, note that what we need to know in order to predict whether a context will satisfy p in $A \rightarrow B_p$ includes a number of semantic relations, namely (i) between C and p, (ii) between A and p and (iii) between the inferences invited by $A \rightarrow B_p$ in C and p. But, echoing Karttunen, we won't be able to tell what $A \rightarrow B_p$ *actually* presupposes in isolation. This is important because conditionals are prone to invite a family of different inferences—including $\neg \mathsf{K}_S \neg[A] \wedge \neg \mathsf{K}_S[A]$).

We suggest to look at the issue from this perspective by looking into whether other detectable inferences brought up by conditional statements may sanction the availability of conditionalized presuppositions. Here's a plausible explanation in this vein. Suppose that upon hearing (24), the hearer might conclude that the truth of p is contingent on A *and nothing else*; i.e. they infer that A is in fact both a necessary and sufficient condition for B (and hence p) to obtain. If nothing else than A is necessary to obtain p, then the fact that A constitutes the antecedent of a conditional statement, with its associated inferences relative to the context, it follows that the only condition required for p to be the case is indeed A, and p is taken to be contingent on A and nothing else.

It follows that, if we were to manipulate what counts as a sufficient condition by adding an additional condition X for p, p should be felt to be conditionalized to X as well.[14]

(26) If Tom doesn't exercise, he will regret getting a bypass. Unless he follows his strict diet; if so he may be OK.
$\rightsquigarrow$ *If Tom doesn't exercise [and he doesn't follow his diet], he'll get a bypass*

[14]Note that this is not specific to cases where $A \vDash_c p$, but applies instead generally also to cases where $A \vDash p$ and cases where A and p are logically independent. We use (24) simply as a means of illustration.

Now it is the whole mini-discourse in (26) that is felt to presuppose the conditional presupposition; in turn, the sufficient condition for Tom's bypass is no longer just A, but also X.

It is thus at least plausible to think that there is a connection between the lack of global projection and the subsequent weakening to a conditionalized presupposition on the one hand, and the interpretation of the antecedent A as providing all sufficient and necessary conditions for p to obtain. This is the same as to say that as a result of this connection there is an inferrable symmetric entailment between A and p. But of course, if so, if p entails A, A being the antecedent of a conditional, then Epistemic Defensibility preempts p from projecting globally, for reasons discussed above.

If this is on the right track, then the weaker conditionalized presupposition does not follow from world knowledge or contextual entailment between A and p; it follows instead from an additional inference that the antecedent is sufficient for p to obtain; in other words, it resembles the "perfected" interpretation of a conditional, the result of an inference that turns $\rightarrow$ into $\leftrightarrow$ (Geis & Zwicky 1971).

(27) a. *Tom doesn't exercise → Tom will get a bypass*
  b. *Tom exercises → Tom won't get a bypass*

By virtue of uttering (24) the speaker is conveying that they cannot settle the antecedent A. But if the speaker is in addition felt to convey that A is in fact the only reason why p may obtain, then p will be exclusively contingent on A and nothing else. In effect, this amounts to the listener taking the speaker to convey both (27a) and (27b) when they utter (24), and the whole statement is taken to convey that exercising is indeed a necessary and sufficient condition to avoid surgery. If so, Epistemic Defensibility prevents the presupposition p that *Tom will get a bypass* from projecting globally: if it did, it would follow that Tom did not exercise, contradicting A in (27b). In other words, the projection of p in (24) directly depends on the assumption that A is the only sufficient and necessary condition for p to obtain, a result that amounts to a strengthened—perfected—interpretation of the minimal admissibility conditions of any conditional statement (i.e. that $A \rightarrow p$; (27a) in this case).

The proposed solution might seem convoluted and one may argue that simply appealing to world knowledge would be enough to capture both the lack of global projection and the weaker conditionalized presupposition in cases like (24). However, notice that oftentimes (*i*) the hearer may not be in possession of the relevant piece of knowledge, and, in addition, (*ii*) further contextual manipulations, like adding some further condition X, may provide enough conditions for global projection of the presupposition. The following is one such example, in contrast to the earlier (24):

(28) If Tom doesn't exercise, he will regret getting a bypass. But if his condition worsens significantly, he won't regret getting a bypass.
$\rightsquigarrow$ *Tom will get a bypass*

The presupposition is now felt to project globally: getting a bypass does not depend on a single condition and, as a consequence, exercising is no longer considered a necessary condition. For us this means that A is no longer sufficient for p to obtain, and thus the admissibility conditions remain weak (i.e. "unperfected").

6 Discussion and problems

The main tenet explored in this paper holds that presuppositions do not project if they lead to an inference that the speaker is representing themself as holding an inconsistent epistemic state. The proposal is that only those presuppositions that preempt Epistemic Defensibility—the proposed pragmatic principle acting to conserve speaker's epistemic consistency—are argued not to project. We then suggested that, in certain contextual circumstances, assumptions about what counts as necessary conditions can be taken to be also sufficient, through a process akin to that delivering the perfected interpretation of conditionals, and in turn these necessary and sufficient conditions can explain what happens to those presupposition that failed to project for violating Epistemic Defensibility: just like predicted by satisfaction theories, they are conditionalized to the truth of the antecedent clause, from p to $A \rightarrow p$. This means that under the present account semantic presuppositions need not be "weak" and may be expected to project by default, whereas conditionalization of p is the result of an inferrable process.

The resulting account bears a great similarity to other cancellation-style approaches, but there are fundamental differences. We have adopted a view of presuppositions where they are taken to be contextually necessary, i.e.

admittance conditions in the Stalnaker/Karttunen tradition that must be true in all worlds of the context set. This is so because the very nature of presuppositions requires them to be entailed by the context, thereby requiring a certain speaker's attitude with respect to its content—making them also epistemically necessary. This is different from Gazdar (1979)'s notion of presupposition, for whom presupposed content must merely be consistent with the context (see Gazdar 1979: 107).[15]

Note also that, in comparison, Gazdar (1979) argues that *all* presuppositions that may be incompatible with *any* implicatures and entailments should be precluded from projecting. Instead, van der Sandt (1992) holds that cancelled presuppositions are those which when conjoined with the utterance are inconsistent with *any* (neo-Gricean in his case) conversational principle. The proposal presented here, while clearly in the same vein as these two works, is still more general in that maintaining epistemic consistency is not a pragmatic principle *per se*—although obviously pragmatic principles may act against expressing such epistemic states—but rather a general consideration sanctioning good/licit conversational practices.

The resulting state of affairs is one where it is possible to cover a surprising empirical ground with minimal assumptions about projection and following Karttunen (1974)'s spirit that projection can only be determined on a context-by-context basis. As mentioned earlier, the goal is not so much to provide an account of presuppositions, not even of presupposition projection, but to propose a plausible admissibility condition on projection, namely Epistemic Defensibility, which is fully general and completely independent from the theory of presupposition. I take it that this is not just a methodologically sound position, but one that, in our particular case, shows promise as it is supported by the empirical results obtained. The predictions of the account however are not perfect, and in the remainder of the paper I point out two cases where the predictions of Epistemic Defensibility do not fully line up with our intuitions.

[15]This is precisely at the root of the criticism in van der Sandt (1992) and Beaver (2001) against prefixing Gazdar's "potential presuppositions" with Hintikka (1962)'s K operator. Note also that the notion of "pre-supposition" utilized in Gazdar (1979) can be dispensed with in this proposal.

6.1 Variability in projection

We saw above that Epistemic Defensibility coupled with a theory of default projection of presuppositions makes the correct predictions for cases where the antecedent A entails a presupposition p in the consequent, but p entails neither A nor $\neg A$. In such situations, both $\neg A$ and A are epistemically accessible for the speaker, $\mathsf{P}_S[A] \wedge \mathsf{P}_S\neg[A]$. Here no conflict arises between $\mathsf{K}_S[p]$ and $\neg\mathsf{K}_S[A] \wedge \neg\mathsf{K}_S\neg[A]$, and thus p is expected to project. There are however cases where we find a fair amount of variability, in two respects: cases where our own intuitions are variable and cases where intuitions are relatively clear, but vary sharply with minimal changes on the trigger. We discuss the two in turn.

Some speakers have declared p in (29) below is not felt to project.[16]

(29) If Mary is a professional biker, her helmet must be expensive.
$\rightsquigarrow$ *If Mary is a professional biker, she has a helmet.*
$\overset{?}{\rightsquigarrow}$ *Mary has a helmet.*

Assume for the sake of the argument that this is so; how can we then make sense of this variability? On the approach suggested here, this should be a matter of how the conditional statement is interpreted as whole; i.e. whether further additional inferences are drawn from the conditional that can affect the conditions that relate antecedent and consequent. As elaborated above in Section 5, whether the presupposition projects wholesale depends on whether the antecedent is taken to be a necessary and sufficient condition for the consequent to obtain. Note that, without further assumptions, p cannot contextually settle whether A is the case, and thus Epistemic Defensibility alone does not preempt projecting p wholesale. However, the prediction goes, if a listener infers somehow that A is in fact both a necessary and sufficient condition for B and thus also for p to obtain, then that listener should only be able to feel a presupposition where p is conditionalized on A: p should not project globally because if it did, such a speaker would be able to settle whether A is the case and thus the utterance of the conditional would be infelicitous, which is effectively precluded by Epistemic Defensibility.

[16]These observations come from informal data querying native speakers of (American) English. Others do feel that p projects however, and thus the it is not so clear what the right presupposition pattern might be in (29).

Whether this strengthened interpretation of a conditional like (29) possible or even plausible is, of course, a different matter, and thus cases like these might at the end of the day result more problematic for accounts like ours.

We can also find cases minimally differing from each other where different triggers seem to give rise to different projection patterns.

(30) a. If Liz is in Berlin, Bill will discover that she is visiting Europe.
$\rightsquigarrow$ *Liz is visiting Europe*

b. If Liz is in Berlin, Bill will establish that she is visiting Europe.
$\not\rightsquigarrow$ *Liz is visiting Europe.*

c. If Liz is in Berlin, Bill will know that she is visiting Europe.
$\overset{?}{\rightsquigarrow}$ *Liz is visiting Europe.*

Given the position defended in this paper, the hope is that a closer examination on the contextual properties of such statements, with special attention to the types of inferences drawn from the fact that these are conditional statements, might shed some light on the perceived variable behavior. But for now the matter will have to wait until a future occasion.[17]

6.2 Unexpected strengthening

The second and perhaps more substantial empirical hurdle that a general account of projection like the one sketched here faces has to do with cases where a statement of mini-discourse is not epistemically defensible, and yet the weakening does not occur, leading to an infelicitous utterance. As an illustration, consider the following example with the two candidate presuppositions:

(31) If John has a stress fracture, he'll stop running cross-country.

a. If John has a stress fracture, he once ran cross country. $p1$

b. John once run cross-country. $p2$

Suppose that a speaker uttering (31) in an ordinary context C presupposes $p1$, which is what local satisfaction theories would predict. Following the narra-

[17] In this respect, a full assessment of the proposal in this paper would require a thorough examination of the empirical data available in resources such as the CommitmentBank (de Marneffe & Simons & Tonhauser 2019) and those with an emphasis on the variability of projection; see Simons et al. (2011); Tonhauser & Beaver & Degen (2018) among others.

tive of the satisfaction theorist, the speaker is nevertheless felt to presuppose something asymmetrically stronger than $p1$, namely $p2$. The strengthening process leading from $p1$ to $p2$ is based on general pragmatic grounds, and Mandelkern (2016) puts the prediction effectively to test: If we find a context where there are strong pragmatic reasons *against* strengthening $p1$ to $p2$, this type of theory predicts that no strengthening should be expected. For that we need a case where, if we took the speaker to presuppose $p2$ their assertion would, as a result, be pragmatically deviant in some way, but not if we were only assuming $p1$. The prediction, as Mandelkern shows, is incorrect:[18]

(32) John was limping earlier; I don't know why. Maybe he has a stress fracture. I don't know if he plays any sports, but #if he has a stress fracture, then he'll stop running cross-country now. (Mandelkern 2016: 396)

In the context of (32), (31) is odd. The reason, presumably, is because the speaker is declaring her ignorance with respect to John's sport practices, but goes on to utter a conditional statement where she seems to accept that John in fact runs cross-country. That the oddness of (32) is due to such clash is corroborated easily: deleting the offending clause where the speaker declares her ignorance restores the felicity of the mini-discourse—and the presupposition in inherited wholesale.

(33) John was limping earlier; I don't know why. Maybe he has a stress fracture. If he has a stress fracture, then he'll stop running cross-country now.

[18] Judgments about (32) are not crisp however, as one anonymous reviewer disagreed with the reported oddness. The following is adapted from (Grove 2022), who argues that in fact the statement does not imply that John runs cross-country:

(i) I saw John limping earlier. If he has a stress fracture, then I assume that he runs cross-country, but I actually don't know if he actually plays any sports. Indeed, if he has a stress fracture, then he'll stop running cross-country now.

What (i) seems to convey instead is the conditional presupposition that If John has a stress-fracture, John runs cross-country, which is compatible with the approach advocated here based on Epistemic Defensibility.

In other words, (32) is odd *because* the felt presupposition is $p2$, not $p1$. This is a case where pragmatic pressures go against strengthening and yet strengthening nevertheless happens.[19]

One might expect then that if a pragmatic process of strengthening yields the wrong results, the opposite will fare better. And yet, it does not: (31) is as problematic for satisfaction theorists as it is for us. Avoiding epistemic inconsistencies like the one leading to the oddness in (31) is the sole *raison d'ětre* of Epistemic Defensibility, if there is a context where the principle should kick in, it is this one.

One could, of course, assume that Epistemic Defensibility is more granular and that its scope of action is limited locally. But this would detract from the general methodological ethos with which we started the paper: to explore the extent to which general and independently motivated presupposition– and trigger-independent principles may help sanction the projection of presuppositions. What cases like (31) tell us, then, is that Epistemic Defensibility cannot be the whole story, a conclusion that is at any rate not entirely surprising. Whether there might be additional general principles correctly sanctioning (31) or whether these cases are indicative of the necessity for a theory of presupposition that incorporates some notion of locality is a question that I will leave open here.

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[19] Mandelkern (2016) provides a whole battery of examples reaching the general conclusion that a pragmatic response to the proviso problem faces serious challenges.

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From music to dance: The inheritance of semantic inferences

Pritty Patel-Grosz • Jonah Katz • Patrick Georg Grosz • Tejaswinee Kelkar • Alexander Refsum Jensenius

Abstract This paper looks at short musical segments and motion-capture animations of body movements that were generated spontaneously in response to those musical segments. Building on recent research on music semantics, we ask whether abstract meaning inferences that listeners draw on the basis of the musical segments are also inherited by the corresponding body movements. We present an experiment in which participants rate how well the emotion terms *Angry*, *Bored*, *Calm* and *Excited* are expressed by the auditory stimuli and visual stimuli. The experimental findings indicate a correlation between the sounds and animations with regards to the inferences that participants draw.

Keywords music semantics · dance semantics · iconic semantics · formal semantics · experimental semantics

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1 Overview

Music can give rise to abstract semantic inferences about music-external situations and/or emotions. We ask whether dance, defined as music-accompanying body movement for the scope of this paper,[1] also gives rise to similar abstract semantic inferences. Focusing on emotional meaning, we experimentally test whether inferences from a given musical sequence are inherited by body movement produced in response to this musical sequence. Our results indicate that such an inheritance of semantic inferences does

[1]This glosses over dance that does not accompany music, see, e.g., Patel-Grosz et al. (2018; to appear).

occur. This finding is consistent with a view where abstract meaning can be communicated in different modalities, here music and dance.

2 Theoretical underpinnings – from music to dance semantics

Recent research in formal semantics argues that music can give rise to inferences about music-external objects (so-called *virtual sources* or *denoted objects*), which allow listeners to infer descriptive or narrative meaning, Schlenker (2017; 2019a; 2021). A typical example is found in Saint-Saëns's *Carnival of the Animals*, where a low-pitched melody is mapped onto a large object, namely an elephant (Schlenker 2017: 11-12). By contrast, a high-pitched version of the same melody may instead give rise to the inference that there is a small object in the narrative – for example, a mouse. Such inferences are iconic in that the denotation of the meaning-bearing object – in this case the music – operates on its form. To illustrate, we can apply Greenberg's (2021) formalism to the above example and posit the iconic semantics in (1) for object-denoting pitch.

(1) For a piece of music $\boldsymbol{M}$, a constant k in a narrative situation s, $[\![\boldsymbol{M}]\!]$ is satisfied by s only if:
size-category($\iota x.x$ is an object in s) = k / pitch($\boldsymbol{M}$)

For Greenberg, an iconic semantics is defined such that the form of the sign, symbolized by the bold-typed M in (1), also occurs in its denotation. When we interpret a piece of music M with regards to a narrative situation s, we can draw an inference that the pitch of M is inversely mapped onto the size of a salient object in s. The higher the pitch, the smaller the object. This inverse mapping of pitch and size can be implemented by dividing a contextually given constant k by the pitch of M, which yields an abstract numerical size category. Assuming size categories rather than exact sizes is needed to account for the abstractness of such inferences. A similar difference between a high pitch and a low pitch (e.g., 880 Hz vs. 110 Hz) may be mapped onto an elephant (the large object) vs. a mouse (the small object), but it may just as well be mapped onto a hawk (the large object) vs. a sparrow (the small object), or onto a landscape (the large object) vs. a house (the small object). If we take our constant k to be 880, then a pitch of 880 places the denoted object into size category 1 (≈ small), whereas a pitch of 110 places the denoted object into size category 8 (≈ big).

When all inferences of this type are met for a situation *s* in a given narrative, then we can say that $[\![M]\!]$ is true in *s* (or $[\![M]\!]$ is satisfied by *s*). This means that a low-pitched melody is true of a narrative situation in which we are dealing with a large object, and false of a narrative situation in which we are dealing with a small object (relative to a baseline of what counts as large or small in the narrative). Such inferences are by their very nature abstract, i.e., it does not matter whether the object is an elephant, a landscape, or, even more abstractly, a magnificent idea.

Crucially, the properties of music that give rise to such iconic inferences (pitch, loudness, speed, silence, dissonance, change of key; see Schlenker 2019b: 433-436) have counterparts in music-accompanying movement, for example dance. An observation from choreomusicology suggests that musical pitch corresponds to the direction of gestures in space in body movement, in that, for example, high pitch is correlated with upward movement whereas low pitch is correlated with downward movement (Mason 2012: 10); see Kelkar & Jensenius (2018) for critical discussion. Alternatively, Gadir (2014: 55), in a study of electronic dance music, observes that the musical pitch inversely correlates with the size of the body parts that dancers use to move to the music, i.e., lower pitch is correlated with bigger movements (of the legs, hips, etc), whereas higher pitch is correlated with smaller movements (of the arms, hands, etc). We can refer to this difference in terms of the amplitude of the body movement. We can thus posit the lexical entry in (2) for a given body movement *D*, which differs from (1) in that the size of the denoted object is now calculated by multiplying (rather than dividing) the constant *k* with the amplitude of the dance movements.

(2) For a music-accompanying movement $\boldsymbol{D}$, a constant k in a narrative situation s, $[\![\boldsymbol{D}]\!]$ is satisfied by s only if:
size-category($\iota x.x$ is an object in s) = k * amplitude($\boldsymbol{D}$)

The fact that (1) and (2) are non-isomorphic is unsurprising, since musical inferences are typically attributed to natural associations between sound qualities and their sources (Schlenker's 2019b: 433-436 *reasons* for musical inferences). Bigger objects tend to create sounds at a lower pitch than smaller objects. For body movements, the same association naturally does not hold:

bigger objects will often create bigger movements than smaller objects (in terms of the absolute amplitude of the movement, not relativized to the given object's baseline), simply by virtue of their size. This may in turn have implications for the perception of body movement perceived to communicate meaning: if such a body movement is bigger, onlookers plausibly infer that the denoted object is also bigger, and so forth.

We take such analogies between music and body movement as our point of departure and present an experimental study that addresses the following questions: (i.) do abstract body movements (e.g. dancing or moving spontaneously to a piece of music) give rise to semantic inferences? (ii.) are there parallels between the inferences that we draw from hearing music, and the inferences that we draw from seeing abstract body movement? (iii.) if we perceive body movement *D* that was initially performed as an interpretation of a short musical sequence *M*, is there a correspondence between our inferences from *D* and our inferences from *M*?

To investigate these questions, we used materials from an experiment by Kelkar & Jensenius (2018).[2] In their study, participants were asked to trace short musical segments with their hands while standing centrally in a motion capture lab and being filmed by eight motion capture cameras; this gave rise to abstract music-accompanying body movement (i.e., dance), consisting in particular of upper-body movements. More specifically, we could classify the movement as a music-*responsive* body movement, in that it was caused by the music. Our own experiment is set up to test the hypothesis that body movements *D* which are performed in response to a musical sequence *M* 'inherit' properties of *M*, thus giving rise to the same or similar semantic inferences. We can illustrate this question for our toy example in (1)-(2): assume that a musical sequence *M* triggers the inference that the denoted object is big; the question is then whether a body movement *D* that was evoked by *M* would also trigger the inference that the object is big. Specifically, would a lower pitch of *M* trigger more expansive body movements in *D*?

Two qualifications are in place before we proceed with the discussion of our experiment. The first concerns the distinction between perception and production of music and dance; the second concerns the nature of inferences

[2] See Kelkar (2019) for more detailed discussion of the stimuli.

that we investigate.

In our experiment, we probe participants' perception of musical sequences and body movements. While both are produced intentionally (in the case of our stimuli), it is not necessarily the case that their producers consider the inferences that listeners and onlookers may draw. To use our previous example of musical pitch, a composer may intend for a low pitch melody to symbolize a large object, but may also lack any such intention; listeners would draw the exact same inference in either case – namely that the music describes a large object. The same reasoning applies to body movements.

As for the nature of the inferences, we aimed to test whether participants converge on a given meaning for a given stimulus, and whether there is a correspondence between the meaning that was assigned to a musical sequence and the body movement that ensued from it. The meanings that we tested in our experiment are the meanings associated with the emotion terms *Angry*, *Bored*, *Calm* and *Excited*. We used emotion terms as opposed to concrete properties such as size (cf. the toy example in (1)-(2)), to avoid participants directly interpreting properties of the music or movement; furthermore, there is a precedent of probing emotive meanings in music and movement in the findings of Sievers et al. (2013). It is worth emphasizing that, by design, this task does not directly probe for the descriptive/referential musical inferences proposed in Schlenker (2019b); these are more physical in nature, amounting to a description of the denoted object as big or small, more or less energetic, closer or further away, etc. As a consequence of this methodological choice, our conclusions apply primarily to emotional meaning, and it is an open question whether they carry over to referential semantics.[3]

3 Experimental design

3.1 Stimuli

Owing to the nature of materials from Kelkar & Jensenius (2018), we depart from toy inferences of the type in (1) and (2). We use six combinations of short musical sequences (between 1.45 seconds and 5.0 seconds in duration)

[3]On the difference between emotional meaning and referential meaning, see, e.g., Meyer (1956), Patel (2008), and Juslin (2013). See Schlenker (2017: 28-33, 2019a: 86-95) on how they may be connected.

and video animations of motion capture renderings of movements carried out to accompany those sequences by the study participants of Kelkar & Jensenius (2018). Our musical sequences thus correspond to the original experimental stimuli of Kelkar & Jensenius, one of which is illustrated in Figure 1.

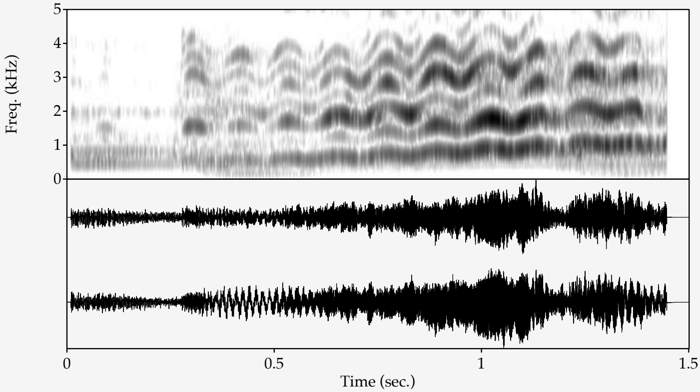

Figure 1 Waveform (stereo) and spectrogram from experimental item b, an operatic soprano voice singing an ascending major-scale melisma on an [e]-like vowel over a much quieter piano accompaniment.

Our visual stimuli were selected from the Kelkar & Jensenius's experimental results, in order to create music-video pairings. The type of motion capture-based animations used in our experiment is illustrated in Figure 2, which is a movement sequence that was produced in response to the musical stimulus in Figure 1.[4]

The six combinations of auditory and visual stimuli that we used were selected pseudo-randomly from the set of 32 combinations available to us. While we tried to avoid stimuli that made a particular emotion especially salient, we did not have any evidence or prior expectation with regards

[4]The complete set of visual stimuli can be found at the following link: `https://www.youtube.com/playlist?list=PLodCnZzwa9N4aVfOTZce-WHVMPg5dYbdI` The auditory stimuli correspond to the auditory stimuli 02, 13, 19, 27, 29, and 30 in Kelkar & Jensenius (2018) (direct download link for ZIP file: `https://www.mdpi.com/2076-3417/8/1/135/s1?version=1516685118`), renumbered to 01, 02, 03, 04, 05, and 06 for our experiment.

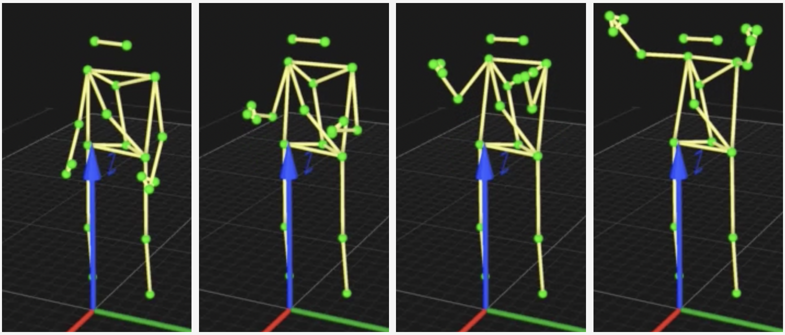

Figure 2 Stills of animations created from motion-capture data from experimental item 2.

to the emotion association of our six combinations; they were thus not counterbalanced with respect to emotion association.

All participants listened to the six sound files and separately watched the six silent animations; participants did not watch combinations of animations and sound files. Stimuli were organized in two blocks, one with only audio stimuli and one with only silent animations. The order of the two blocks was counterbalanced across subjects and stimuli were presented in random order within each block. Subjects heard or saw each stimulus four times, once with each of the emotion descriptors described below.

We used a within-subject design to maximize the power of the experiment. In this design, each subject watches each video stimulus and hears each audio stimulus multiple times, once with each emotional descriptor. This allows us to gather more data from fewer subjects, and to isolate the audio vs. video modality as an experimental manipulation without also changing the identity of subjects between conditions. The main potential drawback to such designs is the possibility of 'contamination', where completing one condition influences the behavior of a subject on following conditions. To adjust for such effects, we counterbalanced the order of conditions across subjects and incorporates the effect of task order into the statistical analysis reported below.

3.2 Task

Participants were prompted to rate on a slider scale from 0 to 100 how well the sound / animation expressed one of the following emotions: *Angry*, *Bored*, *Calm* and *Excited* – with 1 trial for each emotion (2x6x4 trials in total). Participants were able to play the sounds and animations as many times as they desired. The experiment took about 15 minutes to complete. The emotion terms are based on the four quadrants of Russell's (1980) circumplex model of emotion, where *Angry* is [Valence: negative, Arousal: positive], *Excited* is [Valence: positive, Arousal: positive], *Calm* is [Valence: positive, Arousal: negative], and *Bored* is [Valence: negative, Arousal: negative].

3.3 Participant recruitment

Participants were recruited via announcements on social media and various online fora devoted to music, dance, and linguistics. The experiment was carried out online in the PCIbex environment (Zehr & Schwarz 2018). Before the experiment, participants filled out a questionnaire on their demographic, linguistic, and musical background. Both native and non-native speakers of English participated in the study; only participants who reported being native speakers of English are analyzed here, since emotion words were provided in English, and cross-linguistic variation cannot be excluded. The results reported on below are for the 22 native English speakers who completed the experiment.[5]

3.4 Hypotheses

Our experiment tests several hypotheses related to (i-iii) in Section 2. In particular, we examine: (a.) whether participants draw consistent inferences about particular stimuli, i.e., if stimuli with high ratings for *Angry* received low ratings for *Calm*, and so forth; (b.) whether some of the information that auditory stimuli convey can be recovered from movement stimuli that were created as a response to those sounds. Positive answers to these questions would support the idea that music and music-accompanying movement encode descriptive information in comparable ways, i.e., that participants draw the same types of inferences about musical and movement stimuli.

4 Results

The first question we examined is whether listeners respond to auditory and visual stimuli in a broadly comparable way, bearing on (i) and (ii) above, repeated here in simplified form:

[5]The data set is available at `https://doi.org/10.17605/osf.io/abgz4`

		Auditory	Visual
Angry	Mean	34	46
	SD	28	33
Bored	Mean	28	33
	SD	30	29
Calm	Mean	26	29
	SD	29	26
Excited	Mean	52	49
	SD	36	31

Table 1 Mean slider ratings and standard deviations for auditory and visual stimuli on the four descriptors in the study. Data pooled across all stimulus items and subjects.

(i.) do abstract body movements give rise to semantic inferences?
(ii.) are there parallels between inferences from hearing music and inferences from seeing abstract body movement?

Table 1 shows the mean responses and standard deviations to each of the four emotion descriptors for auditory and visual stimuli. Overall rating levels are similar for the two modalities, as are the relative patterns amongst descriptors. Participants exhibit a tendency to assign higher scores for high-arousal descriptors (*Angry, Excited*) than low-arousal ones (*Bored, Calm*); this may be an artifact of the stimuli selection, since stimuli were not counterbalanced with regards to emotion association (see section 3). There are no gross differences between the two modalities here, suggesting that participants are as likely to infer emotional content from movement as they are from music.

Next, we ask if individual auditory and visual stimuli are subject to consistent inferences from participants. Figure 3 shows two attempts to validate the response space.

The left plot in Figure 3 tests a form of split-half reliability, where what is being split into random halves is the participant pool. The question is whether, for each stimulus, when a randomly-selected half of participants infer high levels of some descriptor from that stimulus, do the other half do the same? The answer is an emphatic yes (r = 0.91), showing that partici-

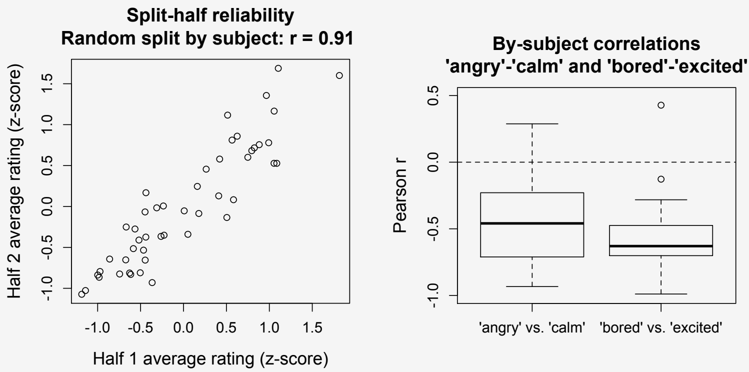

Figure 3 Left: correlation between two randomly-selected halves of the participant pool on the scores assigned to each combination of stimulus and descriptor. Right: Correlations between 'opposite' descriptors, computed across all stimuli within each participant.

pants broadly agree on how much the terms *Angry*, *Calm*, *Excited*, and *Bored* are associated with particular stimuli. The right plot in Figure 3 summarizes within-subject correlations between 'opposite' descriptors. Our assumed theory (Russell 1980) situates the four descriptors in terms of a two-dimensional space of valence and arousal. If this is valid, we expect strong negative correlations between descriptors differing in both valence and arousal. As shown in the right plot, correlations are almost uniformly negative, some of them quite strongly so. This indicates, e.g., that when a participant infers high *Angry* content from a particular stimulus, they are likely to infer low *Calm* content from that stimulus.

Finally, we ask whether the inferences participants draw from visual stimuli tend to resemble the inferences they draw from the auditory stimuli that inspired the motion in the video animation, corresponding to (iii) in section 2. That is, do participants implicitly recover information from motion about the sound that the motion was intended to accompany? Figure 4 shows audiovisual correlations, treating each combination of stimulus, descriptor, and participant as a separate observation. The observed correlation suggests that motion can be used to encode and decode some information from an auditory stimulus. That said, the effect here is not particularly large, suggesting that about 5% of the variance associated with visual scores can be accounted for by taking into account the audio scores of the corresponding items.

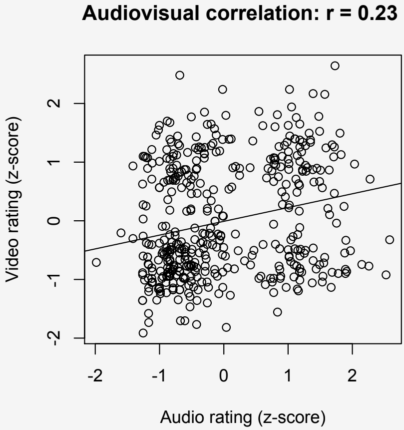

Figure 4 Correlation between slider scores for auditory stimuli and the visual stimuli that were created in response to them. Line shows general linear model.

While the scatterplot and simple correlation analysis above give us a useful summary of the data, they also ignore several aspects of the design that must be taken into account in a statistical analysis. In particular, our study has several *crossed random variables*, variables that are sampled from some larger population of interest. Here, we have asked a number of participants to rate a number of specific stimuli with regard to four particular linguistic terms used to describe emotions. Participant, stimulus item, and linguistic descriptor are all random variables, and fully analyzing the results requires a model that takes into account differences between participants, items, and descriptors while attempting to generalize across these variables.

To examine whether audiovisual correlations are robust across stimuli, descriptors, and subjects, we fit a linear mixed-effects regression model using the lme4 package in R (Bates et al. 2015). This type of model (also referred to as a 'multi-level' or 'hierarchical' model) is specifically designed for analyzing studies with multiple random variables in a crossed or nested design. It allows us to examine the *fixed effects* of interest, those that are systematically manipulated in the design of the experiment, while explicitly modeling variation associated with random variables. The dependent variable in our model was the slider-score for visual stimuli, using the slider score for the corresponding auditory stimulus as a predictor. The model also included fixed effects of the order in which the two tasks were performed (auditory first vs. visual first), as well as its interaction with auditory scores. The model included random intercepts for item, subject, and descriptor. We tested random effects for model improvement using the likelihood-ratio test; the by-item random slope of auditory score significantly improved fit and was retained. All slider scores were centred around the midpoint of the scale, to aid interpretation of fixed effects. The significance of fixed effects was gauged by dropping parameters and using the likelihood-ratio test. A summary table of the final model is shown below.

Random effects	Var.	SD			
Sub: intercept	23.7	4.9			
Item: intercept	16.0	4.0			
Item: audio response	0.07	0.26			
Descriptor: intercept	99.2	27.1			
Fixed effects	β	SE	t	χ^2	p
Intercept	-0.12	5.96	-0.02		
Audio response	0.29	0.12	2.32	4.73	0.03
Order: video first	-13.68	3.63	-3.77	11.64	<0.001
AudResp x VidFirst	-0.19	0.08	-2.32	5.33	0.021

Table 2 Summary of linear mixed-effects regression model of responses to video stimuli.

In the auditory-first order, auditory score was a significant (positive) predictor of visual score, as shown by the second fixed effect. On average, for every slider-point higher that a subject rated a sound for a particular affect word, they rated the corresponding video file 0.29 slider-points higher. Visual scores were about 14 points lower on a 100-point scale when the visual condition was completed first than when the auditory condition was, as shown by the third fixed effect. And the correlation between visual and auditory scores was substantially lower when the visual condition was completed first, as shown by the interaction between auditory rating and task order. It appears, then, that participants draw inferences from animations of movements that mirror inferences from the auditory stimuli that inspired those movements, but they do so much more reliably when the auditory stimuli are presented first than when the visual stimuli are.

The random effect of descriptor significantly improved model fit, with the low-arousal descriptors assigned negative intercepts and the high-arousal ones assigned positive intercepts. This matches the observation from 1 that the high-arousal words are assigned higher scores in general than the low-arousal ones. The by-item random slope of audio score also significantly improved model fit. This means that some particular stimuli generated tighter correlations across audio and visual modalities than other stimuli did.

While the model here finds a significant positive effect of audio score on visual score, showing that some information is carried over between the two modalities, the scatterplot and statistical model should make it clear that this is not the only, the biggest, or the most important factor affecting scoring. In particular, while the general effect is robust enough to be unlikely to arise by chance, we've also seen two factors here that significantly affect the size of the correlation: particular stimulus items and task order. As a follow-up, we examine each of these in turn.

To further examine differences by stimulus item, slider ratings for the 4 descriptors were forced onto a 2-dimensional Euclidean valence-arousal space. This was done by averaging the 'opposite' descriptors onto a linear scale, then rotating the resultant two coordinates 45 degrees so as to weight the high-arousal descriptors for one axis and the high-valence descriptors for the other. This is a fairly naïve procedure and we do not claim absolute validity for the results, but they do allow us to inspect separation between the stimuli and correspondence between auditory and visual stimuli. Results are shown separately for each auditory stimulus and the corresponding visual stimulus in Figure 5.[6]

Comparing the plots vertically, we see that several of the stimuli occupy

[6]See footnote 4 for link to the materials; for improved readability, Figure 5 uses the letters *a*, *b*, *c*, *d*, *e*, and *f*, instead of numerals; the letters map onto the numerical order of the original stimuli (*02*, *13*, *19*, *27*, *29*, and *30*).

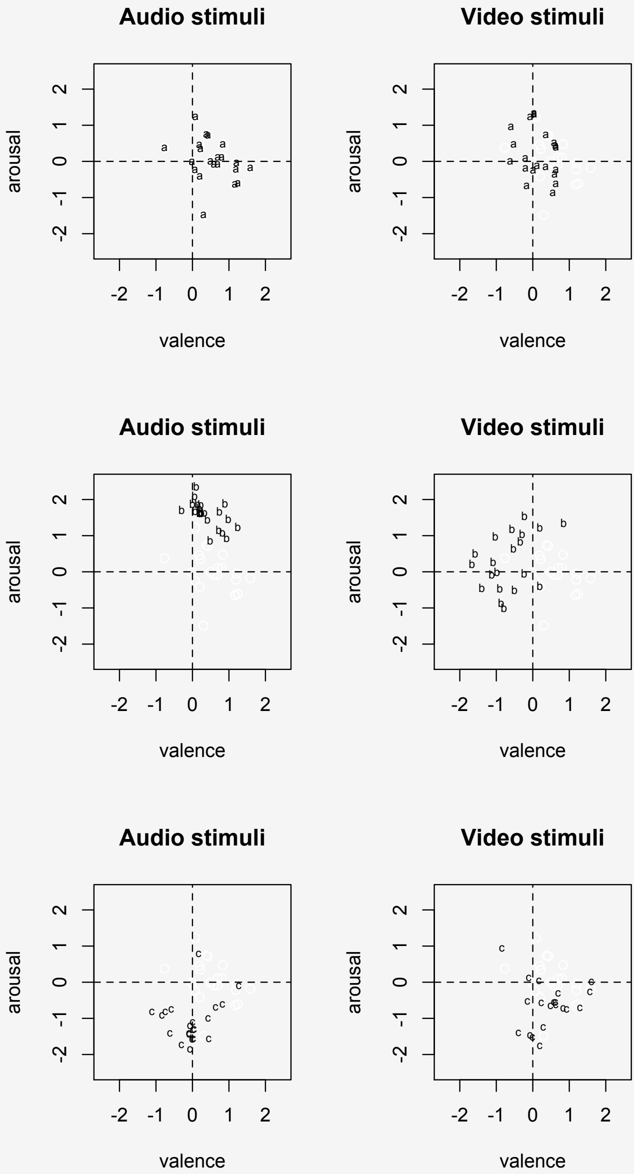

Figure 5 Ratings for each stimulus in a two-dimensional valence-arousal space. Each point represents one participant rating one stimulus on all 4 descriptors.

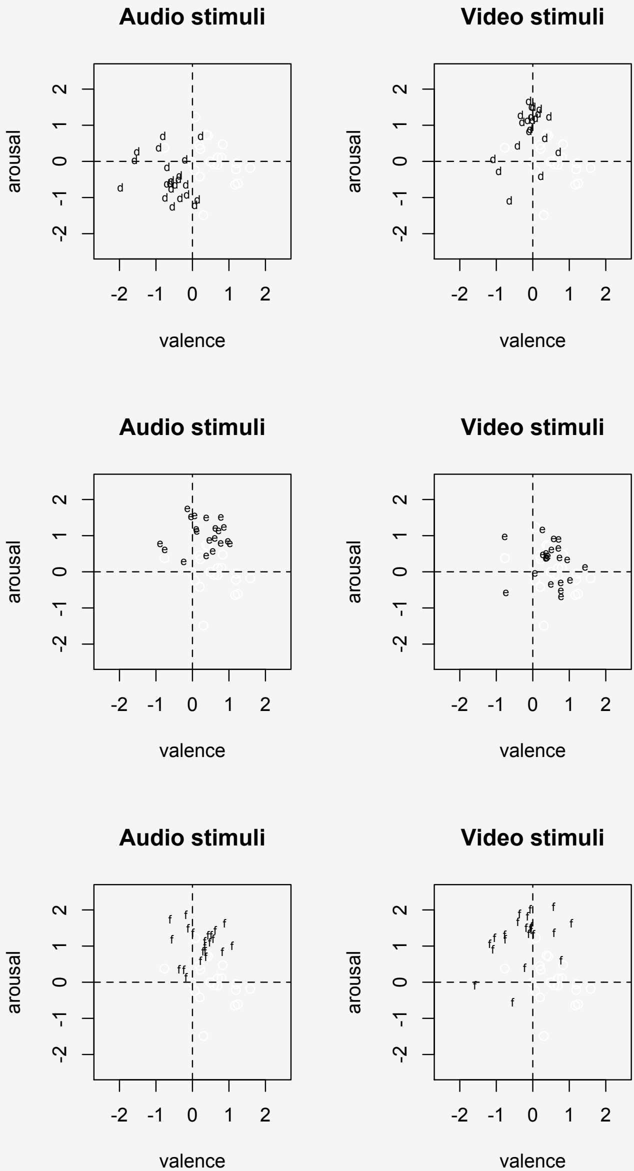

Figure 5 Ratings for each stimulus in a two-dimensional valence-arousal space. Each point represents one participant rating one stimulus on all 4 descriptors.

overlapping ranges in the affective space (e.g., auditory b, e, and f). Nonetheless, each stimulus is located almost entirely in 1 or 2 quadrants (possibly with the exception of video a), and different stimuli differ in which quadrants they mainly occupy. Turning our attention to the horizontal comparisons in Figure 5, we observe that some stimuli have closer audiovisual correspondences than others, as indicated by the random slopes in our statistical model. In particular, both the random slopes returned by the model and the visualizations above suggest that stimuli c and f are judged quite similarly across modalities, while b is quite different (the other three items are intermediate). So one reason why the main effect of audiovisual correlation in our study is not extremely large is that it is not fully robust across items: some items have high correlations, the model judges that correlations are generally positive, but some items have smaller correlations or none at all. There are no obvious or straightforward properties that separate the stimuli with high audiovisual correspondence from those with less correspondence. For instance, stimuli b and d, which both display clear audiovisual mismatches, are not situated in similar regions of the two-dimensional space, nor are they especially dissimilar in their positions from other stimuli that display tighter correspondence. So at this point, we cannot draw any clear conclusions about what makes particular stimuli transmit affective information more effectively than others.[7] One possibility worth following up on, however, is the duration of stimuli: items c and f, which have the highest audio and video correlations, are also the two longest stimuli. It is possible that as visual and auditory stimuli grow longer, subjects are more certain about their affective content and therefore able to 'decode' such content more reliably across modalities.

Figure 6 examines the effect of task order on audiovisual correlations. The statistical model showed that subjects who completed the auditory rating task first had higher correlations with their ratings on the visual task. Figure 6 clearly reflects this difference. It also shows that correlations between matched auditory and visual stimuli are somewhat more variable for those who rated the visual stimuli first.

[7] One open issue beyond the scope of this paper concerns a formal background theory of how movement systematically reacts to sound and music, and how musical properties are preserved in music-responsive movement.

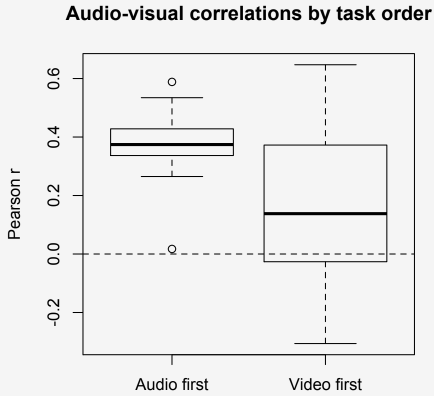

Figure 6 Distribution of within-subject correlations between matched auditory and visual stimuli, separated by task order.

5 Discussion

Our results suggest that inferences from music and inferences from body movement are coherent, consistent, and mutually informative. This is in line with a view where (i.) body movement gives rise to similar inferences to what we find in music, (ii.) there are parallels between the inferences from music and the inferences from body movement, and (iii.) listeners can recover information about inferences from music just from viewing body movement based on the music. While the effect of cross-domain inference was detected in the study and is statistically significant, it is not a particularly large effect, and does not generalize equally across all stimuli, nor across task orders.

The finding that correlations are more robust when the auditory condition occurs before the visual condition was not expected. We had anticipated that there might be some effect of order, but had no particular hypothesis about what that would be. A post-hoc hypothesis that might explain this finding involves the fact that, according to Schlenker's (2017; 2019a; 2021) theory, musical stimuli give rise to inferences on the physical movement of virtual sources / denoted objects (among other things). The inferred semantics of the auditory stimuli, when presented first, could thus activate various kinds of movement schemata; that would facilitate further processing of actual visual representations of movement. Because the motion-capture animations are straightforward representations of people moving, the effect of order could reflect such a facilitation in the auditory-first condition. Conversely, there is no reason to think that viewing movements activates auditory and/or musical schemata, so the auditory condition would not benefit from this facilitation after viewing movements. This fundamental asymmetry, if replicated in future work, could thus be seen as support for Schlenker's hypothesis that musical stimuli are interpreted in terms of physical, spatial movements.

The study also found significant variation across the six stimuli used here in how closely auditory and visual scores tracked one another. While there was no obvious generalization about the acoustic, visual, or perceived affective properties of stimuli that yielded closer multi-modal correspondence, this finding suggests that investigating such variation could be an interesting avenue for further research. Developing a detailed theory of how low-level auditory or visual cues affect valence and arousal may yield insights into cases where affective information is easier or harder to transmit across modalities.

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The scalar contrastive *wa* in Japanese

Osamu Sawada

Abstract In recent years, various proposals have been made concerning the relationship between scalar implicature and contrastive *wa*, and various opinions have been expressed as to whether the scalar meaning generated by contrastive *wa* is a conventional lexical meaning or a conversational one resulting from a general pragmatic principle (e.g., Hara 2006; Sawada 2007; Schwarz & Shimoyama 2011 for a lexicalist approach and Tomioka 2010; 2016 for a non-lexicalist approach). In this paper, based on the examples of A-*wa* A construction, embedded contrastive *wa* and other related phenomena, I will argue that in at least some uses of contrastive *wa*, the scalar meaning of the contrastive *wa* has been conventionalized and that it is difficult to analyze all types/meanings of contrastive *wa* based on a single lexical item or a pragmatic principle.

Keywords contrastive *wa* · Adjective-*wa* Adjective · scalarity · embedded interpretation

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1 Introduction

In recent years, the relationship between contrastiveness and scalar implicature has been a controversial issue in studies of the Japanese contrastive particle*wa*. Broadly, there are two main approaches to the relationship: a lexicalist view (e.g., Hara 2006; Sawada 2007; Schwarz & Shimoyama 2011) and a non-lexicalist view (e.g., Tomioka 2010; 2016). In the lexicalist view, the scalar meaning (the scalar implicature-like meaning) of *wa* is encoded in the lexical meaning of the contrastive *wa*, while in the non-lexicalist approach, it is triggered/drawn by Gricean reasoning, as in the Standard Recipe by Geurts (2010); see Tomioka (2016) for an overview of the two competing approaches.

In this paper, based on new data (i.e., the phenomenon of the adjective doubling construction A-*wa* A and the related contrastive expressions), I argue that in at least some uses of contrastive *wa*, the scalar meaning of contrastive *wa* has been conventionalized, making it difficult to analyze all types of contrastive *wa* in a uniform fashion. Theoretically, it will be shown that Sawada's 2007 analysis of the scalar contrastive *wa*, which assumes it to be a mirror image of *even*, can apply to these new data as well.[1]

This paper is structured as follows. In Section 2, we begin the discussion by reviewing the scalar and non-scalar uses of contrastive *wa* based on Sawada (2007). Section 3 further investigates the low scalar property of contrastive *wa* based on the A-*wa* A construction. Section 4 discusses the interpretation of the scalar contrastive *wa* in the embedded context and further supports the idea that the scalar meaning of contrastive *wa* has been conventionalized. In Section 5, we provide some additional notes on the scalar-based analysis. Section 5.1 discusses the seemingly problematic examples of contrastive *wa* that involve a high proportional quantifier and show that it is not a counterexample. Section 5.2 analyzes the interpretation of contrastive *wa* in a negative environment that involves scale-reversal and Section 5.3 clarifies the relationship between scalar and non-scalar contrastive *wa*. Section 6 compares my analysis to existing approaches to contrastive *wa* and Section 7 discusses similar scalar phenomena in other particles such as the Japanese *mo*, *shika* 'only, except' and English *only*. Finally, Section 8 summarizes the paper and presents a tentative idea of how scalar *wa* developed.

2 The dual use of contrastive *wa*

To begin the discussion of contrastive *wa*, this section overviews Sawada's idea of contrastive *wa*, which explicitly assumes a low scalar meaning.

Sawada (2007) posits that when contrastive *wa* is attached to a non-scalar element, it has a polarity reversal function, as shown in (1). When it is attached to a scale-invoking element, however, it functions as a scalar particle whose meaning has a mirror image of *even*, as shown in (2), where the subscript *CT* stands for contrastive:[2]

[1]The scalar phenomenon is also found in Korean contrastive *nun*. In his research, Lee argues that the Korean contrastive *nun* triggers a conventional scalar implicature (e.g., Lee 1999; 2003; 2006; 2008). He argues for conventionality of scalar meaning in connection with its intonation. Lee claims that the scalar meaning in the sentence with the contrastive *nun* is conventional because it is evoked by the morpheme plus a high tone. Lee also addresses the conventionality of contrastive topic in English (see e.g., Lee (2008)).

[2]Prosodically, as many researchers have pointed out, contrastive *wa* displays focus

(1) *Taro-wa ki-ta.*
Taro-CONT come-PST
'[Taro]$_{CT}$ came.' (But the others didn't/but the others may or may not have come.)

(2) (Context: Both amateur and professional tennis players participating in a tournament.)
a. *Taro-wa shirooto-ni {-wa / ??-sae} kat-ta.*
Taro-TOP amateur-DAT CONT / even win-PST
'Taro beat [an amateur]$_{CT}$. /??Taro even beat [an amateur]$_F$.'
b. *Taro-wa puro-ni {??-wa / -sae} kat-ta.*
Taro-TOP professional-DAT CONT / even win-PST
'??Taro beat [a professional]$_{CT}$. / Taro even beat [a professional]$_F$.'

In this view, there are two types of contrastive *wa*: the scalar contrastive (CT) *wa* and the non-scalar contrastive *wa* (*C* in (3) denotes a contextually determined set of relevant alternatives):

(3) a. $[\![wa_{\text{CTnon.scalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q]$
b. $[\![wa_{\text{CTscalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow q >_{\text{unlikely}} p]$

The non-scalar contrastive *wa* in (3a) conventionally implies that (it is possible that) the contextually determined alternative propositions are not true (e.g., Oshima 2005; To appear), while the scalar contrastive *wa* in (3b) conveys not only this conventional implicature (CI) but also a scalar CI that the at-issue proposition is the least unlikely among the alternatives (i.e., it has a low scalar value).[3]

prosody. The sentence with contrastive *wa* either has a pitch peak on the focused element or a pitch peak on *wa* itself (see Tomioka (2010; 2016) for the detailed explanation)(The capital letter stands for the location of the pitch accent):

(i) *{TARO-wa / Taro-WA} ki-ta.*
Taro-CONT / Taro-CONT come-PST
'Taro came.' (But the others didn't/but the others may or may not have come.)

[3]In this paper, I do not go into an "ignorance" (uncertainty) inference of the contrastive *wa* (e.g., Hara 2006; Tomioka 2010; Hirayama 2019); instead, I assume that the ignorance inference can be captured by assuming that a possibility operator ◇ can be inserted in the

Although Sawada's (2007) observation in (2) seems to be intuitively understandable, a problem occurs because it is possible to use the contrastive *wa* in (2b) in a polarity reversal context (i.e., Taro beat a professional, but he could not beat an amateur). Thus, the data examined so far on its own do not provide conclusive evidence of the existence of the scalar contrastive *wa*.[4]

3 The A-*wa* A construction

In this section, we focus on the first phenomenon, the adjective doubling expression. I argue that the adjective doubling expression A-*wa* A offers stronger evidence for the existence of a scalar contrastive *wa*.

3.1 The negative meaning of the A-*wa* A construction

As the examples in (4) show, although both the simple adjectival sentence and the adjective doubling sentence denote that "this bread is tasty," their meanings are not the same:[5]

(4) a. *Kono pan-wa oishii.*
This bread-TOP tasty
'This bread is tasty.'

b. *Kono pan-wa oishii-wa oishii.*
This bread-TOP tasty-CONT tasty

meaning of *wa*, as in (3).

[4]In fact, Sawada (2007) discusses the existence of a scalar contrastive *wa*, including interpretations such as contrastive *wa* attached to the standard of comparative sentences, contrastive *wa* attached to the predicate, and polar question sentences (negative-bias reading) accompanied by contrastive *wa*. This paper discusses the existence of a scalar use of *wa* based on new phenomena.

[5]A-*wa* A can also be paraphrased by A-*koto-wa* A (e.g., *oishii-koto-wa oishii* 'tasty-NMLZ-CONT tasty'), where *koto* functions as a nominalizer or A-*ni-wa* A (e.g., *oishii-ni-wa oishii* 'tasty-DAT-CONT tasty'), and *ni* is a dative marker. Furthermore, the conditional idiomatic expression A-*to ie-ba* A 'A-as say-COND A' induces a similar scalar implicature:

(i) *Kono pan-wa oishii-to ie-ba oishii.*
This bread-TOP tasty-as say-COND tasty
'This bread is tasty, but it is not very tasty.' (lit. This bread is tasty, if I say tasty.)

I thank one of the anonymous reviewers for bringing the conditional expression to my attention.

'This bread is [tasty]$_{CT}$.' CI: The bread meets only the standard of "tasty" minimally and it is not very tasty.

Unlike (4a), (4b) implies that the bread meets only the standard of "tasty" minimally ; thus, it is not very tasty.[6]

I assume that this inference is a conventional implicature (CI). In the Gricean theory of meaning, CIs are considered part of the meanings of words, but these meanings are independent of "what is said" (e.g., Grice 1975; Potts 2005; 2007; McCready 2010; Sawada 2010; 2018; Gutzmann 2011; 2012). Furthermore, it is often assumed that CIs are speaker-oriented by default (Potts 2005; 2007). The idea that the meaning triggered by A-*wa* A is a CI is supported by the fact that it is not part of "what is said." Indeed, the CI component cannot be challenged by saying "No, that's false." As the following data show, B can object to the at-issue meaning of A's utterance as shown in (5B), but B cannot object to the CI part of A's utterance as shown in (6B):

(5) A: *Kono hon-wa takai-koto-wa takai.*
This book-TOP expensive-NMNL-TOP expensive
'This book is [expensive]$_{CT}$.'
(CI: The bread meets only the standard of "expensive" minimally and it is not very expensive.)

B: *Iya sonna-koto-wa nai. Mattaku takaku-nai-yo.*
No such-thing-TOP NEG At.all expensive-NEG-PRT
'That's false. It is not expensive at all.'

[6] In terms of prosody, it seems natural to place pitch peak on the first adjective as in (i), but it also seems that placing pitch peak on *wa* itself as in (ii) is possible:

(i) *Kono pan-wa OISHII-wa oishii.*
This bread-TOP tasty-CONT tasty
'This bread is [tasty]$_{CT}$.' CI: The bread meets only the standard of "tasty" minimally. (= It is not very tasty.)

(ii) *Kono pan-wa oishii-WA oishii.*
This bread-TOP tasty-CONT tasty
'This bread is [tasty]$_{CT}$.' CI: The bread meets only the standard of "tasty" minimally. (= It is not very tasty.)

(6) A: *Kono hon-wa takai-koto-wa takai.*
This book-TOP expensive-NMNL-TOP expensive
'This book is [expensive]$_{CT}$.'
(CI: The bread meets only the standard of "expensive" minimally and it is not very expensive.)
B: *Iya sonna-koto-wa nai. # Totemo takai-yo.*
No such-thing-TOP NEG Very expensive-PRT
'That's false. It is very expensive.'

In (5) B is denying the at-issue part of the sentence, that is, the book is expensive. By contrast, B is not denying the CI component in (6), which sounds unnatural.

Further evidence that the meaning produced by using A-*wa* A instead of the simple adjective A is CI is that it does not fall within the scope of the logical operator. The following is an example where external negation is added, but this sentence is unnatural because of the projection of the CI of A-*wa* A:

(7) ??*[Kono pan-wa oishii-wa oishii]-to.iu.wake.dewa.nai.*
This bread-TOP tasty-CONT tasty-it.is.not.the.case.that
At-issue: It is not the case that this bread is tasty.
CI: The bread meets only the standard of "tasty" minimally and it is not very tasty.

By the use of A-*wa* A, there is an implication that the bread meets only the standard of "tasty" minimally and it is not very tasty. However, this meaning cannot be negated by the external negation. As a result, a mismatch (contradiction) arises between the at-issue component and the CI component. (The CI component conveys that the degree of "tasty" minimally satisfies the standard, but the at-issue component does not.)

Furthermore, it is difficult to accept A-*wa* A (but not simple adjective A) in pure questions, pure conditional clauses, and pure modal sentences:

(8) *Kono kuruma-wa {takai/ ?? takai-koto-wa*
This car-TOP expensive/ expensive-NMLZ-CONT
takai}-desu-ka?
expensive-PRED.POLITE-Q

'Is this car {expensive/??[expensive]$_{CT}$}? (CI: This car is expensive but not very expensive.)

(9) *Moshi sono kuruma-ga {taka-kereba*
By.any.chance that car-NOM expensive-COND
/??takai-koto-wa takai-naraba}, kai-masen.
/expensive-NMLZ-CONT expensive-COND buy-NEG.POLITE
'If the car is {expensive/??[expensive]$_{CT}$}, then I will not buy it.' (CI: The car is expensive but not very expensive.)

(10) *Moshikashitara kono kuruma-wa {takai*
Maybe this car-TOP expensive
/??takai-koto-wa takai}-kamoshirenai.
/expensive-NMLZ-CONT expensive-may
'Maybe this car is {expensive/??[expensive]$_{CT}$}. (CI: This car is expensive but not very expensive.)

In these examples, the implication that the given car is minimally expensive arises from A-*wa* A. Because of this projective meaning, it is unnatural to use it for genuinely questioning whether it is expensive, or to infer or assume that it is expensive.[7]

Finally, I would like to confirm that the meaning of A-*wa* A is not a conversational implicature, since it is not cancelable:

(11) *Kono pan-wa oishii-wa oishii-desu. #To.iu.ka totemo*
This bread-TOP tasty-CONT tasty In.fact very

[7] The interrogative sentence (8) with A-*wa* A may increase in naturalness if the interrogative sentence is interpreted as a confirmation-seeking question. Also, if *kamoshirenai* 'may' is interpreted as a speech act usage of "endorsement" (similar to the English *may...but* (Sweetser 1990; Kay 1990), A-*wa* A can co-occur with *kamoshirenai* 'may':

(i) *Tashikani kono sofaa-wa takai-(koto)-wa takai-kamoshirenai-ga totemo*
Certainly this sofa-TOP expensive-NMLZ-CONT expensive-may-but very
suwarigogochi-ga ii-desu.
sit.down.feeling-NOM good-PRED.POLITE
'Certainly, this sofa may be expensive, but it is very comfortable.'

See Sawada (2006) and references therein for the discussion of speech act-oriented *kamoshirenai* 'may'.

oishii-desu.
tasty-PRED.POLITE
'This bread is [tasty]$_{CT}$. #In fact, it is very tasty.'

If we use a simple adjectival sentence (with simple *oishii* 'tasty'), this kind of discourse move is perfectly natural, though.

3.2 Form and meaning of the A-*wa* A construction

Let us now consider the form and meaning of the A-*wa* A construction in more detail. First, it is important to verify that the two adjectives are identical and function as a single adjective. Semantically, A-*wa* A has the same meaning as the single de-adjectival expression "A$_{adverbial.form}$-*wa aru*":

(12) *Kono pan-wa {oishii-wa oishii / oishiku-wa aru}.*
This bread-TOP tasty-CONT tasty / tasty.adverbial be
'This bread is [tasty]$_{CT}$.'

Oishiku is the adverbial (conjunctive) form of the adjective *oishii* and modifies the verb *aru*.

If the first A and the later A do not match, the sentence becomes ungrammatical:

(13) **Kono keeki-wa oishii-wa amai.*
This cake-TOP tasty-CONT sweet

Note that the A-*wa* A construction is different from Japanese NP doubling expressions (which do not involve contrastive *wa*; see Oho & Yamada 2011; Akita 2012):

(14) *Kono resutoran-wa Nihon-Nihon shi-tei-ru.*
This restaurant-TOP Japan-Japan do-STATE-NON.PST
'This restaurant is a typical Japanese restaurant.' (Oho and Yamada 2011)

Intuitively, NP reduplication involves a prototype. Oho & Yamada (2011) claim that it is a gradable predicate that represents closeness to the norm. Although NP reduplication is related to degree, there is no contrastive scalar meaning in A-*wa* A. Note that the contrastive *wa* is obligatory in the A-*wa*

A construction. If there is no *wa*, the sentence becomes ungrammatical (**oishii-oishii*).

Let us consider how the CI meaning of A-*wa* A can be analyzed based on example (4b). I assume that A-*wa* A is a special contrastive expression that has the same at-issue meaning as A but also obligatorily introduces a set of stronger scalar alternatives, as in (15) (θ stands for a contextually determined standard).[8,9]

(15) $[\![[\text{A-}<\text{wa}>\text{ A}]_{\text{CT}}]\!] =$
At-issue: $\lambda x \lambda w.\exists d[d > \theta_A \wedge A(x) = d]$ in w
Alternatives: $\{\lambda x \lambda w.\exists d_1[d_1 >!\theta_A \wedge A(x) = d_1]$ in w,
$\lambda x \lambda w.\exists d_2[d_2 >!!\theta_A \wedge A(x) = d_2]$ in w,
$\lambda x \lambda w.\exists d_3[d_3 >!!!\theta_A \wedge A(x) = d_3]$ in $w\,\}$

! indicates intensification and denotes that the distance between a degree and a standard is large. If ! is used multiple times, the distance becomes larger. In this approach, the at-issue and its alternatives of *oishii-wa oishii* 'delicious-CONT delicious' can be represented as follows:

(16) $[\![[\text{oishiii-}<\text{wa}>\text{ oishiii}]_{\text{CT}}]\!] =$
At-issue: $\lambda x \lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty}(x) = d]$ in w
Alternatives: $\{\lambda x \lambda w.\exists d_1[d_1 >!\theta_{\text{tasty}} \wedge \text{tasty}(x) = d_1]$ in w,
$\lambda x \lambda w.\exists d_2[d_2 >!!\theta_{\text{tasty}} \wedge \text{tasty}(x) = d_2]$ in w, $\lambda x \lambda w.\exists d_3[d_3 >!!!\theta_{\text{tasty}} \wedge$
$\text{tasty}(x) = d_3]$ in $w\}$

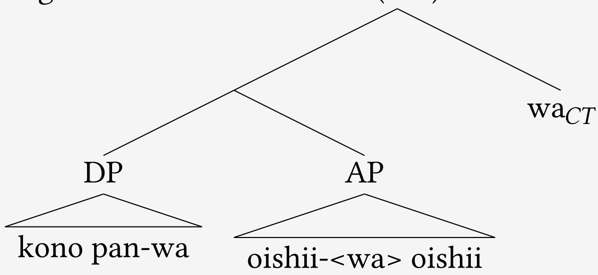
Linguistically speaking, the alternatives of *oishii-wa oishii* in (16) can be understood as *totemo oishii* 'very tasty', *mechakucha oishii* 'extremely tasty', etc. Note that although *wa* is morphologically attached to the adjective, it functions as a propositional operator, as in (17):

[8]Here I assume that a set of stronger scalar alternatives does not contain the adjective A. However, it is also possible to assume another approach where the set of alternatives includes A itself.

[9]Alternatively, it seems possible to define the set of stronger alternatives as follows:

(i) $[\![[\text{A-}<\text{wa}>\text{ A}]_{\text{CT}}]\!] =$
At-issue: $\lambda x \lambda w.\exists d[d > \theta_A \wedge A(x) = d]$ in w
Alternatives: $\{\lambda x \lambda w.\exists d'[d' > \theta_A \wedge A(x) = d']$ in $w\ :\ d' > d\}$

(17) Logical structure of A-*wa* A (=4b)



Following the idea of alternative semantics (e.g., Rooth 1985), I assume that alternatives are interpreted in the same way as at-issue elements in a point-wise fashion, as in (18):

(18) At-issue proposition: $\lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d]$ in w
Alternative propositions: $\{\lambda w.\exists d_1[d_1 >!\theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d_1]$ in w, $\lambda w.\exists d_2[d_2 >!!\theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d_2]$ in w, $\lambda w.\exists d_3[d_3 > !!!\theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d_3]$ in $w\}$

In the final part of the derivation, *wa* is combined with the at-issue proposition and induces a CI, as in (20):

(19) $[\![\text{wa}_{\text{CTscalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow q >_{\text{unlikely}} p]$

(20) $[\![\text{wa}]\!]([\![\text{oishiii-<wa> oishiii}]\!]([\![\text{kono pan}]\!])) =$
At-issue: $\lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d]$ in w
CI: $\exists q[C(q) \wedge q \neq (\lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d] \text{ in } w) \wedge \neg q] \wedge \forall q[C(q) \wedge q \neq (\lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d] \text{ in } w) \rightarrow q >_{\text{unlikely}} (\lambda w.\exists d[d > \theta_{\text{tasty}} \wedge \text{tasty(this.bread)} = d] \text{ in } w)]$

The alternative propositions *q* in (20) correspond to those in (18). Note that based on Potts' (2005) logic of CI, I assume here that the at-issue proposition (i.e., the argument of *wa*) is passed on to the at-issue dimension via CI application.[10] In the at-issue dimension, the sentence denotes that "this bread is tasty", but in the CI dimension, the speaker conveys that the bread's

[10]In Potts' (2005) multidimensional compositional system, there are two types, at-issue type, and a CI type and each type is used in different dimensions. The CI meaning is then calculated based on the following CI application:

being tasty is the least unlikely (i.e., the most likely) among the alternatives. In other words, the bread only meets the standard minimally.

3.3 Pragmatic scale

In the examples above, the alternatives triggered by A-*wa* A are about the degree of A. However, the alternatives are not always related to the degree of A, as shown in the following example:

(21) *[Oishii-wa oishii]-no-desu-ga ranchi-to.shite-wa*
Tasty-CONT tasty-*noda*-PRED.POLITE-but lunch-as-TOP
shoujiki moo chotto nedan-o sage-ta.houga.ii-node-wa.
frankly more a.bit price-ACC lower-better-node-PRT
'It is [tasty]$_{CT}$, but frankly, it would be better to lower the price.' (From the Internet)

In this context, the alternative of *oishii-wa oishii* is "tasty and cheap" (not "very tasty"):

(22) At-issue: It is tasty
Alternative: It is tasty and cheap.

In this context, having the property of being tasty is construed as the minimum by the speaker.

3.4 Extension to the verb doubling construction

I show that the proposed analysis of the A-*wa* A construction can naturally be extended to the V-(*koto*)-*wa* V construction (cf. Nishiyama & Cho 1998; Lee 2003; Potts et al. 2009), as in (23):[11]

(i) CI application (Potts 2005: 65)

$$\beta : \sigma^a$$
$$\bullet$$
$$\alpha(\beta) : \tau^c$$
$$\alpha : \langle \sigma^a, \tau^c \rangle \qquad \beta : \sigma^a$$

The superscript a stands for an at-issue type and the superscript c stands for a CI type. Here an α that is of $\langle \sigma^a, \tau^c \rangle$ takes a β of type σ^a and returns τ^c. At the same time, a β is passed on to the mother node. In this approach, the scalar contrastive *wa* has type $\langle \langle s^a, t^a \rangle, t^c \rangle$.

[11]Note that although the verb doubling is possible, the adverb doubling (ADV-*wa* ADV) is impossible.

(23) *Ame-wa {fut-ta / fut-ta-(koto)-wa fut-ta}.*
Rain-TOP fall-PST / fall-PST-NMLZ-CONT fall-PST
'It rained. / It [rained]$_{CT}$.'

If *fut-ta-(koto)-wa fut-ta* is used, the implication that the amount of rain was very low arises because of the scalar meaning of *wa*. Theoretically, it is possible to deal with the meaning of V-(*koto*)-*wa* V in the same way as A-*wa* A by assuming that the verb used in the construction is gradable.[12,13]

4 Embedded scalar contrastive *wa*

Let us now consider the issue of the conventionality of the scalar *wa* based on the phenomenon of embedded contrastive *wa*. I will show that the phenomenon of the embedded scalar meaning of contrastive *wa* also supports the idea of a conventionalized scalar meaning of contrastive *wa*.

The issue of the conventionality of the scalar *wa* is relevant to the recent discussion of the embedded scalar implicature. Geurts (2010: 163) observes

(i) **Watashi-wa sukoshi-wa sukoshi tabe-ta.*
I-TOP a.bit-CONT a.bit eat-PST
'Intended. I ate [a bit]$_{CT}$.'

This suggests that the contrastive doubling is not unconstrained, and it is only allowed in the predicative position.

[12] The verb doubling construction can be paraphrased by V-*wa suru* (Nishiyama & Cho 1998; Lee 2003):

(i) *Ame-wa furi-wa shi-ta.*
Rain-TOP fall.adverbial-CONT do-PST
'It [rained]$_{CT}$.'

[13] Korean also has contrastive scalar constructions similar to the Japanese V-*wa* V or V-*wa suru* (e.g. Lee 2003):

(i) a. *o-ki-nun hae-ss-e (Korean)*
come-NMLZ-CONT do-PST-DEC
'(She) [came]$_{CT}$.'

b. *o-ki-nun o-ass-e (Korean)*
come-NMLZ-CONT come-PST-DEC
'(She) [came]$_{CT}$.'
(Based on Lee (2003: 361))

that a contrastive focus on the scalar item is often (but not always) necessary (cf. Tomioka 2019) to produce a local scalar implicature, as shown in the contrast in (24):

(24) a. I hope that some of my relatives will remember my birthday.
Scalar implicature: ? I hope that not all of them will remember it. (Geurts 2010: 156)

b. I hope that SOME of my relatives will remember my birthday.
Scalar implicature: I hope that not all of them will remember it. (Geurts 2010: 163)

Geurts (2010) notes that if the contrastive stress is employed as in (24b), this sentence can be used to convey that the speaker would not like all their relatives to remember their birthday.

The necessity of contrastivity is clear in Japanese. To have a local scalar implicature, the contrastive *wa* is necessary. For example, in (25) where a simple adjective sentence is embedded, there seems to be no salient scalar implicature. However, if we use the A-*wa* A construction or the A-*wa aru* construction, then the local scalar implicature obligatorily arises as in (26):

(25) *Taro-wa kono keeki-wa oishii-to omo-tteiru.*
Taro-TOP this cake-TOP tasty-that think-STATE
'Taro thinks that this cake is tasty.'

(26) *Taro-wa kono keeki-wa {oishii-wa oishii-to / oishiku-wa aru-to} omo-tteiru.*
Taro-TOP this cake-TOP tasty-CONT tasty-that / tasty.adverbial-CONT be-that think-STATE
'Taro thinks that this cake is [tasty]$_{CT}$.'
(Implicature: Taro thinks that the cake is not very tasty.)

In (26), there is a clear inference that Taro thinks the cake is not very tasty.[14]

[14]The implication that the cake is not very tasty is anchored to the subject Taro shows that the CI meaning triggered by A-*wa* A can be non-speaker-oriented. This suggests that the CI is speaker-oriented in main clauses, but it shifts to the embedded subject in the embedded contexts. This kind of judge-shifting phenomenon is also observed in expressives and appositives (Amaral & Roberts & Smith. 2007, Harris & Potts 2009, cf. Potts (2005)).

This tendency is observed in the normal contrastive *wa* as well. As example (27) shows, if the contrastive *wa* (with a stress) is added to *nan-nin-ka* 'some,' the local scalar implicature that "not all of the students failed the exam" becomes salient:

(27) *Taro-wa nan-nin-ka-no gakusei-{***wa***/ga} shiken-ni*
Taro-TOP what-CL$_{person}$-KA-GEN student-CONT/NOM exam-to
ochi-ta-to omo-tteiru.
fail-PST-that think-STATE
'Taro thinks that [some]$_{CT}$ of the students failed the exam.'
(Local scalar implicature: Taro thinks that not all the students failed the exam.)

If *ga* (rather than *wa*) is used, the implicature becomes less salient (although it is available as a Gricean quantity implicature). Crucially, if *nan-nin-ka* is replaced with a high scalar term, such as *takusan* 'many', the sentence with the contrastive *wa* (but not with *ga*) sounds odd, as shown in (28):

(28) *Taro-wa takusan-no gakusei-{??***wa***/ga} shiken-ni ochi-ta-to*
Taro-TOP many-GEN student-CONT/NOM exam-to fail-PST-that
omo-tteiru.
think-STATE
'Taro thinks that ??[many]$_{CT}$ of the students failed the exam.'
(Local scalar implicature: Taro thinks that not all the students failed the exam.)

In this case, using *ga* plus a general Q-implicature is the only (at least preferable) option to produce an embedded scalar implicature. This supports the existence of a scalar contrastive *wa*.

5 Some notes on scalar contrastive *wa*

Having discussed the basic idea of scalar contrastive *wa*, this section adds some notes on its degree property, the interpretation with negation, and the relationship with non-scalar contrastive *wa*.

5.1 Contrastive *wa* with a high degree proportional quantifier

As briefly discussed in the previous section, when a contrastive *wa* co-occurs with a quantifier or degree expression, the quantifiers/degree expressions tend to have a low degree and they usually cannot be expressions that have a high degree, as shown in the following examples with floating quantifiers:

(29) (Floating quantifiers)

a. *Taro-wa gohan-o sukoshi-wa tabe-ta.*
Taro-TOP rice-ACC a.bit-CONT eat-PST
'Taro ate a bit of rice'

b. ??*Taro-wa gohan-o ooku-wa tabe-ta.*
Taro-TOP rice-ACC much-CONT eat-PST
'Taro ate a lot of rice.'

c. ??*Taro-wa gohan-o takusan-wa tabe-ta.*
Taro-TOP rice-ACC many-CONT eat-PST
'Taro ate a lot of rice.'

d. ??*Taro-wa gohan-o hotondo-wa tabe-ta.*
Taro-TOP rice-ACC many-CONT eat-PST
'Taro ate most of the rice.'

Although the sentence with *sukoshi-wa* 'a bit-CONT' is natural, the sentences with *ooku-wa* 'many-CONT', *tankusan-wa* 'many-CONT' or *hotondo-wa* 'most-CONT' are quite unnatural. This contrast disappears if we delete the contrastive *wa*:

(30) (Floating quantifiers, without the contrastive *wa*)

a. *Taro-wa gohan-o sukoshi tabe-ta.*
Taro-TOP rice-ACC a.bit eat-PST
'Taro ate a bit of rice'

b. *Taro-wa gohan-o ooku tabe-ta.*
Taro-TOP rice-ACC much eat-PST
'Taro ate a lot of rice.'

c. *Taro-wa gohan-o takusan tabe-ta.*
Taro-TOP rice-ACC much eat-PST
'Taro ate a lot of rice.'

d. *Taro-wa gohan-o hotondo tabe-ta.*
Taro-TOP rice-ACC many eat-PST
'Taro ate most of the rice.'

This supports our idea that contrastive *wa* has a low scalar value. In the case of the determiner, however, the situation becomes more complicated. Namely, in some cases, the quantifiers that have a high scalar meaning can be attached to *wa*. Before considering this point, let us first consider the unproblematic case. As Hara (2003) observes, *takusan* 'many' cannot co-occur (in a positive environment) with *wa*:

(31) #*Takusan-no hito-wa ki-ta.*
Many-GEN people-CONT come-PST
'Many people came.' (Based on Hara (2003))

If *wa* is replaced by the nominative case marker *ga*, then the sentence becomes natural:

(32) *Takusan-no hito-ga ki-ta.*
Many-GEN people-NOM come-PST
'Many people came.'

This makes sense considering the assumption that the scalar contrastive *wa* has a low scalar meaning.[15]

However, the determiner *ooku* 'many/much' seems to be able to co-occur with *wa*, as is also observed in Hara (2003):

(33) a. *Ooku-no hito-wa ki-ta.*
Many-GEN people-CONT come-PST
'Many of the people came.' (Hara 2003)

b. *Ooku-no hito-ga ki-ta.*
Many-GEN people-NOM come-PST
'Many people came.'

[15]Unlike my approach, Hara (2003) considers this point based on the idea that *takusan* 'many' behaves in the same way as universal quantifiers. We will come back to this point in Section 6.1.

As Hara (2003) observes, the determiner *ooku* 'many' as in (33a) is a proportional quantifier.[16]

This kind of proportional reading seems to be less salient if we use *ga* although it may not be impossible.

Similarly, the determiner *hotondo* 'most' can also combine with *wa*:

(34) *Hotondo-no hito-{wa / ga} ki-ta.*
Most-GEN people-CONT / NOM come-PST
'Most of the people came.'

Are these examples counterexample to the scalar analysis of the contrastive *wa*? I consider that they are not because their interpretations are not the same as that of the typical scalar contrastive *wa*. For example, in the case of (33a), the quantifier *ookuno* 'many (proportional)' concerns the proportion in the background set and the sentence conveys that the number of people who came is proportionally many. By using contrastive *wa*, the sentence explicitly signals that there are some people who did not come. I assume that such instances can be analyzed by the non-scalar contrastive *wa* (the sentence with *wa* is partitioning the set of numbers into two parts and contrasting them.) Similarly, *hotondo* 'most' can co-occur with *wa* because it is proportional. In (34), the sentence is contrasting those who came (= majority) and those who did not (= minority).

Note that *ooku* does not always have a proportional reading, but also a cardinal reading. The following sentences have only cardinal readings because they just report the quantity of NP, and it is difficult to assume a proportion based on the background set:

(35) *Kinoo-wa ooku-no ame-{ga/*wa} fut-ta.*
Yesterday-TOP much-GEN rain-NOM/CONT fall-PST
'Much rain fell yesterday.'

[16] The proportional reading in (33a) is semantically similar to the sentence with *daibubun* 'lit. large part':

(i) *Daibubun-no hito-wa ki-ta.*
Large.portion-GEN people-CONT come-PST
'Most of the people came.'

(36) *Konsaato-ni-wa ooku-no hito-{ga/*wa} ki-ta.*
Concert-to-TOP many-GEN people-NOM/CONT came-PST
'Many people came to the concert.'

(37) *Kono sensoo-de ooku-no shimin-{ga/*wa} gisei-ni nat-ta.*
This war-by many-GEN civilian-NOM/CONT sacrifice-to become-PST
'Many civilians were sacrificed in this war.'

5.2 The scalar contrastive *wa* with negation

So far, we have considered examples in which the scalar contrastive *wa* is used in affirmative sentences. However, the contrastive *wa* can also be used in negative sentences where the scale is reversed. That is, when the contrastive *wa* appears in a negative sentence, scale inversion occurs, and it co-occurs with a scale expression with a high degree, but not with a scale expression with a low degree (see also Sawada (2007)):

(38) *Taro-wa {puro / ?? shirooto}-ni-wa kat-e-nakat-ta.*
Taro-TOP professional / amateur-DAT-CONT win-can-NEG-PST
'Taro couldn't beat [a professional]$_{CT}$/[an amateur]$_{CT}$.' (Based on Sawada 2007, slightly modified)

(39) *Taro-wa hon-o {takusan / ??sukoshi}-wa mot-tei-nai.*
Taro-TOP book-ACC many / a.bit-CONT have-PROG-NEG
'Taro does not have [many]$_{CT}$/[a few]$_{CT}$ books.'

How can we analyze this point? As with the analyses of *even*, there seem to be two approaches for the interpretation of scalar contrastive *wa* with negation. The first approach is basically the same as the lexical ambiguity approach used in the analysis of *even* (Rooth 1985; Rullmann 1997; Giannakidou 2007). The approach assumes that in addition to the contrastive *wa* used in affirmative sentences, there is a scalar contrastive *wa* (the NPI scalar contrastive *wa*) which is dedicated to the negative environment. In this approach, the NPI contrastive *wa* is situated below negation and it takes the proposition without negation as its argument and construes it as the most unlikely among alternatives.

(40) $[\![\text{wa}_{\text{scalar.NPI}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow p >_{\text{unlikely}} q]$

For example, under this approach, the negative sentence (39) with *takusan* 'many' has the following CIs:

(41) $[\![\text{wa}_{\text{scalar.NPI}}]\!](\lambda w.\text{Taro has many books in } w) =$
$\exists q[C(q) \wedge q \neq (\lambda w.\text{ Taro mas many books in } w) \wedge (\Diamond)q] \wedge \forall q[C(q) \wedge q \neq$
$(\lambda w.\text{ Taro has many books in } w) \rightarrow$
$(\lambda w.\text{ Taro has many books in } w) >_{\text{unlikely}} q]$

Under this analysis, the proposition that "Taro has many books" is construed as the most unlikely among alternatives.

Another possible way to analyze the meaning of negative sentences with *wa* is the scope-based unitary approach which is the same approach used in the scope theory of the analysis of *even* (e.g., Karttunen & Peters 1979; Wilkinson 1996). In this approach, the contrastive *wa* takes a wide scope with respect to negation. That is, the contrastive *wa* takes a negative proposition as its argument and construes it as the least unlikely among alternatives:

(42) $[\![\text{wa}_{\text{CTscalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow q >_{\text{unlikely}} p]$

Under this approach, the CI meaning of the sentence (39) with *takusan* 'many' will be analyzed as follows:

(43) $[\![wa_{\text{CTscalar}}]\!](\lambda w.\text{ Taro does not have many books in } w) =$
$\exists q[C(q) \wedge q \neq (\lambda w.\text{ Taro does not have many books in } w) \wedge (\Diamond)\neg q] \wedge$
$\forall q[C(q) \wedge q \neq (\lambda w.\text{ Taro does not have many books in } w) \rightarrow$
$q >_{\text{unlikely}} (\lambda w.\text{ Taro does not have many books in } w)]$

In this paper, we will not discuss in depth which approach is more appropriate, but my impression is that the lexical ambiguity approach is more in line with the intuition of the scalar construal. The theory captures the intuition that the negation reverses the way the scale is perceived. However, the scope theory also works and is simpler in terms of the number of lexical entries. Further study, including the correspondence between formal meaning and scale perception, will be needed in the future.

5.3 The relationship between scalar and non-scalar uses

In this paper we have considered that there are two types of contrastive *wa*, scalar contrastive *wa* and non-scalar contrastive *wa*. This section considers how they are used and compartmentalized. Usually, when the contrastive *wa* combines with a quantitative/scalar expression, it is a scalar contrastive *wa*. When *wa* combine with a non-scalar expression, it is a non-scalar type:

(44) *Taro-wa ki-ta.*
Taro-CONT come-PST
'[Taro]$_{CT}$ came.' (But the others didn't/but the others may or may not have come.)

(45) (Context: Both amateur and professional tennis players participating in a tournament.)
Taro-wa shirooto-ni-wa kat-ta.
Taro-TOP amateur-DAT-CONT win-PST
'(lit.) Taro beat [an amateur]$_{CT}$.'

However, a scalar meaning can appear even if the focused element does not inherently have a scalar meaning. For example, (46), with the proper name *Hanako*, is ambiguous between scalar and non-scalar readings:

(46) *Hanako-wa ukat-ta.*
Hanako-CONT pass-PST
'Hanako passed.'
At-issue: Hanako passed.
Scalar reading: Hanako is the least unlikely (= the most likely) person to pass.
Non-scalar (existential reading): There is/can be someone other than Hanako who didn't pass.

The scale reading is possible because, in the context of an exam, it is easy to posit a scale of smartness/ability.

6 Comparison to the existing approaches

In this section, we will compare the proposed analysis of the contrastive *wa* with the existing approaches. Due to space limitations, we will limit our discussion to a few representative approaches (although many other ideas have been proposed), that is, the conventional scalar implicature approach, the Gricean reasoning approach, and the existential approach.

6.1 Conventional scalar implicature approach

First, let us compare my approach to the conventional scalar implicature approach represented by Hara (2003; 2006). In Hara's lexical approach, a contrastive topic triggers stronger propositions than the at-issue proposition p and conventionally implicates that those alternatives may not hold as shown in:

(47) CONTRASTIVE(<B, T>)

a. assert: B(T)
b. presupposes: ∃T'[T'∈ ALT$_C$(T) & B(T') entails B(T) & B(T) doesn't entail B(T')]
c. implicates: ∀ T'[T'∈ ALT$_C$(T) & B(T') entails B(T) & B(T) doesn't entail B(T')]→ Poss (¬B(T'))]
(Hara 2006: 36)

As an illustration, let us consider how this mechanism works based on some examples. First, the following sentence with *nan-nin-ka* 'some people' is natural because the sentence can presuppose a stronger alternative proposition than the at-issue proposition, as shown in (49):

(48) *Nan-nin-ka-wa* *ki-ta.*
What-CL$_{people}$-KA-CONT come-PST
'Some people came.'
(Implicature: It is possible that not everyone came.)

(49)
a. $\exists x[[\text{person}(x)][\text{came}(x)]]$
b. Stronger Scalar Alternative: $\forall x[[\text{person}(x)][\text{came}(x)]]$
c. B(T') entails B(T).
d. B(T) does not entail B(T').
e. Implicature: Poss(¬∀(x)[[person(x)][came(x)]]) (= ¬B(T')
(Based on Hara 2006)

Furthermore, Hara's theory correctly captures the fact that the sentence with *minna* 'everyone' is odd:

(50) #*Minna-wa ki-ta.*
Every.one-CONT come-PST
'[Everyone]$_{CT}$ came.' (Based on Hara (2003; 2006))

(50) is odd because it cannot presuppose a stronger alternative proposition.

Crucially, Hara's theory assumes that every sentence accompanied by a contrastive *wa* has a scalar conventional implicature. For example, in (51) the contrastive *wa* is attached to a proper name, which is not scalar, but the sentence still generates a scalar conventional implicature as in (52):

(51) *John-wa ki-ta.*
John-CONT come-PST
'[John]$_{CT}$ came. (Conventional implicature: It is possible that it is not the case that John and Mary came.) (Hara 2006)

(52) The contrastive *wa* in a sentence α conventionally implicates that the speaker/attitude holder of α believes that the stronger proposition is possibly false.

Although this theory can capture the similarity with a scalar implicature, it does not specify a scalar value (i.e., it does not posit that p is the least unlikely). Thus, this theory predicts that if a stronger alternative proposition can be postulated, then in principle the contrastive *wa* can co-occur with any scalar item. However, as we observed in Section 4 and Section 5.1, it is usually difficult for contrastive *wa* to co-occur with an expression that has a high scalar value:

(53) *Taro-wa gohan-o {sukoshi / ?? takusan}-wa tabe-ta.*
Taro-TOP rice-ACC a.bit / many-CONT eat-PST
'Taro ate [a bit]$_{CT}$ of rice/Taro ate [a lot]$_{CT}$ of rice.'

(54) *Okyaku-wa {sukoshi / ?? takusan}-wa ki-ta.*
Customer-TOP a.bit / many-CONT come-PST
'[A few]$_{CT}$ customers came. [Many]$_{CT}$ customers came.'

Hara (2003) considers that cardinal *takusan* 'many' behaves like the universal quantifiers (e.g., *zenbu* 'all', *minna* 'everyone'). They cannot co-occur with contrastive *wa* in a positive environment and both can co-occur with contrastive *wa* in a negative environment. However, the cardinal MANY and the universal quantifier ALL are semantically not the same. We need to say something special about the similarity between them. My theory on the other hand can correctly capture the oddness of the sentences with *takusan* and the universal quantifiers. They are odd because they have a high scalar meaning, rather than low.[17]

However, as pointed out by Hara (2003) and discussed in Section 5, the proportional determiner *ooku* 'many' or *hotondo* 'most' can be used with *wa*:

(55) *Ooku-no hito-wa kaet-ta.*
Many-GEN people-CONT return-PST
'Many of the people left.'

(56) *Hotondo-no hito-wa kaet-ta.*
Most-GEN people-CONT return-PST
'Most$_{CT}$ people left.'

These sentences are not problematic for Hara's theory and they can be problematic for my theory, but as discussed in Section 5 I am assuming that *wa* in these sentences are not scalar contrastive *wa* in that they are partitioning the set of numbers into two parts and contrasting between them.

6.2 Gricean reasoning approach

Let us now look at Tomioka's non-lexicalist (Gricean reasoning) approach to the scalar meaning of the contrastive *wa* (Tomioka 2010, 2016). Tomioka claims that contrastive topics operate at the level of Speech Acts and the effect of incompleteness/non-finality in the utterance with contrastive *wa* is a result of a general principle of conversation in the Gricean sense.

As for the data, although most studies of contrastive *wa* focus on declara-

[17]Note that in the negative sentence a scale-reversal occurs, and the proposition (without negation) is construed as high on the unlikelihood scale.

(i) *Takusan-wa ko-nakat-ta.*
Many-CONT come-NEG-PST
'[Many]$_{CT}$ came.'

tive sentences, Tomioka shows that it can appear in a wide range of sentence types including interrogative, imperative, exhortative, and performative:

(57) a. Interrogative
Erika-WA/ERIKA-wa doko-e itta-no?
Erika-CONT/Erika-CONT where-LOC went-Q
'Where did ERIKA go?'

b. Imperative
Eego-WA/EEGO-wa chanto yatte-ok-e.
English-CONT/English-CONT without.fail do-prepare-IMP
'At least, prepare yourself for ENGLISH.'

c. Exhortative
Kyooto-NI-WA/KYOOto-ni-wa iko-o.
Kyoto-LOC-CONT/KYOTO-LOC-CONT go-EXH
'At least, let's go to KYOto.'

d. Performative
Sutoraiki-no tame, KYOO-wa/Kyo-WA
Labor strike-GEN-due TODAY-CONT/today-CONT
yasumi-to suru.
off.day-COMP do
'Doe to the labor strike, we make it that there be no work TODAY.'
(Based on Tomioka (2010), gloss is slightly modified)

Based on this assumption, Tomioka claims that the scalar meaning of the contrastive *wa* is a conversational implicature.

Tomioka (2016) discussed the relationship between the scalar meaning of contrastive *wa* and a general pragmatic scalar (scalar reasoning) in more detail. Tomioka claims that the scalar interpretation of contrastive *wa* is very similar to a 'weak scalar' implicature in the so-called standard recipe of scalar implicature (Geurts 2010).

The implicature is calculated based on the following standard recipe:

(58) a. The speaker S says ϕ.

b. S could have made a stronger and/or more informative claim by saying ψ

c. The reason for S's not saying ψ may well be that S fails to believe that ψ is true. (= weak scalar implicature)

d. Assuming S is knowledgeable or has a strong opinion about the truth/falsity of ψ, one can conclude that S believes that ψ is false. (= strong scalar implicature) (Based on Geurts (2010), Tomioka 2016)

The step (d) is often called 'Competence Assumption' in Van Rooij & Schulz (2004). This is an extra step needed to generate a strong implicature. Without this step, it remains weak. Tomioka (2016) considers that the scalar meaning of contrastive *wa* is similar to this weak implicature.

To make sure that the scalar meaning of contrastive *wa* is (often) weak, Tomioka (2016) assumes that contrastive *wa* conventionally signals the avoidance of the competence Assumption (the step from c to d) by positing the following constraint.

(59) Do not apply Competence Assumption to the stronger alternatives generated by the contrastive *wa*. (Tomioka 2016: 767)

According to Tomioka, avoiding the Competence Assumption does not mean that the application of the Incompetence Assumption and the stronger meaning is not automatically ruled out.

Strictly speaking, therefore, Tomioka's (2016) proposal is not purely conversational. It is mixed with both conventional and conversational meanings. However, this theory can still be said to be a conversational (non-lexical) approach in that its scalar meaning is derived by general pragmatic reasoning.

Although the non-lexicalist (general scalar implicature-based) approach successfully captures the similarity with scalar implicature and 'at least', since this approach does not lexically specify a scalar meaning, it does not directly capture the phenomenon of low-degree construal of contrastive *wa* (including the scalar meaning of A-*wa* A construction). Although it does capture the ignorance flavor similar to 'at least', a low-degree scalar construal is not directly relevant. However, as for the environment of contrastive *wa*, it can indeed arise in a variety of sentence types (speech acts). My current approach considers that in those cases *wa* takes a proposition (radical) and the scalar (low-likelihood) meaning will be interpreted below the speech act level. More detailed discussion will also be necessary for the lexicalist (scalar-based) account.

6.3 Existential approach

Finally, let us consider the existential approach to contrastive *wa* represented by Oshima (2005; To appear). Oshima (2005; To appear) considers that contrastive *wa* has an existential (non-scalar) CI (The superscript f stands for the *focus* semantic value and the superscript o stands for the *ordinary* semantic value):

(60) The interpretation of WA(S)
CI: There is some proposition p such that $p \in \text{ALT}(\llbracket \text{S} \rrbracket^f)$, $p \neq \llbracket \text{S} \rrbracket^o$, and $\neg p$ is compatible with the speaker's current beliefs; Entailment: It is not the case that $\llbracket \text{S} \rrbracket^o$

Let us consider this analysis based on example (61):

(61) *John-wa gookaku-shita.*
John-CONT pass.exam-PST
'[John]$_{CT}$ passed.' (Oshima To appear)

As Oshima (To appear) claims, in Hara's approach, the relevant alternatives of (61) would be something like (62a), where the alternatives are semantically stronger than the prejacent proposition. By contrast, in Oshima's analysis the relevant alternatives may include those that are logically independent of the prejacent proposition as in (62b):

(62) a. {'John and Ken passed', 'John and Luke passed', 'John, Ken, and Luke passed'}
b. {'Ken passed', 'Luke passed'}

Although Oshima's approach successfully captures the meaning of the non-scalar contrastive *wa*, it seems that this theory cannot capture the meaning of the scalar contrastive *wa* explicitly. It seems that scalar meaning triggered by contrastive *wa* is purely pragmatic. By contrast, in my approach, there can be scalar and non-scalar contrastive *wa* and this approach captures the alternative set, like (62b), based on no-scalar contrastive *wa*, which is basically the same as Oshima's proposal.

7 Relevant phenomena

In this section, we discuss phenomena similar to scalar contrastive *wa*: *mo* in Japanese, *only* in English, and *shika* in Japanese.

7.1 Japanese *mo*

First let us consider the meanings of the Japanese particle *mo*. The particle *mo* is semantically ambiguous between a scalar additive meaning 'even' and a simple inclusive meaning 'also'. Sawada (2007) claims that the Japanese contrastive *wa* is a mirror image of *mo* 'even, also':

(63) a. *Taro-mo ki-ta.* *(Non-scalar)*
Taro-also come-PST
'Taro also came.'

b. *Tooku-ni 500-nin-mo ki-ta.* *(Scalar)*
Talk-to 500-CL-even come-PST
'{Even 500/as many as 500} people came to the talk.'

(64) a. *Taro-wa ki-ta.* *(Non-scalar)*
Taro-CONT come-PST
'[Taro]$_{CT}$ came. (But I don't know about others.)'

b. *Tooku-ni 500-nin-wa ki-ta.* *(Scalar)*
Tallk-to 500-CL$_{person}$-CONT come-PST
'At least 500 people came to the talk.'

In terms of polarity, while the non-scalar *wa* has a negative CI component, the scalar *mo* has a positive CI component. In terms of scale, while the scalar contrastive *wa* has a low scalar meaning, the scalar *mo* has a high scalar meaning:

(65) a. $[\![\text{mo}_{\text{additive}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge q]$

b. $[\![\text{mo}_{\text{CTscalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow p >_{\text{unlikely}} q]$

(66) a. $[\![\text{wa}_{\text{CTnon.scalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q]$

b. $[\![\text{wa}_{\text{CTscalar}}]\!] = \lambda p.\exists q[C(q) \wedge q \neq p \wedge (\Diamond)\neg q] \wedge \forall q[C(q) \wedge q \neq p \rightarrow q >_{\text{unlikely}} p]$

7.2 Scalar and non-scalar uses of *only* and the exceptive particle *shika*

A similar phenomenon can be found in English *only* and the Japanese *shika*. It has been observed in the literature that *only* has both non-scalar and scalar uses (Horn 2000; Lee 2006; Coppock & Beaver 2014):

(67) a. I only invited [John]$_F$. (*Non-scalar*)
b. Only John came to the party. (*Non-scalar*)

(68) a. John is only a graduate student. (*Scalar*)
b. This is only a down payment. (*Scalar*)
(Coppock & Beaver 2014)

The interpretation of the sentence with scalar *only* is different from that with the non-scalar only. Coppock & Beaver (2014) observe that the sentence with the non-scalar *only* is paraphrased with *nothing other than*, while the sentence with the scalar only is paraphrased with *no more than*:

(69) a. This is for nothing other than fun. (paraphrase: This is only for fun.)
b. This is no more than a down payment. (paraphrase: This is only a down payment.)

A similar phenomenon can be observed in the Japanese *shika*.

(70) *Taro-shika ko-nakat-ta. (Non-scalar)*
Taro-SHIKA come-NEG-PST
'Only Taro came.'

(71) *100-en-shika nai. (Scalar)*
100-yen-SHIKA NEG
'I only have 100yen.'

Regarding the analysis of the meaning of *only*, Coppock & Beaver (2014) give a uniform analysis for complement-exclusion and rank-order readings according to which both readings are scalar. That is, the sentence with an exclusive has an 'at least' component as a presupposition and the 'at most' component as an 'at issue' meaning.

In this paper, I will not discuss in detail the meanings of the English *only* and the Japanese *shika*; however, they seem to have similar pragmatic function to the contrastive *wa*. That is, their functions are to negate alternatives; this kind of use seems to play an important role for the development of scalar use (see also the conclusion).

8 Conclusion

This paper discussed the scalar meaning of the contrastive *wa*. Based on the phenomenon of A-*wa* A construction and the contrastive *wa* in the embedded environment, I argued that in at least some uses of contrastive *wa*, the scalar meaning of the contrastive *wa* has been conventionalized and that it is difficult to explain all types/meanings of contrastive *wa* based on a single lexical item or a pragmatic principle. This paper suggested that there are multiple types of contrastive *wa* (i.e., a scalar type and a non-scalar type) and we need to consider the conventionality of the scalar meaning.

Finally, let us briefly consider the question of where the scalar contrastive *wa* comes from and how it developed. Although this is still speculation, I would like to consider that the scalar contrastive *wa* developed from the non-scalar contrastive *wa* through the conventionality of scalar inference, which arises from sentences with non-scalar contrastive *wa*. That is, when the non-scalar contrastive *wa* co-occurs with an expression that can invoke a degree or a rank, the inference that the degree/rank in question is the lowest among the alternatives arises conversationally. For example, by conveying that there are some universities other than X University that I was not accepted to, we can infer that X University is the lowest among the alternatives (i.e., it is construed as the most likely university to be accepted):

(72) *X daigaku-ni-wa ukat-ta.*
X university-to-CONT pass-PST
' I was accepted to [X University]$_{CT}$.'
Existential CI: There are some universities other than X University that I was not accepted to.
Conversational implicature: X University is the lowest among the alternatives (= X University is the easiest university to get into).

I contend that this kind of low scalar inference has been conventionalized in Modern Japanese (as "the least unlikely (most likely)" inference) similarly to *at least*. That is, when the contrastive *wa* co-occurs with an expression related to degree, a low scalar meaning is interpreted at the lexical level. As a result, if we combine the contrastive *wa* with an expression that has a high scalar meaning in Modern Japanese, then the sentence becomes odd, as shown in the following examples:

(73) a. ??*Takusan-wa aru.*
Many-CONT exist
'There are [many]$_{CT}$.'
b. *Sukoshi-wa aru.*
A.bit-CONT exist
'There are [a few]$_{CT}$.'

(74) a. ??*Taro-wa gohan-o takusan-wa tabe-ta.*
Taro-TOP rice-ACC many-CONT eat-PST
'Taro ate [a lot]$_{CT}$ of rice.'
b. *Taro-wa gohan-o sukoshi-wa tabe-ta.*
Taro-TOP rice-ACC a.bit-CONT eat-PST
'Taro ate [a bit]$_{CT}$ of rice.'

This is still speculation, and more detailed research is necessary to clarify the historical development of the contrastive *wa*.

Abbreviations and glosses

ACC: accusative; CL: classifier; COMP: complementizer; COND: conditional; CONT: contrastive; DAT: dative; DEC: declarative; EXH: exhortative; GEN: genitive; IMP: imperative; KA: Japanese *ka*; LOC: locative; NEG: negation, negative; NMLZ: nominalizer; NOM: nominative; NON.PST: non-past tense; POLITE: polite; PRED: predicative; PROG: progressive; PRT: particle; PST: past; SHIKA: Japanese *shika*; STATE: state/stative; TOP: topic.

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What is the syntax-pragmatics interface?

Martina Wiltschko

Abstract This paper addresses the issue as to how syntax interfaces with pragmatics. I follow the common view that at least some type of contextual information is systematically integrated into syntactic structure. I adopt a particular version of this approach, namely, the interactional spine hypothesis (Wiltschko 2021). Based on a detailed case-study of *huh*, I explore how contextual information is integrated into the structure. Specifically, I explore *huh* in its use as an other-initiated repair, as a sentence-final particle, and its use in self-talk. I show that the interactional spine hypothesis allows for a straightforward analysis of its distribution. As such the linguistic profile of *huh* supports the claim that at least some aspects of what is traditionally considered to belong to the pragmatic domain is regulated by the spine. However, I also show that there is not a single locus that could be identified as the syntax-pragmatics interface, neither in the syntactic structure, nor within the model of grammar. Rather contextual information is distributed across the syntactic structure and there still is the need for (post-syntactic) rules of inference. In other words, pragmatics is modular and hence there cannot be a dedicated syntax-pragmatics interface.

Keywords interactional spine · sentence-final particle · other-initiated repair · syntactization of speech acts · intonational tunes

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1 Introduction

Traditionally, linguistics has been divided into several subdisciplines including phonetics, phonology, morphology, and syntax where each sub-discipline was clearly demarcated by its object of study: *phonetics* as the study of sound at the physical level; *phonology* as the study of sound patterns; *morphology* as the study of how words are formed; and *syntax* as the study of how sentences are formed from words. *Meaning* in language was traditionally thought to be too obscure to be studied with any rigour. Thus, the study of meaning was restricted to etymological investigations of words, on the one hand and philosophical considerations on the other.

Semantics in the modern sense came about through the incorporation of mathematical methods into linguistics, and specifically with Partee's (1975) insight that the formal language devised by Montague (1970) is compatible with the formal approach to syntax that defines the generative enterprise. Nevertheless, two claims that predate modern semantics are still considered core pillars of our understanding of meaning: Saussure's principle of arbitrariness, which pertains to the relation between form and meaning in words and Frege's principle of compositionality, which pertains to the relation between form and meaning in complex expressions.

(1) **Principle of arbitrariness**
The relation between sound and meaning (in words) is arbitrary.

(2) **Principle of compositionality**
The meaning of a complex expression is determined by the meaning its constituent parts and the way they are combined.

Similarly, *pragmatics*, the study of how meaning arises in use and through contextual knowledge, became a sub-discipline of linguistics rather late and mainly inspired by the work of Grice. The importance of context (also recognized by Frege[1]) was explicitly endorsed in the work of the late Wittgenstein and can be formulated as the principle of contextuality, as in (3).

(3) **Principle of contextuality**
Only in the context of a sentence has a word a meaning.

The importance of interpreting language in context has become an important domain of investigation. For example, it was essential in the development of speech act theory, which seeks to explore and explain how what we say can affect others (Austin 1962). Similarly, ever since Kaplan's (1999) seminal work on expressives (like *oops* and *ouch*) the kind of context-dependence involved has been subject to rigorous formal analysis (e.g., Potts 2007; Gutzmann 2013, 2015; McCready 2019).

[1]Pelletier (2001) shows that both principles in (1) and (3) have been frequently attributed to Frege though it is not clear that Frege actually formulated either of them.

While the field of linguistics is still structured in a way that reflects the classical division of sub-disciplines (e.g., in the way the curriculum in linguistic departments is designed or in the way major conferences are organized) the focus in the research of many linguists is less clearly demarcated and the study of the interfaces has become increasingly important (e.g., syntax-morphology, syntax-semantics, semantics-pragmatics, syntax-phonology, etc.).

This shift towards an interest in the interfaces across sub-disciplines correlates with the shift in linguistics towards a mentalistic approach towards language. That is, the classic sub-divisions reflect a descriptive focus on structural properties of language as a system that is to be studied in its own right. The generative enterprise, however, concerns itself with an investigation of what people know when they know a language. In other words, it concerns the cognitive capacities responsible for our language faculty. As such the language faculty is studied as a whole and the question naturally arises as to how knowledge of one particular aspect of language (e.g., sentence-formation) interacts with another aspect of language (sentence-interpretation). The goal of this enterprise then is to develop a model of the language faculty that not only accounts for the patterns observed in individual domains of language and in individual languages but that also accounts for the patterns that arise in the interaction across such domains and that are found universally. Thus, the ultimate goal is to develop a model that reflects the workings of the human mind.

My focus in this paper is on the syntax-pragmatics interface, i.e., the way contextual information interacts with the construction of sentences. The overarching question from a mentalistic modelling point of view concerns the question regarding the locus and nature of this particular interface. This question does not have a straightforward answer within current generative models. Consider why. Within mainstream minimalist approaches, the computational system (i.e., syntax) interfaces with two external systems: the conceptual-intentional (CI-)system, which is largely responsible for interpreting the meaning of an utterance (i.e., semantics) and the sensory-motor (SM-)system, which is largely responsible for interpreting the sound of an utterance (i.e., phonetics/phonology). Within this model, the question where contextual information that arises via language in use (i.e., pragmatics) is located might be answered as follows: outside the language faculty proper,

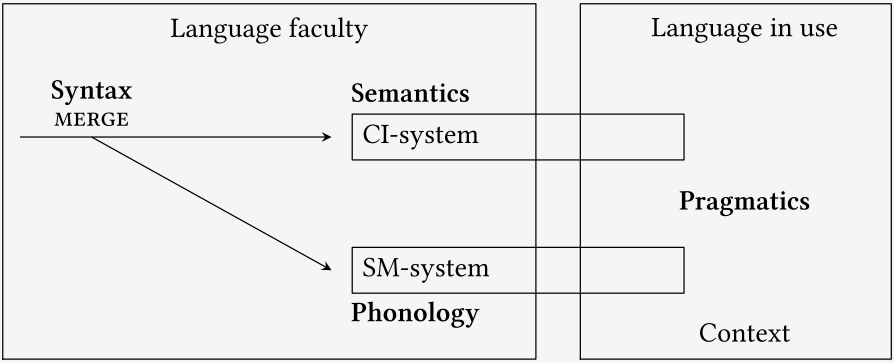


Figure 1 Where is pragmatics?

as illustrated in Figure 1.

On this view then there is no direct interface between syntax and pragmatics. Rather the interface would be mediated by the CI-system, which in turn interfaces with contextual information. This view of pragmatics is a direct consequence of the assumption that the linguistic system is mainly a system that regulates the relation between form and meaning as directly encoded in the linguistic ingredients that make up complex expressions. Chierchia (2004) describes this view as follows.

> here is a widespread view of the latter [interface of pragmatics with syntax and semantics; MW]. Grammar (which includes syntax and semantics) is a computational system that delivers, say, pairs of phonetic representations and interpreted logical forms. The output of the computational system is passed onto the conceptual/pragmatic system that employs it for concrete communication. The computational system of grammar and the conceptual/pragmatic system are separate units and work in a modular way: each unit is blind to the inner workings of the other. Things like agreement or c-command belong to grammar; things like relevance or conversational maxims belong to the conceptual/pragmatic system. (Chierchia 2004: 39)

However, Chierchia (2004: 39f.) continues to argue that, “this view is very plausible and has been quite successful in explaining things. Yet […]

in certain important respects, it is actually wrong." More specifically, he proposes that at least some pragmatic meaning, namely scalar implicatures, are part of the computational system proper. In other words, he argues that they must be fully encoded in the linguistic system (Chierchia 2017). But if this is the case the model depicted in Figure 1 cannot be quite right: not all of what is traditionally viewed as being part of pragmatics lies in fact outside of grammar or even outside of syntax in the narrow sense.

Chierchia's conclusion falls squarely within other approaches according to which contextual information is not simply a matter of extra-linguistic knowledge but is in fact a core part of linguistic knowledge. That is to say that grammar (and syntax in particular) must have a systematic way to incorporate contextual meaning. We know this from the fact that deictic categories, such as tense and personal pronouns, for example, are at the center of grammatical knowledge. Moreover, there has been a long, albeit interrupted, tradition within generative grammar to take aspects of speech acts to be part of syntax. That is, Ross (1970) argued that core properties of Austin's speech act theory are directly encoded in syntax. While Ross' (1970) implementation of this was couched within the framework of generative semantics, which was rejected, his main insight has received a revival within current theorizing. For example, Speas & Tenny (2003) argue that the topmost layer of structure within the functional architecture of clauses consists of an articulated speech act phrase and a point-of-view phrase. Both encode concepts that are traditionally considered to be in the realm of pragmatics. Point-of-view depends on context, and the notion of speech act relates to what we *do* with words when we say things. Speas & Tenny's (2003) paper initiated an updated version of Ross' main insight in that it aimed to implement different speech act types within the functional architecture of clausal structure making use of familiar ingredients of grammar. In subsequent work, researchers have provided further evidence for this higher structure which encodes notions traditionally thought to be a matter of pragmatics (Munaro & Poletto 2002; Pak 2006; Davis 2011; Saito & Haraguchi 2012; Krifka 2013; Haegeman & Hill 2013; Haegeman 2014; Hill & Stavrou 2014; Lam 2014; Servidio 2014; Kido 2015; Corr 2016, 2022; Woods 2016; Zu 2018; Miyagawa 2022 a.o.). Crucially this evidence includes overt units of language which serve to encode these notions, such as sentence-final particles, which can be used to encode the epistemic states of the interlocutors and vocatives which do not correspond to grammatical arguments but instead they name the addressee. These units of language have not traditionally been part of the empirical domain explored within grammatical analyses, including the generative enterprise. Historically, the reason for the absence of grammatical treatments of such units of language has to do with the assumption that the unit of grammatical analysis (and of syntax in particular) is the sentence. Spoken language phenomena are often rather informal and riddled with disfluencies and the like. Hence, they have not been considered to be part of grammar, which was intrinsically prescriptive, at least traditionally. Despite its focus on native speaker intuitions rather than prescriptive rules, generative grammar inherited this focus on the sentence; and ironically its focus on competence rather than performance reinforced the exclusion of purely spoken language phenomena: if an element is restricted to language in use, it is considered part of language performance and hence not within the realm of grammatical analysis. However, this runs counter the findings of conversation analysis, a framework that explicitly denies the primacy of the sentence as the unit of analysis, but instead takes conversational turns to play this role. Interestingly, one of the motivations to study the linguistic properties of conversations is the finding that there is an intricate systematicity in conversational turn-taking, so much so that it suggests a conversational competence that defines the human language faculty just as our competence for building sentences does.[2] This conclusion is further supported by the fact that units of language that serve to regulate conversational interaction are integrated into linguistic utterances systematically. The interactional dimension of grammar has long been investigated outside of the minimalist generative tradition (e.g., Ginzburg 2012, Kempson et al. 2001, Couper-Kuhlen & Selting 2001).[3]

Given this background on the relation between grammatical competence on the one hand and communicative (or pragmatic) competence on the other, it is all the more important to explore how and where pragmatics is integrated into our model of the language faculty. The goal of this paper is to do just that. I do this based on a case study of a unit of language

[2]Interestingly, even Chomsky (1980) proposed a pragmatic competence.

[3]See Wiltschko (2021) for detailed discussion of different frameworks and an attempt to bridge across them.

that is restricted to language in use, namely *huh*. The paper is organized as follows. I start by introducing three empirical facts concerning *huh* in Section 2. In Section 3, I proceed to introduce details of the theoretical framework that I shall use to analyse these facts in Section 4. In Section 5, I conclude with a proposal regarding the main question addressed in this paper: what is the syntax-pragmatics interface? Specifically, I shall conclude that pragmatic knowledge is distributed across various domains and that it is no coincidence that there is no dedicated location for this interface in our model of grammar.[4]

2 Three facts about *huh*

In this section, I introduce three empirical facts about *huh*, a unit of language restricted to language in conversational interaction.[5] These facts demonstrate that there is an intricate systematicity behind the use of *huh* which goes much beyond what would be expected of a matter that is not part of language competence. It has all the hallmarks of what one would expect of a phenomenon that is part of grammatical knowledge, albeit grammatical knowledge that is sensitive to the context of interaction. We observe universal patterns, multi-functionality, and speakers have clear well-formedness

[4]The modular nature of the syntax-pragmatics interface also implies that different types of contextual information will be integrated into the grammatical architecture in different ways. In this paper, I cannot do justice to all of these phenomena, but I restrict myself to a case-study of *huh*, a unit of language which has, to date, not received any attention within the generative tradition. Other contextually determined phenomena, such as discourse particles (German *ja, wohl*), expressives, and information-structure are well-studied. It goes without saying that a complete model of the syntax-pragmatics interface will have to consider these phenomena as well, but this goes beyond the scope of the present paper.

[5]An anonymous reviewer points out that the orthographic representation of this particle as *huh* is an oversimplification as this particle can be pronounced in various ways such that it may not even be a single dedicated form. While I agree that *huh* can be realized in different ways depending on various factors, which go beyond the scope of the present paper, I do not agree that this justifies the conclusion that we might not be dealing with a dedicated form. Evidence to this effect comes from the study on the cross-linguistic properties of *huh* (Dingemanse et al. 2013), which has identified it as a universal word. If *huh* were not in fact a dedicated form, this result would have hardly been obtainable. I here simply follow the orthographic convention in Dingemanse et al. (2013) acknowledging that certain (likely paralinguistic) phenomena can influence its pronunciation – as is the case for any other word.

judgements regarding its use.[6] I will introduce each of these properties in turn.

2.1 Universality: *huh* as other-initiated repair

One of the reasons that led to the postulation of a distinction between competence and performance, and to include only the former in the domain of grammatical investigation, is the fact that language in use is riddled with errors and problems due to limitations that lie outside of linguistic knowledge. This is certainly true. However, what conversation analysis was able to demonstrate is that the language system provides us with means to deal with these problems and to do so systematically. In other words, communicative competence includes systematic knowledge about how to deal with communicative problems, and this is true across languages in remarkably similar ways. One of the universal means to deal with such problems concerns repair strategies. That is, when there is a problem of understanding, interlocutors have ways to repair these problems, either by correcting themselves or by requesting correction from their interlocutor. The latter is known as *other-initiated repair* (henceforth OIR) and *huh* can be used in this way, as shown in (4).[7],[8]

[6]An anonymous reviewer questions the methodology of only using native speaker judgements to gather data that are restricted to spoken language. They suggest that, to get a full picture about the empirical landscape, one has to consult corpus data, as is standard practice in conversation analysis. For reasons of space, I cannot adequately discuss the methodological issues that arise when dealing with language in interaction (see Wiltschko 2021 for discussion). The data which the generalizations I report on here are based on have been collected in targeted elicitation tasks with several native speakers using conversation boards (see Wiltschko 2021). It is clear that speakers have clear intuitions about the use of particles like *huh*. In addition, I regularly explore corpora of spoken language (always in a qualitative manner) to informally test the hypothesis that I entertain. Moreover, as pointed out in Wiltschko (2021), corpus studies typically require the researchers to use their intuition regarding the function a given particle has in a given context. Thus, even corpus linguists rely on native speaker intuitions.

[7]There are several other ways in which repairs can be initiated, including full questions (*What did you say?*) and echo questions, which repeat the initiating move with a question word replacing the problematic phrase (*He bought what?*). See Kendrick (2015) for a recent overview.

[8]Following Wiltschko (2021), I use "I" for Initiator and "R" for Responder when presenting the data. This reflects that fact that in a conversation the standard terms "speaker" and "addressee" are not useful as these roles change in each move.

(4) I: It's not too bad
R: Huh? [hã/]
I: 'S not too bad
(adapted from Dingemanse et al. 2013: extract 1)

There are several interesting properties of *huh* used as OIR. First, it is remarkable that a simple particle such as *huh* can convey what appears to be a complex meaning relating to the course of the conversation.[9] More specifically, if we are to convey its meaning in propositional terms, the contribution of *huh* can be paraphrased as in (5).[10]

(5) ≈ There is a problem in the communication
≈ I don't understand
≈ Can you clarify?
≈ What?

The second striking fact is that OIRs are universal, and not just that. A syllable similar to English *huh* appears to be universally used in this way (Dingemanse et al. 2013). In other words, this is a unit of language whose form and function appears to be universal – at least it is used in a sample of 10 geographically and typologically unrelated languages (Cha'palaa, Dutch, Icelandic, Italian, Lao, Mandarin Chinese, Murriny Patha, Russian, Siwu, Spanish).[11] Furthermore, while most languages realize *huh* with rising intonation, there are languages that use falling intonation (Cha'palaa and Icelandic). But there is a strict correlation between the use of rising intonation in questions and on the OIR *huh*: it is precisely those languages that use falling intonation in questions which also use it on *huh* when used as an OIR.

[9]Other simplex particles that have similar properties and which have recently received some attention in the generative tradition are response particles (*yes, no*). For example, because of their sentence-like meaning, Krifka (2013, 2014) classifies them as *propositional anaphors.*

[10]I provide several paraphrases, which reflects the fact that these particles can never be fully rendered into propositional language. They are ineffable (a defining property of expressive language more generally; Potts 2007). All paraphrases provided should thus be treated as approximations (indicated by ≈).

[11]Though the precise form depends on the phonological constraints of the language such that, for example, languages which do not allow for word-initial /h/ will simply use the vowel.

The universality of the form-meaning relation is of course completely unexpected in light of the principle of arbitrariness introduced above: if the relation between sound and meaning was indeed arbitrary, we would not expect it to be found across even two unrelated languages, except perhaps by virtue of coincidence. *huh* with rising intonation seems to be used to express a universal function (OIR) and it does so with near identical forms. What is crucial for our purpose is that the function that it expresses falls within the realm of language in use: it regulates the flow of conversation and is used to repair problems of understanding that can arise for various reasons.

2.2 Multi-functionality: *huh* beyond its use as OIR

Next, we turn to the multi-functionality of *huh*. While its use as an OIR seems to be universal, it is also attested with other uses, however, preliminary data suggests that this is a source of language variation.

As discussed above, as an OIR *huh* is realized with rising intonation. However, English *huh* can also be realized with falling intonation, in which case it receives a different interpretation. This is illustrated based on the minimal pair in (6).

(6) I: You have to fly to Paris
R1: huh/
[≈ I don't understand. Can you clarify?]
R2: huh\
[≈ I didn't know that but I get it]

When used with rising intonation, as in R1, it expresses exactly the type of meaning we have introduced above: the responder signals that they do not fully understand the preceding turn and that they request repair. When used with falling intonation, as in R2, *huh* expresses that the initiating utterance expresses news but that the responder is able (and willing) to update their common ground with this new information.

The effect of intonation on the interpretation of *huh* indicates two things. First, there is at least some degree of compositionality involved such that changing one of the ingredients (e.g., intonation) will have an effect on the overall interpretation of *huh*. This is the hallmark of a complex expression. Moreover, the fact that the function of *huh* changes with intonation further suggests that the meaning of *huh* identified in (5) cannot be a matter of a simple lexical entry for *huh*; if it were, this kind of change in function would be unexpected or would perhaps suggest multiple lexical entries. While this is of course a possibility, it would miss the systematic correlation with intonation. And that the relation between *huh* and intonation is systematic is independently motivated by the fact that cross-linguistically there is a correlation between question intonation and the intonation on *huh* used as an OIR.

The conclusion that the meaning of *huh* is perhaps more abstract than merely encoding something that can be paraphrased as in (5) is further supported by the fact that *huh* is, cross-linguistically, multi-functional in more than one way. For example, in English *huh* can also be used as a sentence-final particle, as shown in (7). The result of adding *huh* to a declarative clause is a biased question, which can be paraphrased as in (8).[12]

(7) You liked this movie, **huh**?

(8) ≈ I think you liked this movie, confirm that I'm right!

Intuitively, the meaning of *huh* in (7) is related to the meaning of *huh* as an OIR. And this intuition is confirmed by the fact that we observe similar uses of *huh* in unrelated languages. For example, the Urdu equivalent of *huh* is *hain* and it, too, can be used as OIR, as in (9), as well as a confirmational, as in (10).

(9) I: *Ap* *batayain* *daku* *kesi* *hen?*
you.SG.F tell.F robber how be.F
'Tell me how are you robber?'
R: hain? *Daku?* *kia* *matlab?*
what? robber? what mean
'**Hain?** Robber? what do you mean?'
(Sadaf Ansar Abbasi & Danish Farman, p.c.)

[12]The literature on biased questions is too extensive to do justice here (see for example Krifka 2015, Goodhue 2018, Kiss 2021).

(10) *lag raha hy humsheera tum kisi shair kay-sath larr rhi*
seem CONT PRS sister you some couplet with fight CONT
ho, hain*?*
PRS eh
'Sister, it seems like you are trying to balance/make a couplet, **hain**?'
(Sadaf Ansar Abbasi & Danish Farman, p.c.)

Given that the multi-functionality of *huh* is not restricted to English, I concur that the two uses must have a core meaning in common and that this should be reflected in the lexical entry of *huh*. Whatever the lexical entry of *huh* might be, it cannot be dedicated to being an OIR.

2.3 *Huh* in self talk

In this sub-section, I turn to the use of *huh* in self-talk, which in turn provides a novel window into the syntax-pragmatics interface, as I will show. As observed in Holmberg (2010), self-talk comes in two guises: *I*-centered self-talk, which is characterized by the use of *I* when referring to oneself, as in (11a), and *you*-centered self-talk, which is characterized by the use of *you*, as in (11b).

(11) Self-talk
a. I can't do it.
b. You can't do it.

What is crucial for our purpose is the fact that *huh* is restricted to *you*-centered self-talk, as shown in (12) (Ritter & Wiltschko 2021).

(12) Self-talk
a. *So I can't do it, **huh**?
b. So you can't do it, **huh**?

The contrast in the use of *huh* illustrated in (12) is somewhat surprising given that in both cases the speaker and the addressee are identical.[13] Thus,

[13] An anonymous reviewer points out that this is a typical behaviour in self-addressed questions, as discussed in Truckenbrodt (2006) and Zimmermann (2013), for example. However, the kind of self-talk discussed here differs from such self-directed questions. Specifically, self-directed questions can be uttered in the presence of others and crucially

it is not immediately obvious how the use of *huh* can be constraint. This is because, as we have seen above, *huh* is a unit of language that is used to regulate conversations: in its use as an OIR it serves to repair conversations when the interlocutor does not understand the preceding turn; in its use as a confirmational it serves to ask for confirmation from the interlocutor. Since in self-talk the interlocutors are one and the same person, it is not clear why *huh* can be used in the first place: why can one request confirmation from oneself? And second it is not clear why *huh* is sensitive to whether the speaker refers to themselves with *I* or with *you*. Since in both cases the interlocutor is identical to the speaker, regulating the common ground should have identical constraints.

In what follows I argue that the use of *huh* is regulated, at least in part, by grammatical constraints. In turn this means that grammar regulates language in use, which has implications for the syntax-pragmatics interface as I will show. I start by introducing the framework I use to analyse the facts about *huh* just introduced.

3 The interactional spine hypothesis

As introduced in Section 1, the assumption that aspects of language in use are regulated by the syntactic spine has gained traction over the past few decades. It is commonly assumed that speech acts (an intrinsically pragmatic notion) have a syntactic representation. More precisely, this means that information about the interlocutors (speaker and addressee) is syntactically encoded. In this paper, I adopt the particular version of this proposal developed in Wiltschko (2021). What distinguishes Wiltschko's approach from others is that it integrates insights from conversation analysis and thus it is concerned with conversational competence, which includes regulating common ground and turn-taking. Specifically, Wiltschko (2021) argues that conversational interaction is constraint by grammatical regularities in the same way as the construction of propositional content is.[14] Formally this is implemented by

the 2nd person pronoun in this case refers to the bystander (Eckardt & Disselkamp 2019). This differs from self-talk where the 2nd person pronoun is used to "address" (and thus refer to) the speaker.

[14]The bipartition into propositional and interactional structure appears at first site reminiscent of the distinction between truth-conditional and use-conditional (or expressive) content. However, as discussed in Wiltschko (2021), meaning that can be distinguished from

assuming that syntactic structure (i.e., the logic of tree-geometry) extends to include the composition of units of language restricted to language in interaction. Thus, the idea falls squarely within approaches that seek to incorporate speech act theoretic notions into grammatical structure in that it not only regulates those aspects of language that pertain to the content conveyed in linguistic interaction but also those that pertain to what we *do* when we talk. The difference to other approaches is, however, that it takes into consideration more recent developments of speech act theory that go beyond Searle's and Austin's original insights.[15] The defining property of Wiltschko's (2021) *Interactional Spine Hypothesis* (ISH) is the postulation of two articulated layers of structure at the top of the spine. These structures are characterized by two functions: *responding*, which regulates turn-taking, and *grounding*, which regulates the construction of common ground. This is illustrated in Figure 2.

There are several core properties that define the interactional structure. First, each layer is relativized to the interlocutors albeit in different ways. The grounding layer comes in two guises: the lower one is speaker-oriented (Ground-Spkr) and serves to encode how the speaker relates to the propositional content (e.g., is it new or old information?); the higher grounding layer is addressee-oriented (Ground-Adr) and serves to encode the speaker's assumptions about how the addressee relates to the propositional content (e.g., do they already know it or is it news to them).[16] Finally, the high-

truth-conditional (propositional) content does not comprise a uniform class (Wilson 2016). For example, expressive content can be associated with diminutive affixes and hence can be part of words that appear inside the propositional structure. To the best of my knowledge, elements that regulate turn-taking are never realized as word-level affixes.

[15]For example, while classic work on speech act theory recognizes the importance of the addressee by introducing the notion of *perlocution*, in much of the work on speech acts, this notion is typically ignored (Marcu 2000). However, there is a whole body of work (known as *interactional linguistics*) that takes the basic insight of speech act theory further by recognizing that when we talk, we are not only doing things, but we are doing things together (Selting & Couper-Kuhlen 2000; Couper-Kuhlen & Selting 2001; Thompson & Couper-Kuhlen 2005). In the formal tradition, Ginzburg's (2012) interactional stance falls into this tradition. See Wiltschko (2021) for extensive discussion of this development.

[16]The necessity to distinguish between speaker- and addressee-orientation in the grounding of epistemic knowledge has been established in the realm of discourse particles of the German type (e.g. Lohnstein 2000, Zimmermann 2011) as well as intonational contours (Gunlogson 2003).

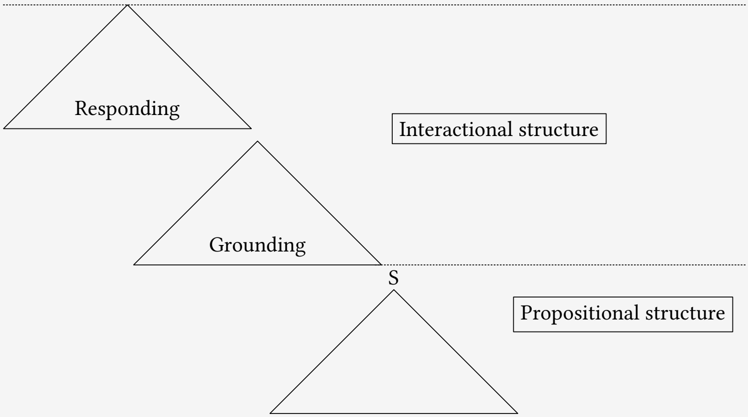
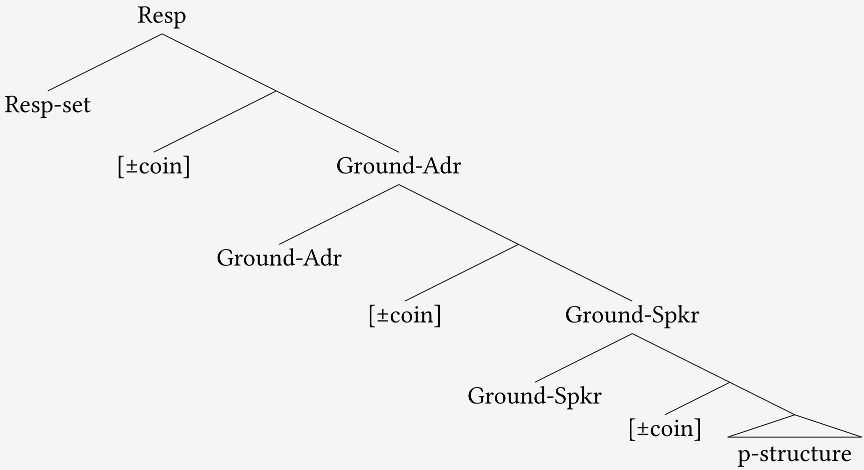


Figure 2 The interactional spine hypothesis

est layer is the response layer (Resp) and it serves to regulate turn-taking. While Resp, too, is relativized to the speaker or the addressee, the two do not typically co-occur in a single conversational move. Rather they define the move itself: an addressee-oriented response layer defines an initiation move in that it serves to encode whether or not a response is required from the interlocutor; in contrast, a speaker-oriented response layer defines a reaction move in that it serves to encode whether the utterance is itself a response.[17] Crucially, the layers in the interactional spine are defined by the same architecture as every other functional category on the spine: the head of a phrase is intrinsically associated with an unvalued coincidence feature that serves to order the two arguments it relates: an abstract argument in the specifier position and the complement it embeds. The abstract argument in the grounding layers correspond to the speaker's and the addressee's ground, respectively, and the abstract argument in the response layer corresponds to the speaker's or the addressee's response set. The coincidence feature is valued by means of units of language that associate with the head position. The full-fledged structure of the interactional spine is given in (13).

[17]The concepts encoded in the grounding and response layers capture many of the insights that are at the core of inquisitive semantics (Farkas & Bruce 2010; Roelofsen & Farkas 2015): the grounding layer can be viewed as encoding the commitment of the interlocutors, while the response layer is akin to the *table* in this work. Thus, the interactional spine could be viewed as the syntacticization of core assumptions within inquisitive semantics.

(13) Interactional structure



According to the ISH, there are aspects of language traditionally considered to be part of pragmatics, which are regulated by grammar, or more narrowly by syntax: the systematic integration of contextual information on the one hand and particular conversational functions on the other. As for the integration of contextual information, this is implemented via the assumption of abstract arguments whose content is contextually determined (e.g., the response set and the interlocutor's grounds). Note that this is not an assumption that is restricted to the interactional spine. It has long been assumed that the propositional spine, too, includes abstract arguments that incorporate contextual information. For example, the functional category tense is, in matrix clauses, deictic, and hence needs to relate the content of the utterance (in this case events) to the utterance situation (in this case utterance time). Crucially, according to some proposals, utterance time is introduced into syntactic structure as an abstract argument which is ordered relative to the reference time in its complement (AspP) via the coincidence feature in the head that introduces it (Demirdache & Uribe-Etxebarria 1997).

As for the integration of conversational functions, the ISH encompasses two such functions that belong to language in use: the construction of common ground and the regulation of conversational turn-taking. Note that while common ground itself is not directly encoded in this model, its individual components, speaker ground and addressee ground as perceived by the speaker, are. Common ground itself will have to be inferred as the common denominator between speaker and addressee ground (Farkas & Bruce 2010). Hence, despite the fact that contextual aspects of language are directly encoded on the syntactic spine, this does not mean that there is no room for inferencing based on what is encoded. In other words, not all of pragmatic knowledge is part of grammar. The ISH thus introduces a particular view on the syntax-pragmatics interface (see Section 5 for further discussion).

In sum, the ISH provides an explicit way to do justice to the principle of compositionality on the one hand and to the principle of contextuality on the other. As for the principle of compositionality, like traditional approaches to syntactic (and semantic) composition, the ISH allows for composition via units of language whose form-meaning relation is arbitrary. These units of language are associated with the spine, which in turn adds meaning to them. Hence the ISH provides an explicit way to understand the second part of the principle of compositionality, which recognizes that the way the individual parts of a complex expression combine influences the interpretation of the whole. And finally, the ISH allows for a systematic way to understand the principle of contextuality as it systematically models the contribution to meaning that goes beyond the individual units of language. Crucially contextual information which is always necessary for reference is contributed by the spine. In this way, the ISH departs from standard minimalist assumptions according to which structure is created by merge and nothing can be added that is not already present in the elements that are being merged (the inclusiveness condition, Chomsky 1995, 2000). It also departs from typical semantic analyses according to which the kinds of meaning components associated with the spine (and thus contextual information) would be written into individual lexical entries.

In what follows, I show how the ISH allows us to analyse the properties of *huh* introduced in Section 2.

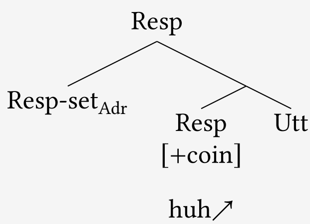
4 Analysing *huh* on the interactional spine

The challenge that *huh* presents us with is that it appears to encode rich contextual information regulating language in use and furthermore that it has several functions, which are not straightforwardly reducible to a single lexical entry. In this section, I show how these properties of *huh* can be analysed using the ISH. I start with *huh* in its use as an OIR.

4.1 *huh* as other-initiated repair: iconicity, intonation, and the meaning of the spine

When used as an OIR, *huh* requests clarification from the interlocutor because something went wrong: there is a lack of understanding which threatens the success of the conversation. I propose that in this use, *huh* merely serves to host an intonational tune. Recall that the particular tune it hosts is precisely the tune that otherwise serves as question intonation: in most of the languages explored in Dingemanse et al. (2013), including English, this is rising intonation, but some languages use falling intonation for this purpose. Moreover, following Wiltschko & Heim (2016) and Heim & Wiltschko (2020), I assume that rising intonation associates with the head of RespP, where it positively values the coincidence feature.[18] Specifically, in this case, the Resp-set is indexed to the addressee. Thus, rising intonation encodes that the speaker places the utterance into the addressee's response set; in other words, they request a response. Given that intonation cannot be realized without segmental content, it cannot be pronounced on its own. I suggest that *huh* (and its cross-linguistic equivalents) does just that: it serves as a dummy minimal syllable to host intonation. This analysis is illustrated in (14).

(14)



The analysis captures the properties of *huh* when used as an OIR as follows. First, consider the interpretation that arises. By requesting a response from the addressee, the speaker indicates that in order to proceed with the current

[18]The assumption that intonation associates with grammatical structure is not new (cf. Trinh & Crnič 2011; Truckenbrodt 2013). However, what is new is the assumption that intonation is not itself associated with a meaning, but instead receives this meaning via the spine (see the discussion below). An anonymous reviewer points out that assuming that prosodic features can mark grammatical meaning is also supported by the fact that some tone languages do this. The question regarding the relation between intonational tunes and tonal meaning is an interesting one, which requires further investigation.

conversation, some information is needed from the addressee. Given that *huh* as an OIR is typically used in isolation, this means that no prompt is provided that would encode a potential target of response (unlike when used as a confirmational which provides content to which the addressee is meant to respond). Thus, the sole meaning conveyed via rising intonation in this context is a request for response. I argue that this is precisely what makes for a minimal OIR, like *huh*. Moreover, given that the interactional spine is, by hypothesis, universal, the meaning that comes with it is, too. It is for this reason that *huh* appears to be a universal word. It is not that *huh* encodes a relation between form and meaning (like typical arbitrary Saussurian signs do). Rather *huh* serves as a host for an intonational contour which in turn directly associates with Resp. There is no lexical mediation between form and meaning; rather by associating a simple sound (rising intonation) with the syntactic spine, the universal meaning of the spine emerges.

There is however one aspect of this analysis, which appears to involve some kind of arbitrariness, and which therefore might invite some variation. Specifically, how does the rising intonation serve to value the coincidence feature positively? Everything else being equal, this appears to be arbitrary. However, everything else is not equal. Specifically, Bolinger (1998: 45) argues that intonation is similar to other paralinguistic features in that it: "is highly iconic and must be studied in relation to the entire gestural setting, especially facial expression, and expressive body language. A higher pitch is typically associated with higher positions of the eyebrows, shoulders and often hands and arms."

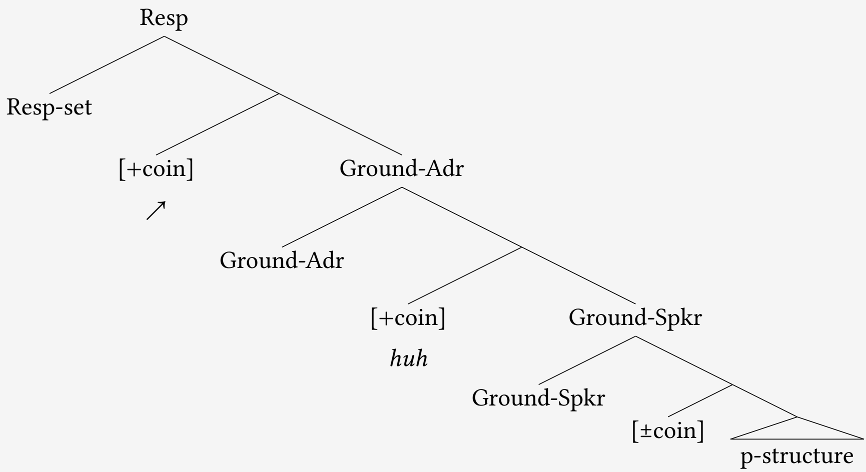
Note moreover that a state of confusion, a lack of understanding, and/or epistemic ignorance is often accompanied by a particular type of body language: rising eyebrows and lifted shoulders. Hence, I argue that rising intonation, mirrors the rising body language associated with ignorance and that it is this iconicity which is responsible for positively valuing the coincidence feature in Resp. In sum, the meaning of the OIR comes about as a combination of iconicity (embodied ignorance) and the meaning provided by the spine (requesting a response). It is for this reason that *huh* as an OIR appears to be a universal word.

4.2 *Huh* beyond its use as OIR: The meaning of *huh* on the spine

In this section I turn to an analysis of the various functions of *huh* and I will show that the ISH allows for a straightforward analysis. First consider the use of *huh* as a confirmational, i.e., when it is used to request confirmation for the content of the host utterance, as in (7) repeated from above.

(7) You liked this movie, huh?

(15) *huh* as a confirmational



As a confirmational, *huh* has a different distribution than as an OIR: it is used as a sentence final particle. This contrasts with its use as an OIR, where it is typically used in isolation. According to Wiltschko (2021), *huh* as a sentence-final particle associates with the addressee-oriented grounding layer while the rising intonation it carries is associated with Resp, as in (15).

This analysis captures several properties of *huh* as a confirmational. First, *huh* is not only used to confirm the truth of p but it also expresses a particular bias towards the epistemic state of the addressee. Specifically, the speaker believes that the propositional content is part of the addressee's ground (i.e., Gunlogson's 2003 commitment set). This is implemented by the assumption that *huh* positively values Ground-Adr. A second distinctive property of *huh* as a confirmational has to do with the fact that the speaker themself has no epistemic bias towards the propositional content (in other words they don't know).[19] This is implemented by leaving the coincidence feature in Ground-Spkr unvalued.[20] Note that this is precisely the reason why the use of *huh* makes it possible to utter a statement about a subjective judgement held by the addressee, as in (7). As is well-known, a bare declarative would be infelicitous as, under normal circumstances, a speaker cannot tell someone else what they like. This is a matter of subjective judgement.

(16) #You liked this movie.

In sum, the contribution of *huh* (7) is best paraphrased as in (17).

(17) ≈ I don't have a basis to commit to p. I believe that you believe p. Confirm that this is the case.

Evidence that this analysis is indeed on the right track comes from the following considerations. First, in contexts where the speaker is committed to the truth of the propositional content, i.e., when they clearly know, the use of *huh* is infelicitous, as shown through the minimal pair in (18). In (18a), the speaker may have only indirect evidence that their addressee has a dog and hence the use of *huh* is well-formed. In contrast, if the speaker is the owner of the dog, they are likely to have direct evidence for this state of affairs. Hence, the use of *huh* is ruled out, as in (18b). (Note that the only context which would allow for the use of *huh* in this sentence is if the speaker really

[19] As pointed out by an anonymous reviewer, these use-conditions seem identical to those described for rising declaratives in Gunlogson (2003). This is not surprising, given the proposal introduced above that *huh* mainly serves as a host for rising intonation. A detailed empirical and analytical comparison between rising declaratives and *huh* suffixed declaratives is still outstanding. Preliminary evidence suggests that the use-conditions are slightly different: for rising declaratives to be felicitous, the proposition has to be completely new (and thus somewhat surprising) to the speaker; for *huh* declaratives the speaker may have had some evidence prior to the time of the conversation, for example via hear-say (on the relevance of the timing of belief see Heim & Wiltschko 2022).

[20] Absence of valuation in the interactional spine does not lead to ill-formedness. This differs from what we observe in propositional structure. Here all features must be valued for well-formedness. Wiltschko (2021) argues that this difference has to do with the type of meaning derived: for propositional language the resulting meaning is about assigning a truth value and hence absence of valuation is fatal; for interactional language absence of valuation simply leads to expression of ignorance, which is not fatal to a successful conversation.

doesn't know if they have a new dog, e.g., in the case of amnesia).

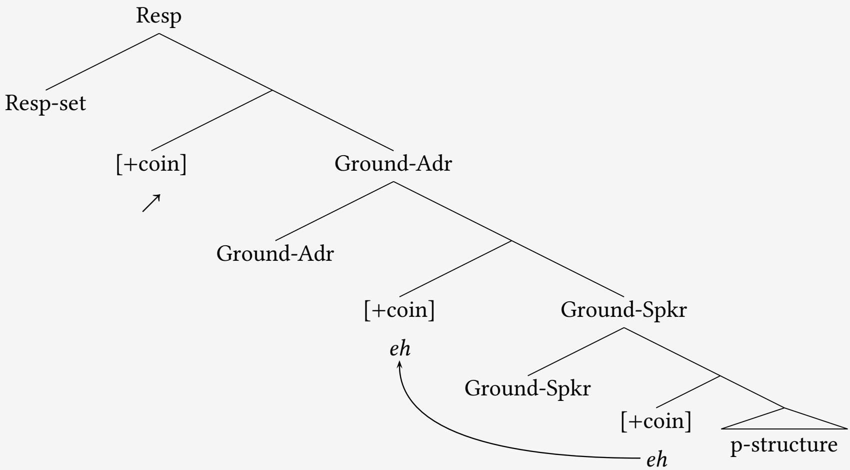
(18) a. You have a new dog, **huh**?
b. I have a new dog, ***huh**?

Crucially, not all sentence-final particles behave in this way. According to Wiltschko (2021), the sentence final particle *eh*, a hallmark of Canadian English, is compatible with a speaker's commitment to the propositional content (cf. Wiltschko & Heim 2016). Hence it can be used even if the speaker clearly knows that the proposition is true. Its contribution in this case is to request confirmation from the addressee that they also know p. This is shown in (19).

(19) a. You have a new dog, **eh**?
b. I have a new dog, **eh**?

Thus, *eh* is analysed as positively valuing both Ground-Spkr and Ground-Adr, while its rising intonation associates with Resp, as was the case with *huh*. This is illustrated in (20).

(20) *eh?* as a confirmational



Finally, consider the use of *huh* in isolation but with falling intonation as in (21) repeated from (6) above. This is an instance of *huh* which appears to have yet another function: the speaker expresses that propositional content is novel, but that they have no reason to contest it, as in the paraphrase given.

(21) I: You have to fly to Paris
R: huh\
[≈ I didn't know that but I get it]

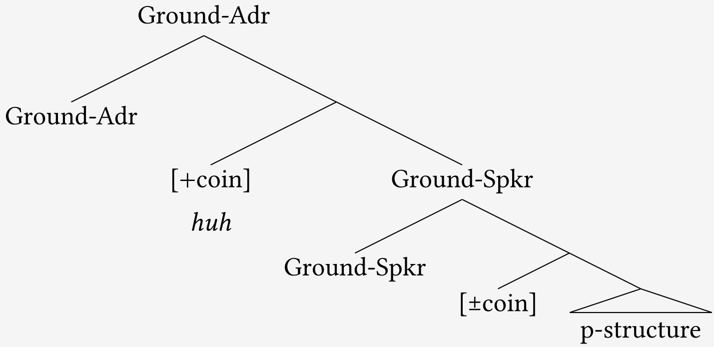
I propose that this use of *huh* be analyzed as follows. First, the absence of rising intonation indicates that the speaker does not request a response from the addressee. I assume that falling intonation is in fact absence of a (meaningful) intonational tune. That is, while it is impossible to utter anything without intonation, it is also the case that pitch declines automatically with the decrease in subglottal air pressure (Cohen & Collier 1982). Thus, falling intonation is the unmarked default case and I assume that it is not associated with RespP. This is consistent with the fact, that unlike in its use as an OIR, when used with falling intonation, *huh* does not request a response from the interlocutor and hence no response is needed. In this way rising *huh* and falling *huh* differ, as shown in (22) and (23). When *huh* is realized with rising intonation it functions as an OIR and hence the interlocutor needs to respond, as in (22); when *huh* is realized with falling intonation, no such response is required, though of course the interlocutor may react, as in (23).

(22) I: You have to fly to Paris
R: huh/
I1: *[silence]
I2: You have to fly to Paris. I thought you knew.

(23) I: You have to fly to Paris
R: huh\
I1: [silence]
I2: It'll be cool, no?

Now, if the segmental content of *huh* when used as an OIR is indeed only present to provide a host for the intonation, and if falling intonation is not meant to be meaningful, then it follows that in this case *huh* must have a life of its own. It cannot merely be used as a host for intonation if there is no intonation to begin with. I propose that in this context its analysis is in fact similar to when it is used as a confirmational. Specifically, I propose that it associates with Ground-Adr while Ground-Spkr remains unvalued. No RespP projects and the propositional content is silent; it is interpreted as referring to the preceding propositional content to which it reacts. This is illustrated in (24).

(24) *huh* as a marker of surprise



This analysis captures the paraphrase for this use of *huh* given in (21) as follows. Leaving Ground-Spkr unvalued indicates that the propositional content is not in the speaker's ground, but at the same time that there is no information to the contrary. That is, it is NOT asserted that the propositional content is NOT in the speaker's ground. It simply remains unvalued. The assumption that Ground-Adr is positively valued reflects the fact that the speaker acknowledges that the propositional content is in the addressee's ground. Following assumptions about the normal course of a conversation (i.e., we believe that the interlocutors will say things that are true) this suggests then that the speaker is not about to contest their interlocutor's claims. And finally, the absence of a request for response makes it clear, albeit indirectly, that the speaker accepts their interlocutor's statement. Otherwise, further response would be requested.

There is however a context, in which this use of *huh* is well-formed but which does not include an interlocutor, as in (25).

(25) Context: I'm watching the news. They are presenting a new invention that promises to reverse climate change, which appears to actually work.

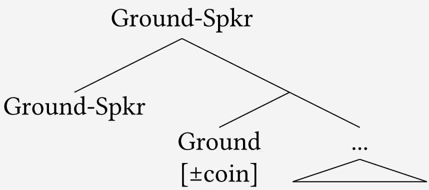
I: *huh!*

Since there is no addressee, the question arises as to why one would use a form which is dedicated to talking about the addressee's epistemic state. I submit that in (25) the speaker engages in a form of *you*-centered self-talk. As we have seen the use of *huh* is felicitous in self-talk, and in what follows I turn to an analysis of *huh* in the context of self-talk.

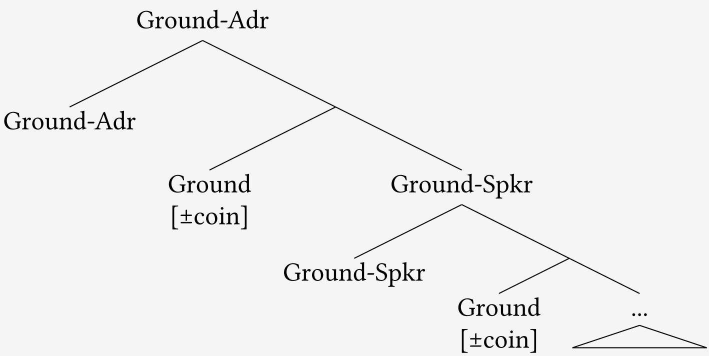
4.3 *Huh* in self talk: the significance of grammatical knowledge

As we have seen in Section 2.3, *huh* is felicitous in *you*-centered self-talk but not in *I*-centered self-talk. According to Ritter & Wiltschko (2021), the two types of self-talk differ in the interactional structure involved and this is what accounts for the observed restrictions on the use of *huh*. Specifically, they argue that *I*-centered self-talk is a way of thinking out loud, while *you*-centered self-talk is like having a conversation with oneself, i.e., the speaker treats themself as the addressee. The ISH provides a straightforward way to account for this distinction: *I*-centered self-talk is characterized by the absence of Ground-Adr, while in *you*-centered self-talk Ground-Adr is present. This is illustrated in (26).

(26) a. *I*-centered self-talk



b. *you*-centered self-talk



The fact that *huh* as a confirmational is restricted to *you*-centered self-talk follows straightforwardly. Since *I*-centered self-talk lacks Ground-Adr, and since *huh* as a confirmational is associated with Ground-Adr, it follows that *I*-centered self-talk is incompatible with *huh*. Ritter & Wiltschko (2021) provide independent evidence for the proposal in (26). Specifically, there are two other phenomena that require the (syntactic) presence of the addressee role: imperatives (cf. Zanuttini 2008) and vocatives (Hill & Stavrou 2014). Crucially, neither of these are possible in *I*-centered self-talk but are perfectly well-formed in *you*-centered self-talk, as illustrated in (27) and (28).

(27) Self-talk
  a. *Stop putting me down!
  b. Stop putting yourself down!

(28) Self-talk (by Martina)
  a. *Martina, I can do it.
  b. Martina, you can do it.

This confirms that there is a correlation between the possibility for using *huh* and the presence of an addressee-oriented syntactic position (Ground-Adr according to the ISH). The intriguing thing about these restrictions on self-talk is that they show that it really makes a difference that grammar provides this addressee-oriented projection. It does not matter if – in the real world – the speaker is identical to the addressee. That is, grammar does not care and treats the addressee as an inaccessible mind with whom the speaker wishes to synchronize their mind. This is further established by the fact (observed in Holmberg 2010) that *you*-centered self-talk, like a regular conversation with another person, does not allow for bare declarative assertions of something that requires a subjective judgment. This is shown by the contrast in (29).

(29) Self-talk
  a. I can't believe my luck.
  b. *You can't believe your luck.

The properties of self-talk provide novel, and rather striking, evidence for the assumption that there is a layer of grammatical structure dedicated to encoding the epistemic state of the interlocutor. Real-world knowledge about the context cannot override the constraints that are intrinsic to the grammatical roles introduced, even if they are pragmatic roles like speaker and addressee.

In sum, I argue that the properties of *huh* in all its functions follow from the assumption that it associates with the spine where it derives its various meaning components and where it combines with intonation.

A skeptical reader may wonder whether it really is necessary to assume that *huh* is integrated into syntactic structure or whether it might not be better treated with a semantic-pragmatic presupposition analysis. While I do not deny that it might be possible to develop such an analysis, I am not aware that such an analysis of *huh* currently exists. It seems, however, based on the facts I have discussed here, that such an analysis cannot rely on a single lexical entry – the meaning patterns simply are too varied. The analysis I have developed here derives these complex patterns via assumptions that have independently been introduced (Wiltschko 2021) and which also derive cross-linguistic patterns of confirmationals and response markers. It remains to be seen whether a presupposition-based analysis can achieve the same generality.

5 What is the syntax-pragmatics interface?

In this paper, I set out to explore the question regarding the nature of the syntax-pragmatics interface. While much recent work within the generative tradition explores topics that are considered to be at the syntax-pragmatics interface, the question as to what this interface might look like is hardly addressed. To be clear, as we have seen, much work is dedicated to the syntacticization of discourse phenomena including speech acts. However, the question as to how and where the content that comes with this structure is interpreted remains to be answered (but see Trotzke 2015). That is, even if we take for granted that syntactic structure contains context-sensitive (i.e., pragmatic) content, we still need to address the question as to where and how this content is interpreted. Within standard generative modelling there is no obvious locus for this interface. This is unlike what is the case for the interface between syntax and phonology or syntax and semantics: both have a dedicated locus in grammatical modelling (PF and LF, respectively).

The proposal I have pursued here is a particular version of syntacticizing speech acts, namely one that centers around interaction. The empirical domain I used to support this hypothesis was the use of *huh* – a unit of language that is used exclusively in conversational contexts and which derives much of its interpretation from its context of use. I have demonstrated that grammar (i.e., syntactic structure) is involved in regulating the form, function, and distribution of this apparently simple form. I have shown that much of the properties of *huh* fall out straightforwardly from the interactional spine hypothesis, according to which certain well-defined aspects of language in interaction are regulated by the same system that regulates the construction of propositional thought. That this is indeed the case is supported by the fact that interactional language (like *huh*) does have all the hallmarks of grammatical knowledge (Wiltschko 2021, 2022). That is, one of the core properties of grammar is that it mediates the relation between form and meaning. This is seen based on the fact that individual units of language are multi-functional in ways that suggest that grammar adds meaning to them. *huh* is not an exception and I proposed an analysis according to which the multi-functionality of *huh* is mediated by syntactic structure (namely the interactional spine). In addition, we have also seen evidence that even seemingly simplex forms have to be computed for their interpretation: they consist of at least the lexical form and their intonation. Thus, there has to be a system in place that combines the two, and arguably this is the computational system that is responsible for all forms of composition.[21]

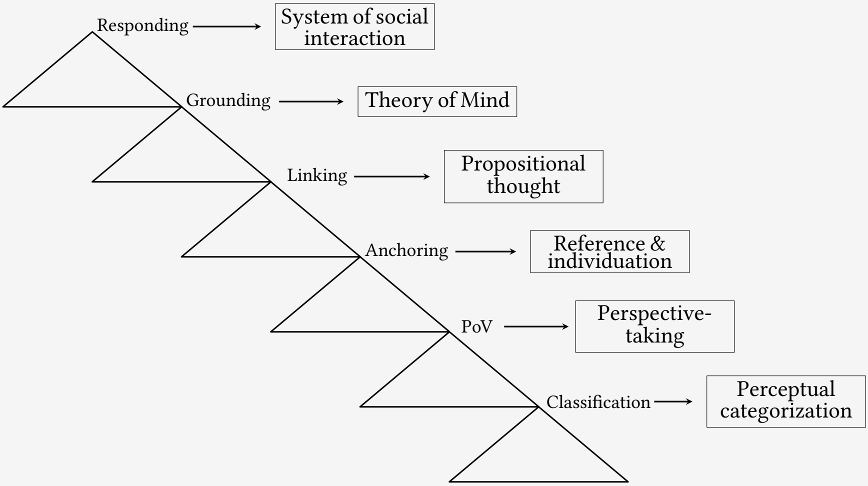
In sum, we now have a partial answer to the question regarding the syntax-pragmatics interface: syntax regulates some aspects of knowledge that is traditionally viewed as belonging to the realm of pragmatics in the sense of contextual knowledge. According to the particular version of this proposal, which I have adopted here, it is the abstract arguments on the spine which allow for contextual knowledge to be systematically integrated into syntactic computation. Moreover, on this view, there are layers of the spine that are dedicated to regulating linguistic conversation (grounding and responding). Given these assumptions, we can conclude that there is

[21]Wiltschko (2021, 2022) provides two other pieces of evidence that grammar regulates interactional language: it is structure-dependent and displays familiar patterns of contrast and paradigmaticity.

not really a dedicated syntax-pragmatics interface. Rather what is taken to be pragmatic information is distributed across various domains: each layer of structure incorporates a particular type of contextual information. In this way, this proposal is in the spirit of the insight that defines *distributed morphology*, according to which morphological knowledge does not interface with syntactic knowledge in one dedicated place ("the syntax-morphology interface") rather, it is distributed across the model. I suggest that the same is true for pragmatic knowledge: it is distributed across the model and there is not one dedicated "syntax-pragmatics interface".

Thus, the spine provides a nuanced way of viewing the so-called interface between syntactic computation and a general conceptual-intentional system. That is, the interactional spine hypothesis, which is in turn an extension of the universal spine hypothesis (Wiltschko 2014), has it that each layer of structure comes with a specific function which provides meaning to the units of language that associate with. This view makes it possible to assume that each of these layers does in fact "interface" with a particular cognitive domain, including domains that relate to interpreting language in use. I sketch a tentative proposal to this effect in (30) where each layer relates to a particular cognitive capacity that goes beyond language. The interactional spine has a responding layer which interfaces with the system of social interaction and the two grounding layers interface with what is known as *Theory of Mind.* As for propositional structure, Wiltschko (2014) proposes four layers, each with a dedicated function. At the bottom we find Classification, which serves to classify events and individuals (e.g., telicity or the mass/count distinction, for example). It arguably interfaces with perceptual categorization. Next comes a Point-of-View layer, which is responsible for introducing a point of view (as for example in the form of aspect). Arguably it interfaces with our ability to take perspective. Next comes the Anchoring layer, which is responsible to connect the event or individual to the utterance situation (as for example in the form of tense or definiteness). Arguably it interfaces with our ability for reference and individuation. And finally, the linking layer serves to connect the constructed reference to the larger discourse context. Arguably it interfaces with propositional thought.

(30) The spine with its interfaces



Whether this view on grammar and its relation to context on the one hand and other cognitive domains on the other is on the right track is an empirical question and defines a research program. In addition to testing further whether it is able to model particular patterns of natural language in connection to cognitive abilities in typically developed adults, one would also want to test this hypothesis based on other populations. Specifically, one will have to explore whether this hypothesis can model data from language acquisition as well as from language profiles in neuro-diverse populations.

Before we conclude, there is still an important point to make. The view on the syntax-pragmatics interface I have just sketched does not imply that all of pragmatic knowledge, or all of language in interaction for that matter is regulated by the spine. There still is room for pragmatic knowledge outside of syntax. While the spine regulates the distribution and interpretation of units of language that pertain to linguistic interaction (such as OIRs and confirmationals) it does not determine when they are actually used. For example, while the interactional spine allows for different moves to be overtly marked as either initiating (via rising intonation) or reacting (via a dedicated response marker), this is not always necessary. The logic for move-typing is not only constraint by the interactional spine, but is also constrained by assumptions about the normal course of a conversation. Discourse markers are obligatory only when conversations depart from the normal course (Heritage 2015). To see this, consider the contrast illustrated in (31) based on the distribution of *well*. According to Wiltschko (2021), *well* is used to mark an utterance as a response (by positively valuing Resp in a reaction move). Of course, not every reaction has to be marked as a response. For example, under normal circumstances, a question is answered and the fact that answering is a reacting move need not be typed. It follows from our assumptions about the normal course of a conversation. Thus, in (31), *yes*, cannot be preceded by *well*. However, if the reaction is not an expected response (i.e., a polar response particle in response to a yes/no question) then the reaction may be marked with *well*. That is, since the type of response departs from assumptions about the normal course of a conversation, the reaction can be marked as such and *well* is well-formed.

(31) I: Did you go to Paris?
R1: *Well, yes
R2 Well, I was sick.

In conclusion, the purpose of this paper was to explore the nature of the syntax-pragmatics interface. Using *huh* as a case-study, I concluded that we cannot perceive of the syntax-pragmatics interface as a unified phenomenon. This is perhaps unsurprising given the model of grammar standardly assumed within generative grammar: there simply is no dedicated place for such an interface. Rather I have shown that there is evidence that what is typically considered pragmatic knowledge (i.e., contextual information) is systematically distributed across the spine. Aspects of pragmatics are in fact part of syntax, while others come about through our general capacity for inferencing. This conclusion echoes a recent proposal in Mao & He (2021) according to which pragmatic competence is modular.

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Mixed comparatives and the count-to-mass mapping

Yoad Winter

Abstract Previous works used comparative sentences like *Sue has more gold/diamonds than Dan* to study the mass/count distinction, observing that mass nouns like *gold* trigger non-discrete comparative measurement, while count nouns like *diamonds* trigger counting. These works have not studied comparatives like *Sue has more gold than diamonds*, which combine a mass noun and a count noun. We show that naturally appearing examples of such 'mixed comparatives' usually invoke non-discrete measurement. We analyze the semantics of this effect and other coercisons of count nouns into mass-like meanings: pseudo-partitives (*20kg of books*), degree interpretations of counting-based denominal adjectives (*more bilingual*), 'grinding' contexts (*bicycle all over the place*) and number unspecified determiners (*most, a lot of*). Based of this analysis we propose a revised system of Rothstein's context-driven counting. In the proposed account, 'impure' semantic atoms replace the role of contextual indices in Rothstein's account. The effacing/grinding ambiguity in Rothstein's system is replaced by one general count-to-mass mapping. The common *rock*-like mass/count polysemy is used as emblematic for this count-to-mass mapping instead of the rather rare *carpet/ing* alternation in Rothstein's proposal. We show advantages of this revised system in treating count-to-mass phenomena, including the unacceptability of mixed comparatives like #*more rock than rocks*.

Keywords comparatives · countability · mass terms · nouns

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1 Introduction

Common nouns are traditionally classified into *mass nouns* (MNs) and *count nouns* (CNs). In English, singular MNs and CNs differ in their ability to appear naturally as bare arguments (*I bought gold/*car*), in their plural meanings (*three golds/cars*), and in the determiners they typically combine with (*much gold/?car*), among other differences. The semantic implications of the mass/count distinction have been hotly debated. McCawley (1975) was apparently the first to recognize that comparatives can be used to probe into meanings of CNs and MNs. More recently, this test has been profitably used in examples like the following (Barner & Snedeker 2005; Bale & Barner 2009):

(1) a. Esme has more shoes/ropes than Seymour.
    b. Esme has more butter/rope than Seymour.

Barner & Snedeker's experiments support the introspective judgement that (1a) involves counting and (1b) involves non-cardinal measuring. The same work also shows preference for counting with *object mass nouns* (OMNs) – MNs that intuitively refer to discrete atomic entities:

(2) Esme has more footwear than Seymour.

Despite the mass status of *footwear*, the OMN in (2) patterns with the CNs in (1a) rather than with the MNs in (1b). Similar results appear with *furniture, clothing* and *jewelry*. From this evidence Bale & Barner (2009: 226-7,246-7), Wellwood (2019: 90) and others deduce a categorical generalization:

(3) Plural CNs and OMNs trigger counting in comparatives. Other MNs – the so-called 'substance' MNs – trigger non-cardinal measurement in terms of weight, volume etc.

Against this generalization, Grimm & Levin (2012) and Rothstein (2017) propose that OMNs do not require cardinality-based comparisons. Rather, comparisons between OMNs may be based on other contextual factors, as in the following example by Rothstein:

(4) John has more furniture than Bill, so he should use the larger moving truck.

Rothstein argues that the prominent interpretation of (4) involves comparison in terms of volume, not cardinality. She proposes that with all mass nouns, including OMNs, comparatives are interpreted in terms of measurement. However, for Rothstein one of the available ways of measuring quantities is *cardinality estimation*. On the basis of psychological evidence, she argues that cardinality estimation is different from counting. Unlike counting with CNs, which is grammatically encoded, cardinality estimation is extra-grammatical and is available with OMNs despite their non-countable grammatical status (Rothstein 2017, p.133).

Examples like (1), (2) and (4) compare quantities referred to by a single noun (*shoes, rope*(*s*) etc.). Here we also examine comparisons between quantities refereed to by different nouns as in the following examples:

(5) a. Esme has more shoes than socks.
  b. Esme has more footwear than clothing.
  c. Esme has more butter than cream.

In (5a-c) the prominent reading compares cardinalities with CNs and OMNs (5a-b), and non-cardinal measures with substance MNs (5c). This is what generalization (3) expects. However, we should also consider comparatives where a CN is mixed with an MN as in the following examples:

(6) a. The first 100 days of the Narendra Modi government offer *more worries than hope.*
  b. Pirates' treasures usually contained *more gold than diamonds.*
  c. I'm still weirded out that Sharon and I have *more shelf space than books* at the moment!
  d. To obtain wealth beyond measure, seek to make *more friends than money.*
  e. While the juveniles prefer insects to greens, adults will need to eat *more vegetation than insects.*

These comparisons involve measurement rather than counting. The obvious trigger is the MN in the comparison, which is either not associated with any standard countable unit (*hope*) or is associated with units that are nevertheless not counted in the given context (*money*). A similar phenomenon is observed in comparisons between OMNs and substance MNs:

(7) a. Self storage is a great solution when you have *more furniture than space.*
  b. Let's explore 4 tips for those troubled souls who have *more artwork than wall space.*

c. I don't think they realize I never cook and the cupboards hold *more dishware than food.*

d. Be wise about the way you shop, and you will find that you can afford to purchase *more footwear than you have room to store.*

e. *More decoration than cake* but who eats the cake part anyway?

The mass nouns *furniture, artwork, dishware, footwear* and *decoration* in (7) are typically classified as OMNs (Erbach 2021: 201). In (7) they are compared with ordinary MNs like *space* and *food*, or in the case of *cake*, a "ground" countable noun in the singular (see section 2.1). In this context we do not count pieces of furniture, works of art etc. but estimate their total volume, area or weight as is often the case with MNs.

Notwithstanding, cardinality-based judgements are also possible when a CN or OMN is compared to a substance MN. When the context makes clear what the relevant units for that MN are, cardinality-based judgements may be invoked.[1] For example, in (8) below, cardinality is primed by Carl Sagan's famous comparison between the number of stars in the universe and of grains of sands on the Earth's beaches. In (9) the mass noun *hair*, usually a substance MN,[2] triggers measurement with the CN *teeth* in (9a), as expected, but counting unexpectedly appears in (9b) due to the explicit reference to individual hairs.

(8) The only way I can reasonably imagine deciding there are *more stars than sand, or more sand than stars,* is if one estimate comfortably exceeds the other by six or more magnitudes...

(9) a. She was a stooped old relic, with *more bald skin than hair and more hair than teeth.*

b. He had *more hair than teeth*, and his hairs totalled three.

Sentences (6)-(9) are evidence that generalization (3) must be refined. In these sentences, comparing the referent of the CN or OMN to the substance MN is usually achieved by applying a non-cardinal scale to the CN/OMN.

[1] We ignore the question if cardinality-based comparisons as in (8) and (2)/(5b) (or even (1a)/(5a)) are due to counting, or due to cardinality estimation as Rothstein (2017) proposes.

[2] Witness the contrast in *Dan has more hair(s) than Sue*, which predominantly involves measurement for *hair* and cardinality for *hairs.*

Regarding OMNs, Rothstein's and Grimm & Levin's approaches can analyze examples like (7) similarly to other cases where OMN denotations are measured on the basis of volume, weight or other dimensions. However, the examples with CNs above raise questions for both approaches. One question concerns the exact characterization of situations that inhibit the usual, cardinality-based, interpretation of comparatives with CNs. This is the subject of section 3. Another question concerns the nature of the semantic change that CNs undergo when they are compared to substance MNs as in (6). This question is addressed in section 4. Before approaching these theoretical questions, however, section 2 reviews some other cases where CNs show a substance-like behavior.

2 Other mass-like readings of count nouns

This section briefly reviews cases where CNs are interpreted or measured as non-discrete entities, which is more typical of MNs. For contrast we also show cases where CNs do not show such meanings despite being in a mass environment. We first discuss the familiar cases of *grinding* of CNs in mass-like syntactic environments, as well as their *measuring* in pseudo-partitives, and the lack thereof with determiners like *most* that are unspecified for mass/count. To these cases we add a less familiar one: denominal CN-based adjectives like *multilingual* (≈'of more than one language') that are used in degree constructions like adjectival comparatives (*more multilingual*) or degree modification (*very multilingual*). We propose that these phenomena stem from one systematic mass-like reading for CNs. The availability of this reading can be described using the same 'last resort' principle that was used by Cheng & Doetjes & Sybesma (2008) for describing differences in 'grinding' between Mandarin and English. This analysis is elaborated in section 3.

2.1 Non-discrete readings in mass-like environments ("grinding")

Pelletier (1975) introduced a test that he referred to as the "universal grinder". Following Gleason (1965), Pelletier puts a singular CN in a syntactic environment that is usually reserved for MNs, as in the following example:

(10) There is bicycle all over the floor.

Sentence (10) is interpreted as meaning that bicycle parts are spread all over the floor. With CNs like *bicycle*, which intuitively have well-established discrete units, this mass-like interpretation is referred to as "grinding". A greater flexibility between discrete and "ground" meanings shows up with nouns like *chicken*, where the discrete interpretation also appears to be the basic one, but the non-discrete, 'grinding' effect is at least as common.

Cheng & Doetjes & Sybesma (2008) point out that in contrast to English, Mandarin Chinese resists "grinding" with nouns whose denotation is intuitively countable. Let us consider Cheng et al.'s examples below:

(11) a. *dì-shang dōu shì shuǐ.*
floor-TOP all COP water
"there is water all over the floor"

b. *qiáng-shang dōu shì gǒu.*
wall-TOP all COP dog
"there are dogs all over the wall" (e.g. painted on a wallpaper)

Similar to typical English MNs, (11a) shows a non-discrete interpretation of the noun *shuǐ* ('water'). By contrast, (11b) shows that in the same syntactic environment the noun *gǒu* ('dog') only gives rise to a discrete interpretation, referring to individual dogs without any "grinding". Cheng et al. analyze this behavior on the basis of the following generalization:

(12) **Last resort grinding** (with CNs): in environments that allow both discrete and non-discrete interpretations, CNs get a discrete reading; "grinding" of CN denotations only takes place in environments that select for non-discrete readings.

In English, bare singular arguments are readily interpreted as mass, which triggers "grinding" in (10), i.e. reference to bicycle parts. By contrast, the Mandarin example (11) is syntactically unspecified for mass/count. Cheng et al. propose that *shuǐ* ('water') is a lexical MN and *gǒu* ('dog') is a CN, which determines the interpretations in (11). The same account is adopted for similar examples in Brazilian Portuguese and Gungbe that do not exhibit an overt mass/count distinction (Cheng & Doetjes & Sybesma 2008: 54).

2.2 Measuring with number-unspecified determiners

Languages with clear mass/count distinctions may also have environments that accept nouns of both sorts. Specifically, certain quantificational expressions freely appear with both singular MNs and plural CNs. In such environments, as with English 'grinding' effects, the noun's number determines its mass/count interpretation. For example, let us consider the quantifiers *most* and *a lot of* in determiner position (13a) and partitives (13b-c):

(13) a. Weathering leads to the gradual ageing of $\left\{\begin{array}{l}\text{most}\\ \text{a lot of}\end{array}\right\}$ stone(s).

b. This year, foxes devoured $\left\{\begin{array}{l}\text{most of}\\ \text{a lot of}\end{array}\right\}$ our chicken(s).

c. She kept $\left\{\begin{array}{l}\text{most of the}\\ \text{a lot of}\end{array}\right\}$ rope(s) to herself.

The singular nouns in (13) are measured as might be expected from MNs, and their plural correlates are predominantly counted. For instance, ageing of *stone* in (13a) pertains to a large quantity of stone material, whereas ageing of *stones* predominantly (or maybe even exclusively) pertains to a large cardinality of discrete units or kinds of stone.

Different languages have different determiners that are underspecified between mass and count, but they show similar phenomena to (13). This is the case with the Dutch determiner *hoeveel* ('how much/how many') and the Hebrew determiner *kama* ('how much/how many', also 'several'):

(14) *Jan weet hoeveel steen (stenen) Piet heeft.*
Jan knows how-much/many stone (stones) Piet has
'Jan knows how much stone (how many stones) Piet has'

(15) *Tal yoda'at kama even (avanim) Dan carix.*
Tal knows how-much/many stone (stones) Dan needs
'Tal knows how much stone (how many stones) Dan needs'

Similarly to (13), the plural nouns in (14) and (15) trigger counting whereas the singular nouns trigger measuring. A related phenomenon was pointed out by Rothstein (2017, p.123, following Landman 2011):

(16) a. In terms of volume, most livestock is cattle.
b. #In terms of volume, most farm animals are cattle.

Unlike the singular OMN use of *livestock* in (16a), the CN *animals* is quite unacceptable with the non-cardinal measuring in (16b). Again we see that number unspecified determiners like *most* require cardinality-based interpretations when combined with plural CNs.

Finally, let us consider the following example:

(17) I didn't think there was very much/a lot of dog inside all that fur, but he had bright attentive eyes.

We cannot interpret the singular quantification in (17) as involving many dogs. The entity that is being measured here is one dog's solid body (or some more abstract quality of "dogness") as compared to dog fur. Importantly, there is no clear sense in which this reading requires violent 'grinding' of the dog. Semantically, what is important is the reference to a part-whole structure, which is absent in 'count' environments of CNs.

2.3 Measuring in pseudo-partitives

Let us consider the following examples from (Rothstein 2017:p.143):

(18) a. five kilos of books/toys/paintings
b. five kilos of rice/glass/paint

Pseudopartitives with CNs as in (18a) involve measuring similar to the MNs in (18b). Rothstein proposes that measure phrases like *five kilos* in (18a) take a mass complement, and that CNs like *books* are shifted to MNs, both syntactically and semantically. She uses this account to analyze the (un)acceptability of the following examples:

(19) #five kilos of three books

(20) a. #Twenty kilos of books are lying on top of each other on the floor.
b. I haven't read much/#many of the twenty kilos of books that we sent.

Rothstein proposes that in (19) the numeral forces the syntactic 'count' feature of the nominal *three books*, hence it is syntactically ruled out in the pseudo-partitive. Further, the syntactic 'mass' feature of the pseudo-partitive in (20a) blocks the reciprocal expression, similarly to *#20kg of rice are lying on top of each other*. This accounts for the *much*/*many* contrast in (20b), but not for the origin of the difference between CNs and the nominals they form: why can the CN *books* syntactically be shifted to an MN in (18a) while the nominal *three books* in (19) cannot be shifted from a 'count nominal' to a 'mass nominal'? An empirical aspect of this question can be observed when considering the following mixed comparative:

(21) A king is worthy of more gold than these few trinkets.

The nominal *these few trinkets* in (21) contains the count quantifier *few* (rather than *little*), hence it syntactically has a 'count' status, and the mixed comparative triggers its measuring. In pseudo-partitives too, complex count numerals are not completely ruled out, as witnessed by the contrast between (19) and the following example:

(22) two kilos of small tomatoes

The pseudo-partitive (22) is used for measuring a set of tomatoes, each of which is discretely categorized as 'small'. Thus, measuring occurs here with a complex nominal headed by a CN whose denotation is discrete. How can this measuring be accounted for *vis à vis* the unacceptability of (19)?

To address these questions, let us first note that we can avoid the reliance on the syntactic categories mass/count in Rothstein's proposal, and describe the data only in terms of discrete and non-discrete *meanings*. Like Rothstein, we assume that measuring in pseudo-partitives results in a non-discrete denotation. Thus, *20kg of books* has a non-discrete denotation, which rules out the discrete quantifiers *each other* and *many* in (20a-b). Following Rothstein again, we assume that measuring with CNs requires shifting their discrete denotation into a non-discrete denotation. However, unlike Rothstein, we do not assume any obligatory change in the syntactic status of CNs when they undergo non-discrete measuring. Thus, in (18a), (22) and (21) the nominals *books*, *small tomatoes* and *these few trinkets* are all ordinary count nominals. Their syntactic acceptability in the pseudo-partitive triggers the shifting of their denotation into a non-discrete denotation. The unacceptability of the numerals like *three* in (19) is assumed to be syntactic, and to follow from the same general principles that govern the distribution of nominals in pseudo-partitives and partitives (Stickney 2009), which are beyond the scope of this paper. With these modifications of the descriptive perspective, we can summarize the observations in this section and section 2.2 using the following generalization:

(23) **Last resort measurement** (with CNs): in environments that allow both counting and measuring, CNs prefer counting; measuring CN denotations only occurs in environments that select for it.

In this generalization, measuring and counting with underspecified determiners (section 2.2) are regulated using the same principles that are observed above with pseudo-partitives. For example, CNs with *most* as in (13) trigger counting despite the fact that measuring is possible in this environment. By contrast, when the environment forces measuring, as with pseudo-partitives, it applies to CNs too. Viewed in this way, 'last resort' measuring is remarkably similar to the 'last resort' grinding principle in Cheng et al.'s proposal (12). This uniform description is a key to our semantic account in section 4 below. Before introducing it, however, let us consider another example of the way 'massy' environments force a coercion of CN denotations into non-discrete meanings.

2.4 Denominal quantity adjectives

Prefixes like *mono-*/*uni-*, *bi-* and *multi-*/*poly-* can be used with certain nominal roots to form adjectives that seem to have a 'count' reading. Thus we have:

(24) *mononuclear* ≈ 'having one nucleus'
unidimensional ≈ 'having one dimension'
bipolar ≈ 'having two poles'
multicentric ≈ 'having more than one center'
polysyllabic ≈ 'consisting of several syllables'
tricolor ≈ 'having three colors'

While these CN-based paraphrases seem to capture the meaning of the positive form of the adjective, they cannot be used to paraphrase its comparative form, as the following texts explicitly state:

(25) a. Bilingualism is not a categorical variable… the more proficient you are in a second language, and the more you use it in your daily life, the *more bilingual* you will be.

b. Is the UK *more multicultural* than America? The US may well have a higher percentage of different races but that it is only part of how multiculturalism works.

These quotes highlight the fact that it is impossible to categorize someone as being *more bilingual* than someone else by just counting the languages that each person speaks (as first language). Similarly, we cannot say that one place *is more multicultural* than another by simply categorizing and counting cultures (or 'races') in the two places. The following texts illustrate the same point with other CN-based adjectives:

(26) a. Australia is far *more monolingual* than it really should be.

b. Results suggested that bisexual men's arousal patterns were markedly *more bisexual* than monosexual men's.

c. The first and most straightforward prerequisite of polycentricity is that there is a distribution of large and small cities… A flat rank-size distribution is *more polycentric* than a steep one.

d. Some of these [functions of accents in German] also emerge in the study of circumflex, but they are irregular and unimportant; circumflex is *more monofunctional* than acc. 1, acc. 2, stød, and nostød. [book on German accentology]

In these cases a comparative like *more monolingual* or *more bisexual* is interpreted as a degree expression, whose meaning is similar to "closer to a situation with only one language" or "closer to the typical bisexual pattern". Such degree comparisons involve dense rather than discrete scales. Furthermore, to the extent that adjectives like *biweekly, bifunctional* and *mononuclear* are used for counting in comparatives, counting is based on a statistics using the numeric interpretation of the positive form. For example, in (27) below the comparative is used for counting occurrences of mononuclear cells, rather than for counting nuclei:

(27) The cellular composition of the foci in vaccinated mice was significantly *more mononuclear* than in normal mice.

This behavior of denominal CN-based adjectives is hardly surprising given generalizations (12) and (23) above and the well-established analysis of comparative adjectives as involving dense scales (Wellwood 2019). Thus, it is the general 'density' of these adjectival forms that triggers degree effects with CN-based adjectives. When the adjective is in an environment that requires measurement, it must be interpreted non-discretely despite the discrete denotation of the underlying CN or nominal root. A similar point holds with respect to degree modifiers like *very* and *somewhat*:[3]

(28) a. My husband and I live overseas in a *very bilingual* environment where the local language is Spanish but we speak English at work.

b. Are there any *somewhat multicultural* small towns in Canada?

The emerging generalization on CN-based adjectives is stated below:

(29) **Last resort measurement** (with CN-based adjectives): in the positive form, which allows both counting and measuring, CN-based adjectives prefer counting (24); non-discrete "measuring" only takes place in environments like degree modifiers or comparatives that select for a non-discrete semantics.

3 The use of the 'count-to-mass' mapping

In view of 'massified' readings of CNs as in section 2, previous works proposed various operators that map countable denotations to uncountable denotations. Here we make the following claims on the count-to-mass mapping:

1. *Measurement requires density*: Only non-discrete readings of CNs can undergo non-cardinal measurement.
2. *Last Resort*: Deriving non-discrete (hence measurable) denotations

[3] An anonymous EISS reviewer points out that degree effects also appear with adjectives like *pregnant* or *Republican*, which are not CN-based but are nevertheless interpreted categorically in the positive, e.g. *very pregnant* (cf. (26),(28)) or *Alabama is more Republican than California* (cf. (27)).

for CNs is a last resort operation, which can be activated by a syntactic 'mass' environment (e.g. 'grinding' in English *à la* Cheng et al.), but also by semantic pressures in syntactically 'count' environments.

3. *Only one count-to-mass mapping*: Unlike Rothstein's proposal, both non-discreteness and measurement phenomena with CNs are treated using the same count-to-mass mapping. There is no evidence for Rothstein's claim that the mass/count alternation in cases like *carpeting*/*carpets* is emblematic of a separate count-to-mass mapping.

This section elaborates on the first two claims, which concern the circumstances in which count-to-mass mappings are used. Section 4 concerns the semantics of the count-to-mass strategy, hence the number of operators that must be involved in its definition.

3.1 Measurement requires density

Although we claim that non-discrete readings and measurement phenomena with CNs are related, we should note that semantically they are not the same: a non-discrete reading does not have to involve any measure phrase, and measuring may in principle apply to discrete entities. With this point in mind, let us summarize the interpretative effects we have seen:

(i) *Discreteness*, with or without explicit counting, is common with CNs, e.g. with 'a' indefinites, numerals and plurals, including comparatives with one or two CNs (*Sue has more ropes than Dan/rocks*), as well as in environments that are unspecified for the mass/count distinction (Mandarin (11b)).

(ii) *Non-discreteness* of CNs appears in English when they are in a singular mass environment. The non-discrete nature of the CN meaning is often interpreted as 'grinding', but it can also manifest itself in other ways, as in (17) above.

(iii) *Measurement* is observed with plural CNs and CN-based adjectives in English when the semantics requires it: in pseudo-partitives with nominals, mixed nominal comparatives, and degree environments like adjectival comparatives.

Countability is a hallmark of discrete sets. However, the linguistic property that we intuitively call 'discreteness' may also appear without any counting expression, e.g. in the Mandarin sentence (11b) or its plural English translation ("there are dogs all over the wall"). Since discreteness and countability are so common with CNs, they are standardly considered as the key for analyzing their semantics. Nonetheless, in syntactic 'mass' environments CNs may get a non-discrete ('ground') reading. Similarly, in environments that unambiguously require measuring, CN denotations can be easily measured. There are two ways to look at these effects. One is to see them as related to one another: to be measured on a dense scale a CN has to receive a non-discrete interpretation.[4] Another way is to disconnect non-discreteness from measurement and allow discrete denotations of CNs to be measured directly. A priori we cannot rule out any of these two options, but there is reason to prefer the former. First, both non-discrete interpretations and measuring appear as last resort options with CNs. In environments that allow both discrete and non-discrete interpretations, CNs receive a discrete reading; in environments that allow both counting and measurement, CN denotations are counted. As summarized above, it is only in environments where non-discreteness and/or measuring are required that these phenomena show up with CNs. Another piece of circumstantial evidence comes from Rothstein's examples (20a-b). These examples illustrate that the distribution of pseudo-partitives like *20kg of books* is similar to that of MNs. This suggests that the CN interpretation is non-discrete: it is straightforward to treat the measure phrase in such pseudo-partitives as a simple modifier of non-discrete denotations. The alternative treatment would be more complex: a function that assigns non-discrete meanings to denotations that may be discrete or non-discrete. An additional piece of evidence comes from denominal forms like *more bilingual*. If measuring in such cases were to be dissociated from density, we might expect them to lead to the same odd effect we get in comparatives like #*more double*.

While these arguments are inconclusive, they support a clear picture about count-to-mass mappings in semantics: in any case where we find a measurement effect or a non-discrete interpretation involving a CN, we assume that a count-to-mass mapping has been at work. Environments like pseudo-partitives, denominal adjectival comparatives and mixed comparatives require measurement, hence we say that they *semantically select* for

[4] Fox & Hackl (2007) propose the more radical thesis, where even cardinal numerals operate on dense scales.

a non-discrete, 'mass' interpretation. Like Rothstein, I consider this to be a plausible null hypothesis, which will be used in the analysis that follows.

3.2 Last resort: lexical, syntactic and semantic information

With this assumption, the following examples all require a count-to-mass mapping of a discrete CN meaning:

(30) pseudo-partitives: *20kg of books*
mixed comparatives: *more money than friends*
denominal comparatives: *more bilingual*

As said above, the idea that certain semantic environments select for a mass reading of CNs meshes well with familiar syntactic and lexical influences on mass/count readings. As representative examples for these effects in English, we consider (31) and (32) below. The English bare singular in (31a) triggers a non-discrete interpretation of the CN (involving 'grinding', i.e. bicycle parts) whereas the bare plural in (31b) involves the common discrete interpretation of the noun. Conversely, sentence (32a) supports a non-discrete interpretation of the MN (i.e. beer liquid) while the bare plural in (32b) sanctions a discrete interpretation that involves 'packaging' beer liquid into containers (bottles, cans, etc.).[5] The 'packaging' mapping will be discussed later in this section.

(31) a. There is bicycle all over the floor. (=(10))
b. There are bicycles all over the floor.

(32) a. There is beer all over the floor.
b. There are beers all over the floor.

As Borer (2005: p.103-4) points out, such syntactic influences on the mass/count distinction should be separated from our tendency to interpret the noun *bicycle* as referring to discrete entities and *beer* as referring to non-discrete stuff. At the same time, while there are certainly nouns that are lexically quite neutral between mass and count readings (e.g. *paper, pizza*), many nouns show a strong lexical preference between mass and count (e.g.

[5]Another discrete reading of (32b) involves *sorts* of beer. This kind of reading appears with MNs and CNs alike (cf. reference to car brands in: *these are the top 10 luxury cars that should be on your bucket list*), hence it is orthogonal to our purposes here.

dust vs. *boy*; see Rothstein 2017,ch.7; Cheng & Doetjes & Sybesma 2008).

We propose that the lexical, syntactic and (formal) semantic influences on the mass/count distinction work operationally as a cascaded decision procedure. A decision at a certain linguistic level may trigger semantic coercion, thus effacing effects of decisions made at previous levels in the meaning derivation. Figure 1 depicts the proposed synthesis. In words:

(i) *Semantic selection*: A 'mass' (m) or 'count' (c) semantic environment determines the discreteness of the noun's interpretation, independently of lexical preferences and syntactic selection (nodes I and II in Figure 1, respectively).

(ii) *Syntactic selection*: If the semantic environment is neutral, then a 'mass'/'count' syntactic environment determines the discreteness of the noun's interpretation independently of lexical preferences (nodes III and IV).

(iii) *Lexical selection*: If the nominal's environment is semantically and syntactically neutral, then the lexical preference of the noun is manifested (nodes V and VI).

Node VII represents a thoroughly neutral situation, where no level dictates any mass/count distinction (see below).

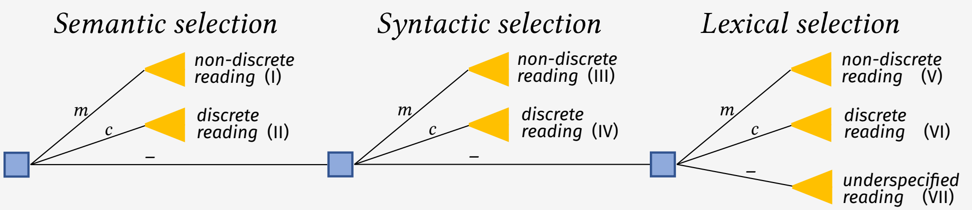

Figure 1 mass/count decision – semantic, syntactic and lexical selection

Suppose that the meaning of a nominal derived by its lexical preference and syntactic environment is discrete (non-discrete). If that meaning does not match the semantic environment, case (i) dictates its coercion into a non-discrete meaning (discrete meaning, respectively). When the nominal's lexical meaning is discrete (non-discrete), case (ii) entails a similar coercion into a non-discrete (discrete) meaning in any syntactic environment that is specified as 'mass' ('count', respectively). To summarize:

(33) **Mass-count coercion**: The meaning of any nominal that is lexically (syntactically) assigned a discrete/non-discrete denotation can be coerced into a non-discrete/discrete meaning if the syntactic environment (semantic environment, respectively) requires that.

According to this principle, mass-count coercions may occur in both directions for syntactic or semantic reasons. We already reviewed some examples for three out of these four coercions, as subsumed by Cases I, III and IV in Figure 1. Under Case I, coercion occurs when the semantic environment is 'mass' but the noun's lexical-syntactic interpretation is 'count'. This is the case with pseudo-partitives like *five kilos of books* as in (18a), with CN-based adjectives in semantic environments that require a degree interpretation (section 2.4), and with most mixed comparatives (6). Coercion in Case III happens when the semantic environment is neutral to the mass/count distinction, the syntactic environment selects for a mass interpretation, but the noun shows a lexical preference for 'count'. This is the case with English grinding as in (31a). Determiners with singular nouns similarly lead to non-discrete interpretations in English, Dutch and Hebrew, as discussed in section 2.2, e.g. in relation to example (17). Coercion in Case IV is a result of a neutral semantic environment with a 'count' syntax of a noun with a lexical 'mass' preference. In English examples like (32b) this results in 'packaging', which is further discussed below.

Cases V and VI are situations where a noun that is lexically specified as either 'mass' or 'count' appears in a semantically and syntactically neutral environment. That such cases are attested in Mandarin is the gist of Cheng et al.'s argument regarding the absence of a 'grinding' effect in (11b). Case VII is illustrated by the following Hebrew example:

(34) *yesh neyar al ha-shulxan*
exists paper on the-table
'There is (a) paper on the table'.

Unlike Mandarin, Brazilian Portuguese and Gungbe, Hebrew does not have number-neutral nouns. However, unlike English, it allows bare singular CNs in argument position. Accordingly, sentence (34) is ambiguous (or vague) between a mass interpretation (paper material) and a count interpretation (a piece of paper). Thus, the sentence can be true if there is a pack of print paper on the table or if there is one piece of written paper there. This ambiguity vanishes when a quantifier disambiguates the noun as mass (e.g. *kcat neyar* 'some paper') or count (e.g. *neyar exad* 'one paper'). We conclude that in (34), the lexical CN/MN status of *neyar* leads to indeterminacy. Replacing *neyar* by an unambiguous MN (Case V, e.g. *avak* 'dust') or unambiguous CN (Case VI, e.g. *xatul* 'cat') removes the indeterminacy.

As said above, the 'packaging' effect in cases like (32b) is described by Case IV of Figure 1 using syntactically-driven coercion. Can semantic 'count' environments similarly coerce a non-discrete meaning into a semantically-driven discrete meaning? There are indications that the answer is positive, which is what Case II in Figure 1 implicitly assumes. Let us consider the following example from (Bale & Barner 2009):

(35) Seymour counted the sugar but not the water.

As Bale and Barner point out, this sentence can be used to describe a situation with sugar packets and bottles of water, where Seymour counted the former but not the latter. In this case the semantic environment of the verb *to count* semantically coerces the non-discrete interpretation of the two MNs into a discrete interpretation, leading to a 'packaging' effect. Bale and Barner argue that this does not necessarily suggest that the denotation of the nouns (or noun phrases) in (35) becomes discrete. It is conceivable that the definite *the sugar* is 'counted' as a whole.[6] However, this logical possibility is less viable when it comes to sentences like the following:

(36) Seymour counted sugar but not water.

In sentence (36) the morpho-syntactic form of the bare singulars requires a non-discrete interpretation. The fact that counting can take place in the same way it does in (35) suggests that the semantic environment coerces the mass noun denotations into countable, discrete denotations.

If indeed the mass-to-count coercion works symmetrically to the count-to-mass coercion, we find ourselves facing an interesting puzzle concerning

[6]It is conceivable, though questionable. We can't say #*Seymour counted the chessboard* when what Seymour did was to count the squares. Bale and Barner's line entails that we might have to make an unprincipled distinction between 'portion counting' with *sugar* (possible) and 'part counting' with *chessboard* (impossible).

mixed comparatives as in (6b) and (9b) from section 1, restated below:

(37) Pirates' treasures usually contained *more gold than diamonds.*

(38) He had *more hair than teeth*, and his hairs totalled three.

In (37) a count-to-mass mapping is prominent, except for contexts where the gold loot is arranged in discrete units (coins, bars etc.). Sentence (38) illustrates the opposite effect: the noun *hair*, whose primary mass use is as a substance MN (note 2), is used for counting in a mixed comparative when the context makes clear that this is what we need in order to make sense of the utterance. A similar effect was illustrated in (8) above. Is there a general rule for comparing CNs and MNs in mixed comparatives? My proposed answer to this question is fairly simple: if the context of the sentence triggers 'packaging' of the MN, as in (36) and (38) above, we apply the mass-to-count mapping. If the context does not contribute any 'salient' packaging of the MN, we must compare quantities using some common measurement (volume, mass, value etc.), which is available independently of context. Thus, the count-to-mass mapping is the default semantic strategy, while the packaging criteria for the mass-to-count mapping must be provided by the context. This idea is supported by the facts on English, German and Icelandic that are covered in (Wiese & Maling 2005). Wiese and Maling observe that 'packaging' effects with MNs are common with certain nouns (e.g. *beers*=sorts of beer or containers with beer) and hardly appear with others (*liquids*=predominantly sorts of liquid).[7]

4 The formal semantics of mixed comparatives

As proposed above, the analysis of mixed comparatives should involve a count-to-mass operator. The semantic details of such an operator depend on how we distinguish 'mass' meanings from 'count' meanings. Here I develop ideas by Rothstein (2017: ch.4) and others: while MNs denote simple lattices over semantic atoms, CN denotations involve a *contextual partition* of the corresponding mass domain. I propose that unlike what Rothstein suggested, this mass/count distinction only supports one 'count-to-mass' operation. That operation is at work whenever the semantic environment selects for a lattice structure. This structure is present with MNs and plural

[7] See (Acquaviva 2004) for related cross-linguistic facts about plural mass terms.

CNs in English and similar languages, as well as with all nouns in languages without marking like Mandarin. However, there is no lattice structure with singular CNs. 'Grinding' effects with singular nouns stem from this distinction: it is only triggered by non-lattices, hence only with singular CNs. This account works in a similar fashion with mixed comparatives and the other phenomena that were reviewed above.

4.1 Noun denotations: mass vs. count, singular vs. plural

We standardly assume that any model contains an arbitrary discrete set E of entities. Elements from E are used as the 'semantic atoms' of mass denotations. We follow Chierchia (1998) in treating any MN as denoting an atomic join semi-lattice generated from a subset of E. For example, suppose that in a given model, $S \subseteq E$ is the set of 'atoms' associated with the concept STONE: the minimal elements that are perceived as instances of STONE in the given model. The mass denotation of the noun *stone* is then the lattice generated by S, which we standardly denote '$*S$'.[8] For example, suppose that in a given model the set S of stone atoms includes the elements a, b and c of E. The mass reading of the noun *stone* has the following denotation:[9]

(39) $[[\text{stone}]]_{\text{mass}} = *S = *\{a, b, c\}$
$= \{a,\ b,\ c,\ a+b,\ b+c,\ a+c,\ a+b+c\}$

According to Rothstein, mass meanings as in (39) are associated with the root of *any* noun. However, a singular CN entry must denote a contextual selection of mutually disjoint sets from its root's mass meaning. Thus, in a model where the mass denotation of *stone* is as in (39) above, Rothstein proposes that the 'count' denotation is some subset of this collection with mutually disjoint elements, as determined by the context.[10] For example, below we illustrate CN denotations of *stone* in two different contexts, '1'

[8] Equivalently, without Link's (1983) metaphysical bias against powersets we can think of $*S$ as the collection $\wp(S) - \{\varnothing\}$: the powerset of 'stone atoms' excluding the empty set.

[9] We standardly use 'x' for singletons $\{x\}$ in a lattice L. Set union on L is denoted using summation, hence a set $\{a, b, \ldots\}$ from L is denoted '$a + b + \ldots$'.

[10] This is a simplification of Rothstein's proposal. In fact Rothstein (2017:110-112) includes contexts in her ontology. This is not necessary in the proposal below, which follows Rothstein's 'context-based' treatment of CNs, but adapts it to Chierchia's treatment of the mass/count distinction without explicit contextual entities in the model.

and ‘2’, both of which are based on the mass denotation in (39):

(40) $[[\text{stone}]]^1_{\text{count}} = \{a, b+c\}$

$[[\text{stone}]]^2_{\text{count}} = \{c, a+b\}$

In context 1 there are two discrete stones: one stone is made of the ‘stone atom’ a, and the other is the sum of the atoms b and c. In context 2, one stone is the ‘stone atom’ c and another stone is made out of a and b.

We summarize Rothstein’s proposal as follows:

(41) **CN denotation – *stone*** (Rothstein):

For any set of stone atoms $S \subseteq E$, the CN denotation of *stone* in a context k is a collection $\mathcal{S}^k$ of mutually disjoint subsets of S. Formally:

$[[\text{stone}]]^k_{\text{count}} = \mathcal{S}^k \subseteq {*S}$, s.t. for any $A, B \in \mathcal{S}^k$: $A \cap B = \varnothing$.

A welcome result of definition (41) is that different contexts may lead to different interpretations of the count noun *stone* without any change in the stone material. This comes in handy when we want to describe a situation where one stone is broken into two, or where two fences may also be conceived of as one. However, definition (41) allows the contextual collection $\mathcal{S}^k$ to exclude atoms from S, which is counterintuitive. For instance, (41) allows a context where $\mathcal{S}^k = \{a+b\}$, with the atom c excluded. In such a context the only discrete stone would be $a+b$. This situation is quite problematic, as it makes the following mixed comparative true, in case Matilda owns all the stone in $\{a, b, c\}$:

(42) #Matilda owns more stone than stones.

Sentence (42) is unnatural: how could anyone own stone material that is not perceived as somehow divided into individual stones? Similar problems appear with other ‘flexible’ nouns like *pizza, hair, paper* etc.

The motivation that Rothstein gives for her method in (41) comes from English noun pairs like *carpet-carpeting* and *fence-fencing*. According to Rothstein’s judgement, the quantity of carpeting material may exceed the material in full-blown carpets. Consider for example a situation where the denotation of *carpeting* is made out of five atoms: a, b, c, d and e. Suppose that we only have two carpets: one carpet made of the sum a+b, and another made of the sum $c+d$. In such a context k we would have:

$$[\![\text{carpeting}]\!]^k_{\text{mass}} = *\{a,b,c,d,e\}$$
$$[\![\text{carpet}]\!]^k_{\text{count}} = \{a+b,c+d\}$$

A mixed comparative sentence like *there is more carpeting than carpets* might correctly describe such a situation.[11]

The mass/count alternation in the case of 'flexible' nouns like *stone* is by far more common than the *carpet*/*carpeting* alternation. Thus, instead of viewing *carpet*/*carpeting* as representative of a general count/mass ambiguity, I revise Rothstein's definition (41) as follows:

(43) **CN denotation – *stone*** (revised version):

For any set of stone atoms $S \subseteq E$, the CN denotation of *stone* in a context k is a partition $\mathcal{S}^k$ of S using mutually disjoint sets. Formally:

$$[\![\text{stone}]\!]^k_{\text{count}} = \mathcal{S}^k \subseteq *S \text{ s.t. } \biguplus \mathcal{S}^k = S.$$

This definition is similar to Rothstein's definition (41), but it eliminates the aforementioned problem: in all contexts, the union of the members in the count denotation of *stone* equals the union of members of the mass denotation. In formula:

(44) $\bigcup[\![\text{stone}]\!]^k_{\text{count}} = \bigcup[\![\text{stone}]\!]_{\text{mass}}$

Our treatment of plural CNs follows Chierchia's account of plural CNs and employs Link's (1983) plurality operator '$\circledast$': [12]

(45) $[\![\text{stones}]\!]^k_{\text{count}} = \circledast[\![\text{stone}]\!]^k_{\text{count}}$

For example, let us consider context 1 in (40), where the countable denotation of *stone* is $\{a,b+c\}$. Here we see another limitation of Rothstein's definitions. Applying the $\circledast$-operator to the set $\{a,b+c\}$ would result in set

[11] Two English speakers that I consulted thought that whole carpets may be excluded from the denotation of *carpeting*. That might raise problems for Rothstein's account of the *carpet*/*ing* alternation, which I do not address here.

[12] The '$\circledast$' operator is Link's plural version (Chierchia's 'PL') of his $*$-operator. For any set $X \neq \varnothing$ and $\mathcal{S} \subseteq *X$, the set $\circledast\mathcal{S}$ is the closure of $\mathcal{S}$ under union, excluding singletons. Formally: $\circledast\mathcal{S}$ is the smallest subset of $*X$ s.t. for any $A,B \in \mathcal{S}\cup\circledast\mathcal{S}$ s.t. $|A\cup B| \geq 2$: $A\cup B \in \circledast\mathcal{S}$.

$\{b+c, a+b+c\}$. This is an odd result: as the sum $b+c$ is conceived of as one unit we should expect the ⊛-operator to ignore the fact that it is made of two atoms, thus exclude it from the plural denotation similarly to the element a. By letting sums play the role of single countable units, Rothstein's account does not allow the ⊛-operator to ignore their internal structure. The same holds for numeral modifiers, which have to be relativised to the contextual partition of CN denotations (Rothstein 2017: p.112).

Instead, we introduce into Rothstein's system the idea that the elements of a CN's denotation in a given context are 'impure atoms' (Link 1984) or 'groups' (Landman 1989) – objects that are ontologically complex but viewed as atoms by the counting system. To avoid confusion, I refer to 'impure atoms' as semantic *molecules*. For any given set $A \subseteq E$ with at least two members, we say that $\uparrow A$ is the *molecule constructed from A*. Formally:

(46) **Molecules**: Let A be a non empty set. We define the 'molecule' $\uparrow A$ made of A to be A itself if A is a singleton, and an element outside A if A is not a singleton.

In the opposite direction we define $\downarrow(\uparrow A) = A$, i.e. the atoms that make up a 'molecule' $\uparrow A$ are simply A's elements.[13] Using the $\uparrow$ operator, CNs are treated as follows:

(47) **CN denotation – *stone*** (final version):

For any set of stone atoms $S \subseteq E$, the denotation of the count noun *stone* is a collection of the atoms and molecules made of a partition $\mathcal{S}^k$ of S. Formally:

$[[\text{stone}]]^k_{\text{count}} = \{\uparrow A : A \in \mathcal{S}^k\}$, where $\mathcal{S}^k \subseteq {*S}$ s.t. $\biguplus \mathcal{S}^k = S$.

The count readings of *stone* of (40) are now modified in (48):

(48)
$$[[\text{stone}]]^1_{\text{count}} = \{a, \uparrow(b+c)\}$$
$$[[\text{stone}]]^2_{\text{count}} = \{c, \uparrow(a+b)\}$$

Using the ⊛-operator, we get in context 1:

[13] More precisely: when $|E| = n$ and M a set of 'molecules' disjoint from E s.t. $|M| = 2^n - n - 1$, we define $\uparrow$ as a bijection mapping any singleton in $*E$ to itself and any non-singleton in $*E$ to an element of M. The $\downarrow$ operator is the inverse function of that bijection.

(49) $[[\text{stones}]]^1_{\text{count}} = \circledast\{a, \uparrow(b+c)\} = \{a + \uparrow(b+c)\}$

In words, when a and $\uparrow(b+c)$ are the individuated stones, the denotation of *stones* is only made of the *sum* of a and the molecule $\uparrow(b+c)$, and it does not contain $\uparrow(b+c)$ itself.

As a more complex example we consider a model with four stone atoms: a, b, c and d. Figure 2 gives the mass denotation of *stone* in this model, as well as the singular and plural count denotations of *stone*(*s*) in context '3', which amalgamates b and c into a molecule.

mass: $a, b, c, d, a+b, a+c, a+d, b+c, b+d, c+d,$
$a+b+c, a+b+d, b+c+d, a+c+d, a+b+c+d$

atoms: a, b, c, d

count^3 **singular**: a, $\uparrow(b+c)$, d

count^3 **plural**: $a+d$, $a+\uparrow(b+c)$, $d+\uparrow(b+c)$, $a+\uparrow(b+c)+d$

Figure 2 from four atoms to a mass denotation; and to singular and plural count denotations in context 3

As in Chierchia (1998), MNs and plural CNs both denote lattices. Countability of plural CNs follows from the assumption that their denotations (perhaps counterintuitively) contain no singular entities, while MN denotations do. Formally:

(50) **Countability**: Let E be a finite set of entities. A join semi-lattice $L \subseteq *E$ is called *countable* if the following holds:

$$\bigcup L = (*\bigcup L) - L.$$

In words, a lattice L is countable if $\bigcup L$ consists of all elements in the uncountable lattice $*\bigcup L$ except the members of L itself. For instance, the lattice for plural *stones* in context 3 (figure 2) does not contain any of the elements $a, \uparrow(b+c)$ or d, hence it is countable. We refer to these elements as the *counting units* of that countable lattice. In general, any plural CN denotes a countable lattice L whose minimal elements are doubleton sums $x+y$, where x and y are the counting units: atoms or molecules. By contrast, any MN denotes an uncountable lattice since that lattice contains all the (atomic) units that make it up.

4.2 The semantics of the 'count-to-mass' mapping

According to Rothstein's line, what distinguishes plural CNs from MNs is the contextual index that is attached to elements of CN denotations. According to Chierchia the distinction lies in the lattice structure of the denotations: countable with plural CNs, uncountable with MNs. The current proposal combines the two lines: on the one hand we incorporate contextual influences on CNs by introducing molecules that are contextually constructed by the ↑ operator into CN denotations. On the other hand we rely on Chierchia's distinction and not on an explicit encoding of contextual indices inside denotations. When it comes to the 'count-to-mass' mapping, we treat it as an operator that makes sure that the denotation of a noun has a lattice structure, whether countable or uncountable. Grinding is only a possible by-product of this mapping. We refer to this 'grinding' operation as *massification*, which is defined below:

(51) **Massification**: Let E be a finite set of entities, and let X be some set disjoint of E containing all molecules over E. For any set $A \subseteq *(E \uplus X)$, we define the *massification* of A as the following set:

$$mass(A) =$$
$$*(\{x \in E : x \in E \cap \bigcup A \text{ or there is } y \in X \cap \bigcup A \text{ s.t. } x \in\downarrow y\}).$$

In words: to 'massify' a set A we collect the atoms making up A's members, including atoms that make up molecules among A's members. For example, suppose that A is the singular CN denotation from figure 2:

$$A = [[\text{stone}]]^3_{\text{count}} = \{a, \uparrow(b+c), d\}$$

The union set $\bigcup A$ is A itself, where the atoms are a and d, and the atoms from A's single molecule are b and c. Massification leads to the mass denotation of *stone* in figure 2: the lattice made up of a, b, c and d.

Using massification we define 'count-to-mass' mapping *c2m* as follows:

(52) Let E be a finite set of entities, and let X be some set disjoint of E containing molecules over E. For any set $A \subseteq *(E \uplus X)$:

$$c2m(A) = \begin{cases} A & \text{if } A \text{ is an uncountable lattice over } E \cup X \\ A \cup \bigcup A & \text{if } A \text{ is a countable lattice over } E \cup X \\ mass(A) & \text{otherwise} \end{cases}$$

The *c2m* operator leaves MN denotations intact. Plural CN denotations have their units added. By contrast, singular CN denotations are mapped to the 'ground' meaning, which is also the denotation of the corresponding MN. More explicitly, for any context k we have:

$$c2m([[\text{stones}]]^k_{\text{count}}) = [[\text{stones}]]^k_{\text{count}} \cup \bigcup [[\text{stones}]]^k_{\text{count}}$$

$$c2m([[\text{stone}]]^k_{\text{count}}) = mass([[\text{stone}]]_{\text{count}})$$

In words: the *c2m* denotation of the plural *stones* has a mass-like structure of an uncountable lattice, with the difference from the mass denotation being that minimal elements in that lattice may be molecules. For example, in the model and context of figure 2 we have for plural *stones*:

$$c2m([[\text{stones}]]^3_{\text{count}})$$
$$= \{a, \uparrow(b{+}c), d, a+d, a{+}\uparrow(b{+}c), d{+}\uparrow(b{+}c), a{+}\uparrow(b{+}c){+}d\}$$

By contrast, the *c2m* denotation of the count reading of *stone* is 'ground', i.e. identical to the mass reading of the noun.

4.3 The semantics of mixed comparatives

With this semantic background we now get back to mixed comparatives as in the following simple examples:

(53) There is more gold than stone(s).

(54) There is more gold than bicycle(s).

(55) There are more bicycles than stones.

To analyze these examples we adopt the following principles:

P1. Nominal comparatives semantically select for lattices, i.e. denotations of MNs and plural CNs.
P2. With countable lattices comparison must be performed by counting.
P3. With uncountable lattices comparison must be performed using a *measure function* (μ), which maps lattice elements to real numbers.

Using these consensual principles we account for the semantic effects in (53)-(55) as follows. In (53) the comparison requires lattice denotations of the nouns (P1). The singular noun *stone* is lexically ambiguous between mass and count. The mass reading entails comparison using a measure function μ as in (56a) below. If the count reading is selected it must be massified using the *c2m* operator to become a lattice (last resort application, section 3). In this case 'grinding' by the *c2m* operator leads to the same result as with the mass reading. With plural *stones* in (53) principles (P2) and (P3) clash with each other: a countable lattice (*stones*) cannot be compared to an uncountable lattice (*gold*). The resolution is by last resort application of *c2m*, which maps the denotation of *stones* to its mass correlate but without any grinding of molecules.[14] This leads to the analysis in (56b) below.

(56) a. $\mu([[\text{gold}]]_{\text{mass}}) > \mu([[\text{stone}]]_{\text{mass}})$
$\mu([[\text{gold}]]_{\text{mass}}) > \mu(c2m([[\text{stone}]]^{k}_{\text{count}})) = \mu([[\text{stone}]]_{\text{mass}})$
b. $\mu([[\text{gold}]]_{\text{mass}}) > \mu(c2m([[\text{stones}]]^{k}_{\text{count}}))$

The analyses (56a) and (56b) are not necessarily equivalent: that depends on whether the measure function μ is also a measure function at the sub-molecular level. For a weight function μ, it is reasonable to assume that a molecule $\uparrow(a + b)$ weighs the same as the two atoms a and b together, in which case it is a measure function for these atoms. By contrast, the value of a precious stone might be greater than the combined value of its parts, hence value is not a measure function at the sub-molecular level. Such a possible difference between (56a) and (56b) may be attested in cases like *more gold than diamond*(*s*). It seems possible that a comparison of values might lead to truth with singular *diamond* but to falsity with plural *diamonds*, while a comparison of weights does not lead to such a contrast.

Sentence (54) is treated similarly to (53), as in (57) below. The difference from *stone*(*s*) is that *bicycle* is unambiguously a CN. Thus, only one analysis of the singular is obtained, using griding by the *c2m* operator.

(57) a. $\mu([[\text{gold}]]_{\text{mass}}) > \mu(c2m([[\text{bicycle}]]^{k}_{\text{count}})) = \mu([[\text{bicycle}]]_{\text{mass}})$
b. $\mu([[\text{gold}]]_{\text{mass}}) > \mu(c2m([[\text{bicycles}]]^{k}_{\text{count}}))$

Sentence (55) involves two countable lattice denotations of the plural CNs. Accordingly, the analysis is standardly in terms of cardinality (P2):

(58) $|\bigcup[[\text{bicycles}]]^{k}_{\text{count}}| > |\bigcup[[\text{stones}]]^{k}_{\text{count}}|$

[14] Another resolution (see section 3) is when the context provides a salient 'packaging' of *gold*. This allows this MN to be interpreted like the count nominal *chunks of gold*.

In words: the cardinality of the maximal element in the *bicycles* lattice is greater than the corresponding cardinality with *stones*. Now let us consider the following example (cf. (21)):

(59) There is more gold than these few trinkets.

Standardly, the denotation of *these few trinkets* is a the (singleton made of) the sum $t_1 + \ldots + t_n$ where $t_1, \ldots, t_n$ are all trinkets. This is not a lattice, hence it triggers the *c2m* operator. Each of the trinkets $t_1, \ldots, t_n$ (possibly) denotes a molecule with some minimal gold elements. For instance, suppose we have three trinkets t_1, t_2 and t_3, which are made out of atoms as follows:

$$t_1 = a \qquad t_2 = \uparrow(b + c) \qquad t_3 = d$$

Thus, t_1 and t_3 are the 'gold atoms' a and d, respectively, and t_2 is the molecule made of the 'gold atoms' b and c. Applying the *c2m* operator leads to massification, i.e. an uncountable lattice corresponding to the gold within the trinkets, where a, b, c and d are all minimal elements. This is the mass denotation in figure 2. The result is that the gold referred to in (59) is compared to the amount of gold in the trinkets: the atoms a, b, c and d.

A similar analysis applies to (60) and (61a-b) below:

(60) 100 kilos of bicycle(s)

(61) a. There is bicycle all over the place.
b. There are bicycles all over the place.

Pseudopartitives like (60) semantically select for a lattice denotation of the noun. If it is not a lattice, as in the singular case, applying *c2m* derives a 'grinding' effect. If the noun is already a lattice as with plural *bicycles*, we do not get such an effect. Sentences (61a-b) are similarly analyzed: the adverbial *all over the place* semantically selects for a lattice. The singular noun is therefore 'ground' by *c2m* whereas the plural is not. CNs as in Mandarin (11b) do not require plural marking in order to have a lattice denotation, hence there is no griding effect, similarly to (61b).

5 Conclusion

Mixed comparisons between mass nouns and count nouns provide a unique window into their semantics, where the meaning of one of the nouns, usually the count noun, is coerced into a meaning of the same kind as the other's. To study this phenomenon we have expanded our view to other cases where count nouns are 'massified'. We have seen how the same last resort principle accounts for cases where lexical preferences are overridden by syntax and where syntactic requirements are overridden by semantic selection. For both cases we have proposed one count-to-mass operator. In that operator, 'grinding' is only a result of the lack of lattice denotations with singular count nouns, rather than a general operation. When a lattice structure is available, as with plural count nouns, the count-to-mass operator is only responsible for shifting that countable lattice into an uncountable one. Our technique combines Chierchia's denotational difference between mass nouns and count nouns with Rothstein's context-driven individuation. Unlike Rothstein's account, the contextual procedure is the well-established process that forms 'impure atoms' out of pluralities. Under this treatment of count nouns Chierchia's elimination of singular elements from their denotation is no longer obligatory: massified, uncountable denotations contain them. It is only *countable* denotations that do not. Further work may use this feature of our proposal to retain interpretations where singularities are necessary with plural count nouns, as in the case of *both Sue and Dan have children* where Sue only has one child.

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