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Preface

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- ✠ Formal syntax, semantics and pragmatics of natural language
- ✠ Model-theoretic and/or proof-theoretic semantics of natural language
- ✠ Computational approaches to semantics and pragmatics
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2nd Day: November 29 (Sat)

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Deriving the diminishing effect

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0. Overview The **diminishing effect** is observed in many natural language phenomena: **negative comparatives** (e.g., *he is no taller than I am*), ***only*-sentences** (e.g., *he is only 49*), and **discourse-softening markers** (e.g., Korean *cina-ci anh-* and Chinese *bú guò* 'not beyond, nothing but'), etc. I propose that the diminishing effect arises from the interation between (i) negation and (ii) universal quantification over items exceeding a certain degree d along a scale: Negating all values above d amounts to an *even*-sentence, and the diminishing effect is a natural consequence of this accommodation of hidden *even*.

1. Data: Negative comparatives There is a subtle **meaning difference** between the negative comparatives in (1) and (2) (see e.g., Nouwen 2008). Apparently, both comparatives have the same truth-conditional meaning: i.e., ¬[HEIGHT(Mary) > HEIGHT(Lucy)].

However, they differ with regard to the availability of the diminishing effect. (1) can be naturally followed by *but both are actually tall*, suggesting that the negative comparative *not taller than* is **non-evaluative** and still compatible with a positive use of *tall*.

In contrast, using the same continuation *but both are actually tall* in (2) sounds confusing and less natural, suggesting that the interpretation of *no taller than* is **evaluative** and at odds with a positive use of *tall* in the same context. Thus, in (2), *no taller than* brings a diminishing effect – the inference that Mary and Lucy are not considered tall.

(1) Mary is not taller than Lucy, (but both are actually tall). **No diminishing effect**

(2) Mary is no taller than Lucy, (#but both are actually tall). ✓ **Diminishing effect**

There is also a **distributional difference** between *not taller than* and *no taller than*: as illustrated in (3) and (4), only the former (*not taller than*), but not the latter (*no taller than*), is compatible with a numerical differential (here *1 inch* in (3) and (4)).

(3) Mary is not 1 inch taller than Lucy. **Compatible with a numerical differential**

(4) *Mary is no 1 inch taller than Lucy. **Incompatible with a numerical differential**

2. The semantics of comparatives and *not taller than* The semantics of *not taller than* and its lack of evaluativity (or diminishing effect) can be immediately explained within the existing understanding of comparatives.

As illustrated in (5), gradable adjective *tall* relates a degree and an individual (see (5a)). With degree abstraction and a maximality operator (see (5b)), the *than*-part denotes the maximal degree such that Lucy's height reaches, i.e., HEIGHT(Lucy). Comparative morpheme *-er* denotes a positive degree that stands for an increase (see (5c); see Greenberg 2010, Zhang and Ling 2021), and numerical differential *1 inch* restricts this increase.

(5) LF of (3): not [Mary is tall [1 inch ...-er [than [$\lambda d'$.Lucy (is d'-tall)]]]]

- 1 inch ...-er: an increase of 1 inch
- [$\lambda d'$.Lucy (is d'-tall)]: the set of height degrees that Lucy's height reaches
- [than [$\lambda d'$.Lucy (is d'-tall)]]: the maximal degree of this set, i.e., HEIGHT(Lucy)
- [1 inch ...-er [than ...]]: an increase of 1 inch based on HEIGHT(Lucy), i.e., $1''$+HEIGHT(Lucy)
- Mary is tall [1 inch ...-er [than ...]]: HEIGHT(Mary)$\geq 1''$+HEIGHT(Lucy)
- not [Mary is tall [...]]: HEIGHT(Mary)$< 1''$+HEIGHT(Lucy)

a. $[\![\text{tall}]\!] \stackrel{\text{def}}{=} \lambda d.\lambda x.\textsc{height}(x) \geq d$ i.e., the height of x reaches degree d

b. $[\![\text{than}]\!] \stackrel{\text{def}}{=} \textsc{max} \stackrel{\text{def}}{=} \lambda P_{\langle dt \rangle}.\iota d[d \in P \wedge \forall d'[d' \in P \rightarrow d' \leq d]]$

c. $[\![\text{-er}]\!]$ is an unspecified positive degree that denotes an increase on a base value (Consider *I ate three apples. Then I ate (two) more apples.* $\rightsquigarrow$ ***more* denotes an increase (of 2 apples) on the base of 3 apples.**)

Eventually, in (5), at the matrix level, (i) *tall* relates the degree '*1 inch ...-er than Lucy*' and the individual Mary, meaning that HEIGHT(Mary) reaches the degree that corresponds to an 1-inch increase based on HEIGHT(Lucy), and (ii) *not* negates this proposition, deriving the meaning of (3): HEIGHT(Mary)$< 1''+$HEIGHT(Lucy).

Obviously, without a numerical differential to restrict the size of an increase (see (1)), at the matrix level, (i) comparison results in the meaning 'HEIGHT(Mary)$>$HEIGHT(Lucy)' (weaker than, i.e., entailed by, 'HEIGHT(Mary)$\geq 1''+$HEIGHT(Lucy)'), and (ii) negating this results in 'HEIGHT(Mary)$\leq$HEIGHT(Lucy)' (stronger than, i.e., entailing, 'HEIGHT(Mary)$<$ $1''+$HEIGHT(Lucy)').

Evidently, both (1) and (3) do not involve a comparison between HEIGHT(Mary) / HEIGHT(Lucy) and the contextually salient threshold of being tall. Thus norm-sensitivity (or evaluativity) is not involved.

3. Deriving the diminishing effect of *no taller than* For the case of *no taller than*, I follow the long existing decompositional view on *no* and decompose it into (i) negation operator *not* and (ii) an existential quantifier (see (6)).

(6) LF of *No students came*: Not [a student came] $\neg\exists x[\textsc{student}(x) \wedge \textsc{came}(x)]$

In *no taller than*, *no* is decomposed into (i) *not* and (ii) an existential quantifier over the domain of degree values. As illustrated in (7), a *no-taller-than*-sentence like (2) means that 'there is no positive degree d s.t., Mary is d-taller than Lucy'. The reason why *no taller than* is incompatible with a numerical differential is immediately explained.

(7) LF of (2): $\neg\exists d.$[Mary is tall[d...-er[than[$\lambda d'$.Lucy (is d'-tall)]]]]

To derive the diminishing effect of *no taller than* in (2), I further analyze $\neg\exists d[P(d)]$ as its truth-equivalent proposition $\forall d[\neg P(d)]$ and unpack this universal quantificational proposition into a set of propositions (see e.g., Bumford 2015). Now I need to explain how this set of propositions gives rise to the inference that Mary and Lucy are not tall.

(8) Mary is no taller than Lucy
= There does not exist a degree d s.t., Mary is d-taller than Lucy
= For any degree d, Mary is not d-taller than Lucy
$\rightsquigarrow$ {Mary is not 1 inch taller than Lucy, Mary is not 2 inches taller than Lucy, ...}
$= \{\textsc{height}(\text{Mary}) < 1''+\textsc{height}(\text{Lucy}), \textsc{height}(\text{Mary}) < 2''+\textsc{height}(\text{Lucy}), \ldots.\}$

Given that the domain of d (height increases) is a **totally ordered set** of degrees, the set of propositions in (8) is actually a totally ordered set of propositions along a scale of informativeness, with 'HEIGHT(Mary) $< \epsilon +$ HEIGHT(Lucy) (ϵ means the minimum value)' being the most informative proposition in this set: it entails all other propositions.

According to Heim (1991)'s pragmatic principle *Maximize Presupposition*, speakers tend to presuppose more rather than less: if the presuppositional requirement of expression X is met, speakers prefer to use X, rather than expressions without such a presupposition.

Thus I propose that in the case of 'HEIGHT(Mary) $< \epsilon +$ HEIGHT(Lucy)', since it naturally meets the presuppositional requirement of *even* (see (10); see recent studies like Greenberg 2018, Zhang 2022), interlocutors naturally accommodate a hidden *even* and interpret 'HEIGHT(Mary) $< \epsilon +$ HEIGHT(Lucy)' as an *even*-sentence:

(9) Mary is no taller than Lucy $\rightsquigarrow$ Mary is not even as tall as X. (X $= \epsilon +$ HEIGHT(Lucy))

(10) The presuppositions of *even*(p) (see Zhang 2022; see also Greenberg 2018):
a. there is a contextually salient degree QUD
b. p is maximally informative in resolving the degree QUD
(as a further consequence, p solves the degree QUD with evaluativity (see below), cf. Greenberg 2018, Zhang 2022)

According to Zhang (2022), an *even*-sentence asserts its prejacent and has the presuppositions shown in (10). This view explains the potential lack of entity-based additivity or low likelihood in interpreting an *even*-sentence. E.g., under the context of (11), no one other than Eeyore took a bite of the thistles, thus this felicitous use of *even* does not require its prejacent to be less likely than alternatives. Rather than addressing who spit the thistles out or who was the least likely to do so, (11) addresses a degree QUD: *how prickly the thistles are*. Compared to its alternatives (e.g., 'Pooh spit them out'), the prejacent 'Eeyore spit them out' is maximally informative in addressing this degree QUD.

(11) (Context: Imagine Pooh and friends coming upon a bush of thistles. Eeyore (known to favor thistles) takes a bite but spits it out. (see Szabolcsi 2017))
Those thistles must be really prickly! Even Eeyore$_F$ spit them out!

Evidently, *Mary is not as tall as* X_F is maximally informative in its alternative set (see (8)), so that it naturally meets the presuppositional requirements of *even* as far as we accommodate an appropriate degree QUD. Given that X is a minimal value in its alternative set (see (8)), an appropriate degree QUD is such that in resolving it, a lower height value corresponds to a higher level of informativeness (e.g., *how short is Mary?*, *to what extent is Mary not tall?*).

The presuppositonal requirements of *even* in (10) bring a pragmatic consequence: prejacent p solves its relevant degree QUD with evaluativity.

As illustrated in (12), the focus associate of *even*, '3', is maximally informative in addressing the relevant QUD, which means that even if numbers higher than '3' are used, informativeness (here the heaviness of burden) is considered the same. Obviously, this maximal heaviness of burden is a superlative value and cannot be lower than the contextual threshold of being heavy (see Krifka 2000; cf. Greenberg 2022).

(12) (QUD: *how heavy is the burden of parenting?*) Mary even has 3_F kids.

To sum up, *Mary is no taller than Lucy* amounts to a totally ordered set of propositions and is thus pragmatically strengthened to *Mary is not even as tall as* X_F. Then since X is maximally informative in addressing a salient QUD (e.g., *how short* or *how not tall*), X is below the contextual threshold (of tallness). Thus we infer Lucy and Mary are not tall.

4. Extension to *only*-sentences and discourse-softening markers Similar to negative comparatives like *no taller than*, *only*-sentences (see Alxatib 2020, Greenberg 2022) and discourse-softening markers like Chinese *bú guò* 'not beyond' also demonstrate a diminishing effect. As illustrated in (13), with the use of *only* or *bú guò*, these sentences cannot be naturally followed by a continuation like *already an old age*, suggesting that the use of *only* or *bú guò* leads to an inference that Bill is not old.

(13) a. Bill is only 29, (?which is quite old). ✓ Diminishing effect
b. tā bú-guò èr-shí-jiǔ suì, (?yǐ-jīng hěn lǎo-le)
3SG not-beyond two-ten-nine year already very old-SFP
'He is only 29, (?which is quite old)'. ✓ Diminishing effect

According to the canonical view (see e.g., Horn 1969, among others), an *only*-sentence has a positive inference (e.g., Bill is 29) and a negative inference (see (14)). The positive inference is considered a presupposition (see e.g., Horn 1969) or an implicature (see e.g., van Rooij and Schulz 2007, Ippolito 2007), while the negative inference is an assertion.

I propose that the negative inference of an *only*-sentence is equivalent to a negative comparative like (2), with the pattern '*no* + comparative' (cf. (1), which has the pattern '*not* + comparative'). Thus the negative inference of (13) amounts to (14). Given the above analysis, the inference *Bill is not old* follows naturally.

(14) Negative inference of (13): Bill is no older than 29
≈ Bill is not even as old as X (X = 29 + a tiny bit)
⇝ X is below a contexutal threshold of oldness, ∴ 29 is not old, Bill is not old

Thus under the current analysis, *only* is actually decomposed to (i) negation word *no* and (ii) comparatives: *only* negates all values above a certain degree along a scale.

5. Discussion The current analysis of *only* is different from the 'exceptive' view in the recent literature on *only* (see von Fintel and Iatridou 2007, Crnič 2024). The current view is compatible with the empirical fact that the focus associate of *only* is not aways an exception (see (15)) and explains the diminishing effect even in such cases: e.g., in (15), '90% of the students' does not constituent an exception, but '90%' is below expectation.

(15) Only $90\%_F$ of the students came to the final. ('90%' is not an exception)
('Exceptive' view: Only $90\%_F$ of the students = no students but 90%)

Compared to existing studies, the current analysis also predicts that (i) negating a minimal value along a scale pragmatically brings a hidden *even* (cf. Lahiri 1998) and (ii) evaluativity (or norm-sensitivity) for both *even* and *only* can be derived without hardwiring (see also Krifka 2000's discussion on *already* and *still*; cf. Greenberg 2022).

A reviewer raises a concern about over-generation: for example, under the current proposal, will (16a) be pragmatically strengthened to (16b) and have a diminishing effect?

My answer is *no*. There are two key distinctions between (16a) and '*no* + comparative'. First, with *not* (cf. *no*), (16a) cannot be unpacked into a totally ordered set of propositions (see (8)), blocking the accommodation of a hidden *even*. Second, even when *even* is overtly present, (16b) does not necessarily convey a diminishing effect. For instance, if John aims to lose weight, (16b) would mean that he is still too heavy. The comparative component in '*no* + comparative' restricts the alternative set, thereby guiding the accommodation of a degree QUD and determining the direction of the norm-sensitive effect.

(16) a. John's weight is not 60 kg.
b. John's weight is not even 60 kg.

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Scope Ambiguity of Polar / Alternative Questions

Ka-fat CHOW

In Chow (2019), I developed a framework that combines the notions and notations of Inquisitive Semantics (IS) (as in Ciardelli *et al* (2019), among others) and Generalized Quantifier Theory (GQT) (as in Peters & Westerståhl (2006), among many others). On the one hand, this framework inherits IS's practice of treating propositions as having type $(st)t$ (hereinafter abbreviated as T) and n-ary predicates as having type e^nT. It also inherits the various operations of IS, including the join and meet operations, the absolute pseudo-complement operator (represented as $\sim$ in this paper), which is the negation operator under IS, and two projection operators: the ! operator, which turns a proposition to an assertion, and the ? operator, which turns a proposition to a question. The definitions of the last three operators are given below:

$$\sim p = \text{Power}(W - \bigcup p) \qquad (1)$$

$$!p = \text{Power}(\bigcup p) \qquad (2)$$

$$?p = p \cup \sim p \qquad (3)$$

where Power represents the power set operation and W represents the set of all possible worlds.

On the other hand, this framework also tries to incorporate the classical treatment of GQT for generalized quantifiers (GQs) under the IS framework. It proposes an additional type for n-ary predicates, namely $s(e^nt)$. Thus, for each predicate X of the standard type e^nT, there is a corresponding predicate X^* of the additional type $s(e^nt)$. The following formulae are used for switching between X and X^* (where w and x are variables of types s and e^n, respectively):

$$X^* = \lambda w[\{x : \{w\} \in X(x)\}] \qquad (4)$$

$$X = \lambda x[\text{Power}(\{w : x \in X^*(w)\})] \qquad (5)$$

Using the additional type, we can then denote GQs in a way that resembles the classical denotations of GQs under GQT. Let Q' be a monadic GQ under the classical GQT with the denotation $Q' = \lambda X'_1 \ldots \lambda X'_n[C(X'_1, \ldots, X'_n)]$ where $X'_1, \ldots, X'_n$ are variables of type et and C is the truth condition associated with this GQ. Then there is a corresponding monadic GQ Q under IS with the following denotation (where $X_1, \ldots, X_n$ are variables of type eT):

$$Q = \lambda X_1 \ldots \lambda X_n[\mathrm{Power}(\{w : C(X_1^*(w), \ldots, X_n^*(w))\})] \qquad (6)$$

Based on the aforesaid framework, in this paper I first propose the proper treatments of polar/alternative questions containing GQs (this paper mainly discusses alternative questions with two noun phrases as choices, i.e. the terms connected by "or" in an alternative question). Regarding polar questions, I propose that the denotations of such kind of questions should have the following general form:

$$?!p \qquad (7)$$

where $!p$ represents the declarative sentence associated with the polar question (the operator ! is used to suppress any inquisitiveness which p may have).

Regarding alternative questions, according to Roelofsen & van Gool (2010), Pruitt & Roelofsen (2011), Biezma & Rawlins (2012) and Steiner-Mayr (accepted 2024), the choices in such kind of questions are subject to a "true alternative requirement" according to which the addressee must choose one of the choices in the question as answer, as well as a "mutual exclusiveness requirement" according to which the addressee can only choose one of the choices as answer.

To meet the aforesaid two requirements, I propose the following treatment of alternative questions which contains two main points. First, I propose a "higher order modifier" (borrowing a term from Zuber (1997)) called PREC, short for "precisification", which acts on the choices of an alternative question and turns them to their "precisified" version, with the following denotation (where Q is a variable of type $\langle 1 \rangle$ GQs and X is a variable of type eT):

$$\textsc{prec} = \lambda Q \lambda X[\mathrm{Power}(\{w : X^*(w) \in \mathrm{Wit}(Q)(w)\})] \qquad (8)$$

In the expression above, Q is a type $\langle 1 \rangle$ GQ, $\mathrm{Wit}(Q)$ represents a function mapping a world to the set of witness sets of Q in that world. The formal definition of "witness sets" can be found in Chow (2024). Roughly speaking, a witness set of Q in a world w is a set that can serve as a representative of Q in w. For example, in a model that contains the predicate **mi** (representing "musical instrument"), the witness sets of $\textsc{a}(\mathbf{mi})$ in w are all those sets that precisely contain at least a member of $\mathbf{mi}^*(w)$. Since the members of $\mathbf{mi}^*(w)$ may differ as w varies, $\mathrm{Wit}(\textsc{a}(\mathbf{mi}))$ is a function dependent on possible worlds.

Second, I propose that the aforesaid two requirements give rise to a presupposition whose purpose is to restrict the set W of all possible worlds to those that satisfy these requirements and I treat this presupposition as an additional expression appended after the core denotation of the alternative question.

In the light of the above discussion, I now write down the canonical form of the denotation of an alternative question as follows:

$$d = \textsc{or}(\textsc{prec}(Q_1), \textsc{prec}(Q_2))(X); \;\; W = \bigcup d \qquad (9)$$

where d represents the core denotation of the alternative question, Q_1 and Q_2 are type $\langle 1 \rangle$ GQs representing the two choices, X is a unary predicate, and OR has the following recursive definition (adapted from Winter (2001) and Ciardelli *et al* (2019)):

$$\text{OR} = \begin{cases} \lambda(p_1, p_2)[p_1 \cup p_2], & \text{if } p_1,\ p_2 \text{ have type } T \\ \lambda(X_1, X_2)\lambda Y[\text{OR}(X_1(Y), X_2(Y))], & \text{if } X_1,\ X_2 \text{ have type } \tau_1\tau_2 \text{ and } Y \text{ has type } \tau_1 \end{cases} \tag{10}$$

In the first expression in (9), which is the core denotation, the operator OR occupies the first position without falling under the scope of any GQ because it is precisely this operator that gives rise to the inquisitiveness of the question. If it falls under the scope of a GQ, its inquisitiveness will be suppressed by the GQ. The second expression in (9), which is the presupposition, states that W is the union of the members of d and so contains all those worlds that satisfy the aforesaid two requirements.

I then discuss the scope ambiguity of certain types of questions. As a matter of fact, Chow (2019) discussed the much-studied scope ambiguity of certain constituent questions such as "Which book did every girl read?" and proposed a proper treatment for its two readings, namely the "individual reading" and the "pair list reading". Instead of discussing such kind of scope ambiguity, in this paper I will discuss the less-studied scope ambiguity of certain polar/alternative questions.

To treat scope properly, I adopt the standard GQT practice of treating GQs as arity reducers (as in Peters & Westerståhl (2006)) as well as case extension operators with the following definitions adapted from Keenan (1987) (where nom and acc represent the nominative and accusative case extensions respectively, Q is a type $\langle 1 \rangle$ GQ, R is a variable of type e^2T, and x and y are variables of type e):

$$Q_{\text{nom}} = \lambda R\lambda y[Q(\lambda x[R(x, y)])] \tag{11}$$

$$Q_{\text{acc}} = \lambda R\lambda x[Q(\lambda y[R(x, y)])] \tag{12}$$

It has been shown in Chow (2019) that by using (4), (5), (6), (11) and (12), one can derive the correct denotations of quantified statements with iterated GQs under the IS framework. In fact, the treatment can even be extended to quantified statements containing certain "higher order modifiers" or "generalized noun phrases" discussed in Zuber (1997), Zuber (2018), Zuber (2019), Chow (2024), etc.

In addition, I further propose the following "scope reversal cum case extension" version of Q (where rv is short for "reversal", nom/acc is a variable label which may be instantiated as either nom or acc, P is a variable of type $\langle 1 \rangle$ GQs and R is a variable of type e^2T):

$$Q_{\text{rv,nom/acc}} = \lambda P\lambda R[P(Q_{\text{nom/acc}}(R))] \tag{13}$$

By applying the operator Q above (with the labels suppressed) to a GQ P, we obtain $P(Q(...))$, hence reversing the scope relation between Q and P.

There are two sources of ambiguity in polar/alternative questions. The first source is the scope structures of certain GQs. According to the study of GQT and other related studies, a declarative sentence with certain GQs at the subject and object positions of the sentence such as "A kid climbed every tree" is ambiguous between an "object narrow scope (ONS) reading" under which the GQ at the object position takes a narrower scope than that at the subject position, and an "object wide scope (OWS) reading" under which the GQ at the object position takes a wider scope than that at the subject position. A polar question with the same GQ structure such as the following also exhibits the same scope ambiguity:

Did a kid climb every tree? (14)

The ONS and OWS readings of (14) can be represented by using the general form of polar questions given in (7) above and the operators (11), (12) and (13) introduced above as follows:

$$?!\textsc{a}(\mathbf{kid})(\textsc{every}(\mathbf{tree})_{\mathrm{acc}}(\mathbf{climbed})) \qquad (15)$$

$$?!\textsc{a}(\mathbf{kid})_{\mathrm{rv,nom}}(\textsc{every}(\mathbf{tree}))(\mathbf{climbed}) \qquad (16)$$

In (16) above, I use the operator $\textsc{a}(\mathbf{kid})_{\mathrm{rv,nom}}$ because under the OWS reading, the subject "a kid" in (14) takes a narrower scope than the object "every tree". By substituting (13) into (16), (16) will finally turn out to be an expression with $\textsc{every}(\mathbf{tree})$ taking a wider scope than $\textsc{a}(\mathbf{kid})$.

The second source is the inherent ambiguity of the word "or" such as the following:

Did John learn a musical instrument or a foreign language? (17)

The question above is ambiguous between a polar question (which expects the answer "yes" or "no" according as it is or it is not the case that John learned a musical instrument or a foreign language) and an alternative question (which expects the answer "a musical instrument" or "a foreign language"). As I have discussed the proper treatments of polar/alternative questions above, the polar question and alternative question readings of (17) can be represented as follows (where $\mathrm{I}_{\mathbf{j}}$ is the Montagovian individual representing "John"; moreover, the presuppositions of all alternative questions are omitted below as they can easily be determined from the core denotations of these questions):

$$?!\mathrm{I}_{\mathbf{j}}(\textsc{or}(\textsc{a}(\mathbf{mi}), \textsc{a}(\mathbf{fl}))_{\mathrm{acc}}(\mathbf{learned})) \qquad (18)$$

$$d = \textsc{or}(\textsc{prec}(\textsc{a}(\mathbf{mi})), \textsc{prec}(\textsc{a}(\mathbf{fl})))(\mathrm{I}_{\mathbf{j}\mathrm{nom}}(\mathbf{learned})) \qquad (19)$$

The aforesaid two sources of ambiguity can even be exhibited in a single question such as the following:

Must a musical instrument or a foreign language be taught to every student? (20)

Since this question contains "a" and "every" at the subject and object positions respectively, it is ambiguous between an ONS reading and an OWS reading. Moreover, since it contains "or", it is also ambiguous between a polar question and an alternative question. Thus, this question is ambiguous with at least four readings.

The ONS polar question reading and OWS polar question reading of (20) can be represented in a way similar to (15) and (16) above (in what follows, I treat "must be taught to" as a whole unit and represent it by **mbtt**, ignoring its internal structure):

$$?!\textsc{or}(\textsc{a}(\mathbf{mi}), \textsc{a}(\mathbf{fl}))(\textsc{every}(\mathbf{student})_{\mathrm{acc}}(\mathbf{mbtt})) \qquad (21)$$

$$?!\textsc{or}(\textsc{a}(\mathbf{mi}), \textsc{a}(\mathbf{fl}))_{\mathrm{rv,nom}}(\textsc{every}(\mathbf{student}))(\mathbf{mbtt}) \qquad (22)$$

The ONS alternative question reading of (20) can be represented in a way similar to (19) above:

$$d = \textsc{or}(\textsc{prec}(\textsc{a}(\mathbf{mi})), \textsc{prec}(\textsc{a}(\mathbf{fl})))(\textsc{every}(\mathbf{student})_{\mathrm{acc}}(\mathbf{mbtt})) \qquad (23)$$

Note that in the expression above, the GQs $\textsc{a}(\mathbf{mi})$ and $\textsc{a}(\mathbf{fl})$ take a wider scope than $\textsc{every}(\mathbf{student})$, which agrees with the ONS reading of (20).

As for the OWS alternative question reading of (20), the situation is a bit more complicated. On the one hand, we must place the operator $\textsc{or}$ at the first position of the representation as dictated by the requirement that its inquisitiveness should not be suppressed by other operators. On the other hand, we also need to place $\textsc{every}(\mathbf{student})$ in front of $\textsc{a}(\mathbf{mi})$ and $\textsc{a}(\mathbf{fl})$ because under the OWS reading, "every student" takes a wider scope than "a musical instrument" and "a foreign language".

To resolve the aforesaid paradox, we can make use of the "scope reversal cum case extension" version of $\textsc{prec}(\textsc{a}(\mathbf{mi}))$ and $\textsc{prec}(\textsc{a}(\mathbf{fl}))$ and represent the OWS alternative question reading of (20) in the following non-canonical form:

$$d = \textsc{or}(\textsc{prec}(\textsc{a}(\mathbf{mi}))_{\mathrm{rv,nom}}, \textsc{prec}(\textsc{a}(\mathbf{fl}))_{\mathrm{rv,nom}})(\textsc{every}(\mathbf{student}))(\mathbf{mbtt}) \qquad (24)$$

If we substitute (10), (11) and (13) into the expression above and then apply λ-reduction, we will obtain the following as an intermediate result:

$$\begin{array}{ll} & \textsc{every}(\mathbf{student})(\textsc{prec}(\textsc{a}(\mathbf{mi}))_{\mathrm{nom}}(\mathbf{mbtt})) \\ \cup & \textsc{every}(\mathbf{student})(\textsc{prec}(\textsc{a}(\mathbf{fl}))_{\mathrm{nom}}(\mathbf{mbtt})) \end{array} \qquad (25)$$

The expression above has the form $p \cup q$, and so it is inquisitive. Moreover, in both p and q, the GQ $\textsc{every}(\mathbf{student})$ takes a wider scope than $\textsc{a}(\mathbf{mi})$ and $\textsc{a}(\mathbf{fl})$, and so this represents the OWS reading of (20). Thus, (24) is a correct representation of the OWS alternative question reading of (20).

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On the semantics of *good*, *better*, and *ought*

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Most research on deontic modalities in logic, linguistics and philosophy focuses on the meaning of *ought* and closely related modal expressions, such as *should* and *must*, sometimes including permission operators in the analysis (see, e.g., [6, 7, 14, 17] and, for a collection of recent articles, [3]). Although corresponding formal models usually feature a binary relation for comparing worlds or propositions with respect to *goodness*, few authors place the semantics of *good* and *better* at the center of their analysis. An exception in this respect is Lassiter's *Graded Modality* [16] (see also [15]), which explicitly departs from the received view and introduces a theory of deontic (and epistemic) modalities that focuses on the scale structure of gradable adjectives.[1]

Following Lassiter, we propose to approach deontic semantics and logic by analyzing assertions and inferences involving *better* and *good* as gradable modalities, rather than starting with Kripke/Lewis/Kratzer-style models of *ought*, *should*, and *must*. Our take of the topic is motivated by the following observations:

1. As already indicated, Lassiter [16] makes a strong case for placing the structure of the *better* relation at the center of a semantic theory of deontic modalities. However, as we will argue, Lassiter omits a few relevant aspects concerning the interplay between the *better* relation on propositions and logical connectives.

2. Several philosophers and logicians have proposed to reduce the monadic predicates *good* and *bad* to the binary relation '*better*'. These proposals focus on the specific structure of the *better* relation between propositions, but ignore an approach that is arguably more plausible from

[1]The literature on the semantics and logics of *good*, *better*, and *best* is too vast to be surveyed here exhaustively. We focus on recent observations regarding [16] and [5]. But see, e.g., [1, 4, 8, 9, 10] for some classic contributions to this topic.

a linguistic point of view. Namely, to relate a scalable adjective (in our case '*good*') to its positive form via contextually given comparison classes or thresholds for admissible assertions of the positive form (in our case '*It is good that* ϕ').

3. In deontic logic the reduction of the deontic modal operator *ought* or *should* to a proposition expressing the (relevant) goodness of a state of affairs is often dismissed as too crude. Recent linguistic studies, in particular [5], suggest, however, that such a reduction can actually provide a more appropriate analysis of deontic modalities than the standard model (as presented, for example, in [14]), at least for certain languages.

In the rest of the abstract we briefly indicate how we intend to tackle the challenges arising from the above observations.

Ad 1. Lassiter [16] places his investigation of the *better* relation $\succeq_{good}$[2] in the context of the representational theory of measurement (RTM). RTM investigates how gradable predicates correspond to underlying numerical or ordered structures, ensuring that semantic scales reflect the formal properties (e.g. order, ratio) of measurement systems. In particular, Lassiter searches for structural properties of $\succeq_{good}$ that can explain the validity of the following inference pattern $B_\vee$:

(a) If $\chi \succeq_{good} \phi$

(b) and $\chi \succeq_{good} \psi$,

(c) then $\chi \succeq_{good} (\phi \vee \psi)$

He suggests that the following property is best suited to justify $B_\vee$:

Intermediacy (simplified): If $\phi \succ_{good} \psi$, then $\phi \succ_{good} (\phi \vee \psi) \succ_{good} \psi$.

But note that *Intermediacy* is a local property that does not constrain the relation of ϕ, ψ or $\phi \vee \psi$ to a third proposition χ. As a consequence, in contrast to Lassiter's claim, the validity of $B_\vee$ does not follow from *Intermediacy*, unless rather strong additional constraints are placed on $\succeq_{good}$. The (largely[3]) uncontroversial transitivity of $\succeq_{good}$ is insufficient for this purpose. One needs

[2]We write $\phi \succeq_{good} \psi$ to denote that ϕ is at least as good as ψ and $\phi \succ_{good} \psi$ to denote that ϕ is strictly better than ψ.

[3]Hanson [12] maintains that it is problematic to assume that any preference relation is transitive, since this would imply the transitivity of indifference. Arguably this criticism applies to the *better* relation as well.

to postulate its *connectedness*[4] (or even stronger properties) to justify $B_\vee$. But it is problematic to assume that for any two given propositions ϕ and ψ, either ϕ is at least as good as ψ or ψ is at least as good as ϕ.

The most direct way to acknowledge the validity of $B_\vee$ is to declare it a basic property of the *better* relation as follows:

$\vee$-*Domination*: If $\chi \succeq_{good} \phi$ and $\chi \succeq_{good} \psi$, then $\chi \succeq_{good} (\phi \vee \psi)$.

Alternatively, one could postulate

***Weak Connectedness*:** If $\chi \succeq_{good} \phi$ and $\chi \succeq_{good} \psi$, then $\phi \succeq_{good} \psi$ or $\psi \succeq_{good} \phi$ (or both).

Jointly with *Intermediacy*, this suffices to justify $B_\vee$.

Ad 2. A much discussed suggestion to define *good* in terms of *better*, advocated, among others, by [1, 11, 18] is the following:

***Basic Reduction*:** $good(\phi)$ if and only if $\phi \succ_{good} \neg\phi$.

This has been criticized and refined in various ways by Chisholm and Sosa [4], Hansson [12], and Carlson [2]. Significantly, only intrinsic properties of *good* and *better* are considered there. None of the cited philosophers discuss a general method for relating the positive form of a gradable predicate to the underlying scale structure.

The standard linguistic approach to (not only deontic) modalities, due to Kratzer [14], also seems problematic in this respect, since *good* is only treated indirectly in Kratzer's model. First, one extracts an order relation on worlds from the ordering source g of the model $\mathcal{M} = \langle W, f, g, V\rangle$ that maps worlds into sets of propositions (i.e., set of sets worlds):

$$u \succeq_{g(w)} v \text{ if and only if } \forall X \in g(w) : v \in X \Rightarrow u \in X.$$

The relation $\succeq_{g(w)}$ is then lifted from worlds to propositions by

$$A \succeq^s_{g(w)} B \text{ if and only if } \forall u \in A\, \exists v \in B\colon v \succeq_{g(w)} u, \text{ where } u, v \in \bigcap f(w)$$

and $f(w)$ is a set of relevant propositions singled out by the modal base f of $\mathcal{M}$. One may proceed to define

$$\mathcal{M}, w \models \text{BETTER}(A, B) \text{ iff } A \succeq^s_{g(w)} B \text{ and } B \not\succeq^s_{g(w)} A.$$

[4] An ordering is connected if any two items are comparable; in our case, for all propositions ϕ and ψ: $\phi \succeq_{good} \psi$ or $\psi \succeq_{good} \phi$.

But this approach does not result in a compositional model of *better*, which should consist of a functional application of $[\![more/\text{-}er]\!]$ to a suitable meaning representation $[\![good]\!]$.

In contrast, Lassiter [16] suggests to model the semantics of *good* like that of any typical gradable predicate (e.g., *tall*), along the line of well established linguistics theories (see, e.g., [13]), where one uses contextually given parameters to determine the acceptability of corresponding comparative assertions and of assertions involving the positive form of the adjective or adverb in question. In our case, these parameters can be represented as cut-off points in $\succeq_{good}$, which separate *good* from not *good* propositions. These cut-off points may in turn depend on certain sets of alternatives, ordered by $\succeq_{good}$. We will discuss how such models should look like and how they are related to the above cited reductions proposed in [1, 2, 4, 12].

Ad 3. Various forms of defining obligation, expressed by *ought*, in terms of a 'best state' and a conditional connective have been suggested in the literature on deontic logic. In the handbook article [17], where this is referred to as Andersonian-Kangerian-Leibnizian Reduction (R), it is pointed out that logicians usually prefer to analyze modal operators expressing obligation or permission via a Kripke/Lewis/Kratzer-style possible worlds semantics. In contrast, Chung [5] argues that evidence from Korean suggests an alternative analysis of ϕ *ought to be* as *only if* ϕ*, good*—i.e. close to (R)—exemplified by

John-un maykcwu-lul masi-eya toy-n-ta
John-TOP beer-ACC drink-only.if GOOD-PRES-DECL
'*John must/should/ought to drink beer.*'

A similar construction that uses the conditional *even if*, instead of *only if*, expresses permission:

John-un maykcwu-lul masi-eto toy-n-ta
John-TOP beer-ACC drink-even.if GOOD-PRES-DECL
'*John may drink beer.*'

This observation leads Chung to conclude that (at least in Korean) modal expressions do not set up a domain of quantification in which the prejacent ϕ is evaluated, as suggested by the common Kratzer-style model [14]. Rather, these expressions directly assess the goodness of ϕ.

We suggest that Chung's investigation is not only relevant for certain languages, but rather motivates the design of a general model of deontic modals that combines conditional operators with a mechanism for evaluating state of affairs with respect to goodness, similar to the Andersonian-Kangerian-Leibnizian Reduction. Moreover, we argue that Lassiter's [16] concerns about the appropriate consideration of the gradability of deontic modalities can also be addressed. This requires the consideration of evaluative predicates that assess the *degree of goodness* of given situations with respect to contextually relevant alternatives.

In conclusion, we note that the three concerns guiding our approach to deontic modalities are closely related: different properties of the *better* relation trigger different forms of reduction to its positive form, which in turn affects the possibilities of defining *ought* in terms of a state of affairs judged to be *good*. Moreover, we argue that this approach is flexible enough to take into account the gradedness of many deontic expressions.

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On Multidimensional Predicates: Social-Choice Model Versus Additive-Difference Model (Extended Abstract)

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1. Motivation

A considerable number of studies have been made on the semantics of unidimensional adjectives and common nouns. On the other hand, as far as we know, only a few attempts, except for van Rooij (2011), ours (2012b), Sassoon (2013) and D'Ambrosio and Hedden (2024), have so far been made on the semantics of multidimensional adjectives and common nouns. For example, 'good', 'clever' and 'big' are usually taken to be multidimensional adjectives. It is assumed that each dimension gives rise to a separate ordering and that whether someone is better/cleverer/bigger than someone else depends on an overall ordering aggregated from these separate orderings. We (2012b) propose a new version of logic for comparisons of multidimensional predicates (adjectives and common nouns)—Multidimensional-Predicate-Comparison Logic (MCL) the model of which can provide, in terms of measurement theory, conditions under which we can justify using the *weighted sum of absolute differences* as a method to construct orderings for positive and comparative sentences involving multidimensional predicates. Recently, D'Ambrosio and Hedden (2024) have given an analysis of multidimensional adjectives in terms of *social choice theory*, though the point of their analysis consists in analysis of vagueness of multidimensional adjectives. Harsanyi (1955)'s Aggregation Theorem is considered to be one of the most promising social-choice-theoretic results that can contribute to furnishing a logic of multidimensional predicates with its model. Harvey (1999, p.66) gives the criticism that Harsanyi's Aggregation Theorem assumes that objects have identical beliefs and that social beliefs are the same as the common individual beliefs but generally the member of a society have different beliefs. In order to escape this critique, Harvey proposes Harvey's Aggregation Theorem (1999, p.72) that has as primitive quaternary preference relations that are only on the set of outcomes but are not on the set of lotteries in Harsanyi's Aggregation Theorem, and that can be represented by algebraic differences (utility differences). So at least when situations are not concerned with the probabilities of outcomes, and since in the theories of multidimensional predicates, no probabilities of outcomes are normally taken into consideration, multidimensional predicates should be explained not from Harsanyi's Aggregation Theorem but from Harvey's Aggregation Theorem. Since D'Ambrosio and Hedden do not consider in terms of model theory, in this paper we furnish a social-choice model of MCL based on Harvey's Aggregation Theorem. This model seems to be plausible. However, this model faces the two hard problems below. The aim of this paper is to demonstrate that our additive-difference model of MCL surmounts these problems. In this paper, we are concerned not with such a concrete *linguistic* analysis as Sassoon (2013) but with a conceptual analysis from a *philosophical* point of view of multidimensional predicates.

2. Multidimensional-Predicate-Comparison Logic (MCL)

2.1. Language

We define the language $\mathscr{L}_{\mathsf{MCL}}$ of MCL as follows:

Definition 1 (Language) *Let $\mathscr{V}$ denote a set of individual variables, $\mathscr{C}$ a set of individual constants, $\mathscr{P}$ a set of one-place i-dimensional predicate symbols. The language $\mathscr{L}_{\mathsf{MCL}}$ of* MCL *is given by the following BNF rule:*

$t ::= x \mid a$

$\varphi ::= P^{(i)}(t) \mid t_k \gg_{P^{(i)}} t_l \mid \top \mid \neg\varphi \mid \varphi \wedge \psi \mid \forall x\varphi,$

where $x \in \mathscr{V}$, $a \in \mathscr{C}$, $P^{(i)} \in \mathscr{P}$, and no nesting of $\gg$ occur. $P^{(i)}(t)$ means that t is i-dimensionally P (positive sentence). $t_k \gg_{P^{(i)}} t_l$ means that t_k is i-dimensionally P-er than t_l (comparative sentence). The set of all well-formed formulae of $\mathscr{L}_{\mathsf{MCL}}$ is denoted by $\Phi_{\mathscr{L}_{\mathsf{MCL}}}$.

2.2. Social-Choice Model Krantz et al. (1971, p. 151) defines an algebraic difference structure as follows:

Definition 2 (Algebraic-Difference Structure) *Suppose that $\mathscr{O}$ is a nonempty set of objects and $\succsim$ a quarterary relation on $\mathscr{O}$ (i.e., binary relation on $\mathscr{O} \times \mathscr{O}$). $(\mathscr{O}, \succsim)$ is an algebraic-difference structure iff, for any $a, b, c, d, a', b', c' \in \mathscr{O}$ and any sequence $a_1, a_2, \ldots, a_i, \ldots \mathscr{O}$, the following five conditions are satisfied: **Weak Order**: $\succsim$ is a weak order. **Reversal**: If $(a, b) \succsim (c, d)$, then $(d, c) \succsim (b, a)$. **Weak Monotonicity**: If $(a, b) \succsim (a', b')$ and $(b, c) \succsim (b', c')$, then $(a, c) \succsim (a', c')$. **Solvability**: If $(a, b) \succsim (c, d) \succsim (a, a)$, then there exist d, d'' such that $(a, d') \sim (c, d) \sim (d'', b)$. **Archimedeanity**: If $a_1, a_2, \ldots, a_i, \ldots$ is strictly bounded standard sequence (i.e., $(a_{i+1}, a_i) \sim (a_2, a_1)$ for any a_i, a_{i+1} in the sequence; $(a_2, a_1) \nsim (a_1, a_1)$; and there exist $d, d'' \in \mathscr{O}$ such that $(d', d'') \succ (a_i, a_1) \succ (d'', d')$ for any a_i in the sequence), then it is finite.*

Harvey (1999, p. 70) defines Pareto Conditions as follows:

Definition 3 (Pareto Conditions) $(\mathscr{O}, \succsim_i, \succsim)$ *satisfies* Pareto Conditions *iff the following conditions are met for any $a, a', b, b' \in \mathscr{O}$: (I) If $(a, a') \sim_i (b, b')$ for any $i = 1, \ldots, n$, then $(a, a') \sim (b, b')$. (II) If $(a, a') \succ_i (b, b')$ for some $i = 1, \ldots, n$ and $(a, a') \sim_j$ for any $j \neq i$, then $(a, a') \succ (b, b')$.*

We define a social-choice model $\mathfrak{M}_{SC}$ of MCL as follows:

Definition 4 (Social-Choice Model) *$\mathfrak{M}_{SC}$ is a sequence $(\mathscr{O}, \ldots, a^{\mathfrak{M}_{SC}}, b^{\mathfrak{M}_{SC}}, \ldots, \ldots, \ldots, \spadesuit^{(1)}_{F^{(q)}}, \ldots, \spadesuit^{(q)}_{F^{(q)}}, \spadesuit_{F^{(q)}}, \spadesuit^{(1)}_{G^{(r)}}, \ldots, \spadesuit^{(r)}_{G^{(r)}}, \spadesuit_{G^{(r)}}, \heartsuit^{(1)}_{F^{(q)}}, \ldots, \heartsuit^{(q)}_{F^{(q)}}, \heartsuit_{F^{(q)}}, \heartsuit^{(1)}_{G^{(r)}}, \ldots, \heartsuit^{(r)}_{G^{(r)}}, \heartsuit_{G^{(r)}}, \succsim^{SC(1)}_{F^{(q)}}, \ldots, \succsim^{SC(q)}_{F^{(q)}}, \succsim^{SC}_{F^{(q)}}, \succsim^{SC(1)}_{G^{(r)}}, \ldots, \succsim^{SC(r)}_{G^{(r)}}, \succsim^{SC}_{G^{(r)}}, \ldots, s)$, where: • $\mathscr{O}$ is a nonempty set of objects. • $a^{\mathfrak{M}_{SC}} \in \mathscr{O}$. • $\spadesuit^{(j)}_{P^{(i)}}$ (resp. $\spadesuit_{P^{(i)}}$) $\in \mathscr{O}$ is a (hypothetical) average object relative to the j-th factor of $P^{(i)} \in \mathscr{P}$ (resp. relative to $P^{(i)} \in \mathscr{P}$). • $\heartsuit^{(j)}_{P^{(i)}}$ (resp. $\heartsuit_{P^{(i)}}$) $\in \mathscr{O}$ is a (hypothetical) zero-point object relative to the j-th factor of $P^{(i)} \in \mathscr{P}$ (resp. relative to $P^{(i)} \in \mathscr{P}$). • $(\mathscr{O}, \succsim^{SC(1)}_{P^{(i)}}, \ldots, \succsim^{SC(i)}_{P^{(i)}}, \succsim^{SC}_{P^{(i)}})$ is an algebraic-difference structure where* quaternary relations $\succsim^{SC(j)}_{P^{(i)}}$ and $\succsim^{SC}_{P^{(i)}}$ on $\mathscr{O}$ *satisfy also Pareto Conditions. • We call $\succsim^{SC(j)}_{P^{(i)}}$ the j-th part of i-dimensional-P-comparison SC-ordering relation. • We call $\succsim^{SC}_{P^{(i)}}$ the i-dimensional-P-comparison SC-ordering relation. • $s : \mathscr{V} \to \mathscr{O}$ (resp. $\tilde{s} : \mathscr{V} \cup \mathscr{C} \to \mathscr{O}$) is a (resp. extended) assignment function.*

We can prove the following representation and uniqueness theorem for the i-dimensional-P-comparison ordering relation by modifying the method of Krantz et al. (1971, p. 158):

Theorem 1 (Representation and Uniqueness) *Suppose that $\succsim^{SC(j)}_{P^{(i)}}$ is the j-th part of i-dimensional-P-comparison SC-ordering relation. Then there exists such a function $f_j : \mathscr{O} \to \mathbb{R}$ that $(\tilde{s}(t_k), \tilde{s}(t_l)) \succsim^{SC(j)}_{P^{(i)}} (\tilde{s}(t_m), \tilde{s}(t_n))$ iff $f_j(\tilde{s}(t_k)) - f_j(\tilde{s}(t_l)) \geq f_j(\tilde{s}(t_m)) - f_j(\tilde{s}(t_n))$, for any $\tilde{s}(t_k), \tilde{s}(t_l), \tilde{s}(t_m), \tilde{s}(t_n) \in \mathscr{O}$. The same goes for $\succsim^{SC}_{P^{(i)}}$. The above function f_j is unique up to a positive affine transformation, that is, f_j forms an interval scale. The same goes for f for $\succsim^{SC}_{P^{(i)}}$.*

We can prove the following aggregation theorem by modifying the method of Harvey (1999, pp. 75–77):

Theorem 2 (Aggregation) *Suppose that $\succsim^{SC(j)}_{P^{(i)}}$ (resp. $\succsim^{SC}_{P^{(i)}}$) is the j-th part of i-dimensional-P-comparison SC-ordering relation (resp. the i-dimensional-P-comparison SC-ordering relation). Then there exist such $\alpha_j, \beta \in \mathbb{R}$ that $f(\tilde{s}(t)) = \sum_{j=1}^{i} \alpha_j f_j(\tilde{s}(t)) + \beta$, for any $\tilde{s}(t) \in \mathscr{O}$.*

Corollary 1 (Weighted Utilitarianism) *Suppose that* $\succsim_{P^{(i)}}^{SC(j)}$ *(resp.* $\succsim_{P^{(i)}}^{SC}$*) is the* j*-th part of* i*-dimensional-*P*-comparison* SC*-ordering relation (resp. the* i*-dimensional-*P*-comparison* SC*-ordering relation). Then there exist such* $\alpha_j \in \mathbb{R}$ *that, for any* $\tilde{s}(t_k), \tilde{s}(t_l), \tilde{s}(t_m), \tilde{s}(t_n) \in \mathscr{O}$*,* $(\tilde{s}(t_k), \tilde{s}(t_l)) \succsim_{P^{(i)}}^{SC} (\tilde{s}(t_m), \tilde{s}(t_n))$ *iff* $\sum_{j=1}^{i} \alpha_j (f_j(\tilde{s}(t_k)) - f_j(\tilde{s}(t_l))) \geq \sum_{j=1}^{i} \alpha_j (f_j(\tilde{s}(t_m)) - f_j(\tilde{s}(t_n)))$

We provide MCL with the following satisfaction definition relative to $\mathfrak{M}_{SC}$, define the truth in $\mathfrak{M}_{SC}$ by means of satisfaction, and then define validity as follows:

Definition 5 (Satisfaction, Truth and Validity) *What it means for* $\mathfrak{M}_{SC}$ *to satisfy* $\varphi \in \Phi_{\mathscr{L}_{\mathsf{MCL}}}$ *with* s*, in symbols* $\mathfrak{M}_{SC} \Vdash \varphi[s]$ *is inductively defined as follows: • The clauses of* $\top, \neg\varphi, \varphi \wedge \psi, \forall x \varphi$ *are standard ones. •* $\mathfrak{M}_{SC} \Vdash P^{(i)}(t)[s]$ *iff* $(\tilde{s}(t), \heartsuit_{P^{(i)}}) \succ_{P^{(i)}}^{SC} (\spadesuit_{P^{(i)}}, \heartsuit_{P^{(i)}})$*. •* $\mathfrak{M}_{SC} \Vdash t_k \gg_{P^{(i)}} t_l[s]$ *iff* $(\tilde{s}(t_k), \heartsuit_{P^{(i)}}) \succ_{P^{(i)}}^{SC} (\tilde{s}(t_l), \heartsuit_{P^{(i)}})$*. If* $\mathfrak{M}_{SC} \Vdash \varphi[s]$ *for all* s*, we write* $\mathfrak{M}_{SC} \Vdash \varphi$ *and say that* φ *is true in* $\mathfrak{M}_{SC}$*. If* φ *is true in all social-choice models of* MCL*, we write* $\Vdash \varphi$ *and say that* φ *is SC-valid.*

The next corollary follows from Corollary 1 and Definition 5:

Corollary 2 (Multidimensionality in $\mathfrak{M}_{SC}$) *Suppose that* $\succsim_{P^{(i)}}^{SC(j)}$ *(resp.* $\succsim_{P^{(i)}}^{SC}$*) is the* j*-th part of* i*-dimensional-*P*-comparison* SC*-ordering relation (resp. the* i*-dimensional-*P*-comparison* SC*-ordering relation). Then there exist such* $\alpha_j \in \mathbb{R}$ *that •* $\mathfrak{M}_{SC} \Vdash P^{(i)}(t)[s]$ *iff* $\sum_{j=1}^{i} \alpha_j (f_j(\tilde{s}(t)) - f_j(\heartsuit_{P^{(i)}}^{(j)})) > \sum_{j=1}^{i} \alpha_j (f_j(\spadesuit_{P^{(i)}}^{(j)}) - f_j(\heartsuit_{P^{(i)}}^{(j)}))$*. •* $\mathfrak{M}_{SC} \vDash t_k \gg_{P^{(i)}} t_l[s]$ *iff* $\sum_{j=1}^{i} \alpha_j (f_j(\tilde{s}(t_k)) - f_j(\heartsuit_{P^{(i)}}^{(j)})) > \sum_{j=1}^{i} \alpha_j (f_j(\tilde{s}(t_l)) - f_j(\heartsuit_{P^{(i)}}^{(j)}))$*.*

2.3. Example and Two Hard Problems in Social-Choice Model

Let us see the following example:

Example 1 (Dependence in Multidimensionality) *(1) Ramen shop a is* better *than ramen shop b. Suppose that in (1) 'better' has such 3-dimensions as cost performance, price, and taste.*

Remark 1 (Defective Analysis of Example 1 by Social-Choice Model) *When* $\succsim_{\text{cost performance}}^{SC}$*,* $\succsim_{\text{price}}^{SC}$ *and* $\succsim_{\text{taste}}^{SC}$ *(resp.* $\succsim_{\text{good}}^{SC}$*) are the parts of* 3*-dimensional-good-comparison* SC*-ordering relation (resp. the* 3*-dimensional-good-comparison* SC*-ordering relation), it follows from Corollary 2 that there exist such* $\alpha_1, \alpha_2, \alpha_3 \in \mathbb{R}$ *that* $\mathfrak{M}_{SC} \vDash (1)$ *iff* $\alpha_1(f_1(a^{\mathfrak{M}_{SC}}) - f_1(\heartsuit_{\text{cost performance}})) + \alpha_2(f_2(a^{\mathfrak{M}_{SC}}) - f_2(\heartsuit_{\text{price}})) + \alpha_3(f_3(a^{\mathfrak{M}_{SC}}) - f_3(\heartsuit_{\text{taste}})) > \alpha_1(f_1(b^{\mathfrak{M}_{SC}}) - f_1(\heartsuit_{\text{cost performance}})) + \alpha_2(f_2(b^{\mathfrak{M}_{SC}}) - f_2(\heartsuit_{\text{price}})) + \alpha_3(f_3(b^{\mathfrak{M}_{SC}}) - f_3(\heartsuit_{\text{taste}}))$*. This analysis is defective because each dimensional value is doubly counted.*

So the model faces the following two hard problems:

Problem 1

If multidimensional ordering relations can be represented by weighted sums at all, each dimensional ordering relation must not depend on the other relations. However, Corollary 2 furnishes no conditions (reasons) for excluding such dependent cases as Example 1 where the cost performance of a ramen shop depends on both the prices and the tastes of its ramens.

Remark 2 (Independent Cases) *Our additive-difference model below of* MCL *is designed for independent cases with which the social-choice model of* MCL *should deal, though in practice such cases are not so many. About the analysis of dependent cases, refer to* ***Concluding Remarks****.*

Problem 2

Since Corollary 2 states only the existence of the degree α_j of contribution of the dimensional value $f_j(\tilde{s}(t))$ to the multidimensional value $f(\tilde{s}(t))$, no function that evaluates this contribution, that is, outputs α_j when $f_j(\tilde{s}(t))$ is inputted is given.

2.4. Additive-Difference Model

We (2012b) construct an additive-difference model $\mathfrak{M}_{AD}$ of MCL in *three* steps, which surmounts Problems 1 and 2. Because ours (2012b) is included in the inner (unpublished) proceedings, we would like to cite with substantial modifications the necessary parts for the arguments in this paper. *First*, Suppes et al. (1989, pp. 160–161) prepares a basic multidimensional structure, called a *factorial proximity structure*:

Definition 6 (Factorial Proximity Structure) *Suppose that $\mathscr{O}$ is a set and $\gtrsim$ a binary relation on $\mathscr{O} \times \mathscr{O}$. Then $(\mathscr{O}, \gtrsim)$ is a* proximity structure *iff the following conditions are satisfied for any $a, b \in \mathscr{O}$: (I) $\gtrsim$ is a weak order (connected and transitive). (II) $(a,b) \succ (a,a)$ whenever $a \neq b$. (III) $(a,a) \sim (b,b)$ (Minimality). (IV) $(a,b) \sim (b,a)$ (Symmetry). The structure is called* factorial *iff $\mathscr{O} := \mathscr{O}^{(1)} \times \cdots \times \mathscr{O}^{(i)}$.*

Second, in order to make each dimensional factor the *absolute* value of a scale *difference*, a factorial proximity structure $(\mathscr{O}, \gtrsim)$ should satisfy both *Betweenness* and *Restricted Solvability* (ibid., p. 180):

Definition 7 (Betweenness) *Let $\gtrsim^{(j)}$ denote the induced order on $\mathscr{O}^{(j)}$ from $\gtrsim$. We say that b is between a and c, denoted by $a|b|c$, iff $(a^{(j)}, c^{(j)}) \gtrsim^{(j)} (a^{(j)}, b^{(j)}), (b^{(j)}, c^{(j)})$ for any j. A factorial proximity structure $(\mathscr{O}, \gtrsim)$ satisfies* Betweenness *iff the following hold for any $a, b, c, d, a', b', c' \in \mathscr{O}$: (I) Suppose that a, b, c, d differ on at most one factor, and $b \neq c$, then (i) if $a|b|c$ and $b|c|d$, then $a|b|d$ and $a|c|d$; (ii) if $a|b|c$ and $a|c|d$, then $a|b|d$ and $b|c|d$. (II) Suppose that a, b, c, a', b', c' differ on at most one factor, $a|b|c$, $a'|b'|c'$, and $(b,c) \sim (b',c')$, then $(a,b) \gtrsim (a',b')$ iff $(a,c) \gtrsim (a',c')$.*

Definition 8 (Restricted Solvability) *A factorial proximity structure $(\mathscr{O}, \gtrsim)$ satisfies* Restricted Solvability *iff, for any $e, f, d, a, c \in \mathscr{O}$, if $(d,a) \gtrsim (e,f) \gtrsim (d,c)$, then there exists $b \in \mathscr{O}$ such that $a|b|c$ and $(d,b) \sim (e,f)$.*

Third, in order to obtain the *sum* of independent dimensional factors, a factorial proximity structure $(\mathscr{O}, \gtrsim)$ should satisfy *Independence* (ibid., p. 182):

Definition 9 (Independence) *A factorial proximity structure $(\mathscr{O}, \gtrsim)$ satisfies* Independence *iff the following holds for any $a, a', b, b', c, c', d, d' \in \mathscr{O}$: If the two elements in each of $(a,a'), (b,b'), (c,c'), (d,d')$ have identical components on one factor, and the two elements in each of $(a,c), (a',c'), (b,d), (b',d')$ have identical components on all the remaining factors, then $(a,b) \gtrsim (a',b')$ iff $(c,d) \gtrsim (c',d')$.*

Suppes et al. (ibid., p. 184) defines an additive-difference structure as follows:

Definition 10 (Additive-Difference Structure) *A factorial proximity structure $(\mathscr{O}, \gtrsim)$ is an additive-difference structure iff Betweenness, Restricted Solvability, Independence, Archimedeanity, (and Thomsen Condition for $i = 2$ (ibid., p. 182)).*

We define an additive-difference model $\mathfrak{M}_{AD}$ of MCL as follows:

Definition 11 (Additive-Difference Model) $\mathfrak{M}_{AD}$ *is a sequence* $(\mathscr{O}^{(1)}_{F(q)}, \ldots, \mathscr{O}^{(q)}_{F(q)}, \mathscr{O}^{(1)}_{G(r)}, \ldots, \mathscr{O}^{(r)}_{G(r)}, \ldots, a^{(1)\mathfrak{M}_{AD}}_{F(q)}, \ldots, a^{(q)\mathfrak{M}_{AD}}_{F(q)}, b^{(1)\mathfrak{M}_{AD}}_{F(q)}, \ldots, b^{(q)\mathfrak{M}_{AD}}_{F(q)}, a^{(1)\mathfrak{M}_{AD}}_{G(r)}, \ldots, a^{(r)\mathfrak{M}_{AD}}_{G(r)}, b^{(1)\mathfrak{M}_{AD}}_{G(r)}, \ldots, b^{(r)\mathfrak{M}_{AD}}_{G(r)}, \ldots, \spadesuit^{(1)}_{F(q)}, \ldots, \spadesuit^{(q)}_{F(q)}, \spadesuit^{(1)}_{G(r)}, \ldots, \spadesuit^{(r)}_{G(r)}, \ldots, \heartsuit^{(1)}_{F(q)}, \ldots, \heartsuit^{(q)}_{F(q)}, \heartsuit^{(1)}_{G(r)}, \ldots, \heartsuit^{(r)}_{G(r)}, \ldots, \gtrsim^{AD}_{F(q)}, \gtrsim^{AD}_{G(r)}, \ldots, s^\circ)$, *where:* • $\mathscr{O}^{(j)}_{P(i)}$ *is a nonempty set of the j-th factors $a^{(j)\mathfrak{M}_{AD}}_{P(i)}, b^{(j)\mathfrak{M}_{AD}}_{P(i)}, \ldots$ of* *objects relative to* $P^{(i)} \in \mathscr{P}$*.* • $\mathscr{O}_{P^{(i)}} := \mathscr{O}^{(1)}_{P^{(i)}} \times \cdots \times \mathscr{O}^{(i)}_{P^{(i)}}$*.* • $a^{\mathfrak{M}_{AD}}_{P^{(i)}} \in \mathscr{O}_{P^{(i)}}$ *is defined as the* i*-tuple denoted by* $a^{(1)\mathfrak{M}_{AD}}_{P^{(i)}} \cdots a^{(i)\mathfrak{M}_{AD}}_{P^{(i)}}$*.* • $\spadesuit_{P^{(i)}} \in \mathscr{O}_{P^{(i)}}$ *is a (hypothetical) average object relative to* $P^{(i)} \in \mathscr{P}$*, and defined as the* i*-tuple denoted by* $\spadesuit^{(1)}_{P^{(i)}} \cdots \spadesuit^{(i)}_{P^{(i)}}$*.* • $\heartsuit_{P^{(i)}} \in \mathscr{O}_{P^{(i)}}$ *is a (hypothetical) zero-point object relative to* $P^{(i)} \in \mathscr{P}$*, and defined as the* i*-tuple denoted by* $\heartsuit^{(1)}_{P^{(i)}} \cdots \heartsuit^{(i)}_{P^{(i)}}$*.* • $(\mathscr{O}_{P^{(i)}}, \succsim^{AD}_{P^{(i)}})$ *is an additive-difference structure.* • *We call* $\succsim^{AD}_{P^{(i)}}$ *the* i*-dimensional-*P*-comparison* AD*-ordering relation.* • $s^\circ : \mathscr{V} \to \bigcup_{P^{(i)} \in \mathscr{P}} \mathscr{O}_{P^{(i)}}$ *(resp.* $\tilde{s}^\circ : \mathscr{V} \cup \mathscr{C} \to \bigcup_{P^{(i)} \in \mathscr{P}} \mathscr{O}_{P^{(i)}}$ *is a (resp. extended) assignment function.*

We prove the following representation and uniqueness theorem for the i-dimensional-P-comparison AD-ordering relation by modifying the method of Krantz et al. (1989, p. 191):

Theorem 3 (Representation and Uniqueness) *Suppose that* $\succsim^{AD}_{P^{(i)}}$ *is the* i*-dimensional-*P*-comparison* AD*-ordering relation. Then there exist functions* $f_j(1 \leq j \leq i) : \mathscr{O}_{P^{(i)}} \to \mathbb{R}$ *and strictly monotonically increasing functions* $g_j(1 \leq j \leq i) : \mathbb{R} \to \mathbb{R}$ *such that for any* $\tilde{s}^\circ(t_k), \tilde{s}^\circ(t_l), \tilde{s}^\circ(t_m), \tilde{s}^\circ(t_n) \in \mathscr{O}_{P^{(i)}}$*,* $(\tilde{s}^\circ(t_k), \tilde{s}^\circ(t_l)) \succsim^{AD}_{P^{(i)}} (\tilde{s}^\circ(t_m), \tilde{s}^\circ(t_n))$ *iff* $\sum_{j=1}^{i} g_j(|f_j(\tilde{s}^\circ(t_k^{(j)})) - f_j(\tilde{s}^\circ(t_l^{(j)}))|) \geq \sum_{j=1}^{i} g_j(|f_j(\tilde{s}^\circ(t_m^{(j)})) - f_j(\tilde{s}^\circ(t_n^{(j)}))|)$*. Furthermore, the* f_j *are interval scales and the* g_j *are interval scales with a common unit.*

We provide MCL with the following satisfaction definition relative to $\mathfrak{M}_{AD}$, define the truth in $\mathfrak{M}_{AD}$ by means of satisfaction, and then define validity as follows:

Definition 12 (Satisfaction, Truth and Validity) *What it means for* $\mathfrak{M}_{AD}$ *to satisfy* $\varphi \in \Phi_{\mathscr{L}_{\mathsf{MCL}}}$ *with* s°*, in symbols* $\mathfrak{M}_{AD} \models \varphi[s^\circ]$ *is inductively defined as follows:* • *The clauses of* $\top, \neg\varphi, \varphi \wedge \psi, \forall x\varphi$ *are standard ones.* • $\mathfrak{M}_{AD} \models P^{(i)}(t)[s^\circ]$ *iff* $(\tilde{s}^\circ(t), \heartsuit_{P^{(i)}}) \succ^{AD}_{P^{(i)}} (\spadesuit_{P^{(i)}}, \heartsuit_{P^{(i)}})$*.* • $\mathfrak{M}_{AD} \models t_k \gg_{P^{(i)}} t_l[s^\circ]$ *iff* $(\tilde{s}^\circ(t_k), \heartsuit_{P^{(i)}}) \succ^{AD}_{P^{(i)}} (\tilde{s}^\circ(t_l), \heartsuit_{P^{(i)}})$*. If* $\mathfrak{M}_{AD} \models \varphi[s^\circ]$ *for all* s°*, we write* $\mathfrak{M}_{AD} \models \varphi$ *and say that* φ *is true in* $\mathfrak{M}_{AD}$*. If* φ *is true in all additive-difference models of* MCL*, we write* $\models \varphi$ *and say that* φ *is AD-valid.*

The next corollary follows from Theorem 3 and Definition 11:

Corollary 3 (Multidimensionality in $\mathfrak{M}_{AD}$) *Suppose that* $\succsim^{AD}_{P^{(i)}}$ *is the* i*-dimensional-*P*-comparison* AD*-ordering relation. Then there exist functions* $f_j(1 \leq j \leq i) : \mathscr{O} \to \mathbb{R}$ *and strictly monotonically increasing functions* $g_j(1 \leq j \leq i) : \mathbb{R} \to \mathbb{R}$ *such that* • $\mathfrak{M}_{AD} \models P^{(i)}(t)[s^\circ]$ *iff* $\sum_{j=1}^{i} g_j(|f_j(\tilde{s}^\circ(t^{(j)})) - f_j(\heartsuit^{(j)}_{P^{(i)}})|) > \sum_{j=1}^{i} g_j(|f_j(\spadesuit^{(j)}_{P^{(i)}}) - f_j(\heartsuit^{(j)}_{P^{(i)}})|)$*.* • $\mathfrak{M}_{AD} \models t_k \gg_{P^{(i)}} t_l[s^\circ]$ *iff* $\sum_{j=1}^{i} g_j(|f_j(\tilde{s}^\circ(t_k^{(j)})) - f_j(\heartsuit^{(j)}_{P^{(i)}})|) > \sum_{j=1}^{i} g_j(|f_j(\tilde{s}^\circ(t_l^{(j)})) - f_j(\heartsuit^{(j)}_{P^{(i)}})|)$*.*

Remark 3 (Overcoming Problems 1 and 2 by Additive-Difference Model) *Because Independence (Definition 9) is not satisfied in Example 1, we cannot have the* 3*-dimensional-good-comparison* AD*-ordering relation. In this way the additive-difference model of* MCL *excludes such dependent cases as Example 1 and so overcomes Problem 1. The functions* g_j *in Corollary 3 evaluate the contribution of the dimensional value to the multidimensional value. So the additive-difference model overcomes Problem 2.*

3. Concluding Remarks

We (2012b) propose a version of logic MCL for comparisons of multidimensional predicates. Recently, D'Ambrosio and Hedden (2024) have given an analysis of multidimensional adjectives in terms of social choice theory. Since D'Ambrosio and Hedden do not consider in terms of model theory, we have furnished a social-choice model of MCL based on Harvey (1999)'s Aggregation Theorem. However, this model faces the two hard problems above. We have demonstrated that our (2012b) additive-difference model of MCL surmounts these problems. Our additive-difference model of MCL is not designed for such dependent cases as Example 1. On the other hand, we (2012a) propose a new version of logic for interadjective comparisons—Interadjective-Comparison Logic (ICL). In the near future, by using the model of ICL, we would like to give a measurement-theoretic analysis of dependent cases of multidimensional predicates.

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Ignorance with Domain Widening in Bangla

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Introduction: This paper examines a particle complex *na-ʤani*, which literally means 'I do not know' (where *na* means 'not' and *ʤani* translates to 'I know'), in Bangla (a.k.a. Bengali; Eastern Indo-Aryan language) *wh*-clauses. Although *na-ʤani* has two separate components, *viz.* $\neg$ and $K_{Speaker}$, we argue for treating *na-ʤani* as a single complex that receives the status of a (Di)scourse (P)article that finds its room in the left periphery. Even though the literal translation of the complex means the speaker's ignorance about something, as a particle, it additionally brings in *domain widening* (Kadmon & Landman 1993), which refers to lifting restrictions on the domain of quantification. In this paper, we analyze this particle-complex compositionally at the syntax-semantics interface.

na-ʤani $\neq$ only ignorance: We unpack the claim that *na-ʤani* is not simply a compositional sum of the unary negation operator ($\neg$) and the speaker's knowledge operator in context ($K_{Speaker}$). Let us look at the following comparison:

(1) *ʤan-i* *na* kara eʃ-eʧ^{h}ilo parʈi-t̪e
know-PRES.1P NEG who.PL come-PERF.PAST.3P party-LOC
'I do not know who came to the party.'

(2) *na* *ʤan-i* kara eʃ-eʧ^{h}ilo parʈi-t̪e
NEG know-PRES.1P who.PL come-PERF.PAST.3P party-LOC
'I do not know who came to the party.'
+ ASSERTION: The people who came to the party are somehow unusual in nature.

The above sentences do not turn out to be semantically similar. The former expresses mere ignorance of the speaker in context, whereas the latter is uttered in a context where the speaker is not only ignorant of the answer to the *wh*-clause but also renders a sense where the probability of some 'unusual' people coming to the party is quite higher than that of 'normal' people coming to the party. Considering (1), it only gives us the reading where the speaker simply does not know the people who came to the party. However, (2) can be felicitously uttered in a context where, for example, you got back home and found out the after-party condition of your friend's room quite awful (e.g. the room being squalid, broken bottles and drug packets scattered everywhere, two/three guns here and there, etc.); in this kind of situation, you can utter (2). However, it is reasonable to use (1) when you do not have information on the whereabouts of the people who came to the party. Hence, this kind of additional semantic layer associated with (2) is not available in (1) unless uttered with a particular intonation. We also exhibit that (2) becomes ungrammatical if a topic particle, for instance, *t̪o* (cf. Kidwai 2000 for Hindi-Urdu) intervenes between the negation marker and the *know* verb. See (3). On the other hand, the topic particle intervention is fairly possible with *ʤani na* 'I don't know' (i.e., mere ignorance which (1) coveys). Consider (4).

(3) **na* *t̪o* *ʤan-i* kara eʃ-eʧ^{h}ilo parʈi-t̪e
NEG TOP know-PRES.1P who.PL come-PERF.PAST.3P party-LOC

(4) *ʤan-i* *t̪o* *na* *kiʧ^{h} u-i.*
know-PRES.1P TOP NEG some-FOC
'I do not know anything.'

Thus, it can be contended that *na ʤani* behaves as a particle complex, the components of which cannot be parted away – it acts like a frozen lexical unit, carrying the extra meaning, as exhibited above, apart from the ignorance reading. Another observation to mention about *na ʤani* is the pre-verbal position of negation, which is a marked phenomenon because Bangla manifests its negation post-verbally in finite clauses (see Simpson & Syed 2014; Bhattacharjee 2017). See (1). It also indicates the idiosyncratic behavior of *na ʤani*, which is different from the regular *ʤani na* 'I don't know'.

na ʤani-clause = speaker-orientation? It seems from the first-person morpheme on the verbal morphology (i.e., *ʤan-i* 'know-PRES.1P) that *na ʤani*-constructions are strictly speaker-oriented particles (e.g., *quickly*, *again*, etc.). However, these clauses can be embedded under some attitude verbs. See the following:

(5) mina_i $\text{b}^\text{h}\text{ab-ʧ}^\text{h}\text{e}$/ b^h ɔj pa-$\text{ʧʧ}^\text{h}\text{e}$ [(?ʤe) na ʤan-i
Mina think-PROG.PRES.3P/ fear get-PROG.PRES.3P that NEG know-PRES.1P
t̪ake_i ʃɔbai kɔt̪o bok-be].
she.ACC all how-much berate-FUT.3P
'Mina_i is {pondering over/fearing about} how much everyone will berate her_i.'

The *na ʤani*-clause is not a quote here; the pronoun binding fact shows that it is a true subordinate clause and not a quotation. Assuming that S(peech) A(ct) P(hrase)s do not embed except as quotations (Dayal 2023), we, therefore, argue that *na ʤani* is not an SAP-level particle. Let us investigate where it is slotted in the following section.

Syntactic profile of *na-ʤani*: The clause-initial position of *na-ʤani* in (2) evinces that it is not base-generated TP-internally; it merges above the TP level. However, it is also not situated above the ForceP level because it shows typical clause-type sensitivity (cf. Nasu 2012) — it occurs only in clauses containing wh-phrases. Hence, it merges somewhere between ForceP and TP. As evinced by the following, *na-ʤani* can either precede the wh or immediately follow it (6); it never allows any intervenor between wh and itself (7).

(6) {✓na ʤani} ram {✓na ʤani} kake {✓na ʤani} $\text{d̪ek}^\text{h}\text{eʧ}^\text{h}\text{e}$ rast̪aj
NEG know.1P Ram NEG know.1P whom NEG know.1P has.seen in.road

(7) kake ram {✗na ʤani} $\text{d̪ek}^\text{h}\text{eʧ}^\text{h}\text{e}$ {✗na ʤani} rast̪aj.
whom Ram NEG know.1P has.seen NEG know.1P in.road

Assuming that Bangla is a wh-in-situ language, we predict that when the wh is left dislocated, it lands on the edge of FocP. We predict from (7) that ungrammaticality arises when there is an intervenor between FocP and PrtP that hosts *na-ʤani* in its head. When the wh is preceded by the particle in question, we argue that the wh remains in situ. Although *na-ʤani* projects as PrtP, it, unlike other Bangla discourse particles like *t̪o*, *ʤe* (cf. Bayer et al. 2014; Bayer & Dasgupta 2016), does not act as an attractor. The edge of PrtP in this case is occupied by a *pro* which is co-indexed with the speaker in the matrix case (2) and with the matrix subject in the embedded case, as in (5). The syntax is proposed as follows:

(8) $[_{\text{ForceP}}\ \text{Force}^0\ [_{\text{TopP}}\ [_{\text{FocP}}[_{\text{PrtP}}\ \textit{pro}\ [_{\text{Prt}'}[_{\text{Prt}^0}\ \textit{na-ʤani}]\ ...[_{\text{TP}}\ ...]]]]]]$

(9) Force^0 ... Prt^0 ... wh $\xrightarrow{\text{AGREE}}$ Force^0 ... Prt^0 ... wh
*i*Force[ ] ... *u*Force[ ] ... *u*Q[ ] ⟹ *i*Force[**7**] ... *u*Force[**7**] ... *u*Q[**9**]
*u*LSF[ ] ... *i*LSF[ ] *u*LSF[**9**] ... *i*LSF[**9**]

We followed Pesetsky & Torrego's (2007) feature-sharing version of Agree. An intriguing fact about *na-ʤani*-clauses is that they manifest the speech act of an assertion, but not of a question, despite containing a wh-phrase that carries an "*u*Q" feature. We argue for an interpreted *local saturation feature* (LSF) on Prt^0 which the wh probes for its *u*Q feature deletion. In other words, the purpose of importing LSF is an Ad hoc way to delete the *u*Q on wh; it is a type of placeholder for sustainable replacement. By the term *local*, we refer to the requirement that *na-ʤani* and wh need to occur in the same clause — see the ungrammaticality in (10).

(10) *ram **na ʤani** ʃunetʃʰe ʤe ʃæm **ki** kortʃʰe.
Ram NEG know.PRES.1P has.heard that Shyam what doing

This Prt^0 also carries an uninterpretable Force feature, which agrees with the interpretable Force feature of assertion on Force^0.

Meaning components of *na-ʤani*: Now, coming to the semantics, we argue that *na-ʤani* has the following interpretation, relative to a contextually salient domain D of 'usual' entities:

(11) $[\![\text{na-ʤani}_D]\!] = \lambda Q_{\langle st,t\rangle_H}\lambda x_e \lambda w_s : \neg K_x(\text{ANS-D}_w(Q)) \wedge \neg K_x(\neg\text{ANS-D}_w(Q)).\exists D'\exists p[D \subset D' \wedge p \in ([\![Q]\!]_{D'_w} - [\![Q]\!]_{D_w})]$
D_w= set of members of D that live in w; D'_w= set of members of D′ that live in w
$\text{ANS-D} = \lambda w \lambda Q.\iota p \in Q[p(w) \wedge \forall q \in Q[q(w) \rightarrow p \subseteq q]]$ (Dayal 1996, 2016)

It takes a Hamblinized set of propositions Q (i.e., the focus-alternative value), of type $\langle st,t\rangle_H$, along with an e-type individual x as its second argument. It presupposes x's ignorance of the answer(s) to Q in w. Here we traditionally define *ignorance*, following Fine (2018); Carrara et al. (2021), where ignorance is viewed as a lack of knowledge, i.e., an agent x does not know whether φ (φ is a formula) (see Hintikka 1962). (11) returns true iff there exist an *expanded/widened* domain of quantification D′ and a proposition p, such that p is picked out from the expanded domain of question denotation, but not from the ordinary question denotation. This domain widening occurs along a contextually given dimension. Albeit (11) takes a Hamblin-type, it does not return us a Hamblin-type expression; rather, it yields an ordinary-type expression of type $\langle e,\langle s,t\rangle\rangle$. Let us elaborate on how it works, relative to (2). The following are the semantic compositions:

(12) a. $[\![\text{TP}]\!]^f = \{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\}$; $[\![\text{TP}]\!]^o$ = undefined

b. $[\![\text{Prt}']\!] = \lambda x_e \lambda w_s : \neg K_x(\text{ANS-D}_w(\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\})) \wedge \neg K_x(\neg\text{ANS-D}_w(\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\})).\exists D'\exists p[D \subset D' \wedge p \in ([\![\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\}]\!]_{D'_w} - [\![\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\}]\!]_{D_w})]$

c. $[\![\text{PrtP}]\!] = \lambda w_s : \neg K_{x_i}(\text{ANS-D}_w(\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\})) \wedge \neg K_{x_i}(\neg\text{ANS-D}_w(\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\})).\exists D'\exists p[D \subset D' \wedge p \in ([\![\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\}]\!]_{D'_w} - [\![\{\lambda w'.\text{x came to the party in } w' : x \in \text{Person}\}]\!]_{D_w})]$

Now, let us have a look at how D and D′ work in the context of uttering (2). Suppose the usual domain of quantification D consists of normal people (e.g., friends, colleagues, relatives) whom the speaker considers normal to come to the party. Now, the widened domain D′ additionally includes individuals such as stoners and individuals carrying firearms. In our case in (2), $[\![Q]\!]_{D_w}$ and $[\![Q]\!]_{D'_w}$ refer to the following sets:

(13) {friends came to the party, colleagues came to the party, relatives came to the party}

(14) {friends came to the party, colleagues came to the party, relatives came to the party, stoners came to the party, goons came to the party}

(12-c) asserts that there are two things: (i) a widened domain of quantification and (ii) a proposition which is not an alternative picked out from the ordinary question denotation, but from the widened denotation, i.e., from the set {stoners came to the party, goons came to the party}. This assertion part is defeasible by the speaker in an embedded context. Let us consider the embedded instance of *na-ʤani* in (5). We can quite easily add a follow-up clause, as in the following to (5), where the speaker cancels what Mina is pondering over/fearing about.

(15) kint̪u, ami ʤan-i keu take kitʃʰu bol-be na.
but I know-PRES.1P someone she.ACC something say-FUT.3P NEG
'But, I know no one will say anything to her.' [OK after (5)]

However, the ignorance part is not defeasible: even if the follow-up (15) is added to the attitude report of Mina in (5), Mina remains ignorant about the answer to the question *how much will everyone berate me [Mina]?*. Hence, the ignorance component associated with the particle always projects because it is a semantic presupposition. Our semantics successfully captures the interpretation of (2) that not only tells us about ignorance but also conveys the additional assertion triggered by *na-ʤani* that acts as a domain widener. Since we treat this particle as a domain widener, one question that might come to the readers' mind is — are these clauses what we call *exclamatives* (see Zanuttini & Portner (2003) for this clause type)? In the next section, we will find the answer to it.

Are *na-ʤani*-clauses exclamatives? Exclamatives are clauses that express the speaker's surprise or astonishment toward a state of affairs (Zanuttini & Portner 2003; Rett 2008, a.o.). This clause type comes in several types, such as (i) wh-exclamatives (e.g., *(My,) What spices John eats!*, (ii) definite DP-exclamatives (e.g., *(Oh,) The shoes Sue wore!*, and (iii) inversion constructions (e.g., *(Boy,) Did Sue wear orange shoes!*) (Rett 2008). Let us consider the wh-exclamatives and check if they can align with our *na-ʤani*-sentences. In a wh-exclamative, as we note, the speaker knows (or at least claims to know) the answer to the wh-clause. For example, while uttering *what spices John eats!*, the speaker knows what kind of spices John eats. However, the *na ʤani*-clauses like (2) presuppose the speaker's ignorance. Although domain widening is associated with wh-exclamatives (à la Zanuttini & Portener 2003), domain widening in and of itself does not guarantee exclamativity. The difference between these two clause types is laid out in the following table:

Clause type	**Domain Widening**	**Ignorance**
Wh-exclamative	✓	*
na-ʤani-clause	✓	✓

Table 1: Wh-exclamatives & *na-ʤani*-clauses

There are some languages, like Telugu (Balusu 2019), that allow wh-exclamatives to be embedded under verbs like *think* and *say*, where factivity is not derived. However, even in these cases, the matrix subject claims to know the answer to the wh-clause. In other words, no ignorance is present on the part of the matrix subject. But, in contrast, in embedded *na-ʤani*-clauses, as in (5), ignorance on the part of the matrix subject is presupposed.

The nature of domain widening *na ʤani* triggers: In this section, we investigate the nature of the initial domain of quantification that is widened triggered by *na-ʤani*. As evinced in (2), the initial domain of quantification is the set of contextually salient 'usual' members. We argue that *na-ʤani* widens the domain of quantification by crossing the parameters of usualness/commonness. Let us consider another example below.

(16) mina na ʤani koth̪aj gije boʃe atʃhe.
Mina NEG know.PRES.1P where go sit exists
'I do not know where Mina is.'
+ ASSERTION: The place Mina is in now is not usual/commonplace.

(16) can be uttered in a scenario where the speaker has tried to call Mina several times over the phone, but her number is not reachable. Here, we assume that the initial domain consists of places where cellular networks are available. The widened/largest domain here will include all the places where cellular networks are weak or totally unavailable. In this case, the speaker indicates that Mina is currently in a location where she cannot be reached by phone. The current context, thus, determines how the commonness threshold will be exceeded. Likewise, in (5), the widened domain includes the degrees of scolding that the matrix subject thinks are high and intense. The initial domain in (5) consists of those degrees that Mina considers normal/moderate.

Summary: Discourse particles are generally viewed as speaker-oriented elements (Bayer & Obenauer 2011, Bayer et al. 2014, a.o.), where they are adverse to occurring in embedded clauses. However, some German modal particles are reported to occur in embedded contexts (see Coniglio 2007, Döring 2013, Gutzmann 2017). This paper notes a Bangla particle *na-ʤani* that can also be embedded under certain attitudes. This is why we do not call this particle strictly speaker-oriented; instead, it is placed in the left periphery immediately below the FocP, containing a null *pro* that can be co-indexed either to the speaker (matrix case) or to the matrix subject (embedded case). As a domain widener, this particle acts on a question set and checks if there are a widened domain of quantification D' and a proposition that is picked out from the expanded domain of question denotation, but not from the ordinary question denotation. At the same time, it requires that the speaker (in the matrix case)/matrix subject (in the embedded case) be ignorant about the answer to the wh-clause. This requirement differentiates this clause type from wh-exclamatives.

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“I like Metallica, but...”: the Overton window as a model of acceptable persona

Samuel Laperle

Reading works in pragmatics since Grice (1975), it is easy to assume that cooperation is a default in conversations. Nevertheless, *discursive harmony*, namely how speakers can maintain a conversation without any conflict, depends on constant work from all agents involved in the conversation. People cannot say everything they want to anyone all the time. As Bourdieu (1982) wrote “the social acceptability of an utterance cannot be reduced to its grammaticality”. In other words, speakers do not just have to construct well-formed sentences, they have to choose utterances that can be acceptable for listeners at their moment of utterance. To be able to represent this dynamic, this work aims to adapt the concept of the Overton Window (OW), a theoretical tool generally used to account for opinions or ideas, to analyze discourse acceptability within conversations. In this work, we assume that it is not opinions or ideas themselves that are socially acceptable or not, but the *personae* that these opinions are related to. Based on this, we can see how the OW can shift making unacceptable utterances acceptable by dissociating problematic persona from linguistic production. Consider a context where a speaker communicates terrible news to a listener. The listener might respond with either (1) or (2), among other options:

(1) Damn, that sucks.
(2) That is terrible news.

Although these two replies have essentially the same propositional content, they differ in acceptability. Response (1) may be entirely appropriate if produced by someone close to the speaker, but it would be surprising to hear from a psychologist. Conversely, response (2) might be perceived as redundant or trivial coming from a friend but would be expected coming from a health professional. The acceptability of both of those sentences thus depends on the perceived identity of their speaker. Similarly, imagine a situation where you are cooking a basic meal, and your roommate, who never cooked in their life, starts to give you advice. Despite the fact that this person means well, it is likely that their advice will be poorly received or, at the very least, considered impertinent. As another illustration, consider examples (3) and (4):

(3) You are a hypocrite.
(4) I believe that you are saying things that are in contradiction with your beliefs.

Both utterances convey the same thing. We can assume that (3) is more socially acceptable than (4) being less direct. However, we can also imagine a context where being bluntly honest is well perceived. A friend could expect another friend to never let them be a hypocrite and – being coherent - they would prefer brutal honesty. They could be surprised to see someone close walking on eggshell around them. Conversely, they could probably be offended if it was said by a stranger. In all these cases, the concept of acceptability is broad and can cover a range of specific social dynamics. It can characterize trivial conversational elements such as those mentioned in (1) to (4), but it can also encompass everything related to hate speech. (5) is the most typical example of this where the speaker is trying to dissociate the socially unacceptable label – being racist – from a statement that will (most likely) be racist.

(5) I don’t want to sound racist, but…

Here, I want to make precise (i) what makes a statement socially acceptable or not, and (ii) how can we formalize this relationship between speaker and listener. To this end, I propose constructing a formal system based on elements coming from the OW.

Originally characterized as a window of political possibility, this concept was proposed by Joseph P. Overton while working for Mackinac Center for Public Policy in the 90s. It is a theoretical tool used to characterize the level of acceptability of a public discourse or policy. It is generally presented as a ladder where the gradient indicates the level of acceptability – unthinkable, radical, acceptable, sensible, popular or policies – as seen in the figure 1 (for a recent, detailed, introduction see Youvan 2024). This representation is useful because it not only locates an idea within a spectrum of acceptability but also models how its position can shift.

As simple as it is, this theoretical tool can help us do the inventory of what we need to be able to formalize it. Essentially, we must find what could be its content, its shape and how it could move. In terms of content, the most straightforward way, keeping with the original intuitions behind the OW, is to think about it as containing propositions. In other words, it would be to say that it is the propositions themselves that are subject to an evaluation about being acceptable or not. However, as illustrated by examples (1)-(2) or (3)-(4), propositional content alone is not enough to explain acceptability. Thus, this work is part of a broader theoretical context that assumes that linguistic code can convey multiple meanings that are not only referential or truth-conditional. For example, lexical elements can convey argumentative content (Anscombre & Ducrot, 1976), resonances (Beaver & Stanley, 2023), word stories (Erk & Chronis, 2022), etc. As such, this proposal echoes texts on social meaning that assume that linguistic forms such as the choice of certain words or style of production can signal elements related to the speaker's identity or ideology (Beltrama, 2020). Linguistic forms are however still insufficient to account for the properties of the OW: as seen with examples (1)-(2), the same form might be judged acceptable or not depending on the identity of the speaker. Instead, I argue that it is not propositions, nor linguistic forms themselves but the persona that such forms signal that are subject to evaluation and judged to be in or out of the OW. Eckert (2008) defines persona as indices coming from a sociolinguistic variable that primes "constellation of ideologically related meanings". For Burnett (2020), the concept can be summarized as abstract identity or, more specifically, as a set of properties that go well together (Burnett, 2023). Furthermore, in this work, I will adopt a position closer to that proposed by Beaver and Stanley (2023) regarding the social meaning conveyed by a statement. Instead of simply saying that a sentence indexicalizes a persona, here we will assume that a statement can resonate with a community of practice. This position allows us more flexibility than that taken by Eckert (2008) and Burnett (2023), who summarize the indexicality of personas as the use of different morphosyntactic and phonetic variants. This position also allows us to account for intergroup social dynamics between the identities perceived and projected by a speaker. Essentially, the OW allows us to account for the us vs. them dynamic introduced by different linguistic behaviors.

Following this, my position aligns with previous work on the meaning of expressions like slurs and dogwhistles. For example, McCready & Davis (2017) showed that the interpretation of a slur depends not only on the identity of the person targeted by it, but also on the identity of the speaker. In similar ways, dogwhistles are coded expression that can send a message to a majority while at the same time send a crypted message – generally controversial – to a smaller audience (Henderson & McCready, 2024). By doing this, a speaker can not only keep a persona acceptable for most of the listeners but can also index a tabooer persona related to the marginal group. Similarly, the speaker can maintain a form of deniability if the dogwhistle is interpreted as such and suddenly associated with the problematic group (Ibid.). Following this line of research, I assume that the content of the OW consists of the persona indexed by linguistics productions, and that these personas may or may not be acceptable.

For the shape, i.e. the dimensions, of the window, I build on proposals by Burnett (2020) based on the treatment of conceptual spaces by Gärdenfors (2004). Essentially, Gärdenfors proposed to represent conceptual spaces in a geometric manner. Concepts are represented as areas in a multidimensional space whose dimensions are phenomenological proprieties. For example, the concept of [[apple]] may be characterized on two dimensions with the level of sweetness on the x-axis and the level of crunchiness on the y-axis. Then, one can partition the space for the different prototypical representations of apple species like Spartan or McIntosh. Based on this, Burnett accounts for personas in the following way. <*D, sim, PERS,* μ > is a tuple such that D is a dimensional space and *sim* represents the relation between the points inside of D. *PERS* is the cluster where those points could be identified as personas and μ is a function that computes a positive or a negative value associated to the persona by the speaker and the listener. For Burnett (2020), the value of μ is either positive or negative representing if the speaker or the listener likes the persona or not. I propose extending the value of μ from positive to negative to -1 to 1. This will allow us to visualize μ as a relative value of the comfort of the speaker and the addressee with a persona produced and perceived. Indirectly, this value allows us to characterize the ingroup and outgroup aspects of certain linguistic productions. For example, an element that would be perceived as an unthinkable persona will necessarily be a qualifier of an outgroup. The dimensions are related to the one that could constitute a persona. Thus, we can partition the interval of μ in equal spaces to imitate the original OW:

Table 1: μ values and persona acceptability

μ values	Persona acceptability
[-1, -.5[	unthinkable personas
[-0.5, 0[	radical personas
[0, 0.5[	sensible personas
[05, 0.8[	popular persona
[0.8, 1]	loved persona

With content and shape established, we can now see how it moves or, in other words, how we can be able to make something acceptable or not. I propose two operations:

- **Contraction**: suppressing a dimension associated with a specific persona
- **Expansion**: adding a dimension associated with a specific persona

These two operations allow for four manipulations: (i) making something acceptable by adding a dimension (ii) making something unacceptable by adding a dimension (iii) making something acceptable by removing a dimension (iv) making something unacceptable by removing a dimension. The processes that trigger social acceptance are numerous and complex. Here, by way of example, I will focus mainly on hedges and derogatory terms. On one side, hedges can help a speaker push an assertion while still protecting their reliability (McCready, 2015) which can trigger the contraction of the OW. On the other hand, hearing and uttering a slur can have multiple consequences depending on the context. Among the latter, it is possible that this kind of language, when heard and spoken, normalizes or makes acceptable various forms of hateful behavior. Similarly, other slogans or the sabotage of social scripts can allow positive associations to emerge, thereby also expanding the OW.

As an illustration, we can see how this can help us analyze sentences such as (6), uttered in central Canada:

(6) I like Metallica, but I'm not like those who like that band.

In (6), the speaker signals that listening to Metallica might be associated with a persona they wish to dissociate from. Metallica is an interesting example because the band has been linked to multiple ideological positions. Kotarba (2016) notes that early criticism came from religious far-right groups, while other critiques emerged from left-leaning elitist rock critics. In this case, the context of central Canada is also important. The music from Metallica is mostly broadcast by famous central Canada far-right radio stations. Thus, the speaker in (6) conveys "I like Metallica, but I'm not a far-right person". The relevant dimensions of the OW for the evaluation of (6) are whether one enjoys/listens to their music, and whether one is far-right. Thus, the ideological space looks like this :

(7) Two dimensions of ideological space
   a. Appreciation of Metallica (Hate ↔ Love)
   b. Appreciation of far-right ideology (Hate ↔ Love)

We can assume that valuation of the speaker is that the more far-right one is, the lower the value of μ, across all possible values for being a Metallica enthusiast, making any far-right persona fall out of the OW. Non-far right personae are probably all acceptable ($\mu > 0$), whether they like Metallica or not. Thus, by removing the problematic far-right indexing of Metallica, the speaker limits the evaluation of their contribution to the personas associated with other, innocuous, properties that come with listening to Metallica (e.g. musically themed ones). Conversely, we can use the example of Beaver and Stanley (2023) about the slogan "love is love" for equal access to marriage in the United States. They report that the strength of this slogan is that it allows 2SLGBTQIA+ people to resonate with collective American values regarding a good marriage. In the United States, a good marriage is perceived as such if it is built on mutual romantic love between two adults. As a result, people who strongly disagree with same-sex marriage may still resonate with the slogan. Similarly, it also resonates with the perspective that love is a personal choice. Therefore, "if marriage is the idealized state for those in a state of love, and love is entirely a matter of personal choice, it follows from attunements to personal freedom that marriage among those of an age to make such choices should be unfettered by further institutional restrictions." (p.169). Thus, we can see a form of expansion of the Overton window, where a dimension is added to a prototypical representation that harmonizes with the others using those ideological dimensions:

(8) Dimensions of ideological space
  a. Opinions about love (negative ↔ positive)
  b. Love as a personal choice (negative ↔ positive)
  c. Love between two adults of the same gender (negative ↔ positive)

The rational behind this slogan is that, ideally, the positive opinion associated with love would bleed into the opinion associated with same-sex marriage.

In sum, this work offers a formal framework for modeling discourse acceptability by extending the Overton Window to capture how linguistic production index persona and how these dynamics shift across conversational context.

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Explicitness, Honorification and Indices

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One of the most prominent instances of mismatches between morphosyntactic and semantic features concerns honorifics (Wang 2023): e.g. non-2nd person forms being used for polite 2nd person reference implying social distance between the speaker (s_c) and the addressee (a_c). One understudied instance of this phenomenon are cases where 1st person indexicals are used to refer to a_c (or a plurality thereof). This honorific pattern occurs in **Nurse *We*** (NW) constructions in English (Collins et al. 2012, i.a.), where, in addition to being used as an a_c-directed imposter, 1PL also conveys that s_c is presenting as a 'caretaker' before whom a_c has diminished autonomy. A similar case concerns Japanese 1SG pronoun *boku* (1b), which can be used in a context where the speaker is addressing a child interlocutor with slightly condescending undertones (McCready 2007).

(1) a. Have *we*$_{i=you}$ taken our$_i$ medicine today?
b. boku$_{=you}$-wa horensoo-ga kirai na n?
1SG-TOP spinach-NOM dislike COP Q 'Don't you like spinach?'

Wang (2023: 1315) argues that honorific meanings emerge as inferences when the politeness principle (3) overrules Maximize Presupposition (MP) (Heim 1991, Schlenker 2012). Since she assumes, following Sauerland (2008), the denotations in (2), speakers may choose to use a presuppositionally weaker form (e.g. 3rd person) to refer to an entity that would be less ambiguously identified by a presuppositionally stronger form (e.g. 1st or 2nd person), cf. (2). But, because of MP, this only happens when ToD is active.

(2) $[\![3]\!] = \lambda x.x$ | $[\![1]\!] = \lambda x : s_c \leq x.x$ | $[\![2]\!] = \lambda x : a_c \leq x.x$ | $[\![\text{PL}]\!] = \lambda x.x$ | $[\![\text{SG}]\!] = \lambda x : |x| = 1.x$

(3) **Taboo of Directness (ToD):** In respect contexts, use the semantically weaker (i.e. unmarked) form.

Wang's approach predicts the existence of mismatches in honorifics across languages without requiring them to be encoded by features like HON or split ϕ-features as in Smith (2021). However, her account also encounters some challenges, such as: **(i)** In many cases, replacing a presuppositionally stronger expression with a weaker one does not result in an honorific interpretation – i.e. not all weak forms function uniformly as honorifics. **(ii)** Since 1st and 2nd person have equally strong presuppositions, cf. (2), there is no reason why only the former can be recruited for honorification according to ToD. **(iii)** A purely inferential account of honorifics fails to capture the specific conventional flavors of constructions like (1): e.g. in (1a), the speaker is not only being 'polite', but also presenting as a 'caretaker' of sorts. **(iv)** The symmetry between 1st and 2nd presuppositions implied in (2) fails to explain the typologically robust fact that, in languages without clusivity distinctions, inclusive 2nd person reference is always accomplished by first-person form (Zwicky 1977, Bobaljik et al. 2023, i.a.)

Our account of honorifics reconciles Wang's inferential approach with the existence of 1st person honorifics and conventionalized use-conditions on honorific forms. Our implementation is framed within a theory of PER and NUM as constraining assignments directly (originally devised to solve problems of indexical binding, cf. Sudo 2012, Podobryaev 2014), instead of their presuppositional treatment. In our theory, indices are treated as complex objects consisting of a natural number (*i* in (4)) and a set of PER and NUM features (marked with $\boxed{}$ in (4)). The definition we propose in (4) tracks closely the one in Sudo (2012: 180), with the difference that we assume that 3rd person and PL introduce no restrictions of their own – i.e. they are semantically unmarked. Crucially for NW, we treat 1st person as less marked than 2nd, motivated by the fact that in many languages 1PL can include a_c even in non-honorific contexts, but 2PL never includes s_c. It follows from (4) that some indices are semantically more explicit (i.e. more restricted w.r.t. their possible values) than others depending on the ϕ-features they carry; e.g. $\langle i, \boxed{\text{3PL}} \rangle$ can be assigned to any entity in D_e, whereas $\langle i, \boxed{\text{2SG}} \rangle$ can only be assigned to the addressee. This notion of explicitness, as defined in (5), replaces the notion of presuppositional strength in Wang (2023). Due to the Maxim of Quantity (MQ) (Grice 1975, Sauerland 2004), speakers should aim to use the most restrictive index, according to (4) and (5) – similarly to the calculation of scalar implicatures.

(4) **Constraint on Assignment Functions:** Let indices be $\langle i, \boxed{\phi} \rangle$ pairs. A function g from indices to D_e is an **admissible assignment function** for a complete utterance u in a context c iff for every $i \in \mathbb{N}$:
a. $s_c \leq g(\langle i, \boxed{1} \rangle) \vee a_c \leq g(\langle i, \boxed{1} \rangle)$ b. $s_c \nleq g(\langle i, \boxed{2} \rangle) \wedge a_c \leq g(\langle i, \boxed{2} \rangle)$ c. $g(\langle i, \boxed{\text{SG}} \rangle) \in \text{ATOM}(D_e)$

(5) **Explicitness of Indices:** For every $i \in \mathbb{N}$ and ϕ-feature sets ϕ and ϕ', a complex index $\langle i, \boxed{\phi'} \rangle$ is more explicit than $\langle i, \boxed{\phi} \rangle$ iff $\{x | \exists g \text{ such that } g(\langle i, \boxed{\phi'} \rangle) = x\} \subset \{x | \exists g \text{ such that } g(\langle i, \boxed{\phi} \rangle) = x\}$

Based on (4)–(5), we can infer a ranking of ϕ-features according to the extent to which indices containing them constrain assignment values (Fig. 1). That is, indices with $\boxed{\text{3PL}}$ are the least constrained, i.e. $\boxed{\text{3PL}}$ could be assigned to all possible entities in D_e. In contrast, indices with $\boxed{\text{1PL}}$ are more constrained, i.e. the set of possible values of the assignment function applied to $\boxed{\text{1PL}}$ is a proper subset of the set of possible values of the assignment function applied to $\boxed{\text{3PL}}$ **(*ad* ii)**. According to MQ, features lower in Fig. 1 (i.e. more explicit) should be used if possible. Honorific readings arise precisely in contexts where ToD favors a weaker index than what could be expected on the grounds of MQ alone. Since $\boxed{\text{3PL}}$ is the least explicit of all feature sets, entities that are only in the set of possible values of $g(\langle i, \boxed{\text{3PL}} \rangle)$ (for any g) have no way of being honorifically singled out by PER/NUM. Crucially, pluralities including s_c can be 'honored' only by $\boxed{\text{3PL}}$, whereas pluralities including a_c (but not s_c) can be 'honored' both by $\boxed{\text{3PL}}$ and $\boxed{\text{1PL}}$, e.g. when NW refers to a plurality.

Furthermore, we also derive the typologically robust restrictions on the grammatical encoding of inclusive readings of 1PL forms **(*ad* iv)**. Because 2nd person indices are negatively constrained to exclude s_c (4b), any form encoding reference to the speaker has to be grammaticalized as 1st person. Unlike Bobaljik et al. (2023), our account does this without sacrificing the idea that 2nd person is stronger than 1st, which is needed to account for data like (1). An observation from Wang's typological data that is predicted by our account (for independent reasons), Fig. 1, is that 2SG pronouns cannot be used as honorifics in any context, in contrast to 3PL, which are often used as honorifics, cf. German *du* vs. *Sie*. In addition, since we assume GENDER to be part of expressive content (Gutzmann et al. 2014), it should never be used honorifically, not even in cases of unmarked gender – a prediction which is borne out. This generalization, a self-admitted challenge to Wang's (2023: 1132) approach, falls out naturally here, since politeness effects are not assumed to follow from *(inferences about) expressive content* or (contra Wang) from *weak presuppositions*, but from *weak indices* (following Gricean Q-reasoning).

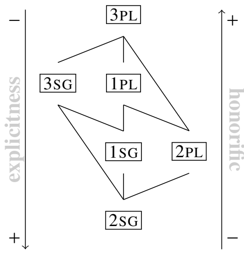

Fig. 1: ordered ϕ-sets

Furthermore, we propose that extra layers of Conventional Implicature (CI) meaning (beyond abstract politeness implications derived from ToD) can be licensed through use-conditional constraints (UCCs), cf. (6) **(*ad* iii)**. These UCCs are language-specific, but they justify MQ violations of assignments by making them no longer 'less informative' than MQ-compliant structures; i.e. they strengthen otherwise 'weak' indices. In other words, these CIs effectively take the weaker honorific forms out of the Q-based competition. No reranking of ToD and MQ is need be posited for politeness contexts: indirectness is only licensed when CIs are in place. We assume utterances are felicitous only if a set of use-conditions it conveys are satisfied in the context (Kaplan 1999, Potts 2005, McCready 2010). If a language lacks a particular UCC for a MQ-violating assignment, that assignment will be blocked by MQ. For instance, $\boxed{\text{1PL}}$ can, due to (4), pick out any entity that includes s_c or a_c. But – according to (6) (abstracting away from other 1PL a_c-imposters) – an assignment where a $\boxed{\text{1PL}}$ index is mapped to a_c must be in a context where 's_c takes care of a_c'. I.e., such non-canonical assignments are what are "evaluated" and consequently acquire an honorific interpretation. This explains why NW is odd in contexts where s_c is distant, but not *ipso facto* performing a 'caretaker' role in the speech act itself. E.g. *Have we been to Greece?* sounds felicitous if a nurse is questioning a patient that displays the symptoms of a virus that is affecting tourists in Greece, but not if they are merely asking a general question about a_c's holiday preferences.

(6) For any $[\![u]\!]^{g,c}$, if $g(\langle i, \boxed{\text{1PL}} \rangle) = a_c$, then u is felicitous in c if $c \in \{c : \texttt{takes-care-of}'(s_c, a_c)\}$

While Wang's approach overgeneralises predicting, *prima facie*, honorific readings whenever expressions with weaker presuppositions are used (e.g. overgenerating in the case of GENDER), our account is more restrictive in that it only predicts such readings: (i) when weaker PER/NUM features are used; and (ii) when such features are enriched by UCCs. Due to our implementation in terms of constraints on assignments, we can also derive more fine-grained distinctions of honorifics (Fig. 1) attaching pragmatic constraints to different properties of indices (e.g. PER vs. NUM) or more explicit language-specific UCCs to indices (6). This approach can be further extended to other indices, e.g. in German a doctor can use $\boxed{\text{3SG}}$ to address their patient a_c. It is precisely by means of such UCCs that we capture language-specific and idiosyncratic properties of honorifics **(*ad* i)**. E.g. the fact that English does not allow $\boxed{\text{3SG}}$ pronouns to be used to refer to a_c (**Is he*$_{=\text{you}}$ *sick?*) is due to it not having a UCC that strengthens this index, like German does. Another example of this can be seen in Spanish, where NW-like readings are only possible for null 1PL *pro*, and not for overt 1PL forms like *nosotros*. Hence, our account offers a more restrictive yet more empirically adequate alternative to prevailing models.

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Beyond personae: honest failures in projecting social meaning

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The notion of *honest signal* is commonly used in certain domains to discuss signals that cannot be faked: the very fact that an agent can send those signals indicates that they possess the characteristic associated with the signal. Thus, Thomson gazelles (among other animals) are known to 'stot' in the presence of certain predators, i.e. they perform a specific form of jump, simultaneously lifting all of their feet off the ground. This behavior signals the fitness of the animal to its potential predators, and acts as a deterrent to be chosen as prey [FitzGibbon and Fanshawe, 1988], given that a predator is deterred from pursuing a fit animal. Stotting is an honest signal: one can only properly stot if one is fit. On the other hand, fiddler crabs use the size of one of their claws as a signal of strength (esp. when fighting for territory) and the possession of the resources needed to maintain a big claw. This signal is, however, potentially dishonest: after losing its big claw, a fiddler crab can grow another one, equally big, but which lacks the muscle tissue of the original one and is not effective in combat. Yet, the display of a big claw has the same effects on other crabs (rivals and partners), independently of whether it is an original or a regrown one [Lailvaux et al., 2009].

In this work, we address the question of (dis)honest signalling in natural language communication, focusing on how speakers convey social meaning about themselves [Podesva, 2011]. In the context of Third Wave Sociolinguistics [Eckert, 2008] a large body of work has focused on how parts of the linguistic code can be used by speakers as indices of certain properties, with the overarching goal of projecting a *persona*, i.e. a maximal consistent set of such properties. A well-known case is the pronunciation of the -ING suffix in English, which has the variant pronunciations [ɪŋ] and [ɪn]. It has been observed that the deployment of these alternatives has different effects on the listener's perception of the speaker's persona: while [ɪŋ] signals something like "aloofness" (amongst other things), [ɪn] signals the opposite property of "friendliness" [Labov, 2012]. From a Third Wave Sociolinguistics perspective, both variants are part of the linguistic system of a community of speakers, and part of the repertoire of an individual speaker. It is the *choice* (conscious or not) of one variant or another that serves to index particular properties, and thus to signal certain aspects of a speaker's persona. Within the usual picture, such variants are taken to be freely available to a given speaker, who can then strategically deploy them in the construction of a desired persona. This has been modelled formally in a game-theoretic framework by Burnett [2019, 2023] with the use of *Social Meaning Games* (SMG). We will not in this abstract go into the details of how such games are formalized, and focus only on certain of their aspects.

First, as just alluded to, the variants for -ING in English are assumed to be equally accessible to all speakers, i.e. they have the same *cost*, which we can assume is null. Burnett notes that in certain linguistic environments, some variants might be more costly because some linguistic factors (e.g. phonological assimilation) make one variant more difficult to produce, and thus more costly. In this research, we want to distinguish between this kind of cost, which we will refer to as a *production cost*, from the cost of having access to the variant in the first place, which we refer to as the *acquisition cost*. The acquisition cost represents the background effort required to be able to correctly deploy the variant; as the name suggests, the acquisition cost reflects the resources required to acquire the variant as part of one's linguistic system. Authors such as Burnett [2023] explicitly conflate the two costs, but we believe there is value in keeping them distinct.

In the case of [ɪŋ] and [ɪn], we assume that the acquisition cost of both variants is zero, since both variants are in the phonetic inventory of every competent English speaker. But this is not always the case: some otherwise analogous cases of alternation involve a non-trivial acquisition cost for the correct deployment of one of the alternatives. As an example, consider the use of *who* versus *whom* in English. In the spirit of Third Wave theorizing, we might posit that the use of *whom* indexes a certain set of social properties; something like *educated, pedantic, aloof*, or the like, not unlike the properties indexed by [-ɪŋ]. But the deployment of *whom* versus *who* is normatively restricted to a subset of grammatical environments, namely, accusative case environments. In order to deploy the 'high register' variant *whom* in accordance with this set of associated norms, one must acquire not only the *form* but also this associated grammatical system. A speaker who has *not* acquired the associated grammatical system can still deploy the form *whom*, but they risk doing so in a way that violates the associated grammatical norms, e.g. producing sentences like "Whom is coming to the party?", where *whom* occurs in the normatively deviant nominative case position. A speaker who deploys the high-register variant in this non-normative fashion will be understood as (attempting to) signal a certain persona, namely one associated with the properties indexed by *whom* (for example, *educated*). But, to a listener who has acquired the grammatical system associated with deployment of *whom*, the speaker will have 'outed' themselves as someone who has *not* acquired the system, since a competent user of the system would not have used *whom* in this environment. In such cases, the speaker can be understood as (attempting to) index a certain persona associated with *whom*, but will also signal something about themselves that they do not intend; namely, that they are not competent at the grammatical system associated with deployment of *whom*.

To understand the situation here, we need to articulate a picture that involves more than the free deployment of alternative forms, characteristic of Third Wave theorizing. Instead, we have alternative *codes*. In the case at hand, the difference between the two codes is straightforward: Code 1 (the 'standard register' code) is one where the variant *who* is deployed across all grammatical environments. Code 2 (the 'high register' code) is one with two alternant forms, *who* and *whom*, whose distribution is determined by grammatical factors (nominative versus accusative case position). These codes are associated with different social groups, and have different acquisition costs. Code 1, we can say, is available across the board, to every speaker of English; it is what would most likely be described in a descriptive grammar of the language (see e.g. Huddleston and Pullum 2002, Chap. 5:16.2.3). Code 2, by contrast, is grammatically more complex (involving a distinction between two forms and an associated set of grammatical environments), and is moreover a code that is normally only acquired in certain circumstances, namely, in highly educated / academic / pedantic speech communities. In our terms, Code 2 has a high acquisition cost, since it is both grammatically complex and the environments in which it can be acquired are socially exclusive. The use of Code 2 is thus associated with membership in those socially exclusive communities where its acquisition is the norm, and the deployment of Code 2 thus signals membership in those communities, and, by extension, social properties associated with those communities.

So now we have two codes, which each have their own social significance. But we also see that Code 2 is associated with a special form, *whom*, and that among those who have not acquired Code 2, this form might itself come to index the social properties that Code 2 does. That is, for non-Code 2 speakers, the deployment of *whom* might itself come to signal certain social properties (e.g. educated, formal, etc.) Such Code 1 speakers might then use the form associated with Code 2 to signal those properties and a corresponding persona. It is here that the notion of (dis)honest signaling arises. For a listener who has acquired Code 2, there are two kinds of grammatical environment: those that license *whom*, and those that do not. There are thus two kinds of 'mismatch' that can exist, from the perspective of Code 2: Environments E_1 where *whom* is expected but in which *who* is used, and environments E_2 where *who* is expected but in which *whom* is used. The use of *who* in E_1 is a 'mistake', being non-normative according to the norms of Code 2, but is the norm for Code 1. Since Code 1 is itself associated with non-highly educated / non-academic / non-pedantic social groups, the use of *who* in such environments can serve to signal second-order properties associated with such groups, such as friendliness or casualness. Basically, this is a kind of code-switching, with the norms (and social indices) of Code 1 in play. By contrast, the use of *whom* in E_2 is unlicensed by either code; its deployment can only be understood (by someone who has acquired Code 2) as a mistaken attempt to deploy the resources of Code 2. Calling *whom* the 'high variant' and *who* (when deployed in environments where Code 2 licenses *whom*) the 'low variant', the following table summarizes the inferences made by a listener who has acquired Code 2, relative to prior assumptions that listener has about the speaker's background (i.e. whether or not the speaker has paid the acquisition cost for Code 2, and is therefore a member of the 'in-group' of Code 2 users):

Belief that Spk. paid acq. cost	*Successful use of high variant*	*Wrong use of high variant*	*Use of the low variant*
Low	Trying	Posering (Hypercorrection)	On character
High	On character	(impossible cf. Bourdieu 1991)	Casualness (Hypocorrection)

In this abstract, we focus attention on use of the high variant *whom*, saving extended discussion of the low variant *who* for the full talk. The form *whom* itself is marked as belonging to Code 2, whose normative use involves a non-trivial acquisition cost, and which is thus associated with an 'in-group' of normative Code 2 users (those who have paid the acquisition cost, and who thus typically are members of social groups where Code 2 is typically acquired). The listener (themselves an in-group user of Code 2) now uses two pieces of information in interpreting the social meaning of this deployment of *whom*. First, they have background beliefs about the speaker's in-group membership (i.e. about whether they are an in-group member who has paid the acquisition cost). They then consider the grammatical environment in which *whom* was deployed, and determine whether its deployment in this environment is correct or not, according to the in-group norms of Code 2. In environments where *whom* is normatively deployed, nothing goes wrong: if the listener takes the speaker to be an out-group member, then they interpret them as someone who is trying, maybe successfully, to deploy the code associated with the in-group. The problem arises when *whom* is deployed in a non-normative way (i.e. when it is used ungrammatically, according to the norms of Code 2). Since the grammar of a fluent Code 2 user does not license *whom* in such environments, and since *whom* is not a part of Code 1, it is 'impossible' that a fluent Code 2 speaker would deploy *whom* here (see infra for more about this). The misuse of *whom* thus 'outs' the speaker as someone who is trying to use Code 2 without having paid the associated acquisition cost. They are thus not a member of the social groups associated with Code 2, but are acting as if they are. The listener concludes that the speaker is a *poser*.

The upshot of the above discussion is that social meaning can go beyond the kind of reasoning explored in Third Wave Sociolinguistics and modeled formally by Burnett [2023], since an attempt to signal a persona associated with a costly code can succeed or fail depending on the listener's own relationship to that code: the listener is in a position to determine whether the listener's deployment of the code was normatively correct or not. What counts as 'correct' use of the code depends on the listener. We can then consider two listener models: an 'out-group' listener and an 'in-group' one.

A straightforward way to model the out-group listener is to treat them as a naive listener, in the way Burnett [2023] models it, i.e. by considering that the listener updates their beliefs about the speaker being part of a group γ in traditional Bayesian fashion as in (1), i.e. as a function of their prior beliefs about the speaker being in γ and the likelihood that someone from that group would use the form m.

(1) $$P(\gamma|m) = \frac{P(\gamma) \times P(m|\gamma)}{\sum_{\gamma'} P(\gamma) \times P_S(m|\gamma')}$$

In Burnett's proposal, the production likelihood is that of the speaker; here we prefer to see it as the listener's belief that a person of a particular group would produce the variant m. Crucially, when the listener is an out-group one, their beliefs can be treated as simply about the form appearing in one's discourse. In the case of *whom* it'd be that producing *whom* is higher if one tries to project 'educated' than if not, irrespective (probably not actually) of the linguistic environment the variant appears in. This makes interpretation of *who* vs. *whom* for the out-group listener parallel to that of the alternant pronunciations of -ING.

By contrast, the non-naive listener is one who is competent in the normative use of the code associated with *whom*. Such a listener uses their own production probability for the variant. Here, we can borrow the format of stochastic language models that approximate the probability of the upcoming word in a sequence. Formally, we can factor the linguistic context in which the target variant appears in the likelihood as in (2), where E represent the linguistic environment of the variant m. In (2), P_L is meant to represent the listener's own internal language model, approximated as a probability distribution over types in a given linguistic environment and given that one belongs to a certain group.

(2) $$P(\gamma|m, E) = \frac{P(\gamma) \times P_L(m|\gamma, E)}{\sum_{\gamma'} P(\gamma') \times P(m|\gamma', E)}$$

On a wrong use of *whom*, an educated listener will assign a very low probability to the sequence according to their own grammar, and in turn a very low probability that the speaker has the target property. This last case (hypercorrection) is an honest signal that the speaker does not belong to the in-group. In that situation, the interpretation thus 'crashes': this is a failure, a move that is not possible for signaling any persona, according to the listener's own grammar. The production by the speaker remains explainable with a different likelihood model, i.e. one in which the speaker belongs to the out-group. In other words, the listener draws the (secondary) inference that the speaker is a poser – they haven't paid the acquisition cost for proper deployment of Code 2 (and its associated high variant, *whom*).

In the full paper we elaborate on the other potential cases and present a more complete model of interpretation. In particular, we discuss what happens when a speaker who is perceived to be in-group 'wrongly' uses the high variant. As discussed by Bourdieu [1991], such cases are special given that such a speaker 'embodies' the norm: they make coincide the principles of evaluation and production of a message. There is therefore no penalty for such a speaker when they use the high variant in an unexpected context.

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Concessive marking in French: *pourtant* vs. *quand même*

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1. Introduction

In this work, we focus on the interpretation of the French discourse markers (DM) *pourtant* (PT) and *quand même* (QM). DM are generally described as invariable expressions that do not affect the truth conditions of the sentence they appear in. They serve three core functions: structuring the logical-temporal fabric of discourse (for which they are usually called *connectives*), expressing the speaker's mental states, and managing the interaction (for recent syntheses see Hansen and Visconti [2024], Dargnat [2024]). At first glance, both PT and QM appear to convey a form of concession between their prejacent and an antecedent. Although concession definitions can vary, a usual approach is to consider it as a negative causal, in which two situations are presented as usually incompatible, such that one negates an expectation created from the other, based on shared background assumptions (see some definitions in Konig and Siemund 2000, Verhagen 2005, Renkema 2009, Morel 1996). In (1), the negated assumption could be that *if one's destination is geographically close, one generally walks there.*

(1) C'était à côté, j'ai (**pourtant** / **quand même**) pris la voiture.
it.was close I.have *pourtant* *quand même* taken the car
'It was close, yet I still drove there.'

A closer examination shows that the two DM differ in important respects and many contexts [de Spengler and Moeschler, 1982]. We elaborate on those differences in section 2, and propose an analysis of the semantics of these two markers in section 3. In a nutshell, we argue that PT is a bona-fide discourse connective, marking a Concession relation, which makes it susceptible to general discourse structure constraints, in particular that of the *Right Frontier*, which specifies how discourse units attach, depending on the type of discourse relation involved [Polanyi, 1988, Asher and Lascarides, 2003]. It also allows PT to bear on various aspects of the interpretation of its antecedent. On the other hand, QM does not appear to function as a full/strong connective: its semantics only bear on the properties of its prejacent, determined by its main content for its concessive meaning. This makes it oblivious to discourse constraints, while limiting its scope to descriptive aspects of its prejacent.

2. Empirical Domain

A corpus based study was conducted on a French corpus comprising approximately 110 millions tokens, compiled from several pre-existing sources. The data, spanning from 1980 to 2017 and semi-automatically annotated for DM under the X research project, covers a diverse range of genres: oral (interviews, courses, friend discussions. . .), written (journalistic texts) and computer mediated discourse (mostly French texts published on Reddit). PT (32,168 occurrences) is more used in written and formal discourse (accounting for 95% of its usage) than QM (64,495 occurrences), which is more frequent in oral or informal discourse (with around 90%

of its occurrences found in spoken language). To further investigate interpretative differences, a substitution task was conducted by a single French native annotator (to be expanded in the final version of the article). The goal was to determine the contexts in which PT and QM can be interchanged, as well as to identify the contextual constraints when they are not. 200 randomly selected, proportionally sampled occurrences per expression were used. We found that PT was replaceable by QM in 87 cases, and QM could be exchanged with PT in only 55, suggesting QM has a broader contextual usage than PT, and fewer discourse constraints. Some relevant contexts for analysis are presented below.

A first context in which PT and QM cannot be freely interchanged is shown in (2).

(2) C'était loin, (donc) j'ai (# **pourtant** / **quand même**) pris la voiture.
it.was far so I.have *pourtant* *quand même* taken the car
'It was far, so I still drove there.'

In (2), the use of QM is felicitous, and carries with it that there was some expectation that the speaker would not drive. Note that this expectation runs contrary to the ones that the first segment of the discourse creates. Unlike QM, the use of PT is not felicitous, and intuitively appears limited to denying the expectations created by the first conjunct (as it does in (1), where QM is also felicitous), which is how its infelicity can be accounted for. Note also that the use of the consequence marker *donc* ('so') slightly improves the felicity of QM, but has no effect on that of PT.

Conversely, in (3), the use of QM appears less natural than PT in the absence of extra contextual information or an additional explicit connective.

(3) J'ai pris la voiture, c'était (**pourtant** / ? **quand même**) à côté.
I.have taken the car it.was *pourtant* *quand même* close
'I drove there, even though it was close.'

Comparing (3) and (1) suggests that there is a difference in the nature of the inferences that QM and PT can deny. While both are licensed in (1), i.e. can be interpreted as denying an inference rooted in the left discourse conjunct, this is not the case in (3), where only PT is able to do so. If QM is felicitous in that discourse, its interpretation is not equivalent to that of PT.

3. Analysis

To analyze the difference between examples like (1) and (3), we first observe that their interpretations involve different semantic domains (cf. Sweetser 1990, and Crible and Degand 2019 for a more recent and refined approach). (1) illustrates a *content domain* link between segments, i.e. a contingency between two states of affairs in which the descriptive information of the left conjunct causes some effects denied by the second (i.e. it is the distance that determines one's mode of transport and not vice-versa). However, (3) relies on the *epistemic domain*: a link is made between a state of affairs and how an information affects the speaker's knowledge about a state of affairs (i.e. learning that one took their car does not change the distance, but modifies one's belief about it via abduction, see e.g. Pearl 2009 for illustrations using Bayesian Belief Networks). QM is felicitous when its prejacent link occurs on the content level, which we assume makes the concessive interpretation more easily accessible, as in (1). In such contexts, the concessive interpretation is easier to establish, and the relation does not need to be strongly signaled [Asr and Demberg, 2012a]. In these cases, PT and QM can be interchanged easily. Furthermore, with the appropriate prosody and face movements, even weaker markers for concession can be used with a concessive interpretation, as in (4).

(4) C'était à coté… **bon…** j'ai pris la voiture…
it.was close *well* I.have taken the car
'It was nearby… well… I drove there '

In contexts that are insufficiently restrictive to ensure a concessive interpretation, such as in the epistemic domain and backward inferences [Asr and Demberg, 2012a], the use of a strong marker like PT to establish the discourse relation is preferred as in (3). A DM like QM is not sufficient to indicate a relation of CONCESSION. To become felicitous, it must either be supported by another strong connective of concession like *mais* ('but'), or must be replaced by another stronger signal, such as *même si* ('even if'), cf. (5).

(5) J'ai pris la voiture, **mais** c'était **quand même** à côté.
I.have taken the car but it.was *quand même* close
'I drove there, though it was close.'

This explanation is tied to Zeevat and Winterstein [to appear]'s hypothesis about the prevalence of causal and identity inferences in discourse interpretation and how discourse markers, and in particular connectives, are there to prevent these defaults (see also Verhagen 2005, Radvansky and Zacks 2014 for more on the prevalence of causal relations in discourse interpretations). In other words: in the absence of a strong concessive marker, a discourse like (3) would be interpreted with the second conjunct as an explanation, an interpretation that QM cannot override on its own.

3.1 The semantics of **pourtant**.

We therefore analyze *pourtant* as a usual canonical concessive: it is anaphoric, in that it requires a left conjunct, and conveys a 'negative' content. Using argumentative terms, a segment '*pourtant* B' requires the identification of a segment A such that A is an argument for $\neg B$ (cf. Anscombre and Ducrot 1983 and many others). PT can bear on either the descriptive or epistemic level a relation of its prejacent, in line with the usual properties of the argumentative relation. In other words, the concessive interpretation is forced with PT, blocking any other discourse relation. This is why PT is felicitous in (1) and (3), but not in (2) (there is no $\neg B$ to identify). A prediction of this analysis is that PT is sensitive to the right frontier constraint for discourse attachment [Polanyi, 1985, Asher and Lascarides, 2003]: we expect that it cannot attach to a segment that is not on the right frontier, even if the interpretation of that segment satisfies the negative content of PT. This prediction is borne out in examples like (6).

(6) [Sam était concentrée]$_{\pi_1}$, mais [le discours était long]$_{\pi_2}$, alors [elle s'est
Saw was focused but the speech was long so she was
quand même / ?pourtant ennuyée]$_{\pi_3}$.
quand même *pourtant* bored
'Sam was focused, but the speech was long, so she was nonetheless bored.'

In (6), the segment π_1 creates an expectation that Sam was not bored, which the segment π_3 denies. Yet, the use of PT to introduce π_3 is not felicitous[1]. In our analysis, this is because π_1 is not accessible because it is not on the right frontier: it is related to π_2 via a coordinating CONTRAST relation (marked by *mais* 'but'), which gives only π_2 or a pseudo-topic subsuming both π_1 and π_2 as possible sites for subsequent discourse attachment. Note that however, QM is felicitous in (6).

3.2 The semantics of **quand même**.

Our basic claim is that QM is used to signal the unexpectedness of its prejacent in its context of utterance, possibly because of the preceding conjunct, but not necessarily. Crucially, the unexpectedness is about the descriptive content of its prejacent, and not about any other level

[1]The infelicity of PT compared to QM was tested in a judgment task, conducted on 63 native French speakers, where they were asked to rate (from 0 to 100) 40 sentences [Dargnat and Sillaire, 2024]. Our results confirm our observation, as sentences with QM were rated about 36 points higher than those with PT (mixed model comparison (ANOVA): $\chi^2 = 209.25$, $p < 0.001$).

of its interpretation. Finally, QM does not mark any specific discourse relation, which makes it compatible with non-concessive relations, as in (2). However, given that its contribution parallels the semantics of CONCESSION, it is naturally found in such discourse configurations. The retrieval of the meaning of QM is thus dependent on the context and more specifically on default inferences (a.o. the presence, or not, of a salient concessive interpretation, and the domain on which it should occur).

4. Conclusion

Hypotheses on how and why discourse relations are signaled are numerous and share the common assumption that hearers make default inferences. The continuity hypothesis posits that hearer expect temporal and causal continuity between discourse segments [Murray, 1997, Segal et al., 1991], the causality-by-default hypothesis establishes that hearer expect them to be causally linked [Sanders, 2005], Hoek and Zufferey [2015] argue that cognitive complexity determines default interpretation, with the simplest possible relation being selected automatically. Following [authors, to app.]'s hypothesis, we posit that DM function to block these default inferences. It is therefore reasonable to hypothesize a high need for signaling concession, as it usually violates default, cognitively simpler, interpretations. Empirical works confirm that concession is typically explicit, i.e. is signaled by a DM (in English, Asr and Demberg [2012a]). Further analyses show that some DMs are more strongly tied with concession than other [Asr and Demberg, 2012b] and that the more strongly tied to a discourse relation a DM is, the more it appears in formal and written settings, whereas the weaker ones are more oral and often require additional disambiguating signals [Crible, 2020].

Our analysis of PT and QM is in line with previous findings while making more precise their respective semantic import. We argue that PT is strong concessive connective, evidenced by its ability to operate across content and epistemic domains, support backward inferences, occur more frequently in formal written discourse, and exhibit typical connective discursive constraints. Conversely, QM is analyzed as a weaker, ambiguous marker, limited to concessive interpretations in the content domain, appearing in contexts where a strong signal is unnecessary.

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Singular generic 'the' and uniqueness

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Generics with singular *the* (GSTs) are generic sentences whose subject is a singular DP with the definite singular determiner. An example is (1) under the reading that Iberian wolves typically or naturally hunt at night.

1. The Iberian wolf hunts at night.

GSTs have a puzzling distribution, and the precise factors that govern the productivity of definite generic *the* are poorly understood. These controversies notwithstanding, there are a few formally developed accounts of the compositional semantics of attested GSTs on the market. These divide into two families: accounts building an ambiguity into the definite article, and accounts building an ambiguity into the NP. Common to both is the idea that GSTs are governed by an extension of the uniqueness requirements imposed by the ι-operator on ordinary atoms. For instance, just as (2a) requires the referent of the DP to uniquely satisfy *Coke bottle* among the atomic individuals in the domain, so the GST reading of (2b) requires the object picked out by the DP to uniquely satisfy *Coke bottle* among the taxonomic entities in the domain.

2. a. The Coke bottle fell from the table.
   b. The Coke bottle has a narrow neck.

I will develop an argument that the discourse behavior of GSTs has properties that do not neatly fit either account. I will begin by distinguishing determiner strategies and NP strategies and laying out their commitments, using Chierchia (1998) as a canonical determiner strategy and Dayal (2004) as a canonical NP strategy. I will then present some cases with felicitous GSTs derived in apparent violation of the presuppositional demands of the ι-operator, and argue that these GSTs challenge, in different ways, both approaches. Finally, I will offer a preliminary survey of the logical space for possible ways to attenuate the difficulty, considering three options in particular: revising the entry-level account of the presuppositional demands of ι; adding a difficulty-circumventing entry to the inventory of definite determiners; and latching the NP onto a metalinguistic property. Whatever the merit of these specific strategies, if the argument points us in the right direction the distribution of GSTs has a gray area that major accounts of GST readings are not immediately equipped to account for. Semantic inquiry into GSTs has tended to center on stand-alone examples or on the distribution of GSTs in miniature contexts; it should pay closer attention to their behavior in sufficiently complex, realistic discourse environments.

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On the semantics of *together, separately* and *alone*

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In this talk I propose a semantic description of *together, alone* and *separately* when they are used as VP modifiers (these items will be called *sorting operators* or SOPs). This description uses a novel proposal concerning the semantic type of VPs: it will be suggested that the semantics of SOPs necessitates that with any VP we associate not only its extension $[VP]$ but also its co-extension $WITH$, a subset of $[VP] \times [VP]$. Informally $WITH$ corresponds to the set of pairs of agents "doing" jointly the action expressed by the VP. In addition, the proposed analysis uses essentially the possibility of having flexible semantic types and, in particular, implies that VPs denote not just sets (of individuals) but also the set of type $\langle 1 \rangle$ quantifiers. This shows that VPs modified by SOPs denote a set of type $\langle 1 \rangle$ quantifiers.

SOPs that will be analysed are VP modifiers as in (1) and not ad-nominal (or subject NP) modifiers. (cf.[6]) :

(1a) Dan and Bo/most students left together.
(1b) Dan and Bo/Most students left separately.
(1c) Dan left alone.
(1d) No two students left separately.

SOPs form "non-homomorphic", and thus logically special, predicates (cf. [2]): (1a) and (2) jointly do not entail (3):

(2) Ed and some students left together.
(3) Dan and Ed left together.

In addition to obvious semantic relations between various SOPs some sentences with SOPs can also be expressed by comitative constructions: (1a) can be expressed by (4), and (1c), by (5):

(4) Dan left with Bo/most students. (5) Dan left with nobody.

Thus SOPs are similar in many respects to reciprocals or *the same CN* type direct objects which also form non-homomorphic predicates ([1],[6],[7]). Consequently, non-homomorphic predicates should be interpreted in the same way.

By analogy with reciprocals and *the same CN* objects ([1], [5], [6]) I will consider that predicates modified by ROPs denote sets of type $\langle 1 \rangle$ quantifiers since ROPs raise "ordinary' VPs. Usually, in simple sentences, a VP is of category (S/NP): it takes an NP and gives a sentence. Semantically it corresponds to a set which is a member of the type $\langle 1 \rangle$ quantifier denoted by the corresponding subject NP. Any VP forming a sentence with an NP as in (5a) can be raised "again" to become of the category $S/(S/(S/NP))$. This can be done using the higher order reduction *via* function application as (5b) ("+" symbolises the function application):

(5a) $NP + S/NP{=}S$
(5b) $S/(S/NP) + S/(S/(S/NP)) = S$

The category S/(S/(S/NP)) denotes a set of type $\langle 1 \rangle$ quantifiers. Any sentence S can be considered as having the form in (5b) and such a sentence is true if the quantifier denoted by the subject NP belongs to the set of quantifiers denoted by the raised VP. Since VPs modified by some ROPs accept only plural quantifiers (cf. **Dan left together* we will use definition (6):

(6) A type $\langle 1 \rangle$ quantifier is plural, $Q \in PL$ iff $Q \neq \emptyset$ and if $A \in Q$ then $|A| \geq 2$.

Since the semantics of ROPs is related to commutative constructions, I will consider that with any VP which can express an event which can be accomplished either by one agent or by a joint action of multiple agents one can associate in addition to its "ordinary" denotation (a set of individuals), also a symmetric binary relation indicating joint agents of the action, if the action has multiple agents. Such multiple-agents action depends in details on the VP. Thus *to write an article with someone, to drink with someone, to travel with someone, to die with someone, to sit with someone* and *tp live with someone* involve very specific properties actions and rules which cannot get a general characterisation (cf.[3]). For instance spatial closeness does not seem to be a necessary condition of such group actions: one can *write together* or *decide together* without being at the same place. Similarly, it is not clear whether even temporal closeness is characteristic to all co-participants in such group actions. Probably one can write a book with someone without this co.-writing be done by co-authors at the same time. However in all these cases one can consider that possible agents participate in a unique event or action. From this it follows that every group action referred to by VPs modified by *together*, for instance. can always be considered as reciprocal or symmetric : if *a VPs with b* (for $a \neq b$) then *b VPs with a*. Consequently, we postulate that with any (?) VP is associated also the symmetic relation $WITH$, a subset of $[VP]/times[VP]$, indicating possible joint agents of VP. Informally:

(7) Let the denotation of the VP be the set $[VP]$, a subset of a given universe E. Then $WITH([VP]) = \{\langle x, y \rangle : x \in [VP] \wedge y \in [VP] \wedge (x \neq y) \wedge x\, VPs\, with\, y\} \wedge x \neq y$.

$WITH$ can be considered as the denotation of the the commutative conjunction *with*. Syntactically, the conjunction *with* forms a pseudo-transitive verb phrase with the intransitive VP to which it applies. Such a pseudo-transitive VP denotes a symmetric binary relation.

We need to decide, in addition, whether $WITH([VP])$ is symmetric or symmetric and irreflexive. This depends on whether sentences like (8) are grammatical;

(8) ?Dan and Bo left together and Ed alone

If (8) is grammatical, then *Together* and *Alone* denote the same type and *Alone* can be interpreted as meaning together with oneself only and then $WITH$ gives just a symmetric relation. If (8) is not grammatical $WITH$ gives a symmetric and irreflexive relation. For simplicity I consider that $WITH([VP])$ is just a symmetric relation.

Any symmetric relation R (on the set A) considered as a set of ordered pairs, can be partitioned into sets of (symmetric) relations each of which is of the form $(B \times B)$, for some $B \subseteq A$. We consider the coarsest partition of R having these properties, that is, the partition Π of R which refines only the trivial partition $\{R\}$. (A partition Π_1 refines a partition Π_2 iff any block of Π_1 is a subset of Π_2).

Thus blocks of this partition are relations of the form $(B \times B)$. Let us call the

the set B the base of the block $(B \times B)$ and let BB be the set of bases of blocks of the partition $\Pi(R)$.

Given this relation between R and its partition the relation $WITH([VP])$ can be represented as in (9);

(9) $WITH([VP]) = \bigcup_{B \in \Pi_{WITH([VP])}} (B \times B)$

The function TOG denoted by *together* is defined in (10). The definition of this function is "by cases" which depend on whether the relation $WITH([VP])$ is trivial or not: $WITH([VP])$ is trivial iff $WITH([VP]) = \emptyset$ or $WITH([VP]) \subseteq I$, where I is the identity relation (that is $I = \{\langle x, x \rangle\}$, for $x \in [VP]$:

(10) (i) $TOG([VP] = \{Q : Q \in PL \wedge \neg 2(E) \subseteq Q\}$ if $WITH([VP])$ is trivial
(ii)$= \{Q : Q \in PL \wedge \exists B \in Pi_w([VP]) \exists Q_0(Q_0([VP] = 1 \wedge Q_0 \subseteq Q\}$, if $WITH([VP])$ is not trivial (where Q and Q_0 are type $\langle 1 \rangle$ quantifiers).

Thus the adverbial *together* denotes a function which applies to the denotation of a verb phrase and gives a denotation of a raised verb phrase that is a set of type $\langle 1 \rangle$ quantifiers. This set is a set of plural quantifiers and its composition depends on whether the relation $w([VP]))$ is trivial or not. If this relation is trivial, then the resulting set contains all quantifiers which are entailed by the quantifier meaning, roughly, "no two objects". So in particular it contains the quantifiers like *no two students, no five teachers*, etc. if the relation $w([VP])$ is not trivial then the resulting set of quantifiers, the denotation of the raised VP, contains plural quantifiers which are true of one of the blocks of the partition induced by the relation $w([VP])$ and in addition all consequences of such quantifiers.

The reason that in (10) we consider all quantifiers entailed by one quantifier true of a block of the partition is related to non-exhaustive interpretation of subject NPs in sentences with *together*: the interpretation of such sentences does not necessitate to indicate all members being in the relation induced by the comitative *with* and the verb phrase. We want also that (11a) entails (11b):

(11a) Three students left together.
(11b) Two students left together.

Thus the adverbial *together* denotes a function which applies to the denotation of a verb phrase and gives a denotation of a raised verb phrase that is a set of type $\langle 1 \rangle$ quantifiers. This set is a set of plural quantifiers, and its composition depends on whether the relation $w([VP])$ is trivial or not. If this relation is trivial, then the resulting set contains all quantifiers that are entailed by the quantifier meaning, roughly, "no two objects". So in particular it contains quantifiers like *no two students, no five teachers*, etc. if the relation $w([VP])$ is not trivial then the resulting set of quantifiers, the denotation of the raised VP, contains plural quantifiers which are true of one of the blocks of the partition induced by the relation $w([VP])$ and in addition all consequences of such quantifiers.

Before considering the semantics of *alone* a remark is necessary about group and individual readings of sentences containing this item in the adverbial position. It seems to me that (12a) when taken in group reading, is contradictory; it can mean only what (13a) or (13b) means:

(12a) Dan and Bo left alone.
(12b) Dan and Bo left.
(13a) Dan left alone and Bo left alone.

(13b) Dan, as well as Bo, left alone.
(13c) Dan and Bo left together.

Observe, in addition, that (12b) does not entail (13b), and (12b) does not entail (13c) but (13c) entails (12b).

The above facts should be taken into account in our analysis of *alone* and the PP *with* in particular.

Given a logical relation between sentences with *together* and sentences with *alone* we can define the semantics of *alone* using the semantic description of *together*. this can be done as in (14):

(14) $ALONE([VP]) = \{I_a : a(WITH([VP])\}$

What (14) says is that $ALONE$ is a function that applies to the denotation of a verb phrase and gives as a result a set of individuals generated by the elements that are in the relation $WITH([VP])$ only with themselves.

The semantics of *separately* uses the relation $WITH$ to define $NOT-WITH$, as in (16). Observe first that (15a), (15b) and (15c) are equivalent:

(15a) Dan and Bo left separately.
(15b) Dan and Bo left, but not together.
(15c) Dan left, but not with Bo and Bo left, but not with Dan.
(16) $NOT-WITH([VP]) = (WITH([VP]))' \cap ([VP] \times [VP])$

$NOT-WITH$ applies to the denotation of a VP and gives a symmetric relation. Given this, we apply the same procedure as in the case of TOG (together): we consider the coarsest partition of the relation $NOT-WITH([VP])$ into sub-relations of the form $B \times B$ In this way we get a set of blocks B. Then a (plural) quantifier Q belongs to the denotation of *VP separately* iff Q is true of one block B.

The above semantics allows us to evaluate not only sentences like (15) or (16) but also sentences with non-conjoined subject NPs, like (17):

(17) Most students left separately.

In addition, the semantics proposed for the three SOPs rightly captures various entailments between sentences containing different SOPs.

In conclusion, the following should be said. The semantic properties of SOPs such as *together, alone* and *separately* essentially involve the non-instrumental meaning of the prepositional phrase *with NP*. This meaning is essentially related to a special ("non-distributive") group action which does not seem to be possible to characterise precisely in general. For instance, the simultaneity of participation in action of multiple agents does not seem to be necessary since (18) is not contradictory:

(18) Dan and Ed left simultaneously but not together.

In English, the non-instrumental *with* forms a pseudo-transitive and denotes a symmetric relation corresponding to the co-denotation of the complete VP. It seems that in some languages, *with* is a conjunction that forms plural NPs which denote *groups*, in the technical sense (cf. [4]). Examples like (1d), (17), and (18) suggest "group analysis" is not adequate. I propose to consider that the semantics of SOPs forces us to introduce an additional semantic primitive concerning VPs, the *co-extension* (or *co-denotation*), supposed to indicate, informally, all co-authors of the action expressed by the VP.

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Noncanonical whether in English: in parallel with Korean/Japanese expletive negation

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1. Introduction

Recent studies (White 2021; White & Rawlins 2020) have shown that some English antirogative predicates—traditionally believed not to embed interrogatives (e.g., think, believe, hope, fear, imagine)—can in fact appear with *whether*-complements, contrary to prescriptive grammar. This paper proposes that these noncanonical whether-complements correspond functionally and semantically to the expletive negation constructions in Korean and Japanese. Both phenomena involve complements that are positively biased yet syntactically marked by interrogative or negative morphology.

We define three key notions as follows:
- Logical interpretation refers to the truth-conditional status of the embedded clause: whether its propositional content contributes to assertion, presupposition, or inquisitive alternatives.
- Positive bias refers to a speaker's epistemic or bouletic leaning toward the truth of the embedded proposition—an expectation or hope that p is true.
- Expletive negation refers to syntactic negation without semantic polarity reversal, functioning as an epistemic hedge comparable to French ne-explétif or Japanese -nai ka in modal contexts.

These notions jointly explain how English noncanonical whether and Korean/Japanese expletive negation mark a cognitively similar stance: a positively biased but epistemically cautious attitude toward a proposition.

2. English know whether and noncanonical *whether*

Epistemic predicates such as know entail veridicality. The proposition "Ed knows whether P" is true iff (i) if P is true, Ed knows P, and (ii) if P is false, Ed knows ¬P. Hence know whether presupposes bivalence and is reducible to know that P or know that ¬P. However, think/believe/imagine whether fail to be factive: they neither presuppose nor assert the truth of P, but instead express a nonveridical epistemic stance. Example:

(1) (Sam is watching a competition they once considered entering, and some contestants seem less talented than Sam remembers. After a family member says, "You would've been amazing at this," Sam says:)
I'm trying to think whether I would have been a star today or not.

Such complements are noncanonical because whether introduces an interrogative structure without genuine question force. We treat them as quasi-interrogatives—syntactically interrogative but semantically propositional, exhibiting a logical interpretation of alternatives resolved within the speaker's belief state.

Corpus findings (White 2021) and our experimental data show that antirogative verbs with whether are acceptable to many native speakers, revealing that whether complements are extending beyond canonical interrogatives.

3. Online Survey and Results

3. Online Survey and Results
A survey was conducted on November 14, 2025, with 61 participants (Gender: 35 female, 26 male; Generation: Millennials 26, Gen X 18, Baby Boomers 13, Gen Z 4; Education: bachelor's degree 23, master's degree 15, high-school graduate 11, some college with no degree 7, doctorate 4, associate's degree 3). The survey examined both the acceptability of attitude verbs selecting whether-clauses and participants' judgments about the clause's function. Participants rated 10 sentences on a 7-point Likert scale and chose among three functional interpretations, and the survey was administered using Prolific.

① Acceptability

Verb + Wh-complement clause	Freq. of Acceptablity							Mean	s.d.	Q1	Q3
	1	2	3	4	5	6	7				
1. I'm trying to think whether I'd have been a star today or not.	2	7	7	3	6	22	14	5.34	1.65	4.5	6.5
2. I tried to think whether I had covered everything.	2	9	0	3	7	19	21	5.38	1.86	5	7
3. We can choose to believe whether the word of God is true or not.	1	6	2	2	9	21	20	5.54	1.64	5	7
4. I struggled to believe whether I could trust the Scriptures.	2	8	10	5	5	21	10	4.74	1.84	3	6
5. I was hoping whether you are able to guide me.	23	21	7	2	4	3	1	2.28	1.53	1	3
6. I was hoping whether someone with more experience could confirm my understanding of a few points.	16	14	9	1	6	13	2	3.23	2.02	1	5
7. I fear whether I'll have use of my arms and hands by age 55 or 60.	9	9	5	7	11	8	12	4.21	2.10	2	6
8. I fear whether this test would run safely on the oxygen sensor	6	5	6	7	12	16	9	4.49	1.87	3	6
9. I'm imagining whether a new sofa will fit into my living room.	2	6	5	7	11	14	16	4.88	1.84	3	6
10. I am imagining whether gangsta rappers ever speak baby talk to their kids.	4	10	7	4	11	19	6	4.46	1.86	3	6

② Interpretation

Verb + Wh-comlement clause	Freq. of Interpretation						x^2	df	p
	neutral		positive bias		not sure				
	freq	%	freq	%	freq	%			
1. I'm trying to think whether I'd have been a star today or not.	51	83.6	9	14.8	1	1.6	70.95	2	< .001
2. I tried to think whether I had covered everything.	40	65.6	19	31.1	2	3.3	35.64	2	< .001
3. We can choose to believe whether the word of God is true or not.	40	65.6	19	31.1	2	3.3	35.64	2	< .001
4. I struggled to believe whether I could trust the Scriptures.	40	65.6	17	27.9	4	6.6	32.69	2	< .001
5. I was hoping whether you are able to guide me.	13	21.3	36	59	12	19.7	18.13	2	< .001
6. I was hoping whether someone with more experience could confirm my understanding of a few points.	11	18	44	72.1	6	9.8	41.93	2	< .001
7. I fear whether I'll have use of my arms and hands by age 55 or 60.	41	67.2	13	21.3	7	11.5	32.39	2	< .001
8. I fear whether this test would run safely on the oxygen sensor	39	63.9	13	21.3	9	14.8	26.10	2	< .001
9. I'm imagining whether a new sofa will fit into my living room.	40	65.6	20	32.8	1	1.6	37.41	2	< .001
10. I am imagining whether gangsta rappers ever speak baby talk to their kids.	46	75.4	14	22.9	1	1.6	52.75	2	< .001

The acceptability results show that *think whether* and *believe whether* clauses received the highest ratings (means: 5.36 and 5.54), *fear whether* and *imagine whether* clauses fell in the midrange (means: 4.21 and 4.46), and *hope whether* clauses had the lowest acceptability (mean: 2.28). To assess interpretive patterns, a chi-square goodness-of-fit test was conducted for each item, comparing observed frequencies with the expected uniform distribution. All items showed significant deviations from expectation (all $p < .001$), indicating systematic interpretive preferences. *Think whether*, *believe whether*, and *fear whether* sentences elicited more neutral interpretations than expected, with the neutral category showing the greatest positive deviation. In contrast, *hope whether* sentences yielded more positive-bias interpretations than expected, representing the largest divergence across verb types. *Imagine whether* sentences also differed significantly, generally showing more neutral or positive-bias readings and consistently fewer "not sure" responses than expected. These findings suggest that although the verbs tested are nonfactive, they can embed closed interrogative *whether*-clauses when these clauses are interpreted as neutral or positively biased (epistemically hedged) propositions.

4. Korean and Japanese Counterparts

Korean and Japanese show parallel structures where a polar question marker co-occurs with a negative element that does not negate the proposition. In Korean, *-ul* (modal) and *-kka* (polar Q) combine with *anh-* (negation).

(2) Mia-nun [caki thim-i iki-ci anh-ul-kka (ha-ko)]
M.-Top [self team-Nom win-C Neg-Mod-Q [+say]-C <u>(w/modal)</u>
{sayingkak-ha-n-ta/?mit-nun-ta/kitayha-n-ta/siph-ess-ta/sangsangha-n-ta}
think-Pres-Dec/believe-Pres-Dec/expect-Pres-Dec/has.a.hunch-Dec/imagine-Pres-Dec
'Mia thinks/believes/expects/has a hunch/imagines whether her team will win.'

The complement clause is syntactically negative but semantically positive: the speaker expects the team to win. Negation here is expletive, functioning as a hedge. A similar pattern occurs in Japanese:

(3) Mia-wa [jibun no chimu-ga katsu no-dewa-nai-ka(-to)]
Mia-Top her of side-Nom win of-CT-Neg-Q-Comp (w/o modal)
omou/shinji-ru/kitai-suru
think/believe-Pres.Dec/hope-Dec
'Mia thinks/believes/hopes whether her team will win.'

Both Korean *-anh-ul-kka* and Japanese *-nai-ka* indicate epistemic uncertainty combined with a positive bias toward the embedded proposition. The parallel to English *whether-or-not* lies in their disjunctive semantics: *whether-or-not* retains both alternatives but pragmatically favors one.

Formally, this bias can be captured by a bouletic modal ordering source, where desirable worlds rank higher according to the subject's preferences.

(4) $BESTw_0(\cap Dox_x(w_0), Bou_x(w_0)) = \{w' \in \cap Dox_x(w_0) \mid \neg\exists v[v \in \cap Dox_x(w_0) \wedge v < Bou_x(w_0)\ w']\}$

A positively biased complement like 'Korea will be united' denotes $\forall w \in BEST(Dox, Bou)$: united(w), expressing epistemic hope or expectation.

5. Expletive vs. Real Negation

When *anh*- conveys genuine negation, it is incompatible with factive predicates such as *know* or *remember*:

(5) a. Mia-nun [caki thim-i iki-ci anh-ass-nunci(-rul)] {al-/kiekha-}n-ta.
M.-Top her team-Nom win-C Neg-Pst-BiPolC-Acc {know/remember}-Pres-Dec

'Mia knows/remembers whether her team didn't win.'

b. #Mia-nun [caki thim-i iki-ci anh-ass-ul-kka {al/kiekha-}n-ta.
M.-Top her team-Nom win-C Neg-Pst-Mod-Q {know/remember}-Pres-Dec
'Mia remembers/knows her team didn't win?'
(Unacceptable: expletive negation cannot co-occur with factive predicates.)

Thus, expletive negation occurs only with nonfactive or preferential predicates (think, hope, fear) but not with factives. It serves as a syntactic hedge marking epistemic tentativeness without logical negation.

6. Comparison and Discussion

Our findings align with the intuition that *whether* in English is undergoing a similar reanalysis: from interrogative complementizer to propositional marker signaling hedged assertion. This historical shift parallels the established expletive negation in Korean and Japanese. In all three languages, positive bias correlates with grammatical markers of tentativeness (negative or interrogative morphology). Although in English this tendency is not as clear as Korean and Japanese, our findings suggest that we can expect some convergence between English and Korean/Japanese will eventually occur with respect to the nonfactive predicates and *whether*.

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Where hyperbole and incrementality meet:
The curious case of Mandarin incremental *hai*

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1 A panorama

Suppose that a man got his face seriously stung by a wasp, and it became swollen. Someone saw this and uttered (1). (1) is truth-conditionally false because no matter how swollen his face became after the sting, it is implausible that his face was literally bigger than a washbasin. Most likely, the speaker was exaggerating the face size and, via this untrue statement, expressing something else, e.g., the medical severity of his face condition. English speakers automatically recognize and accept (1) as hyperbole.

(1) His face is bigger than a washbasin.

Now consider (2a), the Mandarin equivalent of (1). (2a), **un**like its English original (1), feels like the speaker was literally comparing 'his' face and washbasins w.r.t. size, and claiming that the former literally exceeds the latter in size, which leads to a degraded status here in Mandarin. But intriguingly, (2a) becomes perfect in the presence of *hái* – literally *still* and generally taken to be a German *noch*-like operator (e.g.,[19,22]) – as in (2b), which is automatically accepted as hyperbole. This contrast is also attested in (3). (3a), with *hái*, is perfect as hyperbole and listeners automatically recognize the speaker is talking about e.g., the staleness / non-freshness of the food. In contrast, (3b) feels like the speaker is making a literal statement that the death time of the chicken predates the founding time of the school. (see also e.g., [4,20]) for similar observations that *hái* improves *hái*-less *bi* comparatives intended for a hyperbolic interpretation.)

(2) ta de lian bi lianpen #(**hái**) da.
3SG DE face than face.bowl still big

a. *hái*-less: Intended =(1), but feels like a **literal** statement **Degraded**
b. *hái*-marked: His face is (even) bigger than a washbasin. **Perfect**

(3) Context: A student complains about how stale the school's chicken food is:

na ge ji si de shijian bi women xuexiao jianxiao de shijian #(**hái**) chang.
that CL chicken die DE time than 1PL school found.school DE time still long

a. *hái*-marked: The length of the time for which the chicken has been dead is (even) longer than the length of time for which our school has existed since its foundation. **Perfect**
b. *hái*-less: Intended = (3a) but feels like a literal statement. **Degraded**

The felicity contrast as in (2) / (3) begs the question of **why the presence of *hái* (2b,3a) improves the otherwise degraded *bi* comparatives intended for a hyperbolic interpretation (2a,3b)**. To address the puzzle, we will integrate **three independently developed lines of research**. (**i**) Hyperbole requires mapping to an affective / evaluative scale ([14]) but Mandarin regular *bi* comparatives have trouble in this regard, and thus the literal flavor ([3]); (**ii**) *hái* is incremental in its interaction with comparatives ([11]), like German *noch* ([18]) and Russian *noch*-like *ešče* ([13]); (**iii**) incremental operators map to / are correlated with a contextually salient scale ([5,6,8,9,12]). In light of such insights, **we propose that degraded hyperbolic *bi* comparatives (2a,3b) are improved by *hái* (2b,3a) because *hái*, as an incremental operator involving correlation with a contextually salient scale, facilitates the scale mapping required by but lacking in hyperbolic *bi* comparatives and thus helps.**

2 Preliminaries: Three independent lines of research

2.1 Building block#1: Hyperbole involves scale mapping

Recent formal modelings of hyperbole argue that hyperbole involves scale mapping ([10,14]). [14], in particular, proposes that hyperbole involves two scales: a factual scale associated with a factual order-inducing QUD which addresses the real state of affairs, and an affective / evaluative scale associated with an affective / evaluative order-inducing QUD which addresses the speaker's subjective assessment of the state of affairs. Crucially, the factual scale is mapped to the affective / evaluative scale in that the speaker, by addressing the factual order-inducing QUD, is actually addressing the affective / evaluative order-inducing QUD. To illustrate, consider (4). Suppose a party host expected 30 of the 60 invited guests to attend her housewarming party, but 58 of them showed up. A guest, expressing how successful the party was, uttered (4).

(4) There were a hundred people in your living room. ([14], ex.1)

Following [14], the factual order-inducing QUD is '*how many people attended the party?*' and the affective / evaluative order-inducing QUD could be '*how successful was the party?*'. By uttering (4), which is clearly untrue, the speaker was not really addressing the factual QUD but addressing the affective / evaluative QUD. Crucially, the two scales associated with the two QUDs are aligned in that the answer to the factual QUD is mapped to the affective / evaluative QUD: The degree of the party success is determined by the number of attending guests. That is, the larger the number of guests uttered to be, the more successful the party was deemed to be. In light of [14]'s modeling of hyperbole, [3] shows how Mandarin *even*-like *dou*, which is independently argued to encode scale mapping [2](see also [7,21] for *even*'s scale mapping), can help to improve the degraded hyperbolic *bi* comparatives via *dou*'s encoded scale mapping, and suggests that Mandarin hyperbolic *bi* comparatives (i.e., cases like our (2a) and (3b)) are degraded because they have trouble in mapping to the affective / evaluative scale.

2.2 Building block #2: *Hái*, in its combination with comparatives, is incremental

Hái is generally taken to be a German *noch*-like operator [19,22]. Among its various uses, *hái* has an incremental use (e.g., [11,19,22]) like English incremental *more* (marked as $more_{incre}$ below) / *another* in the sense of [5,15,16,17], as in (5). Following [11] which models incremental *hái* on [17]'s English $more_{incre}$, incremental *hái* in (5) involves an asserted eventuality e where 2 students talked with 'him' in the afternoon (i.e., the *hái*-hosting conjunct) and a presupposed eventuality e^* where some students talked with 'him' on another occasion (i.e., the first conjunct), and incremental *hái*, encoding a **summing** operation, combines the two eventualities (e and e^*) into a larger one by summing the cardinality of the two sets of students in e and e^*, ending up with five students talking with him in total.

(5) shangwu you san-ge xuesheng gen ta tanhua, xiawu **hái** you liang-ge
morning have three-CL student with 3SG talk afternoon still have two-CL
(xuesheng) gen ta tanhua
student with 3SG talk

In the morning three students talked with him; in the afternoon, **another** two / two **more**$_{incre}$ (students) talked with him.

Crucially, *hái*, in its interaction with comparatives (6), has been argued to be incremental ([11]). [11] observes that (6) has a norm effect that both Zhangsan (ZS) and Lisi (LS) are tall, an effect absent in its *hái*-less counterpart. [11] argues that *hái* in (6) is incremental, and involves two comparatives: the asserted comparative (COMP^A) (i.e.,the prejacent) and a presupposed comparative (COMP^P); the comparison target of this COMP^P is precisely the comparison standard of the COMP^A (i.e., LS here) whereas the comparison standard of the COMP^P is contextually assigned g(c), which is accommodated to be the norm on the height scale out of the blue. *Hái*, with its summing operation, sums the two differentials: the differential between ZS and LS provided by the COMP^A and the differential between LS and g(c) provided by the COMP^P, leading to the total height differential between ZS and g(c). Recall that g(c) is accommodated to be the norm, thus the norm effect in (6). This analysis is cross-linguistically echoed by [18]'s account of German *noch* with comparatives and [13]'s account of Russian *noch*-like *ešče* with comparatives: *noch* and *ešče* are both translational equivalents of *hái*, and they are both taken to be incremental in their interaction with comparatives and evoke a presupposed comparative. (see [13,18])

(6) Zhangsan bi Lisi **hái** gao.
Zhangsan than Lisi still tall

Zhangsan is even taller than Lisi.

2.3 Building block #3: Incremental operators correlate with a contextually salient scale

[5,8] observe that for English *more*$_{incre}$ to be licensed, the summing of the presupposed eventuality and the asserted eventuality must yield a 'more developed' eventuality s.t. the *more*$_{incre}$-hosting utterance is paraphrasable using 'comparative correlatives'. Consider (7).

(7) I baked three cakes for my son's birthday and a woman I know in New York baked some #**more**$_{incre}$ (cakes). ([5], ex.22b)

[5] observes that *more*$_{incre}$ is not licensed in (7) uttered out of the blue because the presupposed eventuality e^* (my birthday cake baking in the first conjunct) and the asserted eventuality e (the birthday cake baking by the woman in NY in the second conjunct) are 'too unrelated' s.t. their sum ($e \oplus e^*$) does not lead to a more developed one. In contrast, *more*$_{incre}$ gets licensed in a scenario where some rich man suggests donating a certain sum of money for poor children for every birthday cake baked in the world. In this case, the number of cakes baked is correlated with the amount of the donation by the businessman, and (7) can be paraphrased using 'comparative correlatives', viz., the

more cakes baked, the larger the donation is. Likewise, $more_{incre}$ is not licensed in (8B) (cf. the felicitous use of '*too*' as in '*I have three white cats, too*'), but gets licensed in a scenario where the interlocutors are preparing for shooting a cat food advertisement where several white cats are needed. And in this case, (8) can be paraphrased using 'comparative correlatives': the more white cats there are, the faster the ad can be shot.

(8) A: (Telling B about herself, on the first date) I have three white cats.
B: Amazing! I have three #$\mathbf{more}_{incre}$ white cats. ([8], ex.7b)

Based on such observations, [5,8] argue that $more_{incre}$ encodes scale mapping in that the increase on a certain scale S (e.g., the cardinality of cakes baked (7) and the cardinality of white cats available (8)) leads to the increase on another contextually salient scale S^* (e.g., the amount of donation (7) and the speed at which the ad is shot (8)), and formally models this using [1]'s semantics for 'comparative correlatives'. (See additional evidence supporting $more_{incre}$'s correlation with a salient scale in [8]). In addition, German *noch* ([9]), Hebrew *noch*-like *od* ([6]) and Russian *ešče* [12] are all shown to involve scale mapping in this sense on their incremental use. Crucially, we observe that **Mandarin incremental *hái* also involves scale mapping**. The translation equivalents of (7) and (8) using *hái* display the same felicity contrast, as illustrated in (9a) (duplicated from (8B)) (cf. (9b) with *ye*, the Mandarin equivalent of additive *also*). Besides, the additional support [8] provides for $more_{incre}$ also applies to incremental *hái* (see details in the full paper).

(9) wo **ye** / #**hái** you san-zhi bai mao.
1SG also still have three-CL white cat

a. With *hái*: I have three #more_{incre} white cats.
b. With *ye*: I have three white cats, too.

3 The proposal

Given the above research, we adopt three assumptions: (**i**) Hyperbole in general requires mapping to an affective / evaluative scale but hyperbolic *bi* comparatives have trouble in this regard. (**ii**) *Hái* in its interaction with comparatives is incremental, and evokes a presupposed comparative (COMP^P); the comparison target of COMP^P is the comparison standard of the asserted comparative (COMP^A) whereas the comparison standard $g(c)$ of COMP^P is accommodated to be the norm on the adjective-encoded scale. And the differentials provided in COMP^P and COMP^A are summed, due to *hái*'s summing operation, to calculate the total differential between the comparison target of COMP^A and $g(c)$ (accommodated as the norm). (**iii**) Incremental *hái* involves mapping from one scale S (e.g., number of cakes in (7)) to a contextually salient scale S^* (e.g., amount of donation in (7)). Given the three assumptions, we propose that *hái* improves hyperbolic *bi* comparatives because *hái*, as an incremental operator which encodes scale mapping, facilitates mapping to an affective / evaluative scale required by but lacking in such hyperbolic *bi* comparatives. Take (2b) for instance. Suppose that the factual QUD is *'how big is his face after the sting?'* (serving as the S scale), and the affective / evaluative QUD is '*how medically severe is his face condition?*' (serving as the S^* scale). The speaker talks about the medical severity of his face condition by talking about its size, i.e., mapping from S to S^*. Following [3], in (2a) this mapping fails. In contrast, in (2b), *hái*, via its encoded scale mapping, helps to overcome this issue and makes this required mapping achieved. To paraphrase (2b) using 'comparative correlatives' on which [5,8] model scale correlation of $more_{incre}$ (and we adopt for incremental *hái*): The larger the total gap between his face and $g(c)$ (the accommodated norm) is in size, the more serious the medical condition of his face is, thereby achieving mapping from the size scale to the medical severity scale. Note that the total size gap is calculated by summing the size differential between his face and *washbasin* provided by COMP^A and the size differential between *washbasin* and $g(c)$ (which is accommodated to be the norm on the size scale) provided by COMP^P; the total / summed differential between his face and g(c) depends on what is selected as the comparison standard in COMP^A, i.e., the hyperbolically used expression (*washbasin* here): the more extreme the selected item, the larger the summed differential, and the more serious his face condition. In the full paper, we will, by using [17]'s scale segment-based framework which offers a uniform analysis of comparison and our incrementality, present a full composition integrating the various building blocks from the adopted three lines of research.

4 Implications & Open issues

This work engages with and contributes to studies on (**i**) formal perspectives on hyperbole, a phenomenon claimed by e.g., Feinmann (2023) to resist a formal analysis, and (**ii**) scale mapping argued to be involved also in e.g., *even*-like operators and exclamatives.

There are many open issues. **First**, **constraints on the scale**. How we can constrain the choice of the affective / evaluative scale when several options are available? (Thanks to an anonymous reviewer for pointing to this issue.) **Second**, **cross-linguistic variation**. Languages like Mandarin and Vietnamese (thanks to a Vietnamese informant) require a *hái*-like particle in such hyperbolic comparatives whereas languages like English (e.g., (1)) do not. Why this variation? **Third**, **cross-construction variation**. Even within Mandarin, constructions seem to vary w.r.t. whether a *hái*-like particle is required when it comes to hyperbole. For instance, (10), an equative construction, does not need any *hái*-like particle thought it is hyperbolic. **Fourth**, **convetionalisation of hyperbole**. E.g., (11) is not understood literally though without a *hái*-like particle. Expressions like (11) have been conventionlizaed as into a single expression. Two aspects are of interest here. (a) What facilitates the conventionalization? Does frequency play a role? (b) Expressions like (11) are more complex than cases investigated in our work: (11) is more a mixture of hyperbole and metaphor than hyperbole *per se*. In our e.g.,(2), both items under comparison can be measured on the scale encoded by the adjective: Both his face and washbasins can be measured in size. In contrast, in (11), though gold can be measured w.r.t its hardness on a Mohs scale, love is something that cannot be measured in this sense. Intuitively, speakers compare love to some gold-like substance and then compare it with gold w.r.t hardness; this perhaps involves metaphor first and then hyperbole.

(10) ta gen dianxiangan yiyang gao.
3SG with electricity.cable.pole same tall
He is as tall as an utility pole.

(11) qing bi jin jian.
affection than gold hard
The love is stronger than gold.

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The semantics of split-antecedent reciprocals

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1 Introduction

It has been noted in the literature that a reciprocal pronoun can have two or more separate antecedents simultaneously, as in (1) and (2). In (1), for instance, the reciprocal pronoun *each other* has two separate antecedents, *Tom* and *Mary*.

(1) Tom shouted and Mary cried each other's names. (from Chaves (2014))

(2) John sent a Christmas card, and Mary sent a party invitation, to each other's bosses. (from Kubota and Levine (2020, p. 105))

A reciprocal pronoun that has more than one antecedent will be referred to as a split-antecedent reciprocal in this paper. In what follows, it will be shown that the existence of split-antecedent reciprocals poses a challenge to existing theories of the semantics of reciprocals, and an attempt will be made to construct an adequate alternative account using Minimal Recursion Semantics (MRS) (Copestake et al. (2005)).

2 Problems posed by split-antecedent reciprocals

Split-antecedent reciprocals are problematic for all the existing theories of the semantic interpretation of reciprocals, although here I will only discuss the theories presented in Heim, Lasnik, and May (1991) and Haug and Dalrymple (2020).

The theory presented in Heim, Lasnik, and May (1991) is based on the view (i) that a reciprocal pronoun always has a plural antecedent, (ii) that there is an unpronounced distribution operator adjoined to that plural antecedent, and (iii) that the reciprocal itself is interpreted as meaning something like ''every individual in a given group other than x,'' where x is a variable bound by the distribution operator adjoined to the antecedent. In this theory, a sentence like (3) is predicted to mean something like (4).

(3) Chris and Pat saw each other.

(4) Each member x of the group consisting of Chris and Pat saw every individual in that group other than x.

Because the theory contains the assumption that part of the meaning of a reciprocal is a variable bound by the distribution operator adjoined to a plural expression, it cannot be applied to a sentence like (1), in which the antecedent of the reciprocal is not a plural expression but two separate singular proper nouns.

Haug and Dalrymple (2020) propose a theory in which (i) a sentence is interpreted under a set of assignments, not just a single assignment, and (ii) a sentence like *Chris and Pat saw each other* is interpreted in such a way that it means ''Chris saw Pat'' under one assignment and ''Pat saw Chris'' in another. Since the theory relies on the assumption that a reciprocal pronoun has a single antecedent that denotes different entities under different assignments, it cannot be applied to a sentence like (1), where the reciprocal does not have a single antecedent but has different antecedents in different conjuncts.

We could envisage a theory that consists of either Heim et al.'s theory or Haug and Dalrymple's theory and an additional mechanism for dealing with split-antecedent reciprocals, but such a theory would arguably not be a realistic model of speakers' ability to assign truth conditions to the types of sentences that we are considering. The construction exemplified by (1) and (2) is not something that every native speaker is likely to have encountered in the normal course of language acquisition, and its existence should therefore be a consequence of the way simpler sentences like (3) are analyzed. We need to seek a theory of reciprocals that does not have a component designed to deal specifically with split-antecedent reciprocals.

3 An alternative account

Let us say that f is a *reciprocal function* when f is a non-empty set of ordered pairs that satisfies the following condition: $\forall a[\exists b[\langle a, b\rangle \in f] \rightarrow \exists c \exists A[\langle c, A\rangle \in f \wedge a \in A \wedge c \notin A]]$. I submit that a sentence like (3) is associated with a semantic representation like that shown in (5), which contains an existentially bound variable, f, which is forced to denote a reciprocal function, as I will explain below.

(5) c = Chris ∧ p = Pat
∧ some(z, $z = \{c, p\}$,
∃f[reciprocal(f,
every(x, member_of(x, z),
every(y, member_of(y, $f(x)$),
saw(x, y))))])

In this proposed semantic representation, quantification other than that expressed by the existential quantifier binding f is expressed by using a three-place predicate whose first argument is the variable bound by the quantifier, whose second argument is the restriction, and whose third argument is the nuclear scope. The first two lines of (5) are the contribution from the subject noun phrase *Chris and Pat*, the fourth line is the contribution from the unpronounced distribution operator that is assumed to be adjoined to that subject noun phrase, the final line is the contribution from the verb *saw*, and the third line and the fifth line are the contribution from the reciprocal pronoun *each other*. The predicate *member_of*, used in lines 4 and 5, is assumed to be satisfied if and only if the denotation of its first argument is a member of the set denoted by its second argument. The predicate *reciprocal*, used in line 3, is interpreted in the following way.

(6) $[\![\text{reciprocal}(f, X)]\!]^{M,g} = 1$ if and only if the following conditions are met:
- $g(f)$ is a reciprocal function,
- $[\![X]\!]^{M,g} = 1$, and
- there is no assignment g' such that (i) $g'(x) = g(x)$ for every variable x in dom(g) other than f, (ii) $g'(f)$ is a proper subset of $g(f)$, and (iii) $[\![X]\!]^{M,g'} = 1$.

Assuming that $[\![\text{every}(x, R, S)]\!]^{M,g}$ is undefined if for any g' such that $g' \supseteq g$, either $[\![R]\!]^{M,g'}$ or $[\![S]\!]^{M,g'}$ is undefined and that $[\![\text{member\_of}(x, y)]\!]^{M,g}$ is undefined if either $[\![x]\!]^{M,g}$ or $[\![y]\!]^{M,g}$ is undefined, the semantic representation in (5) is true if and only if the second argument of the *reciprocal* predicate is true under an assignment that maps the variable f to the function $\{\langle \text{Chris}, \{\text{Pat}\}\rangle, \langle \text{Pat}, \{\text{Chris}\}\rangle\}$, because in order to satisfy the *reciprocal* predicate here, the domain of the reciprocal function denoted by f has to include Chris and Pat and no other entity. Thus, the sentence is predicted to be true if and only if Chris saw every member of the set {Pat} and Pat saw every member of the set {Chris}.

Following the same strategy of using an existentially bound variable representing a reciprocal function, sentence (1) can be associated with a semantic representation like that shown in (7). Here I am assuming that the noun *names* in this sentence is a dependent plural licensed by the reciprocal pronoun and is hence interpreted in a number-neutral way.

(7) t = Tom $\wedge$ m = Mary
$\wedge\ \exists f$[reciprocal(f,
and(every(w, member_of(w, $f(t)$)),
some(x, name_or_names_of(x, w),
shouted(t, x))),
every(y, member_of(y, $f(m)$)),
some(z, name_or_names_of(z, y),
cried(m, z)))))]

This semantic representation is true if and only if an assignment that maps f to the function $\{\langle \text{Tom}, \{\text{Mary}\}\rangle, \langle \text{Mary}, \{\text{Tom}\}\rangle\}$ makes the second argument of the *reciprocal* predicate true. That means that sentence (1) is predicted to be true if and only if Tom shouted the name or names of every member of the set {Mary} and Mary cried the name or names of every member of the set {Tom}.

Both (5) and (7) express adequate truth conditions, and as will be demonstrated in detail in the next section, they can be produced by a grammar that does not have any component whose sole function is to deal with split-antecedent reciprocals. Moreover, the line of analysis proposed here makes correct predictions when applied to more complicated examples involving disjunction, such as (8).

(8) Chris shouted or Pat cried, and Mary whispered, each other's names.

In the proposed account, this sentence is associated with the semantic representation shown in (9), and is thus predicted to be true if and only if either Chris shouted Mary's name and Mary whispered Chris's name or Pat cried Mary's name and Mary whispered Pat's name, assuming that $[\![\text{or}(d_1, \ldots, d_n)]\!]^{M,g} = 1$ if and only if $[\![d_i]\!]^{M,g} = 1$ for some i, irrespective of whether $[\![d_j]\!]^{M,g}$ is undefined for some j.

(9) c = Chris $\wedge$ p = Pat $\wedge$ m = Mary
$\wedge\ \exists f$[reciprocal(f,
and(or(every(u, member_of(u, $f(c)$)),
some(v, name_or_names_of(v, u),
shouted(c, v))),
every(w, member_of(w, $f(p)$)),
some(x, name_or_names_of(x, w),
cried(p, x)))),
every(y, member_of(y, $f(m)$)),
some(z, name_or_names_of(z, y),
whispered(m, z)))))]

Given the assumptions, the *reciprocal* predicate here can be satisfied only if the variable f is mapped to a reciprocal function whose domain is either {Chris, Mary} or {Pat, Mary}, that is, only if the variable f is mapped either to $\{\langle \text{Chris}, \{\text{Mary}\}\rangle, \langle \text{Mary}, \{\text{Chris}\}\rangle\}$ or to $\{\langle \text{Pat}, \{\text{Mary}\}\rangle, \langle \text{Mary}, \{\text{Pat}\}\rangle\}$.

4 The syntax-semantics interface

In the theory being proposed, the meaning of reciprocity expressed in a simple sentence manifests itself in two separate places in the semantic representation; in the case of (5), for instance, it is the material in line 3 and the material in line 5 that are responsible for the reciprocal meaning. Let us henceforth refer to the *reciprocal* predicate, its first argument, and the existential quantifier that binds it, which are in line 3 in (5), as the upper portion of reciprocal meaning, and to the universal quantifier and its first two arguments, which are in line 5 in (5), as the lower portion of reciprocal meaning.

It seems natural to presume that both the upper portion and the lower portion of reciprocal meaning are part of the meaning of a reciprocal pronoun, but at first blush, that presumption seems to lead to a problem when we consider split-antecedent reciprocals. In the example (1), the reciprocal pronoun is shared by the two conjuncts, and has to be given a different interpretation in each conjunct, since intuitively the reciprocal inside the object of the verb *shouted* in the first conjunct has to refer to Mary whereas the reciprocal inside the object of the verb *cried* in the second conjunct has to refer to Tom. Adopting the MRS-based analysis of right-node raising proposed in Yatabe and Tam (2021), we could allow the reciprocal pronoun to receive different interpretations in different conjuncts and to retain those interpretations even after it has been right-node-raised. However, such an analysis will yield a semantic representation that contains two instances of the upper portion of reciprocal meaning as well as two instances of the lower portion. This is a problem because in the proposed account, the semantic representation for (1) contains two instances of the lower portion of reciprocal meaning but only *one* instance of the upper portion, as shown in (7).

The fact that (7) contains only one instance of the upper portion of reciprocal meaning might seem to indicate that the upper portion here is contributed to the semantic representation not by the reciprocal pronouns (i.e. the one in the first conjunct and the one in the second conjunct, which are fused into one reciprocal pronoun by the operation of right-node raising) but by an unpronounced item that binds both the reciprocals, but such an analysis would be a mistake. In an analysis in which a reciprocal pronoun is assumed to be always bound by a unpronounced item that contributes the upper portion of reciprocal meaning and that item is assumed to be capable of binding more than one reciprocal pronoun at the same time, an example like (10) is incorrectly predicted to be a possible sentence synonymous with (1).

(10) *Tom shouted each other's name(s) and Mary cried each other's name(s).

It is my contention that there are certain independently motivated modifications to be made to the MRS-based analysis proposed in Yatabe and Tam (2021) and that everything falls into place once those modifications are made. Suppose first that the meaning of a lexical item is represented as a set of elementary predications rather than as a list of elementary predications as in the standard version of MRS (Copestake et al. (2005)) and that the meaning of a sentence is represented as a list of sets, each of which represents the meaning of a lexical item contained in the sentence. This is arguably a natural modification to the theory because when the meaning of a lexical item is represented by multiple elementary predications, there is no reason to give any particular linear order to those elementary predications. Suppose also that, when a lexical item is right-node-raised out of two or more phrases and retains the multiple meanings that were assigned to it inside those multiple phrases even after the application of right-node raising, the meaning of the right-node-raised lexical item is the union of those multiple meanings, each of which is a set of elementary predications. In a theory thus modified, the meaning of a reciprocal pronoun that has been right-node-raised out of two conjuncts can be the union of two sets, both containing the upper portion and the lower portion of reciprocal meaning, and will contain two instances of the lower portion and one instance of the upper portion if the upper portions coming from the two conjuncts happen to be identical to each other while the lower portions coming from the two conjuncts happen not to be identical to each other.

Given these modifications to the theory, the grammar will yield the desired result if the lexical item *each other* is given the meaning shown in (11) and is associated with the conditions stated in (12). In (11), the first two elementary predications represent the upper portion and the other two elementary predications represent the lower portion of reciprocal meaning.

(11)
$$\left\{ \begin{bmatrix} \text{HNDL} & \boxed{1} \\ \text{RELN} & \exists \\ \text{VARIABLE} & \boxed{2} \\ \text{SCOPE} & \boxed{3} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & \boxed{3} \\ \text{RELN} & \text{reciprocal} \\ \text{ARG1} & \boxed{2} \\ \text{ARG2} & \boxed{4} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & \boxed{5} \\ \text{RELN} & \text{every} \\ \text{VARIABLE} & \boxed{6} \\ \text{RESTRICTOR} & \boxed{7} \\ \text{SCOPE} & \boxed{8} \end{bmatrix}, \begin{bmatrix} \text{HNDL} & \boxed{7} \\ \text{RELN} & \text{member\_of} \\ \text{MEMBER} & \boxed{6} \\ \text{SET} & \boxed{2}(\boxed{9}) \end{bmatrix} \right\}$$

(12) Conditions: (Note that the denotation of a boxed integer is a piece of feature structure, not something in the outside world.)

a. The INDEX value of the reciprocal pronoun must be identical to the denotation of $\boxed{6}$.

b. The denotation of $\boxed{9}$ must not be identical to the denotation of $\boxed{6}$.

c. The denotation of $\boxed{8}$ must contain at least one occurrence of the variable denoted by $\boxed{9}$.

The conditions in (12) capture, among other things, the fact that *Tom* and *Mary* are obligatorily chosen as the antecedents of *each other* in (1) despite the reciprocal being an exempt anaphor here in the sense defined in Pollard and Sag (1994).

5 Conclusion

I have argued in this paper that the existence of split-antecedent reciprocals necessitates a new theory of reciprocals in which the meaning of a reciprocal involves an existentially bound variable representing a certain type of function, and proposed some modifications to the analysis of right-node raising proposed in Yatabe and Tam (2021) that allow this theory to be formulated in a straightforward fashion.

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Dependency relations inform quantificational scope

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1 Introduction

This paper explores how dependency relations, including anaphora resolution, being the links that tie together lexical content for an interpretation, can contribute to resolving otherwise ambiguous scope relations. The approach is readily compatible with theories such as Meaning Text Theory (Mel'čuk 2016) and Relational Grammar (Perlmutter 1983), where language analysis is about accumulating information through staged relational connections.

The approach is illustrated with a specific implementation, a refinement of Treebank Semantics (Butler 2021), that calculates dependency relations from parsed constituency tree input. The dependency relations that include restriction and scope information for operator dependencies are then processed to derive scoped logical formulas, following assumptions from Discourse Representation Theory (Kamp and Reyle 1993) of existential closure and unselective binding.

The paper is structured as follows. Section 2 introduces data, while section 3 outlines analysis. Section 4 concludes the paper.

2 Some data

With its universally quantified subject and existential object, (1) is ambiguous: true if each princess loves the same prince (the wide scope reading), but also true if each princess loves a possibly different prince (the narrow scope reading).

(1) Every princess loves a prince.

The wide scope reading of (1) is forced for discourse (2): This is how there can be an antecedent for *He* of the second sentence.

(2) Every princess loves a prince. He is handsome.

In contrast, a narrow scope reading is required for (3), with its *handsome* judgement about a prince relativised to each princess.

(3) Every princess loves a prince who is handsome for her.

Following (2), we can expect a successful anaphoric link for (4) if *a car* takes wide scope. But this clashes with expectations of no car gained from the first sentence alone, hence reactions of (4) as ill-formed.

(4) John doesn't have a car. ?It is in the garage.

In contrast to (4), the switch to a wide scope reading in (2) happens as a special case of the narrow scope reading and so adjustment is without the disruption experienced with (4).

The potential for an anaphoric link to *a car* in the first sentence of (4) improves when we can continue to deny the existence of any car, as shown by (5) (adapted from Seuren 2010, p.262).

(5) John doesn't have a car. So it can't be in the garage.

Data of this section supports viewing interpretation as accumulative with dependency relations, including anaphora resolution, contributing to resolving quantificational scope.

3 Analysis

This section outlines analysis for the data in section 2, implemented with the Treebank Semantics approach. The approach applies at scale to data of the Treebank Semantics Parsed Corpus (TSPC; Butler 2023), a corpus of English for general use with hand worked constituency tree analysis for approaching half-a-million words.

Following the TSPC annotation scheme, a constituency tree for (1) above is (6).

(6)
```
(IP-MAT (NP-SBJ;{FEM} (Q Every) (N princess))
        (VBP;~Tn loves)
        (NP-OB1;{MASC} (D a) (N prince))
        (PUNC .))
```

This has word class information: `Q` (quantifier), `N` (noun), `VBD` (past tense verb), `D` (determiner); verb code information: `;~Tn` (transitive verb with noun phrase object); constituency information: `IP-MAT` (matrix clause), `NP` (noun phrase); function information for clause level phrases: `-SBJ` (grammatical subject), `-OB1` (grammatical object); referent feature information used to filter anaphoric antecedent choice: `;{FEM}`, `;{MASC}`.

As a first stage for reaching dependency relation information, (6) is converted into (7).

(7)
```
fresh(['.event','.e'],
closure(
  local(['arg0','arg1'],
    %% contribution of every princess
    launch(x('FEM',1),'.e',
    move('.e','arg0',
    relate(x('QUANT',2),'every__quant',
    move('arg0','h',
    phrase_restriction(local(['h'],pred('princess', ['h'])))),
    %% contribution of a prince
    launch(x('MASC',3),'.e',
    move('.e','arg1',
    tie(
    bodyClimb('.e',
    move('arg1','h',
    phrase_restriction(local(['h'],pred('a_prince', ['h']))))),
  %% contribution of loves
  launch(x('EVENT',4),'.event',
  pred('loves', ['.event','arg0','arg1']))
  )))))))
))
```

Term (7) preserves the essential constituency of (6) while adding information about bindings: sources with `fresh`; point of availability with `closure`; creation with `launch`; subsequent management with `local`, `move`, `phrase_restriction` (remove bindings except `'h'`) and `tie` (conjunction). There is `bodyClimb` to lift content to a point of closure. `relate` and `pred` establish governors for dependencies, with `pred` taking a `'h'` (item, attribute, qualifier) or `'.event'` binding as governor content. Finally, names for dependencies connect governors to governed: `'restriction'` and `'scope'` are internal to `relate` and so hidden in (7); `'arg0'` (logical subject) and `'arg1'` (logical object) come from the information for a transitive verb.

Term (7) is evaluated with respect to an assignment that assigns sequences of values (cf. Vermeulen 1993), with this being the point at which dependency relations are first seen. All following transformations have to do with refactoring these dependencies, starting with a pretty print, (8), that is a TPTP predicate logic formula (where '`?`' is the existential quantifier, while '`!`' would be the universal quantifier). Note that at this point, formulas are a way to encode dependency relations and not final scoped semantic representations of the input.

(8)
```
? [QUANTX2,EVENTX4,FEMX1,MASCX3] :
  ( is_a(QUANTX2,every__quant)
  & restriction(QUANTX2) = FEMX1 & scope(QUANTX2) = EVENTX4
  & is_a(FEMX1,princess)
  & is_a(MASCX3,a_prince)
  & is_a(EVENTX4,loves)
  & arg0(EVENTX4) = FEMX1 & arg1(EVENTX4) = MASCX3 )
```

Formula (8) is transformed to extract a distilled version of the dependency relations with a process that follows conversion to clause normal form (CNF). As an implemented way to reach CNF, we can use the E theorem prover (Schulz, Cruanes, and Vukmirović 2019). A call with the `--cnf` flag converts TPTP input into output CNF. Output is (9) when input is (8).

(9)
```
cnf(i_0_1, plain, (arg1(esk2_0)=esk4_0)).
cnf(i_0_2, plain, (arg0(esk2_0)=esk3_0)).
cnf(i_0_3, plain, (is_a(esk2_0,loves))).
cnf(i_0_4, plain, (scope(esk1_0)=esk2_0)).
cnf(i_0_5, plain, (is_a(esk3_0,princess))).
cnf(i_0_6, plain, (restriction(esk1_0)=esk3_0)).
cnf(i_0_7, plain, (is_a(esk1_0,every__quant))).
cnf(i_0_8, plain, (is_a(esk4_0,a_prince))).
```

Further processing presents the dependency information of (9) as Datalog facts in (10).

(10)
```
arc(every__quant,loves,scope).
arc(every__quant,princess,restriction).
arc(loves,a_prince,arg1).
arc(loves,princess,arg0).
```

While (10) says `princess` is under the restriction of `every__quant` and `loves` is under the scope, construction of a scoped predicate logic formula from the information of (10) could place `a_prince` together with `loves` under the scope of `every__quant` since it needs to contribute the logical object of `loves` or place it outside `every` altogether to bind inside.

Now, let's consider the second sentence of (2) above. This will add the content of (11) to the formula material in (8).

(11)
```
? [...,MASCX5,EVENTX6] :
  ( ... & MASCX5 = MASCX3
  & is_a(EVENTX6,is_handsome) & arg0(EVENTX6) = MASCX5 )
```

Conversion of (8) supplemented by (11) to CNF will add to (9) the conditions of (12).

(12)
```
cnf(i_0_9, plain, (arg0(esk6_0)=esk5_0)).
cnf(i_0_10, plain, (is_a(esk6_0,is_handsome))).
cnf(i_0_11, plain, (esk4_0=esk5_0)).
```

Extra conditions (12) lead to dependency (13) being added to the dependencies of (10).

(13) `arc(is_handsome,a_prince,arg0).`

Notably, `is_handsome` of (13) is content that is not governed by `every__quant`. Following assumptions from Discourse Representation Theory (Kamp and Reyle 1993) of existential closure and unselective binding, and taking (10) with (13) as the basis for a scoped logical formula, the quantificational presence of `a_prince` should occur with a level of existential discourse closure, so as to provide the logical subject for discourse level `is_handsome` and the logical object for under quantification `loves`. Thus, TPTP formula (14) is produced as a final scoped semantic representation for the input, reflecting the wide scope reading for `a_prince`.

(14)
```
? [A_PRINCE,IS_HANDSOME] :
  ( is_a(A_PRINCE,a_prince)
  & ! [PRINCESS] :
      ( is_a(PRINCESS,princess)
     => ? [LOVES] :
          ( is_a(LOVES,loves)
          & has_arg0(LOVES,PRINCESS) & has_arg1(LOVES,A_PRINCE) ) )
  & is_a(IS_HANDSOME,is_handsome)
  & has_arg0(IS_HANDSOME,A_PRINCE) )
```

Formula (14) cashes out the contribution for `every__quant` from (10) as a logical implication with material of its `restriction` dependency as antecedent content and material of its `scope` dependency as consequent content. Moreover, material of the `restriction` dependency without links from outside the quantification is universally quantified (`!`) with scope over the implication, while material confined to the dependency labelled `scope` is existentially quantified (`?`) with scope limited to the consequent.

Now, let's consider the relative clause of (3) above. This will add the content of (15) to the formula material of (8). Note: `inv_arg0` indicates a restrictive logical subject dependency, while `for__nim` indicates an adverbial `for` relation that is not verb selected.

(15)
```
? [...,FEMX5,EVENTX6] :
  ( ... & FEMX5 = FEMX1
  & is_a(EVENTX6,is_handsome)
  & inv_arg0(EVENTX6) = MASCX3 & for__nim(EVENTX6) = FEMX5 )
```

Conversion of (8) supplemented by (15) to CNF will add to (9) the conditions of (16).

(16)
```
cnf(i_0_9, plain, (esk3_0=esk5_0)).
cnf(i_0_10, plain, (inv_arg0(esk6_0)=esk4_0)).
cnf(i_0_11, plain, (for__nim(esk6_0)=esk5_0)).
cnf(i_0_12, plain, (is_a(esk6_0,is_handsome))).
```

Extra conditions (16) lead to dependencies of (17) being added to the dependencies of (10).

(17)
```
arc(is_handsome,a_prince,inv_arg0).
arc(is_handsome,princess,for__nim).
```

Now there is a dependency on `is_handsome` that will need its placement under the scope of `every__quant`. In addition, the dependency connecting `is_handsome` to `a_prince` is labelled `inv_arg0` reflecting how this is restrictive information about `a_prince`. Following this dependency information, the TPTP formula (18) is produced as a final scoped semantic representation for the input reflecting the narrow scope reading for `a_prince`.

(18)
```
! [PRINCESS] :
   ( is_a(PRINCESS,princess)
  => ? [LOVES,A_PRINCE,IS_HANDSOME] :
        ( is_a(LOVES,loves)
        & has_arg0(LOVES,PRINCESS) & has_arg1(LOVES,A_PRINCE)
        & is_a(A_PRINCE,a_prince)
        & has_inv_arg0(A_PRINCE,IS_HANDSOME)
        & is_a(IS_HANDSOME,is_handsome)
        & has_for__nim(IS_HANDSOME,PRINCESS) ) )
```

Analysis for (5) above leads to the dependency relations of (19) to support creation of the formula (20). Here, the anaphoric link manifests as a duplication of content under distinct existential quantifications inside distinct negations, denying the existence of any car.

(19)
```
arc(does_have,john,arg0).
arc(does_have,a_car,arg1).
arc(not,does_have,scope).
arc(not,can_be_in,keep_scope).
arc(can_be_in,a_car,arg0).
arc(can_be_in,the_garage,arg1).
```

(20)
```
( ~ ? [JOHN,DOES_HAVE,A_CAR] :
        ( is_a(JOHN,john)
        & is_a(A_CAR,a_car)
        & is_a(DOES_HAVE,does_have)
        & has_arg0(DOES_HAVE,JOHN) & has_arg1(DOES_HAVE,A_CAR) )
& ~ ? [A_CAR,CAN_BE_IN,THE_GARAGE] :
        ( is_a(A_CAR,a_car)
        & is_a(THE_GARAGE,the_garage)
        & is_a(CAN_BE_IN,can_be_in)
        & has_arg0(CAN_BE_IN,A_CAR) & has_arg1(CAN_BE_IN,THE_GARAGE) ) )
```

4 Summary

This paper explored an analysis of data supporting the idea that dependency relations, including anaphoric relationships, can contribute to resolving otherwise ambiguous scope relations.

Reaching scoped logical formulas relied on insights from Discourse Representation Theory. Notably, there was existential closure of discourse and unselective binding with quantification. Also, there is a role for accessibility as the adjudicator for where quantificational scope holds for given dependencies. This result is welcome: Judgements for dependency relations, including anaphora resolution, are reasonably robust. In contrast, scope is an area where judgements are notoriously difficult and marked by interpreter flexibility.

While the approach of this paper and its implementation are new, it can be viewed as an effort to unite aspects of Discourse Representation Theory with graph based approaches to linguistic analysis such as Meaning-Text Theory and Relational Grammar.

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Local Skolemization

Predicate Logic with Anaphora, Calmed Down

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Abstract. Predicate Logic with Anaphora (PLA) (Dekker, 1994) is the compositional treatment of discourse representation theory whose particular appeal is firm logical foundations, conciseness and minimalism: conservatively extending the ordinary first-order logic just enough to describe discourse anaphora and donkey sentences, while maintaining the standard notions of binding.
In this paper we show that the first-order logic as is, *without any extensions*, is capable of clearly and concisely describing the same anaphoric phenomena: intra- and inter-sentential pronomial anaphora, bound-variable anaphora, conditional and relative-clause donkey sentences, quantificational subordination. Our approach is static, simply-typed, first-order and entirely orthodox. It cleanly separates syntax-semantics interface from the pragmatics of pronoun resolution.
The key idea is the familiar Skolemization, extended to implication formulas without requiring their normalization.

Predicate Logic with Anaphora (PLA) was proposed by Dekker [5] as a compositional and rigorous formulation of discourse representation theory with the fully orthodox notions of scope and binding (unlike its predecessor Dynamic Predicate Logic (DPL) [6]) and as a proper, *dynamic*, extension of ordinary predicate logic. Its main idea is treating (nominal) pronouns as a separate category of terms, distinct from both constants and variables. In stark contrast to DPL, pronouns are not subject to binding. However, PLA is predicated on the pronouns being already resolved. Like DPL, PLA is a dynamic logic theory through and through.

Dekker paper [5] has also identified the principal stumbling block for any logical theory of discourse anaphora: if an antecedent for a pronoun is an indefinite in an earlier sentence in the discourse and the sentence is represented by a closed existential formula, there is no way to refer to that antecedent. We would need an "existential disclosure" so to speak [4]. Dynamic semantics is one way of achieving such disclosure; Σ-types in Dependent Type Semantics is another. (Dynamic semantics and dependent types may, of course, have other uses.)

In this paper we observe that the "existential disclosure" can be achieved by Skolemization, which is the tried-and-true way to replace an existential with its witness. It was proposed back in 1920s and is widely used in logic meta-theory (e.g., in Henkin method for proving completeness) as well as in automated theorem provers.

Based on this observation, we present a theory of intra- and inter-sentential pronomial anaphora, bound-variable anaphora, conditional and relative-clause donkey sentences and quantificational subordination that is based *solely* on the orthodox predicate logic, with no extensions and with the standard model-theoretic semantics. It is static, with the standard notions of scope and binding.

Our goal is to explain the mechanism of anaphoric references in the simplest and rigorous logical terms; give the orthodox classical logic[1] account of discourse anaphora and donkey sentences; reproduce the empirical data (e.g., the absence of binding out

[1] Our approach also works in intuitionistic logic.

of negated and universally quantified clauses). Pronoun resolution is not baked-in but becomes an explicit step, after the semantic analysis.

For the lack of space, and just like PLA, we mostly restrict our attention to singular pronouns whose referent is a bound variable. We use the completely standard classical first-order logic (FOL); see [9] for reference and notation.

Discourse and Bound-Variable Anaphora In our approach, truth conditions are represented as a predicate logic formula, derived using whatever semantic theory (syntax-semantic interface) one prefers. *A pronoun is represented by the term* $F(x_1, \ldots, x_n)$ *where* F *is a fresh function symbol (constant) and* $x_1, \ldots, x_n$ *are the variables in scope.* The following examples illustrate. The simplest is

(1) A man walked. John saw him.

(2) $(\exists x.\, \mathsf{Man}(x) \wedge \mathsf{Walk}(x)) \;\wedge\; \mathsf{Saw}(F_1, \mathsf{John})$

The meaning of the two-sentence discourse (1) is straightforwardly expressed by (2). Since the second sentence has no quantifiers or free variables, 'him' is represented by the constant: F_1.

Recall, an *interpretation* $\mathcal{M} = (\mathcal{D}, \mathcal{I})$ of a logical formula ϕ like (2) is specified by a non-empty set $\mathcal{D}$ (domain of discourse) and an interpretation function $\mathcal{I}$ that maps every constant to a member of $\mathcal{D}$, every arity-n function symbol to a map $\mathcal{D}^n \mapsto \mathcal{D}$ and every arity-n predicate letter to a n-place relation over $\mathcal{D}$. *Satisfaction* is a relation between ϕ, $\mathcal{M}$, and a variable assignment $\mathcal{V}$ mapping variables to elements of $\mathcal{D}$ – notated as $\mathcal{M} \models_{\mathcal{V}} \phi$ and read as $\mathcal{M}$ satisfies ϕ (under the assignment $\mathcal{V}$, which is often left implicit). As an example, $\mathcal{M}$ satisfies an existential formula $\mathcal{M} \models_{\mathcal{V}} \exists x.\, \phi$ if and only if $\mathcal{M} \models_{\mathcal{V}'} \phi$ for some assignment $\mathcal{V}'$ that agrees with $\mathcal{V}$ except possibly at the variable x.

Formula (2) has a variety of satisfying interpretations. In some of them x is interpreted as the same domain element as F_1 (that is, $\mathcal{V}(x) = \mathcal{I}(F_1)$), in some it is not. That corresponds to the range of meanings of (1): the pronoun may be resolved to the object introduced by the indefinite, or it may remain unresolved (that is, refer to something else in the discourse or common knowledge, or just left to the speaker imagination: pragmatic use of pronouns, or exophora [8]).

Skolemization is replacing existentials by constants (generally, function symbols): the witnesses [10]. The Skolemized version of (2) is

(3) $(\mathsf{Man}(C_1) \wedge \mathsf{Walk}(C_1)) \;\wedge\; \mathsf{Saw}(F_1, \mathsf{John})$

where C_1 is a fresh constant. We write the Skolemized version of a formula ϕ as $\mathbb{S}[\phi]$. The Skolemization theorem states that the formulas ϕ and $\mathbb{S}[\phi]$ are *equi-satisfiable*: if there is an interpretation for one, then there is for the other. In order for Skolemization to apply, the formula must be in a prenex or negation normal form (NNF) – in any case, has no quantifiers in the scope of negation or within the left-hand-side of implication.

Therefore, formula (3), like the original (2), has the same variety of satisfying interpretations. In some, C_1 and F_1 are mapped by $\mathcal{I}$ to the same element of $\mathcal{D}$, in some they are not. Again, that corresponds to the range of meanings of (1): the pronoun may be resolved to the object introduced by the indefinite, or it may remain unresolved. If we are interested only in resolved interpretations, we can state so as the side-condition (narrowing of the interpretations): "$\mathcal{I}$ where $\mathcal{I}(C_1) = \mathcal{I}(F_1)$". Alternatively, we may adjoin to (3) an equality

(4) $$(\mathsf{Man}(C_1) \wedge \mathsf{Walk}(C_1)) \;\wedge\; \mathsf{Saw}(F_1, \mathsf{John}) \;\wedge\; C_1 = F_1$$

Now, only interpretations with 'him' referring to the walking man satisfy (4). The restricted formula is, of course, not equivalent to (3); rather, (4) implies (3). The constraint $C_1 = F_1$ is quite like the co-indexing notation commonly used in semantic analyses.

How exactly to resolve a pronoun to an available antecedent – that is, which Skolem constant to pick out of several available – is in the domain of pragmatics and out of scope for us (as it was for Dekker). It is in scope for Butler [2], who describes the procedure in more detail.

The next example: the original sentence, the corresponding logical formula, its Skolemization, and the augmented formula reflecting the pronoun resolution.

(5) A man walked. A passer-by saw him.

(6) $(\exists x.\ \mathsf{Man}(x) \wedge \mathsf{Walk}(x)) \wedge (\exists y.\ \mathsf{PB}(y) \wedge \mathsf{Saw}(F_1(y), y))$

(7) $(\mathsf{Man}(C_1) \wedge \mathsf{Walk}(C_1)) \wedge (\mathsf{PB}(C_2) \wedge \mathsf{Saw}(F_1(C_2), C_2))$

(8) $(\mathsf{Man}(C_1) \wedge \mathsf{Walk}(C_1)) \wedge (\mathsf{PB}(C_2) \wedge \mathsf{Saw}(F_1(C_2), C_2)) \;\wedge\; F_1(C_2) = C_1$

F_1 is interpreted as a function that maps an element of $\mathcal{D}$, such as $\mathcal{I}(C_2)$ to another element of $\mathcal{D}$, which may be equal to $\mathcal{I}(C_1)$, or not. To make sure it is equal we may adjoin the formula as in (8), which hence expresses the resolution of the pronoun. In the related "A colleague left. He said he was ill." the two pronouns are represented by two different constants F_1 and F_2, which may however be interpreted the same, and specified by the resolution condition $F_1 = F_2$. At the stage of deriving a logical formula we, unlike PLA, do not have to decide if the two 'he' refer to the same person or not. We defer the decision to the pragmatic resolution step.

The example "A man walked. Every passer-by saw him." illustrates that only existentials are subject to Skolemization; the universal quantifier is left as is, see [10].

$$(\mathsf{Man}(C_1) \wedge \mathsf{Walk}(C_1)) \wedge (\forall y.\ \mathsf{PB}(y) \rightarrow \mathsf{Saw}(F_1(y), y)) \;\wedge\; \forall x.\ F_1(x) = C_1$$

On the other hand, "Every man walked. He whistled." has only the universal quantification, to which Skolemization does not apply. There is nothing therefore to identify F_1 with. For "No man walked. He whistled." we recall that in order for Skolemization to apply, no quantifier should be in the scope of negation.

(9) $(\neg\exists x.\ \mathsf{Man}(x) \wedge \mathsf{Walk}(x)) \wedge \mathsf{Wh}(F_1) = (\forall x.\ \neg(\mathsf{Man}(x) \wedge \mathsf{Walk}(x))) \wedge \mathsf{Wh}(F_1)$

Therefore, in our example we first have to push the negation in: (9). The result has no existentials and hence no Skolemization applies. The pronoun remains unresolved. Another (intuitionistic) way to understand negation is as an implication to false. The implication is dealt in later, where we return to this example.

The example borrowed from [7] "Exactly one man loves Annie. He is rich" shows that our approach does not over-generate: it does *not* give a reading that there are possibly several men who love Annie, but only one of them is rich. That in "Bryan bought a bottle of wine at every store in the neighborhood. It was always a pinot noir."

one may not drop "always" is a manifestation of quantificational subordination [7]. The Skolem function for "a bottle of wine" must be an arity-1 function symbol, since it is in scope of "every store". It is also an arity-1 symbol in the next phrase, being in the scope of the universal "always". The two function symbols may then be identified. Dropping "always" changes the arity.

Donkey Sentences Donkey sentences are one of the main motivations for developing discourse representation theory and dynamic semantics. The discourse-anaphora donkey sentence "A farmer owns a donkey. He beats it." [5, (1)] is straightforward, as expected. The famously problematic is the conditional donkey sentence "If a farmer owns a donkey he beats it." – or a simplified version (10), see [7, (25)], whose logical formula may be written as (11):

(10) If Sarah owns a donkey, she beats it.

(11) $$(\exists d.\ \mathsf{D}(d)) \to \mathsf{B}(F_1)$$

where D is some predicate concerning Sarah and donkeys and B is about beating. Notably, the consequent is out of scope of the quantifier. The existential being on the left-hand-side of the implication, Skolemization does not apply either. We now show how the "existential disclosure" happens – naturally, without any extensions – and maintaining the scope of all quantifiers.

The solution is simple: observe that for any logical formulas ϕ and ψ

$$\phi \to \psi \ \equiv\ \phi \to (\phi \wedge \psi)$$

both classically and intuitionistically, which leads to

Proposition 1 (Skolemization of implication formulas). *If ϕ is in NNF then $\phi \to \psi$ is equi-satisfiable with $\phi \to \mathbb{S}[\phi] \wedge \psi$*

Therefore, (11) is equivalent to

$$(\exists d.\ \mathsf{D}(d)) \to (\exists d.\ \mathsf{D}(d)) \wedge \mathsf{B}(F_1)$$

Indeed, both formulas express the meaning of the original sentence: either the set of donkeys Sarah owns is empty; or the set of Sarah's donkeys and the set of things she beats are both non-empty. The existential on the right-hand-side of implication (in the consequent) is Skolemizable. We thus obtain the equi-satisfiable

$$(\exists d.\ \mathsf{D}(d)) \to \mathsf{D}(C) \wedge \mathsf{B}(F_1)$$

Just like in the original sentence, there is no guarantee that the sets of donkeys owned by Sarah and what she beats have anything in common. (After all, 'it' in (10) may well refer to something else, other than a donkey. Perhaps, owning a donkey predisposes a person to be violent.) However, the sentence does include the reading that what Sarah beats is a donkey. That is, the Skolem constants C and F_1 may be interpreted the same – or, the constraint $C = F_1$ may be imposed, giving the 'donkey reading' of the sentence. Although not explicit, identifying C and F_1 means that whatever interpretation of C satisfies $\mathsf{D}(C)$, the same domain element – the same donkey – satisfies $\mathsf{B}(F_1)$, i.e., gets beaten. We obtain thus the strong reading of the donkey sentence.

Relative-clause Donkey Sentences and Binding out of DP The other, just as challenging variety of donkey sentences is relative-clause sentences such as (12). They present an additional puzzle, noted by Charlow [3], who contrasted them with inverse linking, (13).

(12) $[_{\mathsf{DP}}$ Every farmer who owns a donkey$_i]$ beats it$_i$.

(13) $[_{\mathsf{DP}}$ Some kid from every city$_i]$ likes it$_i$.

Both sentences exhibit so-called 'binding out of DP' (specifically, the DP marked in the examples). The puzzle is that in (12), 'it' may refer to 'donkey' in case 'a donkey' scopes out of DP, *as well as* when the indefinite is confined within DP (that is, within the scope of "every framer"). The meanings of course differ slightly. On the other hand, in (13) the pronoun can be construed as bound by 'every city' only when 'every city' scopes above 'some kid'. Charlow noted that Barker and Shan analysis of donkey anaphora [1] cannot reproduce the asymmetry: the very mechanism that lets Barker and Shan analyze donkey anaphora would apply to inverse linking, and incorrectly predict inverse linking for the narrow scope of 'every city'.

We analyze the relative-clause donkey sentence as (14), which becomes (15) upon Skolemization:

(14) $$\forall f.\ \mathsf{Farmer}(f) \to (\exists d.\ \mathsf{Donkey}(d) \wedge \mathsf{Own}(d, f)) \to \mathsf{Beat}(F_1(f), f)$$

(15) $$\forall f.\ \mathsf{Farmer}(f) \to (\exists d.\ \mathsf{Donkey}(d) \wedge \mathsf{Own}(d, f)) \to \mathsf{Donkey}(C_1(f)) \wedge \mathsf{Own}(C_1(f), f) \wedge \mathsf{Beat}(F_1(f), f)$$

The function symbol F_1 may be identified with C_1, giving the donkey reading.

For (13), we obtain, for the surface and inverse scoping, resp.:

(16) $$\mathsf{Kid}(C_k) \wedge (\forall c.\ \mathsf{From}(C_k, c)) \wedge \mathsf{Like}(F_1, C_k)$$

(17) $$\forall c.\ \mathsf{Kid}(C_k(c)) \wedge \mathsf{From}(C_k(c), c) \wedge \mathsf{Like}(F_1(c), C_k(c))$$

Identifying 'it' with the city (that is, interpreting $F_1(c)$ as c) is indeed only possible upon the inverse scope.

The full paper has much more detail and discussion.

In conclusion, We have described how the ordinary orthodox predicate logic by itself, without any extensions, represents a variety of discourse and donkey anaphora. We employ the standard Skolemization, and extend it to apply to implication without prior normalization (which makes it applicable, incidentally, to intuitionistic logic).

For future work, we would like to analyze further anaphoric phenomena: paycheck pronouns, epistemic modalities, telescoping and parascoping.

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A Proof-theoretic Analysis of VP Ellipsis

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1 VP Ellipsis

Verb phrase (VP) ellipsis is a linguistic phenomenon so named because the semantic content of an anaphoric verb phrase, such as *did (too)* and its elliptical inversion *so did* is "elided" (or left unpronounced) in discourse. A mini-discourse (1) provides an example of VP ellipsis, where *Bill did (too)* and *So did Bill* in (1b) are interpreted as elided forms of a verb phrase *praised his father*.[1]

(1) a. John praised his father.
 b. Bill did, too. / So did Bill.

The analysis of VP ellipsis began with the central problem of how to derive the strict/sloppy ambiguity, which arises when the pronoun *his* in (1a) is interpreted as being coreferential with *John* (the reading *John praised his own father*). In this case, the *strict* reading of (1) is the one in which (1b) entails *Bill praised John's father*, whereas the *sloppy* reading of (1) is the one in which it entails *Bill praised Bill's own father*.

Early research adopted two major approaches to derive this ambiguity. One, known as the syntactic approach (Ross, 1967; Hankamer and Sag, 1976; Sag, 1976; Williams, 1977; Fiengo and May, 1994; Fox, 1999; Merchant, 2008), combined operations such as Quantifier Raising (QR) at LF with PF-deletion or VP-copying. In contrast, the semantic approach (Dalrymple et al., 1991; Asher, 1993; Bos, 2012; Wijnholds and Sadrzadeh, 2018; McPheat et al., 2021; Bumford and Charlow, 2022) treated VP ellipsis as a higher-order anaphora and sought a semantic solution. While various debates on the correct approach arose throughout the 1990s and 2000s, a unified analysis has yet to be established. Among the debates are the problems of (i) split antecedents and (ii) voice mismatch, both of which were pointed out by Hardt (1999). The problem of split antecedents arises when an elided VP in a discourse like (2) has a reading that is equivalent to *swim the English Channel and climb Kilimanjaro*, even though no single syntactic constituent corresponding to this content exists in the overt structure.

(2) Mary swam the English Channel, and Jane climbed Kilimanjaro. So did John.

Voice mismatch, on the other hand, refers to the observation that in a discourse like (3), the elided content can be recovered in the active voice despite its antecedent being passive, namely, the reading *Bill cited Mary's paper*.

(3) Mary's paper was cited by John. So did Bill.

While both of these phenomena pose problems for the syntactic approach, no single semantic analysis has yet been able to solve them simultaneously.

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[1]Following Hankamer and Sag (1976), we distinguish surface anaphora such as *did (too)/so did* and deep anaphora such as *did it* and *did so*, which do not require a linguistic antecedent in discourse. This paper focuses on surface anaphora, and we will discuss deep anaphora in another oppotunity.

The goal of this paper is to propose a novel semantic approach within the framework of dependent type semantics (DTS: Bekki (2014)). This analysis not only demonstrate a unified derivation of the strict/sloppy ambiguity but also provides a solution to the problems of split antecedents and voice mismatch. The core ideas are twofold: (i) any verb phrase can optionally undergo a *VP raising* operation, which adds its content to the signature (which serves as a common ground in DTS) through the global accommodation; and (ii) the elided VP functions as a higher-order anaphora whose content is proof-theoretically constructed from the contents available in the signature. In the following, we will first briefly describe DTS and then explain these two theoretical hypotheses.

2 Dependent Type Semantics

DTS is a verificational theory of meaning based on Martin-Löf type theory (MLTT: Martin-Löf (1984)). In particular, DTS employs underspecified dependent type theory (UDTT), which extendeds MLTT with *underspecified types* that represent the lexical contributions of anaphoric expressions and presupposition/CI triggers. This allows for a uniform analysis of the *projective* contents of natural language while maintaining the compositionality required at the syntax-semantics interface. This is achieved by performing proof search during UDTT's type checking and inference procedure (Bekki, 2021). This proof search is the same process that is used to calculates the validity of inferences between sentences. The type checking, type inference, and proof search are defined as functions that take UDTT queries of the forms $\Gamma \vdash M : A$, $\Gamma \vdash M : ?$, and $\Gamma \vdash ? : A$, respectively, as input and return a list of MLTT proof diagrams (it returns an empty list when it fails). In particular, the proof diagrams resulting from type checking shows the well-formedness of a semantic representation (henceforth SR), which is type in MLTT, and which corresponds to a certain reading of the given sentence.

We assume Combinatory Categorial Grammar (CCG: Steedman (1997, 2024)) as our syntactic theory for the following discussion, and the syntactic structure of (1a), and the lexical items in (1a), as provided below. For the sake of brevity, we omit the analysis of events and tense.

(4) $[_S[_{NP}\ \texttt{John}][_{S\backslash NP}[_{S\backslash NP/NP}\ \texttt{praised}][_{\boldsymbol{T}\backslash(\boldsymbol{T}/NP)}[_{\boldsymbol{T}\backslash(\boldsymbol{T}/NP)/(N/NP)}\ \texttt{his}][_{N/NP_{of}}\ \texttt{father}]]]]$

(5)
$$\begin{array}{l}[\![\texttt{John} \vdash NP]\!] \stackrel{def}{\equiv} j,\\ [\![\texttt{praised} \vdash S\backslash NP/NP]\!] \stackrel{def}{\equiv} \lambda y.\lambda x.\mathbf{praise}(x,y),\\ [\![\texttt{father} \vdash N/NP_{of}]\!] \stackrel{def}{\equiv} \lambda z.\lambda y.\mathbf{fatherOf}(y,z),\end{array} \quad [\![\texttt{his} \vdash \boldsymbol{T}\backslash(\boldsymbol{T}/NP)/(N/NP)]\!] \stackrel{def}{\equiv} \lambda r.\lambda p.\lambda\vec{x}.\begin{bmatrix} u@\begin{bmatrix} x:\mathsf{e}\\ \mathbf{male}(x)\end{bmatrix}\\ v@\begin{bmatrix} y:\mathsf{e}\\ r(y)(\pi_1 u)\end{bmatrix}\\ p\vec{x}(\pi_1 v)\end{bmatrix}$$

Here and in all subsequent discussion, e is an abbreviation for entity. The entity type is one of the enumeration types within DTS, and it serves as the type designated for existent beings.

Semantic composition yields the SR for (1a) as the preterm shown on the left side of (6), where u and v are variables corresponding to the proof terms of *his* and his father, respectively. In order for the semantic felicity condition (SFC) to be fulfilled, DTS initiates the type-checking procedure on the judgment on the left of (6). This process, in turn, triggers a proof search for the underspecified type $u@\ldots$, as shown on the right of (6). Specifically, this is a search for the antecedent of *his* that returns a set of proof diagrams, each corresponding to a potential male antecedents available in the context.

(6)
$$\Gamma \vdash_{\mathbf{UDTT}} \begin{bmatrix} u@\begin{bmatrix} x:\mathsf{e}\\ \mathbf{male}(x)\end{bmatrix}\\ v@\begin{bmatrix} y:\mathsf{e}\\ \mathbf{fatherOf}(y,\pi_1 u)\end{bmatrix}\\ \mathbf{praise}(j,\pi_1 v)\end{bmatrix} : \mathbf{type} \qquad \Gamma \vdash ? : \begin{bmatrix} x:\mathsf{e}\\ \mathbf{male}(x)\end{bmatrix} \rightsquigarrow \left\{ \dfrac{\overline{j:\mathsf{e}}^{\,\{\}F} \quad \overline{mj:\mathbf{male}(j)}^{\,(VAR)}}{(j,mj):\begin{bmatrix} x:\mathsf{e}\\ \mathbf{male}(x)\end{bmatrix}}, \ldots \right\}$$

In the branch of the search where *John* is selected as the antecedent, the variable u is replaced with the proof term (j, mj). Consequently, the term $\pi_1 u$ is reduced to j, and type checking continues until it reaches the judgment on the left of (7). Assuming that $\mathbf{f}$ is a function of type $\mathsf{e} \to \mathsf{e}$ that returns the father of a given entity (i.e., we have the assumption $f : (x : \mathsf{e}) \to \mathbf{fatherOf}(\mathbf{f}x, x)$ in the signature), the presupposition that John has a father is bound in a similar manner to (6), yielding the term on the right of (7). The resulting SR for (1a) is shown in (7), which represents one of the possible coreference readings.

(7) $$\Gamma \vdash_{\mathbf{UDTT}} \begin{bmatrix} v@\begin{bmatrix} y : \mathsf{e} \\ \mathbf{fatherOf}(y, j) \end{bmatrix} \\ \mathbf{praise}(j, \pi_1 v) \end{bmatrix} : \mathsf{type}$$

3 VP Ellipsis in DTS

Following Hockenmaier and Steedman (2005), we assume that the syntactic types of *so did* and *did (too)* are, as a whole, S/NP and $S\backslash NP$, respectively.[2]The SR of *so did* is given as the left side of (8), where $\mathbf{U}$ is the first universe of MLTT and dec is the constructor that decodes a term from the first universe into its corresponding type.[3] The SR of *So did Bill* is shown on the right side of (8).

(8) $$[\![\texttt{so did} \vdash S/NP]\!] \stackrel{def}{\equiv} : \lambda x. \begin{bmatrix} v@(\mathsf{e} \to \mathbf{U}) \\ \mathsf{dec}\,(vx) \end{bmatrix} \qquad [\![\texttt{so did Bill} \vdash S]\!] \stackrel{def}{\equiv} : \begin{bmatrix} v@(\mathsf{e} \to \mathbf{U}) \\ \mathsf{dec}\,(vb) \end{bmatrix}$$

A key challenge for the standard combination of CCG and DTS is that the first sentence of the discourse must provide an antecedent for the VP anaphora in the second sentence. For that purpuse, we assume the existence of the following empty categories, which we call `vpRaising`.

(9) $$\begin{aligned} & [\![\texttt{vpRaising} \vdash S_{+raise}\backslash NP\backslash(S_{+event,-neg,-raise}\backslash NP)]\!] \\ = \; & [\![\texttt{vpRaising} \vdash S_{+raise,+psv}/NP\backslash(S_{+event,-neg,-raise,+psv}/NP)]\!] \\ = \; & \lambda v.\lambda x. \begin{bmatrix} p@\begin{bmatrix} v' : \mathsf{e} \to \mathbf{U} \\ v =_{\mathsf{e}\to\mathsf{type}} \lambda z.\mathsf{dec}\,(v'z) \end{bmatrix} \\ \mathsf{dec}\,((\pi_1 p)x) \end{bmatrix} \end{aligned}$$

Intuitively, `vpRaising` takes a phrase of the syntactic type $VP \equiv S\backslash NP$ as its argument[4], represented by a variable v. It then asserts that the *name* of some one-place predicate v' corresponds to this VP[5],and the subject x satisfies this predicate. We assume that the use of `vpRaising` serves as a *last resort*: the syntactic parser first analyses a discourse using a lexicon without `vpRaising`. If this initial analysis fails to satisfy the semantic felicity condition due to the absence of a VP antecedent, the parser reanalyzes the discourse using a lexicon extended with `vpRaising`. The syntactic feature $\pm raise$ blocks the recursive (and vacuous) application of `vpRaising` to a VP, and the syntactic feature $-neg$ blocks its application to the negated VP. For instance, the sentence *John does not praise his father, but Bill does* lacks a reading in which Bill does *not* praise his father.

3.1 Demonstration: Deriving Strict/Sloppy Readings

Reanalyzing the first sentence via `vpRaising` yields the syntactic structure in (10), where the internal structure of *praised his father* remains the same as in (4). The semantic composition of this structure boils down to

[2]For the sake of brevity, we do not analyze their internal structures here, nor do we describe the presuppositional content of *too*, though we note that the latter can be analyzed by a standard analysis of presupposition.

[3]dec is T in the notation of Martin-Löf (1984). We will discuss in the full paper why the variable v' should not be of type $\mathsf{e} \to \mathsf{type}$.

[4]This rule only applies to a verb phrase whose subject is of the syntactic category NP. An anonymous reviewer, however, correctly pointed out that, in the following cases, each subject has a syntactic type other than NP:

(1) a. The proposition that the earth is flat is believed, and so is the claim that vaccines are dangerous. (**Propositions**)
b. Who won the game is known, so is who lost it. (**Questions**)
c. The temperature of this room is increasing, and so is the temperature of that room. (**Higher-order concepts**)

This necessitates a polymorphic version of (9). This will be discussed further in the full paper.

[5]This means that for any term z of type e, $v(z)$ and the decoded pz are intentionally equivalent.

the type checking in (11).

(10) $[_S[_{NP}\ \texttt{John}][_{S\backslash NP}[_{S\backslash NP/(S\backslash NP)}\ \texttt{vpRaising}][_{S\backslash NP}\ \texttt{praised his father}]]]$

(11) $$\Gamma \vdash_{\mathbf{UDTT}} \left[\begin{array}{l} p@\left[\begin{array}{l} v' : \mathsf{e} \to \mathbf{U} \\ \lambda z.\left[u@\left[\begin{array}{l} x : \mathsf{e} \\ \mathbf{male}(x) \end{array}\right] \times v@\left[\begin{array}{l} y : \mathsf{e} \\ \mathbf{fatherOf}(y, \pi_1 u) \end{array}\right] \times \mathbf{praise}(z, \pi_1 v)\right] =_{\mathsf{e}\to\mathsf{type}} \lambda z.\mathsf{dec}\,(v'z) \end{array}\right] \\ \mathsf{dec}\,((\pi_1 p)(j)) \end{array}\right] : \mathsf{type}$$

Type checking in (11) evaluates the left side of the intensional equality in the second line, as shown in (12). Unlike the process in (6), the anaphora resolution of $u@\ldots$ now occurs within the scope of the variable z.

(12) $$\Gamma,\ v' : \mathsf{e} \to \mathbf{U},\ z : \mathsf{e} \vdash_{\mathbf{UDTT}} \left[u@\left[\begin{array}{l} x : \mathsf{e} \\ \mathbf{male}(x) \end{array}\right] \times v@\left[\begin{array}{l} y : \mathsf{e} \\ \mathbf{fatherOf}(y, \pi_1 u) \end{array}\right] \times \mathbf{praise}(z, \pi_1 v)\right] : \mathsf{type}$$

This underspecified type $u@\ldots$ triggers the following proof search.

(13) $$\Gamma,\ v' : \mathsf{e} \to \mathbf{U},\ z : \mathsf{e} \vdash_{\mathbf{DTT}} \ ? : \left[\begin{array}{l} x : \mathsf{e} \\ \mathbf{male}(x) \end{array}\right]$$

This process mirrors the one in (6), but with a crucial difference: the context now includes $z : \mathsf{e}$. The presence of z provides an alternative antecedent for $x : \mathsf{e}$, which enables the BVA reading of *his*. Assuming mz is a proof that the entity z is a male, the pair (z, mz) becomes a solution for (13). This solution, in which the antecedent of *his* is the subject of the verb phrase *praise his father*, corresponds to the BVA reading and is made available only by the application of `vpRaising`.

The original solution from (6), the pair (j, mj), also serves as a solution for (13), which yields a coreference reading.[6] Thus, the anaphora resolution of *his* is ambiguous between (j, mj) and (z, mz). Since $\pi_1(j, mj) = j$ and $\pi_1(z, mz) = z$, each solution replaces $\pi_1 u$ in (12) with j and z, respectively, and the type checking proceeds to check (14).[7]

(14) $$\Gamma,\ v' : \mathsf{e} \to \mathbf{U},\ z : \mathsf{e} \vdash_{\mathbf{UDTT}} \left[\begin{array}{l} v@\left[\begin{array}{l} y : \mathsf{e} \\ \mathbf{fatherOf}(y, j) \end{array}\right] \\ \mathbf{praise}(z, \pi_1 v) \end{array}\right] : \mathsf{type} \qquad \Gamma,\ v' : \mathsf{e} \to \mathbf{U},\ z : \mathsf{e} \vdash_{\mathbf{UDTT}} \left[\begin{array}{l} v@\left[\begin{array}{l} y : \mathsf{e} \\ \mathbf{fatherOf}(y, z) \end{array}\right] \\ \mathbf{praise}(z, \pi_1 v) \end{array}\right] : \mathsf{type}$$

Through a process nearly identical to (7), the presupposition triggered by the underspecified type $v@\ldots$ is bound by $(\mathbf{f}(j), f(j))$ and $(\mathbf{f}(z), f(z))$, respectively. Given that $\pi_1(\mathbf{f}(j), f(j)) = \mathbf{f}(j)$ and $\pi_1(\mathbf{f}(z), f(z)) = \mathbf{f}(z)$, the occurrence of $\pi_1 v$ in (14) is replaced by $\mathbf{f}(j)$ and $\mathbf{f}(z)$. This results in the SRs shown in (15) for the SRs of (1a), representing both the strict and the sloppy readings. These SRs are derived under the updated signatures $p : (v' : \mathsf{e} \to \mathbf{U} \times (\lambda z.\mathbf{praise}(z, \mathbf{f}(j)) = \lambda z.\mathsf{dec}\,(v'(z))))$ and $p : (v' : \mathsf{e} \to \mathbf{U} \times (\lambda z.\mathbf{praise}(z, \mathbf{f}(z)) = \lambda z.\mathsf{dec}\,(v'(z))))$, respectively.

(15) $\Gamma \vdash_{\mathbf{DTT}} \mathsf{dec}\,((\pi_1 p)(j))$

Recall that the SR of the second sentence *So did Bill* in (1b) is given as (8). When (8) is progressively conjoined with (15), the constant symbol p in the signature provides an antecedent $\pi_1 p$ for the higher-order underspecified type $v@\ldots$, we derive the following SR for the discourse in (1).

(16) $\mathsf{dec}\,((\pi_1 p)j) \times \mathsf{dec}\,((\pi_1 p)b)$

Since $\pi_2 p$ is a proof of the intensional equations $\lambda z.\mathbf{praise}(z, \mathbf{f}(j)) = \lambda z.\mathsf{dec}\,((\pi_1 p)(z))$ and $\lambda z.\mathbf{praise}(z, \mathbf{f}(z)) = \lambda z.\mathsf{dec}\,((\pi_1 p)(z))$, we can prove via intensional equality that (16) is equivalent to $\mathbf{praise}(j, \mathbf{f}(j)) \times \mathbf{praise}(b, \mathbf{f}(j))$ in the case of the strict reading, and to $\mathbf{praise}(j, \mathbf{f}(j)) \times \mathbf{praise}(b, \mathbf{f}(b))$ in the case of the sloppy reading. In both readings, the first sentence asserts that j praised j's father, while the second sentence remains ambiguous, asserting either that b praised j's father (strict reading) or that b praised b's father (sloppy reading). This prediction correctly captures the truth conditions, and is derived by a completely compositional process.

[6] Alternatively, we may formalize `vpRaising` as a unary rule instead of as an empty category. However, these options yield different predictions for right-node raising constructions. We discuss the details in the full paper.

[7] We assume for this proof search that the proof of $\mathbf{male}(z)$ can be omitted, and the process focus solely on finding an entity. The details will be provided in the full paper, but the approach is empirically justified by the existence of sloppy readings in VP ellipsis constructions such as *John praised his father. So did Mary*, where *Mary* is not necessarily male.

3.2 DTS on Split Antecedents

In cases of split antecedents such as (2), we assume that VP-raising applies to the first two sentences. We further assume that, following global accommodation, the variables v_1, v_2 are set to functions of type $\mathsf{e} \to \mathbf{U}$ corresponding to the denotations of *swim the EC* and *climb K*, respectively. The underspecified type associated with the ellipsis site in *so did John* can then be resolved during proof search by constructing the proof term $\lambda x.(v_1(x) \times v_2(x))$. This allows the elided VP to take on the combined content of *swim the EC and climb K* as its antecedent. This process prevents overgeneration because the signature contains no other predicates of type $\mathsf{e} \to \mathbf{U}$ besides those introduced through VP-raising and global accommodation.

3.3 DTS on Voice Mismatch

In cases of voice mismatch, such as that in (3), we propose that the first sentence is assigned a CCG syntactic structure as follows.

(17) $[_{S_{+psv}\backslash NP}[_{\boldsymbol{T}/(\boldsymbol{T}\backslash NP)}$ `Mary's paper`$][_{S\backslash NP/NP}[_{S_{+psv}\backslash NP/(S_{pp}\backslash NP)}$ `was`$][_{S_{pp}\backslash NP/NP}[_{S_{pp}\backslash NP/NP_{by}}$ `cited`$][_{\boldsymbol{T}/NP\backslash(\boldsymbol{T}/NP_{by})}$ `by`$]]]]$

This yields a constituent with the overall syntactic type S_{+psv}/NP, to which the second definition of VP-raising can be applied. Through this mechanism, the content corresponding to *Mary's paper was cited by __* is introduced into the signature via global accommodation, thereby allowing the elided VP to refer to it. A more detailed account of these processes will be provided in the full paper.

4 Conclusion and Perspectives

We presented an analysis of VP ellipsis within the framework of DTS, which consists of an introduction of the empty category `vpRaising` in categorial syntax, which provides the first sentence the capacity to provide a higher-order antecedent. However, this gives a pronoun like *his* another antecedent as a side-effect, by introducing a VP-level equation where the subject variable provides an antecedent for the BVA reading that yields the sloppy reading. This is compositionally and computationally derived through the anaphora resolution algorithm of DTS, consisting of type checking in UDTT and a proof search in DTT. An important point is that the strict/sloppy ambiguity comes only from the difference of an antecedent of *his*. The higher-order antecedent of *So did Bill* or *Bill did (too)* is identical between the two readings. We also emphasize that we do not pose any syntactic and semantic assumptions other than `vpRaising`.

Moreover, our analysis yields a correct prediction for the case of an intra-sentential VP ellipsis such as (18) by applying the analysis of donkey anaphora of DTS, which is also discussed in the full paper.

(18) A person who promised to help never did.

Unlike (18), the sentence such as (19) is reported as unacceptable.

(19) A proof that the God exists ever does.

We suspect that the anacceptability comes from the property of `vpRaising` that it only applies to non-stative verb phrase, which is the reason why the argument *VP* is specified as *+event*.

While the present analysis does not immediately constitute a unified account of VP ellipsis, we believe it provides a foundation for future research in this domain. Remaining problems, such as reflexive pronouns and vehicle change, Antecedent Contained Deletion (ACD), are not directly covered by this analysis, but extending our framework to account for these cases is left for future work.

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Split and compose:
Deriving long-distance dependencies in a continuation-based grammar

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Overview The *continuation-based grammar* (Barker & Shan, 2014), which provides an appealing account of scope and binding without employing the notion of c-command, is known to struggle to capture the weak crossover effect in long-distance dependencies (Leong & Erlewine, 2019). To address this issue, we introduce a new combinatory rule SPLIT into the continuation-based grammar. This rule, together with the mechanism of *function composition* (Steedman, 2000), allows the scope of a *wh*-phrase to be appropriately reconstructed to its original position, correctly predicting the behavior of binding in long-distance dependencies.

Background Bound variable anaphora is an essential domain of inquiry in the study of the syntax-semantics interface. While binding is conventionally assumed to require the binder to c-command the pronoun from an A-position (Reinhart, 1983), this view has been challenged by counterexamples such as (1a) (binding out of a possessor) and (1b) (binding out of a VP) (Barker, 2012).

(1) a. [Every$_i$ girl's mother] praised her$_i$. b. We [sell no$_i$ wine] before its$_i$ time.

Against this backdrop, Barker and Shan (henceforth B&S) developed a categorial grammatical framework which derives binding via the left-to-right composition of quantifier scope. Their central assumption is that scope-taking expressions denote functions over their *continuation* (i.e., their surrounding content). Correspondingly, a scope-taker has a syntactic category of the form $C \mathbin{/\!\!/} (A \mathbin{\backslash\!\!\backslash} B)$, where $Y \mathbin{\backslash\!\!\backslash} X$ (resp. $X \mathbin{/\!\!/} Y$) refers to expressions that return X when given Y inside (resp. outside). Intuitively, this complex category indicates that the scope-taker is locally A, takes scope over B, and results in C given its continuation. The behavior of these scope-taker categories is defined by the rules shown in Figure 1, where we use the *tower notation*, which separates the scope-level information above the line.

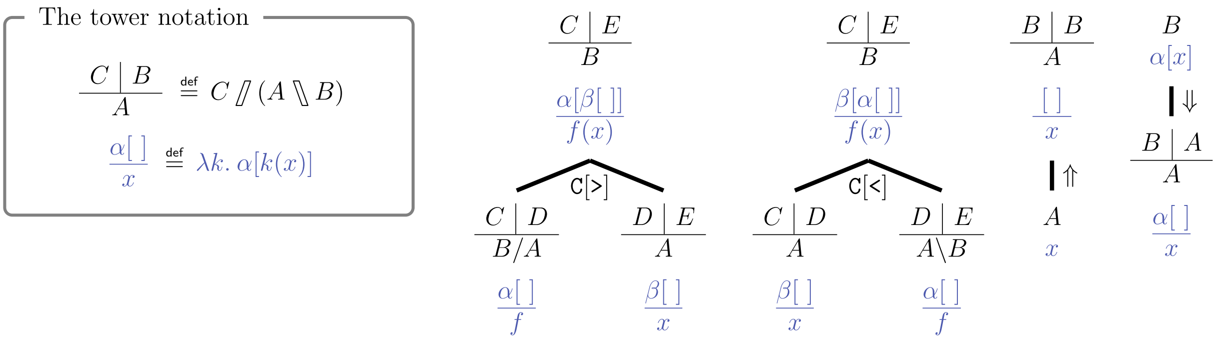
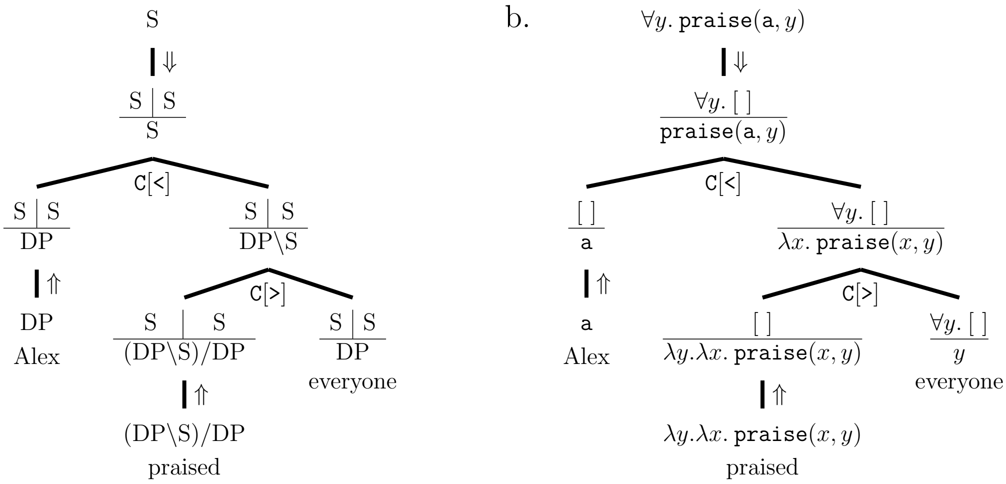


Figure 1: Basic combinatory rules

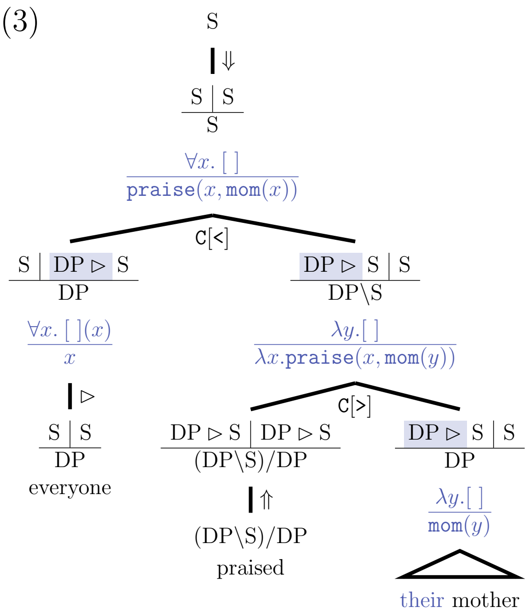
To illustrate their usage, consider the sentence *Alex praised everyone*. We show its derivation in (2), separating the syntactic categories and the denotations for readability. Here, we first apply LIFT $\Uparrow$ to the non-scope-takers (*Alex* and *praised*). Then, we successively apply the "continuized" function application (C[>] and C[<]), which composes scope *from left to right*, regardless of the direction of the function application done at the bottom level. At the root of the tree, we complete the derivation by collapsing the tower with LOWER $\Downarrow$.

(2) a. b.



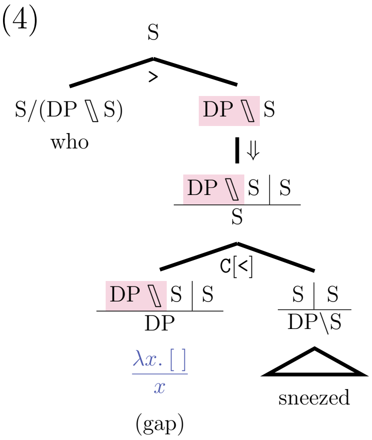
Turning to binding, B&S posit that expressions containing an unbound pronoun have a distinguished category DP $\rhd$ A and denote a function from entities (Jacobson, 1999). Consider (3) for example. Crucially, *their mother* is treated as a scope-taker, with DP $\rhd$ placed on the scope level. On the side of the subject, we apply a unary rule BIND $\rhd$ that makes a scope-taker require an unbound pronoun on its right. At the root of the tree, these two occurrences of DP $\rhd$ cancel each other. Semantically, this amounts to saturating λy with the variable x bound by the quantifier, which yields the desired bound-variable interpretation. Remarkably, this scope-based analysis of binding can immediately capture the problematic cases like (1a) and (1b), since, in these cases too, the quantifier takes scope over the pronoun.

(3)



B&S extend this account to cases where a *wh*-phrase binds a pronoun (e.g., *Who$_i$ praised their$_i$ mother?*), by stipulating a covert operator for the gap. As depicted in (4), a gap introduces the category DP $\bbslash$ S (i.e., a sentence missing a DP inside), which serves as the argument of the *wh*-phrase. Since gaps take scope like quantifiers, a *wh*-phrase can bind a pronoun via the gap: we can construct a derivation parallel to (3) by applying $\rhd$ to the gap.

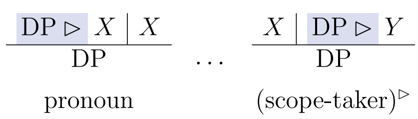
(4)



Finally, their linear order-based account can be applied to the *weak crossover* effect (Postal, 1971), exemplified by (5). The crossover cases have a common configuration, schematized on the right, where the pronoun precedes the scope-taker (e.g., quantifiers, gaps). The account correctly blocks binding since the scope-level composition proceeds from left to right.

(5) a. ?* Their$_i$ mother praised everyone$_i$.

b. ?* Whom$_i$ did their$_i$ mother praise __?



In this way, B&S's framework provides a promising account of binding based on the left-to-right composition of scope, which is made possible by the notion of continuations.

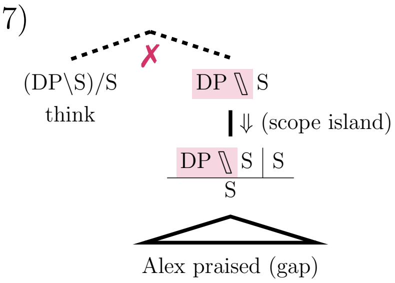
Problem However, this framework faces a serious issue in handling long-distance dependencies.

(6) Whom does Kim think [Alex praised __]?

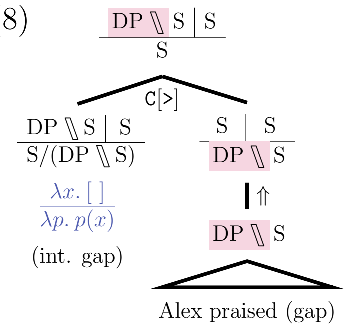
We show an attempted derivation of (6) in (7). Once we derive the finite clause, which is a scope island, we need to apply ⇓ to prevent further scope-taking (Charlow, 2014). Then, there is no way to compose the resultant DP ⑊ S with the complement-taking verb *think*.

As a possible remedy, Leong and Erlewine (2019) posited an *intermediate gap* at the edge of the finite clause (as an analogue of successive cyclic movement), which "re-lifts" DP ⑊ as shown in (8), allowing us to derive (6). However, this revision incorrectly permits binding in (9), an instance of weak crossover. This is because, since the intermediate gap precedes the pronoun, *whom* can bind the pronoun via the intermediate gap, as depicted on the right of (9).

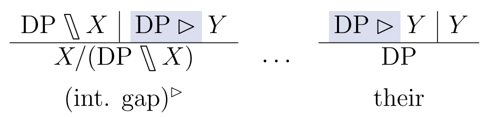
(7)



(8)



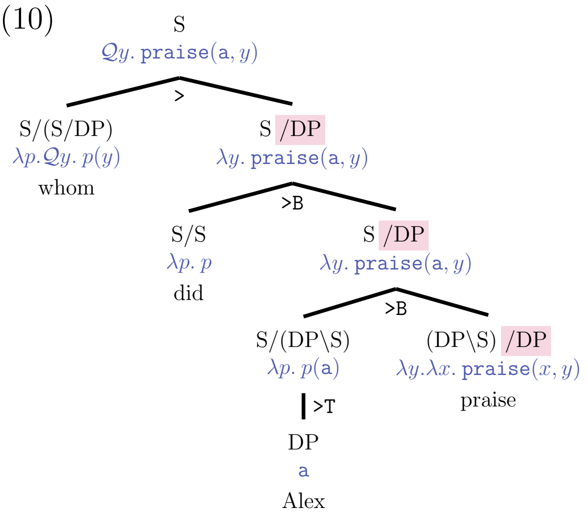
(9) ?* Whom$_i$ does Kim think __ [their$_i$ mother praised __]?



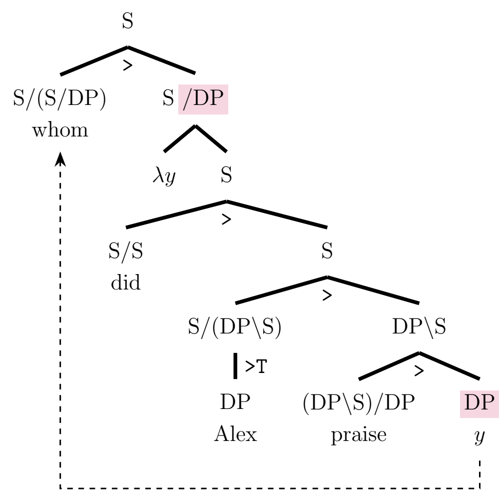
Leong and Erlewine (2019) argued that the core of the issue is that B&S's framework establishes *wh*-dependencies with the same mechanism as scope-taking, which must be blocked by finite clause boundaries. In light of this, they left the analysis of long-distance dependencies as an open problem for the continuation-based grammar.

Proposal (split and compose) To address this issue, we adopt a *gap-free* analysis of long-distance dependencies (Steedman, 2000). The main component of this approach is the combinatory rule of *function composition*, which links two function categories together. To illustrate, consider (10). Here, the subject DP undergoes *type-raising*, which turns A into $X/(A\backslash X)$ (as with LIFT). Then, the resultant category S/(DP\S) can compose into the transitive verb via the forward function composition >B, yielding S /DP (i.e., a sentence missing its object). By repeating this process, we can inherit up the missing argument /DP, until it is finally fed by *whom*. More intuitively, we can metaphorically describe the object DP as moved up to a higher position, as in (11) (although no syntactic movement is involved in reality).

(10)



(11) Movement-like description of (10)



Next, to make this gap-free analysis compatible with the continuation-based grammar, we propose a unary rule SPLIT, which is shown in Figure 2. Formally, this is the *partially applied* version of the continuized function application: as shown in (12), `C[>]` is equivalent to applying $\curlyvee_>$ to the left argument and combining it with the right using `>` (the same holds for `C[<]`). In effect, the rule splits a tower with a slash and creates a function from a tower to another. This resultant function semantically composes the two scopes $\alpha[\ ]$ and $\beta[\ ]$ according to the directionality of the slash. Namely, if the argument A is expected on the right (resp. left), then its scope $\beta[\ ]$ is placed inside (resp. outside) $\alpha[\ ]$. In this way, SPLIT is faithful to the left-to-right composition of scope in the continuation-based grammar.

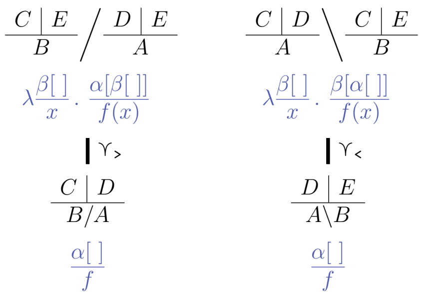
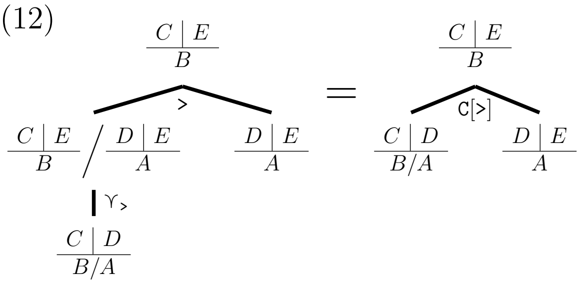


Figure 2: SPLIT (proposal)

(12)



We further assume the auxiliary rules in Figure 3. The first one PROLIFT, which was proposed by Leong and Erlewine (2019), lifts $A\triangleright$ from the bottom level to the continuation level (while we can eschew this additional rule with the monadic formulation of B&S's framework (Charlow, 2014; Bumford & Charlow, 2022), we leave the details for future work). In addition, we introduce, for each unary rule U, its variant $U_{\texttt{>B}}$ that applies U to the result of a function category ($U_{\texttt{<B}}$ is similarly defined). We note that the rule can be derived by composing U and the input with `>B` or `<B`.

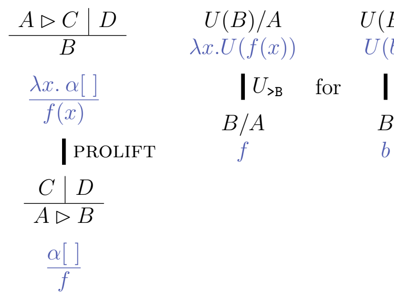
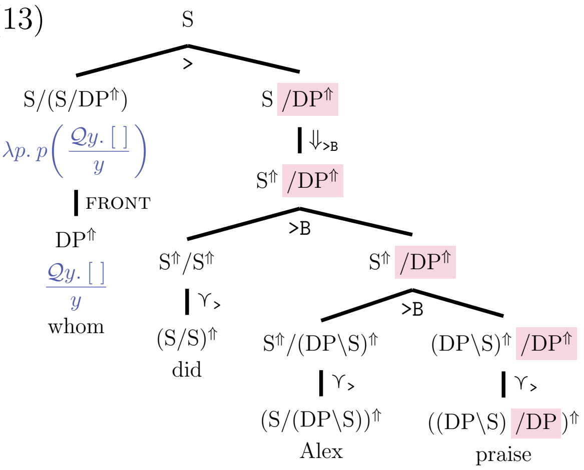


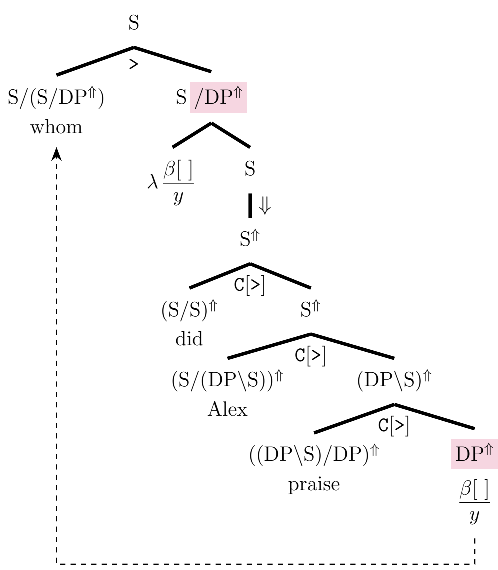
Figure 3: Auxiliary rules

Let us now see how SPLIT interacts with function composition. Consider the derivation (13) of *Whom did Alex praise?*, where we write $A^{\Uparrow}$ for the lifted A (i.e., $\mathrm{S} /\!\!/ (A \setminus\!\!\setminus S)$). Crucially, by applying SPLIT to the lifted constituents, we can compose them with `>B`, as we did in (10). Again, we can give a more intuitive picture with a movement-like description in (14). As we can see, the derivation proceeds as if *whom* were in the object position as a scope taker $\mathrm{DP}^{\Uparrow}$. In other words, the scope of $\mathcal{Q}y$ is reconstructed into the position where $\beta[\ ]$ appears.

(13)

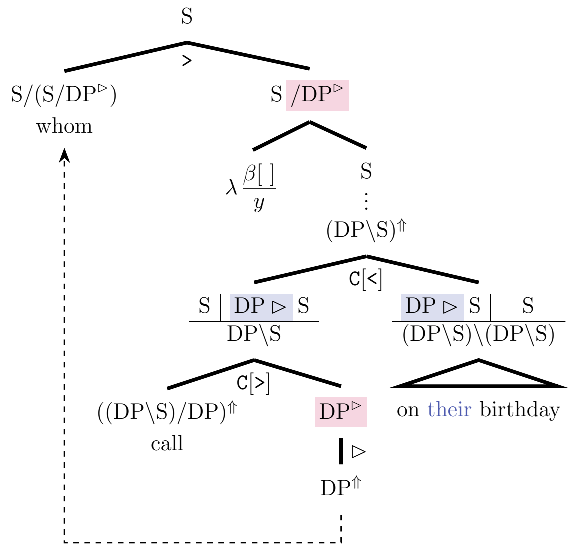


(14)

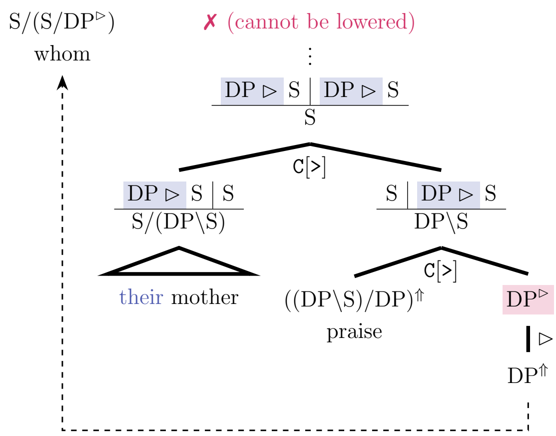


Account This split-and-compose approach derives binding in a way similar to B&S's framework. For instance, consider the acceptable case *Whom$_i$ did Alex call on their$_i$ birthday?*, where the pronoun appears after the object position. In this case, we can split the transitive verb to expect a binder $S \mathbin{/\!\!/} (DP \mathbin{\backslash\!\!\backslash} (DP \rhd S))$ on its right (we abbreviate this category as $DP^{\rhd}$), which allows binding as illustrated in (15). In contrast, in the crossover cases like (5b), the trace cannot bind the pronoun due to the left-to-right nature of the scope-level composition (see (16)). Hence, we correctly predict the weak crossover effect in (5b).

(15)



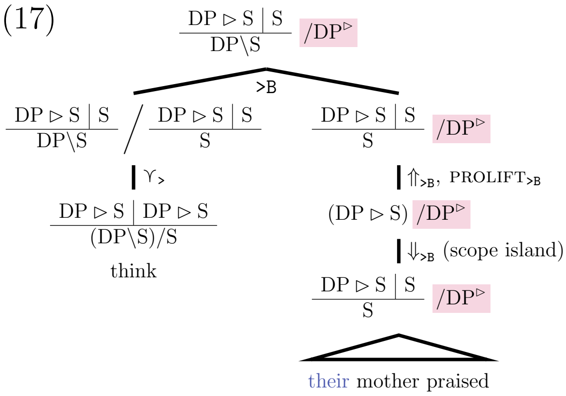
(16)



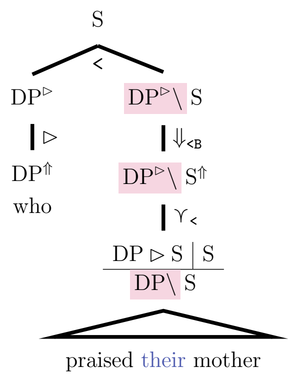
A significant advantage of this account is that function composition can be applied even over clausal boundaries, which immediately yields long-distance *wh*-dependencies. The details are shown in (17). We first apply $\Downarrow_{>B}$ to the embedded clause (as it is a scope island), but we can restore $DP \rhd$ back to the scopal level with $\Uparrow_{>B}$ and PROLIFT$_{>B}$. After splitting the complement-taking verb *think*, we can compose it into the embedded clause. Notably, since we do not posit any intermediate gaps, there is no chance for the pronoun *their* to be bound, as in (16). Therefore, we correctly block binding in (9), for exactly the same reason as in the non-embedded case (5b).

Finally, we briefly consider subject extraction. Consider the derivation (18) for *Who praised their mother?*. After $\curlyvee_<$ is applied to the VP *praised their mother*, the constituent expects a binder $DP^{\rhd}$ to its left. This can be filled by the subject *who*, yielding the desired bound interpretation.

(17)



(18)



Summary Although B&S's continuation-based theory of binding is promising for its left-to-right composition of scope, it cannot adequately handle long-distance *wh*-dependencies because of its treatment of gaps as scope-takers, whose effects cannot go beyond finite clause boundaries. To resolve this problem, we proposed SPLIT, which allows scope-takers to be combined via function composition, thereby providing a gap-free analysis of *wh*-reconstruction. Since function composition, unlike scope-taking, can cross finite clause boundaries, this approach successfully derives the weak crossover effect even in long-distance *wh*-dependencies.

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Individuals as sets of perspectives

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Introduction. It is commonly acknowledged that the substitution of co-referential expressions within the scope of a propositional attitude verb is not valid. (This is one of Frege's famous puzzles.) By contrast, widespread is the assumption that substitution of co-referential expressions is valid in simple sentences. The data put forward by Saul (1997), however, cast doubt on this assumption. Since Clark Kent and Superman are the same individual, (1) seems true, but for each of the minimal pairs in (2), the first sentence seems true while the second seems false.

(1) Superman is Clark Kent.

(2) a. (i) Clark Kent went into the phone booth, and Superman came out.
(ii) *Clark Kent went into the phone booth, and Clark Kent came out.
b. (i) Superman was more successful with women than Clark Kent.
(ii) *Superman was more successful with women than Superman.

In what follows, we propose to take these intuitions seriously and to provide a fully compositional system that correctly predicts the corresponding truth values, without resorting to pragmatic. This system is based of the non-standard notion of *perspectives*, which are intuitively ways of viewing an individual. Marie Curie as a scientist, Marie Curie as a woman, Marie Curie as the recipient of the 1903 Nobel Prize in Physics, etc., are all perspectives on Marie Curie. These perspectives are perspectives *on* an individual rather than perspectives *from* a point of view, and thus differ from the notion of perspective discussed for instance by Lasersohn (2016) but are conceptually closer to Fine (1982)'s *qua-objects*. To theorise certain relations such as that between an object and the matter that constitutes it, Fine postulates qua-objects such as Socrates qua philosopher, and for a statue and the matter that constitutes it, that matter qua statue.

Our proposal relies on the idea that, although Clark Kent and Superman are intuitively the same individual, they correspond to two distinct (though not disjoint) sets of perspectives. And just as the properties of an individual may vary across worlds (e.g. Marie might have been shorter had she eaten less soup as a child), the perspectives associated with a proper name also vary across worlds (in a world where Marie Curie never took an interest in science, she would lack a scientist perspective).

Perspectives as the counterparts of events in the nominal domain. In previous work (de Groote and Bernard, 2025a), following Larson (1998), we argued that a parallel in inference patterns between verb-adverb and noun–adjective combinations should be extended to the level of formalisation by applying a Davidsonian-like treatment to the nominal domain.

More precisely, (3a) does not entail (3b) and (4a) does not entail (4b).

(3) a. Marie dances beautifully and Marie sings.
b. Marie sings beautifully.

(4) a. Marie is a beautiful dancer and Marie is a singer.
b. Marie is a beautiful singer.

The lack of entailment from (3a) to (3b) is accounted for in event semantics, following Davidson (1967), by the hypothesis that an event mediates between a verb, its possible adverbial, and its subject. In the neo-Davidsonian tradition (Parsons, 1990), the meaning of (3a) is typically represented by (5a), which, as expected, does not entail (5b), the meaning of (3b).

(5) a. $(\exists e_1.\, \mathit{dance}(e_1) \wedge \mathit{ag}(e_1) = \mathit{Marie} \wedge \mathit{beautiful}(e_1)) \wedge (\exists e_2.\, \mathit{sing}(e_2) \wedge \mathit{ag}(e_2) = \mathit{Marie})$
b. $\exists e.\, \mathit{sing}(e) \wedge \mathit{ag}(e) = \mathit{Marie} \wedge \mathit{beautiful}(e)$

Similarly, we argued that the lack of entailment from (4a) to (4b) is due to the existence of a perspective mediating between a name and the noun and adjective used to describe it. We represented the meaning of (4a) as formula (6a) and that of (4b) as (6b), where $p > x$ indicates that p is a perspective on individual x. Larson (1998) suggests a similar but more complex analysis, with actions introduced by a *generic quantifier* (Chierchia, 1995) rather than perspectives introduced by a standard existential quantifier.

(6) a. $(\exists p_1.\, \mathit{dancer}(p_1) \wedge p_1 > \mathit{Marie} \wedge \mathit{beautiful}(p_1)) \wedge (\exists p_2.\, \mathit{singer}(p_2) \wedge p_2 > \mathit{Marie})$
b. $\exists p.\, \mathit{singer}(p) \wedge p > \mathit{Marie} \wedge \mathit{beautiful}(p)$

In our previous work, we took intersective adjectives (e.g. *Polish*, *kind*) to lexicalise predicates of individuals, and subsective adjectives (e.g. *skilful*) to lexicalise predicates of perspectives. The system predicted the usual inference patterns without introducing predicate modifiers or invoking the notion of intension as in Montague (1970)'s solution.

In subsequent work (de Groote and Bernard, 2025b), we also proposed to view possible worlds as sets of eventualities, which we take to include not only the usual ones (states and events) but also perspectives, resulting in analyses such as:

(7) a. Marie is a skilful journalist.
b. $\lambda w.\, \exists x.\, \exists p.\, p \in w \wedge \mathit{journalist}(p) \wedge \mathit{skilful}(p) \wedge p > x \wedge \mathit{Marie} = x$

(8) a. A journalist is sleeping.
b. $\lambda w.\, \exists x.\, \exists p.\, p \in w \wedge \mathit{journalist}(p) \wedge p > x \wedge \exists e.\, e \in w \wedge \mathit{sleep}(e) \wedge \mathit{ag}(e) = x$

This previous system, however, is somewhat unsatisfactory, in that (1) is analysed as the term $\lambda w.\, (\mathit{Superman} = \mathit{Clark\ Kent})$, which is a tautology in some models and a contradiction in all others, whereas sentence (1) is neither. Below, we propose a treatment of proper names that accounts for all of the examples above, and leads us to reconsider some aspects of our theory and to clarify the distinction between perspectives and states.

Names as sets of perspectives. The core idea defended here is that proper names lexicalise sets of perspectives rather than individuals. Intuitively, if two set-of-perspectives individuals share one or more perspectives (in a world w), they are the same individual (in that world w). We assume that the actual existence of an individual corresponds to the existence of a *material* perspective, and that if two set-of-perspectives individuals share perspectives, then they share at least their material perspective. On this view, identity statements can be contingents (at least in an epistemic sense), because two set-of-perspectives individuals may share perspectives in some but not all worlds.

In standard formal semantics, individuals (in a broad sense including persons and objects) are treated as primitive, with constants and variables of type e in the logical language. Here, we propose to dispense with the type e. We consider instead perspectives to be primitive, and that certain sets of perspectives are perceived or conceptualised as wholes: these sets of perspectives *are* the individuals. Individuals thus emerge from the notion of perspectives. Explaining why some sets of perspectives but not others constitute individuals — this is related to how we decompose the universe, typically along criteria of spatio-temporal continuity — is out of the scope of this abstract. Instead, we develop our proposal on the basis of this assumption.

Formally, in addition to the type t for truth values, we posit a single type v for events, states, and perspectives. Each model defines a domain D_v, of which a subset $P \subseteq D_v$ is the set of perspectives, and a set of set-of-perspectives individuals $I \subseteq \mathbb{P}(P)$. This set I essentially serves (i) to interpret constants of type $\langle v,t \rangle$ lexicalised by proper names (e.g. *Marie*) and (ii) as the domain of the quantifiers ($\exists x$, $\forall x$) introduced by quantified noun phrases (e.g. *a journalist*). Another subset $W \subseteq \mathbb{P}(D_v)$ specifies the worlds of the model: a world is seen as the set of events, states, and perspectives that occur or obtain in it. Classically, worlds satisfy a maximality condition (they are complete; nothing can be added to them, and in particular, no world is strictly contained within another), though we will not formalise this condition here.

As mentioned above, we impose the two following constraints on individuals and worlds:

(9) $\forall x \in I.\ \forall w \in W.\ \forall p_1, p_2 \in x.\ (p_1, p_2 \in w \wedge material(p_1) \wedge material(p_2)) \rightarrow (p_1 = p_2)$
(Each individual contains at most one material perspective per world.)

(10) $\forall x_1, x_2 \in I.\ \forall w \in W.\ ((x_1 \cap x_2 \cap w) \neq \emptyset) \rightarrow (\exists p.\ material(p) \wedge p \in (x_1 \cap x_2 \cap w))$
(If in a world two individuals share perspectives, their material perspective is among them.)

We analyse (1) above as (11):

(11) $\lambda w.\ \exists p \in (Clark\ Kent \cap Superman \cap w)$

In the Superman fiction world w, Superman and Clark Kent are the same person and therefore share at least one perspective. But things could have turned out different, and Superman could have been, say, the photographer Peter Parker rather than the journalist Clark Kent. Such a possibility implies the truth of (12a), analysed as (12b), where $May(w)$ is interpreted as the set of worlds accessible from w (à la Kripke).

(12) a. Peter Parker may be Superman.
b. $\lambda w.\ \exists w' \in May(w).\ \exists p.\ p \in (Peter\ Parker \cap Superman \cap w')$

We analyse (13a) as (13b) and (14a) as (14b). In w, Clark Kent — but not Superman — is associated with a journalist perspective, so (13a) and (14a) are predicted true and false respectively.

(13) a. Clark Kent is a journalist.
b. $\lambda w.\ \exists p.\ p \in (Clark\ Kent \cap w) \wedge journalist(p)$

(14) a. Superman is a journalist.
b. $\lambda w.\ \exists p.\ p \in (Superman \cap w) \wedge journalist(p)$

Verbal predicates are usually taken to be sortal, unlike adverbial predicates, in the sense that an event satisfying *sing* cannot also satisfy *dance*, though it may satisfy *beautiful* or another adverbial predicate. We assume that not only nouns but also intersective adjectives lexicalise sortal predicates, and thus that the composition of an intersective adjective with a noun describe two perspectives. Our system correctly predicts the equivalence between (15a) and (16a).

(15) a. Marie is a Polish scientist.
b. $\lambda w.\ \exists p_1, p_2.\ p_1, p_2 \in (Marie \cap w) \wedge Polish(p_1) \wedge scientist(p_2)$

(16) a. Marie is Polish and Marie is a scientist.
b. $\lambda w.\ (\exists p_1.\ p_1 \in (Marie \cap w) \wedge Polish(p_1)) \wedge (\exists p_2.\ p_2 \in (Marie \cap w) \wedge scientist(p_2))$

The neo-Davidsonian tradition treats thematic roles as relations (often functional) between events and individuals. Consider, for example, (5a) and (5b), where *ag* is a function from events to individuals. To understand how to model thematic roles in a system where individuals are construed as sets of perspectives, let us turn to the sentence *Marie left*. If Marie left, we can intuitively view her as the agent of a leaving-event (e), as in the traditional picture ($ag(e) = Marie$). But this paraphrase also immediately provides us with an analysis in terms of perspectives; just as the possibility of viewing Marie as a physicist signals, in our view, the existence of a physicist perspective, the possibility of viewing Marie as the agent of an event e signals the existence of an agent-of-e perspective. We therefore introduce, for each thematic role, a function from events to perspectives. For an event e, $ag(e) \in Marie$ indicates that $ag(e)$ is the perspective on Marie as agent of e. Accordingly, we analyse *Marie sang beautifully* as:

(17) $\lambda w.\ \exists e \in w.\ sing(e) \wedge beautiful(e) \wedge ag(e) \in Marie$

Compositional implementation. The fragment of English that we develop here, shown in Figure 1, follows several principles of Champollion (2015)'s *quantificational event semantics*. In particular, the grammar is *directly compositional* (i.e. it does not assume a separate level of Logical Form; Jacobson 2012); verb entries contain an existential event quantifier; information can be transmitted from higher to lower nodes in the syntactic tree (and thus under the quantifier introduced by the verb) through a continuation-based system (see the f variables), which is ultimately closed off by a covert [closure] operator at the root (where $\top$ denotes a tautology); thematic roles are treated as covert operators, such as [ag], which combine with the arguments of verbs. Two adjacent constituents combine, depending on their types, by functional application, by generalised conjunction $\sqcap$, or by continuation application @.

In line with a fairly standard view (Rothstein, 2004), we assume that the copula is semantically vacuous, as is the article *a* in noun phrases used as predicates, and that, in identity statements (such as *Clark Kent is Superman*), the copula triggers a type-shift (here ϕ) of the post-copular DP (*Superman*). A sample of derivations is shown in Figure 2.

$\llbracket$left$\rrbracket$	$= \lambda f w.\ \exists e.\ e \in w \wedge leave(e) \wedge f\, e$	$\llbracket$hastily$\rrbracket$	$= \lambda f e.\ hasty(e) \wedge f\, e$
@	$= \lambda P n f w.\ P\,(n\, f)\, w$	$\llbracket$Marie$\rrbracket$	$= \lambda P f w.\ P\,(\lambda p.\ p \in Marie \wedge f\, p)\, w$
stop	$= \lambda e.\ \top$	$\llbracket$[ag]$\rrbracket$	$= \lambda N P f w.\ N\,(\lambda f' w'.\ P\,(\lambda e.\ f'\, ag(e) \wedge f\, e)\, w')\, stop\, w$
$\llbracket$[closure]$\rrbracket$	$= stop$	$\llbracket$scientist$\rrbracket$	$= \lambda f w.\ \exists p.\ p \in w \wedge scientist(p) \wedge f\, p$
$\llbracket$Polish$\rrbracket$	$= \lambda f w.\ \exists p.\ p \in w \wedge Polish(p) \wedge f\, p$	$\sqcap$	$= \lambda P Q f w.\ (P\, f\, w) \wedge (Q\, f\, w)$
$\llbracket$skilful$\rrbracket$	$= \lambda f p.\ good(p) \wedge f\, p$	$\llbracket$a$\rrbracket$	$= \lambda n P f w.\ \exists x.\ n\,(\lambda p.\ p \in w)\, w \wedge P\,(\lambda p'.\ p' \in x \wedge f\, p')\, w$
ϕ	$= \lambda N f w.\ N\,(\lambda f' w'.\ \exists p.\ p \in w' \wedge f'\, p)\, f\, w$	$\llbracket$may$\rrbracket$	$= \lambda P f w.\ \exists w' \in May(w).\ P f w'$

Figure 1: The compositional fragment.

$\llbracket$[ag]$\rrbracket$ $\llbracket$[Marie]$\rrbracket$	$= \llbracket$[ag]$\rrbracket$ $\llbracket$[Marie]$\rrbracket = \lambda P f w.\ P\,(\lambda e.\ ag(e) \in Marie \wedge \top \wedge f\, e)\, w$
@ $\llbracket$[left]$\rrbracket$ $\llbracket$[hastily]$\rrbracket$	$= \lambda f w.\ \exists e.\ e \in w \wedge leave(e) \wedge hasty(e) \wedge f\, e$
(($\llbracket$[ag]$\rrbracket$ $\llbracket$[Marie]$\rrbracket$)(@ $\llbracket$[left]$\rrbracket$ $\llbracket$[hastily]$\rrbracket$)) $\llbracket$[closure]$\rrbracket$	$= \lambda w.\ \exists e.\ e \in w \wedge leave(e) \wedge hasty(e) \wedge ag(e) \in Marie \wedge \top \wedge \top$
$\sqcap$ $\llbracket$Polish$\rrbracket$ $\llbracket$scientist$\rrbracket$	$= \lambda f w.\ \exists p_1.\ p_1 \in w \wedge Polish(p_1) \wedge f\, p_1 \wedge \exists p_2.\ p_2 \in w \wedge scientist(p_2) \wedge f\, p_2$
@ $\llbracket$scientist$\rrbracket$ $\llbracket$skilful$\rrbracket$	$= \lambda f w.\ \exists p.\ p \in w \wedge scientcist(p) \wedge skilful(p) \wedge f\, p$
$\llbracket$Marie$\rrbracket$ ($\sqcap$ $\llbracket$Polish$\rrbracket$ $\llbracket$scientist$\rrbracket$) $\llbracket$[closure]$\rrbracket$	$= \lambda w.\ \exists p_1.\ p_1 \in w \wedge Polish(p_1) \wedge p_1 \in Marie \wedge \top \wedge \exists p_2.\ p_2 \in w \wedge scientist(p_2) \wedge p_2 \in Marie \wedge \top$
$\llbracket$a$\rrbracket$ ($\sqcap$ $\llbracket$Polish$\rrbracket$ $\llbracket$scientist$\rrbracket$)	$= \lambda P f w.\ \exists x.\ \exists p_1.\ p_1 \in w \wedge Polish(p_1) \wedge p_1 \in x \wedge \exists p_2.\ p_2 \in w \wedge scientist(p_2) \wedge p_2 \in x \wedge P\,(\lambda p'.\ p' \in x \wedge f\, p')\, w$
($\llbracket$[ag]$\rrbracket$ ($\llbracket$a$\rrbracket$ ($\sqcap$ $\llbracket$Polish$\rrbracket$ $\llbracket$scientist$\rrbracket$))) $\llbracket$left$\rrbracket$ $\llbracket$[closure]$\rrbracket$	$= \lambda w.\ \exists x.\ \exists p_1.\ p_1 \in w \wedge Polish(p_1) \wedge p_1 \in x \wedge \exists p_2.\ p_2 \in w \wedge scientist(p_2) \wedge p_2 \in x \wedge \exists e.\ e \in w \wedge leave(e) \wedge ag(e) \in x \wedge \top \wedge \top$
ϕ $\llbracket$Superman$\rrbracket$	$= \lambda f w.\ \exists p.\ p \in w \wedge p \in Superman \wedge f\, p$
$\llbracket$may$\rrbracket$ ($\llbracket$Peter Parker$\rrbracket$ (ϕ $\llbracket$Superman$\rrbracket$)) $\llbracket$[closure]$\rrbracket$	$= \lambda w.\ \exists w' \in May(w).\ \exists p.\ p \in w' \wedge p \in Superman \wedge p \in Peter\ Parker \wedge \top$

Figure 2: Some derivations.

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Logic and linguistic intuitions in dynamic semantics

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1 Introduction

Sentences of the form $(\phi \wedge \neg\phi)$ and $(\phi \vee \neg\phi)$ are judged to be contradictory and tautologous, respectively. This suggests that our intuitions respect the Law of Non-Contradiction (NC) and the Law of Excluded Middle (EM). [7] shows that NC and EM are not valid in standard dynamic semantics. To be sure, cases where ϕ is Boolean do result in contradictory and tautologous updates; however, that result doesn't generalize to all instances of $\phi \wedge \neg\phi$ and $\phi \vee \neg\phi$.

Specifically, although formulas like (1) are of the form $(\phi \wedge \neg\phi)$, they are not contradictory in standard dynamic semantics. Yet our judgments still correspond to classical expectations (e.g., (2) feels contradictory). Similarly, although formulas like (3) are of the form $(\phi \vee \neg\phi)$, they are not tautologies in dynamic semantics. But again, our judgments correspond to classical expectations (e.g., (4) feels tautologous):

(1) $(\Diamond\phi \wedge \psi) \wedge \neg(\Diamond\phi \wedge \psi)$

(2) #Ariel might be home, and Jane is home; and it's not the case that: Ariel might be home, and Jane is home.[1]

(3) $(\Box\phi \vee \psi) \vee \neg(\Box\phi \vee \psi)$

(4) Either Ariel must be home or Jane is home, or else it's not the case that: Ariel must be home or Jane is home.

The objection, then, is not that dynamic semantics is non-classical. After all, dynamic semantics aims to capture ways that natural language diverges from classical logic. The objection is that dynamic semantics predicts non-classical judgment in cases where language users' judgments are classical. These judgments need explaining in a non-classical system.

I argue (contra [7]) that dynamic semantics' non-classical predictions in cases where speakers' judgments are classical is not fatal. Supplementing the theory with minimal and independently motivated pragmatic principles, classical intuitions about sentences like (2) and (4) are easily explained. Furthermore, we can also explain their embedding behavior. Once the judgments are accounted for, non-classicality on its own is not an issue for a semantic theory, so there is no bite to the objection.

2 Formal details

The basic idea in dynamic semantics systems[2] is that sentence meanings are context change potentials (CCPs): (possibly partial) functions from contexts to contexts.

[1] I use # to track linguistic defectiveness without making claims about its source. Later on, I will use ?? to mark sentences that are on the line between acceptable and defective, but for which judgments are unclear.

[2] In particular, here I will focus on [12, 13], following [7], and will leave aside discussion of other dynamic frameworks such as [4]'s or [5].

Context are sets of possible worlds. We write '$[\phi]$' to mean the context change potential of ϕ, and '$c[\phi]$' to mean the result of updating a context c with ϕ.

Let $\mathcal{L}$ be a propositional language (for simplicity, ignore presuppositions) generated by the grammar:

$$\phi ::= p \mid \neg\phi \mid (\phi \wedge \phi) \mid \Diamond\phi$$

The update rules for basic connectives and the epistemic possibility modal $\Diamond$ in dynamic semantics are as follows ($\Box$ is defined as the dual of $\Diamond$). For any context c:

(5)
a. $c[p] = \{w \in c | w(p) = 1\}$
b. $c[\neg\phi] = c - c[\phi]$
c. $c[\phi \wedge \psi] = c[\phi][\psi]$
d. $c[\phi \vee \psi] = c[\phi] \cup c[\neg\phi][\psi]$
e. $c[\Diamond\phi] = \begin{cases} c & c[p] \neq \varnothing \\ \varnothing & \text{otherwise} \end{cases}$

In this framework, a formula ϕ is contradictory iff for any context c, $c[\phi] = \varnothing$ and a formula ϕ is tautologous iff for any context c, $c[\phi] = c$.

3 Non-problematic non-classicality

In this section, I give two pragmatic reasons why (2) and (4) are judged to be contradictory and tautologous respectively. For reasons of space, I spell out the arguments in detail for the case of (2), but everything works analogously for (4). Each of these reasons on its own is enough to explain the judgments, but I develop both lines of thought in order to see the range of responses avaiable to us.

Let us start by identifying those contexts where (2) is non-contradictory and (4) is non-tautologous. Let A be the proposition that Ariel is home, and J be the proposition that Jane is home. Call w_A the worlds where Ariel is home but Jane is not home, w_J the worlds where Jane is home but Ariel is not home, w_{AJ} the worlds where both of them are home, and $w_\varnothing\}$ the worlds where neither of them is home. Here are the different ways the context could look like, taking into account these worlds only:

$$c_1 = \{w_A, w_J, w_{AJ}, w_\varnothing\} \qquad c_9 = \{w_{AJ}, w_A\}$$
$$c_2 = \{w_A, w_J, w_{AJ}\} \qquad c_{10} = \{w_{AJ}, w_J\}$$
$$c_3 = \{w_A, w_J, w_\varnothing\} \qquad c_{11} = \{w_A, w_J\}$$
$$c_4 = \{w_A, w_{AJ}, w_\varnothing\} \qquad c_{12} = \{w_{AJ}\}$$
$$c_5 = \{w_J, w_{AJ}, w_\varnothing\} \qquad c_{13} = \{w_A\}$$
$$c_6 = \{w_A, w_\varnothing\} \qquad c_{14} = \{w_J\}$$
$$c_7 = \{w_J, w_\varnothing\} \qquad c_{15} = \{w_\varnothing\}$$
$$c_8 = \{w_{AJ}, w_\varnothing\}$$

The only context that make (2) non-contradictory are c_3 and c_{11}, and the only contexts that make (4) non-tautologous are c_2 and c_{11} (this is easy to verify using the update rules in (5)). Furthermore, the result of updating these contexts with either (2) or (4) is $c[J]$. That is, updating these contexts with either sentence is equivalent to updating them with J = *Jane is home.*

For illustration purposes, I will show how the update works for the case of (1) and c_{11} (everything proceeds in exactly the same way for all other cases).

Since dynamic update with a conjunction happens sequentially, start by updating with the first conjunct: $\{w_A, w_J\}[(\Diamond A \wedge J)] = \{w_A, w_J\}[\Diamond A][J] = \{w_A, w_J\}[J] = \{w_J\}$.

The result of this update is now updated with the second conjunct: $\{w_J\}[\neg(\Diamond A \wedge J)] = \{w_J\} - \{w_J\}[(\Diamond A \wedge q)] = \{w_J\} - \varnothing = \{w_J\}$. This is the final result, which means that (2) fails to be a contradiction.

The first reason why this context would be ignored by competent conversational participants is that updating it with (2) is equivalent to updating it with J. Since J is a formal alternative (that is, a well-formed, simpler structure that can be derived from it via deletion), it is relevant in the context ([2], [11], [10]). Therefore, given a basic pragmatic norm such as the Gricean maxim of brevity, a cooperative listener can reason that the speaker does not believe (2) to be equivalent to J, and so c_{11} is discarded as a possible context that models the common ground. Since in all other common grounds the sentence is contradictory, the judgments are explained.

Note that this strategy yields desirable results in other cases as well. For example, say a speaker wants to update $c_{13} = \{w_A\}$ with $[A \vee J]$. If the common ground is modeled by c_{13}, then all conversational participants have agreed to behave as though they believe that only Ariel is home. Now the speaker says $A \vee J$, and the result of this update is $\{w_A\}$. But there was a briefer alternative that they could have said to perform this same update, namely A. The listener, reasoning in this way, concludes that c_6 must not be the context that models the common ground.

This is the expected result. If both conversational participants have agreed that the common ground is not one where A and J are both live alternatives, it is pragmatically odd to say the disjunction $A \vee J$. Therefore, either the listener was mistaken about what the common ground was, or the speaker has gained some new information that requires expanding the common ground, but the assertion of $A \vee J$ rules out c_{13} as a candidate that could model the state of the conversation.[3]

The second reason is that if c_{11} models the common ground, then the speaker does not believe (2). So, uttering (2) violates the following basic norm of assertion, call it *speaker support*: assert p only if you believe that p. This extends to conjunctions in the obvious way: assert *p and q* only if you believe that p and you believe that q.

Following [4], I characterize belief within a standard dynamic semantics as follows: S believes that p iff $B_S[p] = B_S$, where B_S is the information state that the agent is in.

Let's see why an assertion of (2) violates *speaker support* when the common ground is c_{11}. The common ground common ground is the set of possible worlds such that all conversational participants are publicly committed to the actual world being contained in that set for the purposes of the conversation. Assuming that the purpose of the conversation is information exchange, then the speakers' public commitments will be a subset of their beliefs ([1]). Furthermore, when the purpose is information exchange, an assertion will not only update the common ground, but will be a proposal for conversational participants to update their beliefs as well.

In a common ground like c_{11}, not all possibilities are live: w_{AJ} has been excluded by a previous assertion or shared knowledge about the actual world. Thus, all participants should have coordinated their beliefs to correspond to c_{11}. But then $B_S = c_{11}$, then $B_S[(2)] \neq B_S$, and so *speaker support* is violated.

Given this, a competent listener will reason that whenever (2) is uttered, the common ground is not modeled by c_{11}. Since in all other contexts the sentence is contradictory, the judgments are explained and failures of NC are not a mark against the theory.

[3] Thank you to an anonymous reviewer for pushing me to discuss this point.

The case of failures of EM is exactly parallel, except that in this case the only contexts in which (4) fails to be tautologous are $c_{11} = \{w_A,\ w_J\}$ and $c_2 = \{w_A,\ w_J, w_{AJ}\}$. In these contexts, once again, updates with (4) are equivalent to updates with J (proof is elementary with the rules given in (5)).

Given this, both pragmatic arguments go through just as before, the judgments are explained, and failures of EC are not a mark against the dynamic theory.

4 Embedded cases

The most obvious concern for the pragmatic explanation is that it cannot account for cases where the sentences are embedded, since on the classical Gricean theory, the contents of embedded clauses are not available as input to pragmatic reasoning. But in our case, there is a straightforward explanation in pragmatic terms, which again I spell out in detail for the case of NC and which works analogously for the case of EM.

Consider a sentence that embeds (2):

(6) ??Eric believes that (Ariel might be home, and Jane is home; and it's not the case that: Ariel might be home, and Jane is home)

(6) is not contradictory, and dynamic semantics does not predict it to be.[4] The objection regarding embedded sentences, then, cannot be that dynamic semantics makes predictions that do not accord with our classical linguistic judgments. Rather, it has to be something along the following lines: (6) attributes to Eric an inconsistent belief, but since in c_{11} (2) fails to be contradictory, dynamic semantics predicts that we could be attributing a coherent belief to Eric if his beliefs are modeled by c_{11}.

But of course, if Eric's belief state contains both w_A and w_J worlds but no w_{AJ} worlds, then his information state does not support (2). This means that he does not believe (2), and therefore that whenever his information state is a context on which (2) is not contradictory, (6) is false (we can bring this out even more clearly by embedding (2) under operators with truth evaluative adverbs such as 'correctly believes that'). So, whenever we attribute a coherent belief to Eric, (6) turns out to be false.

The question is now whether this sort of response generalizes. After all, (2) sits uneasily in many other environments, not just when embedded under 'believe.' Take the antecedent of a conditional:

(7) ??If (Ariel might be home, and Jane is home; and it's not the case that: Ariel might be home, and Jane is home), then their living room light should be on.

To build on our previous story and explain why (7) feels defective, even though dynamic semantics predicts the antecedent to be non-contradictory, we can capitalize on the idea behind the Ramsey Test: evaluating a conditional involves adding the antecedent hypothetically to our stock of beliefs. To make precise the notion of hypothetically adding the content of a sentence to a stock of beliefs, I adopt [8]'s *imaginability constraint*:

> **Imaginability constraint:** the content of a sentence ϕ can be added hypothetically to a stock of beliefs if it is logically possible that there is an agent A such that A knows that ϕ is true.

[4] I grant that our intuitions tend to be on the murky side when it comes to complex sentences like (6). However, it does seem clear that it is not a contradiction to assert that someone else believes a contradiction.

Without going into the details of their semantics, notice that verbs like *suppose*, as well as counterfactual conditionals and epistemic modals seem to involve adding a proposition to a stock of beliefs (hypothetically or otherwise). I put forth that, when the embedded sentence does not fulfill the imaginability constraint, embedding is infelicitous.

For the case of (6), the key observation is that it is not possible for an agent whose beliefs are modeled by c_{11} to believe (2), and therefore to know it to be true. Thus, (2) does not felicitously embed whenever dynamic semantics predicts that it is non-contradictory.

Without going into the details of their semantics, it seems plausible that verbs like *suppose*, as well as counterfactual conditionals and epistemic modals to involve adding a proposition to a stock of beliefs (hypothetically or otherwise). Therefore, we can explain why (2) and sentences like it do not felicitously embed in these environments.

Everything proceeds analogously to what I have just said for the cases of EM. And, as a nice bonus, this pragmatically-flavored explanation explains why embedded cases of violations of NC seem less marked than straightforward assertions, since those instantiate violations of NC and EM, whereas the embedded cases do not violate any classically valid logical principle.

5 Diagnosis of the problem and upshots of the pragmatic explanation

The issues that I have discussed are not an artifact of the particular examples. Rather, the invalidity of NC and EM in the dynamic system is a result of failures of idempotence ($c[\phi] \neq c[\phi][\phi]$) for non-Boolean p. [5]

Failures of idempotence, in turn, are a result of the treatment of modals and conditionals as a test, where update with them always results either in no change to the context or in the empty state. In fact, using the basic update rules, it is easy to check that, out of all the possible configurations that we can form with conjunction or disjunction, plus a modal with narrow scope in one of the conjuncts or disjuncts, plus wide-scope negation, only the following are non-idempotent in some context:

(8) a. $(\Diamond\phi \wedge \psi)$
  b. $(\Box\phi \vee \psi)$
  c. $(\Box\phi \wedge \psi)$

The objection based on non-classicality, then, is much more contained: it is really an objection to a 'test' semantics for modals and conditionals, originally found in [13].[6]

Luckily, dynamic semantics is not committed to the test semantics for epistemic modals. There are analyses where they effect non-trivial updates exist (for example, in the vein of [3]), as well as analyses where they introduce new contexts for use in discourse ([6]) or new live possibilities ([14]).

Fixes to ensure that all formulas are idempotent also exist (for example, [9]). My proposal also rules out non-idempotent updates, but has an advantage over [9]: rather than modifying the meanings of standard operators, such as conjunction and disjunction, to fit the data, I leave the meaning of these operators unchanged. The explanation for why failures of idempotence are undesirable comes from the fact that non-idempotent sentences, in those contexts where they are in fact non-idempotent, conflict with basic pragmatic principles like *speaker support*.

[5] In reality, idempotence is a property of updates, not of sentences. I will stretch the terminology a bit and say that ϕ is (not) idempotent to mean that update with ϕ is (not) idempotent.

[6] Non-idempotence also requires the asymmetric behavior of conjunction, but this treatment has support from natural language phenomena that the treatment of modals does not.

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Rightward and Covert Movement: A Formulation with Directional Minimalist Grammar

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1 Introduction

Generative literature can be characterized by displacement operations, which include covert ones such as feature movement (FM[1]) and quantifier raising (QR, May 1977). A class of grammar formalism called *Minimalist Grammars* (MGs, Stabler 1997a,b) can formulate movement directly (or faithfully). This study considers questions regarding phrasal movement with *directional MG (DMG)* and provides answers to the questions left in previous work. I demonstrate that some checking-free movement (scrambling) in a verb-final language corresponds to QR in verb-initial languages. Then, the ideas are formulated using a DMG with single polarization.

2 Previous work

2.1 Scope rigidity and the right-hand specifier

Since Kayne (1994), specifiers are aligned to the left, which is supported by the scarcity of attested right-hand specifiers (but see Ndayiragije 1999). As far as I can see, Tonoike (1995) is the first to propose that some languages have right-hand-side specifiers in the generative literature (or in the Minimalist Program). Tonoike (2007) also proposed an alternative approach in opposition to Kayne (2005), arguing that leftward scrambling is an overt realization of QR, which is consistent with the correlation between scrambling and rigid scope. (See also Szabolcsi 1997).

As reported in many previous studies (e.g., Hoji 1985, Kuroda 1992, Kobele & Zimmermann 2012, Bobaljik & Wurmbrand 2012, Erlewine & Kotek 2017), both German and Japanese are considered scope-rigid.[2]The exception to such scope rigidity in German is displacement into the *prefield*, the position just before the V2 position.

(1) a. Mindestens ein Politiker hat jedes Baby geküsst
at least one politician has every baby kissed
'At least one politician kissed every baby $^{\geq 1} \gg \forall$

b. Mindestens ein Baby hat jeder Politiker geküsst
at least one baby has every politician kissed
'Every politician kissed at least one baby.' $\forall \gg {}^{\geq 1}$, $^{\geq 1} \gg \forall$

(Kobele & Zimmermann 2012: p. 275)

[1]I rely on this potentially obsolete terminology here for clarity.
[2]In this abstract, all judgments are of the authors or some informants if cited. Other judgments are mine.

The movement found in (1b) differs from the standard scrambling in the sense that some XP must occupy the prefield, involving feature checking of an EPP feature.

2.2 Principle of Chain pronunciation

Fox & Pesetsky (2009) proposed **principle of Chain pronunciation (PCP)**, i.e., copy deletion occurs after and is fed by **planarization** (=linearization, coined by Marcolli, Berwick & Chomsky (2023)). According to this principle, all rightward movements become covert (forming inner specifiers), and all leftward movements become overt. They also conjecture that "All movement in an SOV language will be overt. Hence such languages will have scrambling and rigid scope." (See also Johnson 2012).

3 Scope of this study

I focus on clause-internal phrasal movements in German and Japanese, leaving other issues unaddressed, such as head movement, (very local) short scrambling, and clause-external movements. The so-called *long distance scrambling* was reported in previous work (Saito 1992)[3]. However, I use the term *long scrambling* for referring to (non-short) clause-internal scrambling in this paper. The previous work did not address the *derivation of the FM and remnant movement (RM)*. Regarding the first problem, in particular, Fox & Pesetsky (2009) predicted that SOV languages lack covert movement. For the second case, Fox & Pesetsky (2009) assumes their own proposal Fox & Pesetsky (2005). However, they did not address the problems associated with putting scrambling and QR in the same displacement class. Thus, the following questions are considered: (i) What are the issues regarding scrambling and QR as the same displacement? (ii) What is necessary to explain the surface displacement variants? (iii) If only a small number of rightward phrasal movements are attested, what role do the negative features for right-hand specifiers play in DMG?

4 Proposal

Under the (old) minimalist assumption, feature-driven movements involve feature checking, whereas other free movements do not. Regarding feature-driven movement, I assume that wh-in-situ languages permit covert wh-movement. This contradicts Fox & Pesetsky (2009). However, many previous accounts of Japanese syntax (see, e.g., Nishigauchi 1990, Saito 1985) indicate that Japanese has covert wh-movements. I consider clause-internal long-scrambling as an instance of the second; scrambling does not involve feature checking. Along the lines proposed in Tonoike (2007), QR is treated as a covert long scrambling. I assume that such an optional movement adheres to the harmonic order, ensuring that the head-initial structure allows only QR, whereas the head-final structure allows scrambling. Owing to the possibility of right-hand side outer specifiers, my proposal is closer to Tonoike (1995, 2007) than Fox & Pesetsky (2009) and Johnson (2012). My alternative proposal, for instance, allows some optional wh-movement to the head-initial CP and indicates that V2 order is not due to scrambling.

[3]For instance, Saito (1992) named it long-distance scrambling, distinguishing it from short-distance one. Ueyama (1998) referred to it as surface scrambling, distinguishing it from deep scrambling. Agbayani, Golston & Ishii (2015) treated it as prosodic scrambling. However, because its properties differ from those of clause-internal scrambling, I do not agree that it is *scrambling*. To the best of my knowledge, there is (only) one reason to call it *scrambling*, such that it seems to obey Müller/Takano's generalization. (Müller 1993, 1995, Takano 1994)

5 Scrambling with WCO but without reconstruction

Here, I demonstrate that the alleged immunity to weak crossover (WCO) effects does not hold for some constructions, and the *long scrambling* can be analyzed as overt QR in Japanese.

The QR is susceptible to crossover effects, including WCO. However, in Japanese, scrambling is generally claimed to be immune to WCO effects, as shown in (2):

(2) a. [subete-no waru.gaki-o]$_i$ soitu-no$_i$ hahaoya-ga t$_i$ yurusita
all-GEN bad.kid-ACC they-GEN mother-NOM forgave
'All the bastards, their mother forgave each of them'.

b. [ryoohoo-no sumootori-o]$_i$ kare-no$_i$ haigusya-ga t$_i$ tataeta
both-GEN sumotori-ACC he-GEN spouse-TOP admired
'Both sumotori, his spouse admired each of them'.

However, Cho (1994: pp. 126–135) reported that scrambling over the topic-marked argument can be affected by WCO effects in Korean. Besides, I found that scrambling of D, K, or NP with a different structure is susceptible to WCO effects[4].

(3) a. ?* waru.gaki-subete-o$_i$ soitu-no$_i$ hahaoya-wa t$_i$ yurusita
bad.kid-all-ACC they-GEN mother-TOP forgave
'As for their mother, all the bastards she forgave'.

b. ?* sumootori-ryoohoo-o$_i$ kare-no$_i$ haigusya-wa t$_i$ tataeta
sumotori-both-ACC he-GEN spouse-TOP admired
'As for his spouse, both sumotoris they admired'.

The contrast of acceptability between (2) and (3) can be slightly subtle if the topic markers are interpreted as contrastive(-topic) markers. It may be argued that these examples involve prosodic displacement (so-called A-bar or long-distance scrambling) and the displaced arguments can be (obligatorily) reconstructed below the topic-marked ones at LF. This approach is rejected because scope rigidity can be observed in scrambling over the topic argument.

(4) a. sukunakutomo waru.gaki-hito.ri-o$_i$ keikan-ryoohoo-wa t$_i$ yurusita
at.least bad.kid-one.CL-ACC policeofficer-both-TOP forgave
'As for both police officers, at least one bastard they forgave'. $\geq 1 \gg$ both

b. sumootori-dotiraka-o$_i$ kankyaku-subete-wa t$_i$ tataeta
sumotori-either-ACC audience-all-TOP admired
'As for all audiences, either one of the sumotoris they admired'. either $\gg \forall$

The examples (4) show that the reconstruction option is refuted in such scrambling cases.

In the next section, I will formulate that result with a DMG with a single polarization.

[4]Japanese quantificational NPs may allow at most three different structures.

(i) a. hito-ri-no Taro-ga odoru (koto)
one-CL-GEN Taro-NOM dances (that)
'(that) Taro, who is alone, dances'.

b. Taro-hito-ri-ga odoru (koto)
Taro-one-CL-NOM dances (that)
'(that) only Taro dances'.

c. Taro-ga hito-ri odoru (koto)
Taro-NOM one-CL dances (that)
'(that) Taro dances by himself'.

6 Formulation with a directional MG

All derivational operations in MGs are feature-driven, where the syntactic features for MGs serve as *category*, *selector*, *probe*, and *goal*. The original MG (Stabler 1997a,b) has two subclasses of features, selecting features (selectors and categories) and licensing features (licensors and licensees). They trigger one of the two operations, (external) **merge** or **move** (=internal merge), and each operation then removes the triggering features from the derivation. A pair of a selector and a category invokes **merge**, while a pair of a licensor and a licensee is consumed with **move**. In DMG, selectors are separated into $\overleftarrow{\mathtt{b}}$ and $\overrightarrow{\mathtt{b}}$ to formulate head directionality. Some of their variants generalize the selecting and licensing features (see Stabler 2024) into a single pair of positive features (work as categories and licensees) and negative features (work as selectors and licensors). However, no previous DMG study considered single-polarized DMGs. If negative features have directionality, the MG with single polarization makes room for right-hand specifiers, despite the limited attested evidence supporting them.

6.1 Formal backgrounds

In the DMG to be proposed, every syntactic object is a pair $\langle \nu.\psi, \mathbf{A} \rangle$, where each ν and ψ denotes (unsaturated) negative and positive *feature bundles*, i.e., a sequence of features. $\mathbf{A}$ stands for a lexeme (ε if it is an empty one) or a binary branching planar tree $[_d\, \Gamma\, \Delta\,]$, where $d \in \{<, >\}$ designates the direction of the phrasal head, both Γ and Δ are left and right subtrees, respectively. It will be written as $\mathbf{A}_\phi$ in short. Note that $\langle \emptyset, \mathbf{A} \rangle = \mathbf{A}$ stands for a syntactic object that no longer moves during the derivation. $\mathbf{A} \left\langle \mathbf{B}_\beta \right\rangle_\alpha$ represents a non-leaf syntactic object that contains (at least) one occurrence of a subtree $\mathbf{B}_\beta$ inside it. If $\beta \neq \emptyset$, the shortest move constraint (SMC) ensures that the occurrence of β is unique in $\mathbf{A} \left\langle \mathbf{B}_\beta \right\rangle_\alpha$.

6.2 Directional merge and move

The DMG has **merge** and **move** operations. The standard **merge** in DMG specifies a head-comp order with a specified direction in a negative feature, but **move** does not. I define both **merge** and **move** as a tuple of subfunctions, as shown in (5a) and (5b), respectively; that is, the domain and range of each function are the unions of their respective subfunctions.

(5) a. $\mathbf{merge} = [\mathbf{merge}_{\rightarrow}, \mathbf{merge}_{\leftarrow}]$

b. $\mathbf{move} = [\mathbf{move}_{\rightarrow}, \mathbf{move}_{\leftarrow}, \mathbf{move}_{\sim}]$

These operations are driven by some **positive feature** (=licensee in Stabler (1997a)) and the corresponding **negative feature** (=licensor in Stabler (1997a)). For example, $\mathbf{move}_{\leftarrow}$ and $\mathbf{move}_{\rightarrow}$ always involve symmetric feature deletion, as shown below.

(6) a. $\mathbf{move}_{\leftarrow} \left(\mathbf{A} \left\langle \mathbf{B}_{\mathtt{y}.\psi_0} \right\rangle_{\overleftarrow{\mathtt{y}}.\nu.\psi_1} \right) = \left[_{>} \mathbf{B}_{\psi_0}\ \mathbf{A} \left\langle \epsilon \right\rangle \right]_{\nu.\psi_1}$

b. $\mathbf{move}_{\rightarrow} \left(\mathbf{A} \left\langle \mathbf{B}_{\mathtt{y}.\psi} \right\rangle_{\overrightarrow{\mathtt{y}}.\nu.\psi} \right) = \left[_{<} \mathbf{A} \left\langle \mathbf{B}_{\psi} \right\rangle\ \epsilon \right]_{\nu.\psi}$

In (6), each moved element is planarized immediately after the movement, and the deleted copy is emulated with the empty leaf ϵ. (6b) is a formulation of FM via directionality. Since the standard (D)MG applies planarization at each derivational step, the derivational steps based on the above formulation result in frequent chunking within each cycle. It is purely a matter of formulation, not a problem in the theoretical proposal (cf. Kanazawa 2015). However, the proposed formulation can derive the RM without considering the extent of each derivational cycle (e.g., Phase).

(7) $\left[_< \text{hat} \left[_> [_< \text{das buch}]_i \text{ keiner } \left[_> \ [_> \epsilon_i \text{ gelesen}]_{\texttt{top}}\right] \varepsilon\right]\right]_{\overleftarrow{\texttt{topc}}}$

(8) $\textbf{move}(7) = \left[_< [_> \epsilon_i \text{ gelesen}] \left[_> \text{hat} \left[_> [_< \text{das buch}]_i \text{ keiner } \epsilon_j\right] \varepsilon\right]\right]_{\texttt{c}}$

In (7)[5], the DP *das buch* has undergone scrambling before the topicalization of VP [ϵ_i gelesen]. The copy ϵ_i in the remnant VP in (8) precedes its pronounced copy but is not phonologically realized due to the formulation of Copy-deletion in (9).

6.3 Scrambling and QR

I also define displacements without symmetric feature checking—long scrambling and QR—as subcases of **move**. The operation requires additional *positive* features $\tilde{\texttt{y}}$ that select but do not delete a corresponding category $\texttt{y}$.

(9) $$\textbf{move}_{\sim}\left(\mathbf{A}\left\langle \mathbf{B}_{\tilde{\texttt{y}}.\phi}\right\rangle_{\texttt{y}.\psi}\right) = \begin{cases} \left[_> \mathbf{B}_\phi \ \mathbf{A}\left\langle \epsilon \right\rangle\ \right]_{\texttt{y}.\psi} & \text{if } \mathbf{A}\left\langle \mathbf{B}_{\tilde{\texttt{y}}.\phi}\right\rangle_{\texttt{y}.\psi} \text{ is head-final} \\ \left[_< \mathbf{A}\left\langle \mathbf{B}_\phi\right\rangle \ \epsilon\ \right]_{\texttt{y}.\psi} & \text{otherwise} \end{cases}$$

In (9), the movement direction goes along with the head direction of the movement target $\mathbf{A}\left\langle \mathbf{B}_{\tilde{\texttt{y}}.\phi}\right\rangle_{\texttt{y}.\psi}$. When it is > (head final), the scrambled object $\mathbf{B}_\phi$ precedes $\mathbf{A}\langle\epsilon\rangle$ as the first case in (9). Otherwise, as the second case in (9), the RM realizes the QR. In other words, $\textbf{move}_{\sim}$ obeys the directionality in the target.

The second example is a scrambled quantifier in Japanese.

(10) $[_> [_> [_> [_>$ he-GEN spouse-TOP] $[_>$ sumotori-both-ACC$_{\tilde{\texttt{c}}}$ admire]] did] $\varepsilon]_{\texttt{c}}$

(11) $\textbf{move}_{\sim}(10)$ =
$\left[_>\right.$ sumotori-both-ACC $[_> [_> [_> [_>$ he-GEN spouse-TOP] $[_> \epsilon$ admire]] did] $\varepsilon]_{\texttt{c}}\left.\right]$

In (11), $[_>$sumotori-both-ACC$]_{\tilde{\texttt{c}}}$ undergoes scrambling, resulting in a WCO configuration. Here, unlike the major approach proposed by May (1977), I assume that scrambling (and QR) are adjoints to CP.

7 Conclusions and future work

First, I answer the questions in this study: (i) Like Tonoike's (2007) suggestion, moved XPs involving feature checking occupy [(Outer-)Spec, XP], while others are in [(Inner-)Spec, XP]. I demonstrated that Japanese scrambling can be regarded as an overt QR. (ii) I adopt the PCP (Fox & Pesetsky 2009), which distinguishes between overt and covert movements. The properties of the triggering features determine the optionality. Similar to previous proposals in Tonoike (1995, 2007), Fox & Pesetsky (2009), and Johnson (2012), this formulation does not assume LF movement. (iii) The proposed DMG can successfully formulate right-hand specifiers with single-polarized features. This paper does not propose formal semantics for movement and scope. My past proposal (Tomita 2016, 2018)[6] that combined an MG with Champollion's quantificational event semantics (Champollion 2015, Coppock & Champollion 2019–2025) is adequate for further investigation. Future work should further investigate whether Japanese quantificational modifiers (which, unlike in English, can function as inner modifiers alongside genitive markers) serve as the functional head of D, K, or NPs.

[5]This structure underwent a head movement of *hat* from `infl` to `c`.

[6]Note that Tomita's (2018) title misleads the name of the semantic framework proposed in Champollion (2015).

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Phrasal Comparatives of Gilgiti-Shina

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1 Goal

Comparative constructions are known to exhibit rich cross-linguistic variations (Stassen 1985). Formal semantic research on comparatives used to mainly focus on English, German, and other major languages. However, the languages being analyzed have recently become more diverse, which may bring new findings and breakthroughs.

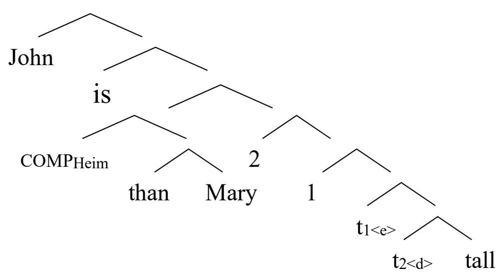
This study investigates phrasal comparatives of Gilgiti-Shina and argues that Gilgiti-Shina employs two types of invisible phrasal comparative operators, namely one proposed by Heim (1985) and another by Kennedy (1997).

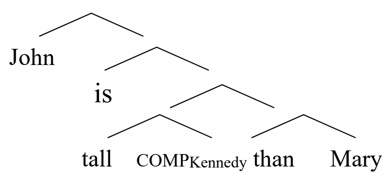
2 Previous studies

Multiple operators have been proposed for phrasal comparatives. The two most prominent ones in the literature are ones by Heim (1985) and Kennedy (1997) that are given in (1) and (2).

(1) $[\![\text{COMP}_{\text{Heim}}]\!]=\lambda y_e.\lambda R_{<d,<e,t>>}.\lambda x_e.\text{MAX}(\lambda d.R(d)(x))>\text{MAX}(\lambda d'.R(d')(y))$ (Heim 1985)
(2) $[\![\text{COMP}_{\text{Kennedy}}]\!]=\lambda R_{<d,<e,t>>}.\lambda y_e.\lambda x_e.\text{MAX}(\lambda d.R(d)(x))>\text{MAX}(\lambda d'.R(d')(y))$ (Kennedy 1997)

$\text{COMP}_{\text{Heim}}$ and $\text{COMP}_{\text{Kennedy}}$ may look similar but the crucial differences are as follows: Heim's operator takes an individual argument first, then the relation provided by the gradable predicate, and finally takes another individual argument. On the other hand, Kennedy's operator takes the relation first and then takes the two individual arguments. The differences are visible in the LF structures of *John is taller than Mary*. Heim's operator undergoes movement as shown in (3), whereas Kennedy's operator does not move as show in (4).

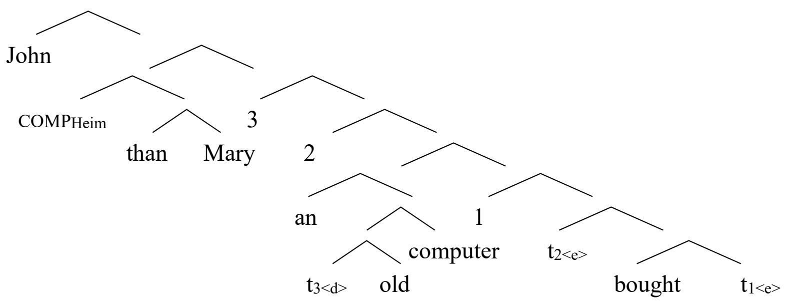
(3)


(4)


The two operators produce the same results for phrasal comparatives with predicative gradable adjectives such as *John is taller than Mary*. For this reason, Berezovskaya (2020) addresses a question as to whether it is necessary to keep $\text{COMP}_{\text{Kennedy}}$ in the inventory of semantics, because $\text{COMP}_{\text{Heim}}$ covers data that are predicted by $\text{COMP}_{\text{Kennedy}}$. Then she argues that it is necessary to keep $\text{COMP}_{\text{Kennedy}}$ following Beck et al.'s (2012), which pointed out that different behaviors are predicted for phrasal comparatives with attributive gradable predicates: DP-internal comparisons are predicted by both operators, whereas DP-external comparisons are predicted only by $\text{COMP}_{\text{Heim}}$, and not by $\text{COMP}_{\text{Kennedy}}$ because DP-external readings require movement out of a noun phrase. See (5) and (6) for examples of DP-internal/DP-external readings. The LF for the DP-external reading of (6) is given in (7).

(5) *John bought an older computer than mine.* (only DP-internal reading is sensible)
(6) *John bought an older computer than Mary*. (only DP-external reading is sensible)

(7)



Berezovskaya (2020) provides evidence for COMP$_{\text{Kennedy}}$ from Russian **GEN**(genitive)-marked phrasal comparatives given in (8) and (9), where only the DP-internal reading is possible, while the DP-external reading is not available (Berezovskaya 2020:44). This means that COMP$_{\text{Kennedy}}$ needs to be adopted to explain the contrast.

Evidence for COMP$_{\text{Kennedy}}$ in Russian

(8) *Masha kupila kompjuter moščn-ee èto-go kompjuter-a*.
Masha bought computer(ACC) powerful-COMP this-**GEN** computer-**GEN**
'Masha bought a more powerful computer than this computer.' (^{OK}DP-internal)

(9) #*Masha kupila kompjuter moščn-ee Vani*.
Masha bought computer(ACC) powerful-COMP Vanya-**GEN**
(intended) 'Masha bought a more powerful computer than Vanya.' (*DP-external)

However, phrasal comparatives with COMP$_{\text{Heim}}$ defined in (1) in Russian is not reported in Berezovskaya (2020). The next section provides data of Gilgiti-Shina, in which phrasal comparatives by both COMP$_{\text{Heim}}$ and COMP$_{\text{Kennedy}}$ are observed.

3 Gilgiti-Shina

Shina is spoken in northern Pakistan and parts of India, and its grammar has only been described in basic terms. According to Eberhard, Simons and Fennig (2023), the number of L1 speakers of Shina could reach up to one million. Shina is known to have rich dialectal variations (Radroff 1992, Schmidt and Kohistani 2008, a.o.) and the data of Gilgiti-Shina in this study were collected in March 2025 in the Gilgit region in northern Pakistan. Note that Shina is an unwritten language. The spellings of the data in this study were improvised by informants.

3.1 Explicit comparisons by invisible comparative operators

Let us start with the basic properties of Gilgit-Shina. According to the classification tree by Beck et al. (2009), Gilgiti-Shina is described as a [+DSP][1][+DAP][2][+DegPP][3]-language (Oda 2023).

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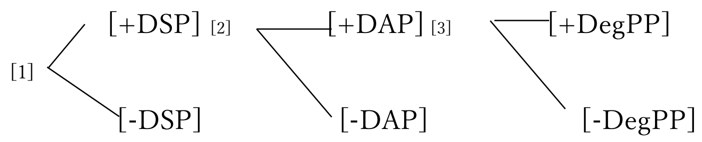
1 Degree Semantics Parameter (DSP): A language {does/does not} have gradable predicates (type <d, <e,t>> and related), i.e. lexical items that introduce degree arguments.

2 Degree Abstraction Parameter (DAP)(Beck, Oda and Sugisaki 2004): A language {does /does not} have binding of degree variables in the syntax.

3 Degree Phrase Parameter (DegPP): The degree argument position of ta gradable predicate {may/ may not} be overtly filled.

(10)



(Modified from Beck et al. 2009:28)

Nevertheless, Gilgiti-Shina has only phrasal comparatives, and it does not have clausal comparatives (Oda 2023). Thus, this study employs Direct Analysis (c.f. Hankamer 1973 a.o.) and assumes that phrasal comparatives in Gilgiti-Shina are underlyingly phrasal.

There are at least two types of phrasal comparatives in Gilgiti-Shina, which I call ***joga***-comparatives and ***fut thai***-comparatives. Both ***joga***[4] and ***fut thai*** serve as standard markers, and I will tentatively gloss them as 'than' for the purpose of this study.

Shina does not have any overt comparative morphemes, but it is reasonable to assume covert comparative operators. (11) and (12) have **differential degrees "1,000m"**. This means that the comparisons are mediated by invisible comparative operators, not by POS-operators.

Evidence for null comparative operators in Gilgiti-Shina

(11) *Raji-s*[5] *Rakaposhi* ***joga*** ***daishall meter*** *uthali sheesher ajigoan.*
Raji-S Mt.Rakaposhi than 1,000 meter high mountain has.gone
'Raji climbed 1,000m higher mountain than Mt. Rakaposhi.'

(12) *Raji-s Rakaposhi* ***fut thai*** ***daishall meter*** *uthali sheesher ajigoan.*
Raji-S Mt.Rakaposhi than 1,000 meter high mountain has.gone
'Raji climbed 1,000m higher mountain than Mt. Rakaposhi.'

3.2 DP-internal vs. DP-external readings

Joga-comparatives are compatible with both DP-internal and DP-external comparisons as shown in (13) and (14). This is evidence for $\text{COMP}_{\text{Heim}}$.

Evidence for $\text{COMP}_{\text{Heim}}$ in Gilgiti-Shina

(13) *Raji-s Rakaposhi-**joga** uthali sheesher ajigoan.*
Raji-S Rakaposhi-than big mountain has.gone
'Raji climbed a higher mountain than Rakaposhi.' ($^{\text{OK}}$DP-internal)

(14) *Raji-s Saeed-**joga** uthali sheesher ajigoan.*
Raji-S Saeed-than big mountain has.gone
'Raji climbed a higher mountain than Saeed.' ($^{\text{OK}}$DP-external)

On the other hand, <u>***fut thai***-comparatives are compatible with only DP-internal readings, and DP-external reading is not available as shown in (16)</u>. This is evidence for $\text{COMP}_{\text{Kennedy}}$. ***fut thai*** in (16) turns out to mean "without" and it creates only an irrelevant interpretation: "Raji climbed a high mountain (alone) without Saeed."

Evidence for $\text{COMP}_{\text{Kennedy}}$ in Gilgiti-Shina

(15) *Raji-s Rakaposhi-**fut thai** uthali sheesher ajigoan.*
Raji-S Rakaposhi-than big mountain has.gone
'Raji climbed a higher mountain than Rakaposhi.' ($^{\text{OK}}$DP-internal)

---

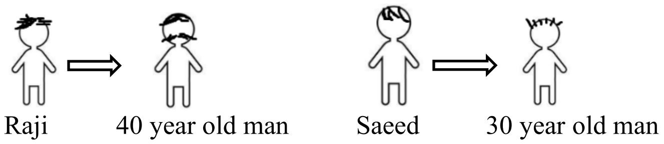
[4] Gilgiti-Shina has another standard marker *jo*, which seems to be a variation of *joga*.

[5] The morpheme *-s* that follows that subject seems to be ergative case marker.

(16) #*Raji-s* *Saeed-* ***fut thai*** *uthali* *sheesher* *ajigoan*.
Raji-S Saeed-without big mountain has.gone
'Raji climbed a high mountain without Saeed.' (*DP-external)

Ample examples are available showing the same contrast between ***joga***- and ***fut thai***-comparatives. Given below are additional data with contexts. In Context 1 given in (17), Raji hired a 40 year old man, and Saeed did a 30 year old man. A DP-external comparison "Raji hired an older man than Saeed" is possible with *joga* as shown in (18) but not with *fut thai* as shown in (19).

(17) Context 1: Raji hired a 40 year old man, and Saeed hired a 30 year old man.



Evidence for $\text{COMP}_{\text{Heim}}$ in Gilgiti-Shina
(18) *Raji-s* *bodo* *mafair* *mushaq* *ginigun* *Saeed* ***joga***.
Raji-s more old man hired Saeed than
'Raji hired an older man than Saeed.' (OKDP-external)

Evidence for $\text{COMP}_{\text{Kennedy}}$ in Gilgiti-Shina
(19) #*Raji-s* *bodo* *mafair* *mushaq* *ginigun* *Saeed* ***fat thai***.
Raji-s more old man hired Saeed than
'Raji hired an older man than Saeed.' (*DP-external)

In Context 2, Raji compared a 40 year old man and Saeed who was in his 30s and hired the 40 old man. A DP-internal comparison "Raji hired an older man than Saeed" is possible either with *joga* or *fut thai*. The above data (18) and (19) turn out to be acceptable under Context 2.

(17) Context 2: Raji compared a 40 year old man and Saeed who was in his 30s, and he hired the 40 old man.

4 Conclusion and issues for further research

I conclude that ***joga***-comparatives are mediated by $\text{COMP}_{\text{Heim}}$, whereas ***fut thai***-comparatives are made possible by $\text{COMP}_{\text{Kennedy}}$. This means Gilgiti-Shina employs two types of phrasal comparative operators within itself. Such language is not mentioned in Beck et al. (2012) nor in Berezovskaya (2020). The contribution of this study is to provide concrete evidence for the existence of the two types of phrasal comparative operators within a language.

Many questions remain to be answered. It is not clear why ***joga/fut thai***-comparatives employ $\text{COMP}_{\text{Heim}}$/$\text{COMP}_{\text{Kennedy}}$ respectively, and how learners distinguish the two operators, especially when they are both phonologically null.

To answer the questions, we need a wider range of data of ***joga/fut thai***. ***joga*** appears in various comparative constructions. Some previous research mentions that ***joga*** serves as an ablative case marker (Schmidt and Kohistani 2008), which is common among standard markers across languages.

The circumstances for ***fut thai*** is much less clear. There is no previous studies on ***fut thai*** to the knowledge of the author, and it seem to be a verbal expression. According to an informant, ***fut thai*** means "leave it" when it is used independently.

(18) ***Fut thai!***
'Leave it!'

Thus, investigation on standard markers across languages that stem from verbal expression might shed some light on it. One such example is *bǐ* (比) in Mandarin, which is a verb 'to compare' and it serves as a standard marker in comparative constructions.

Another possible source of data is Hindi/Urdu. To the knowledge of the presenter, the grammar of Shina is very similar to that of Hindi/Urdu, and it applies to degree constructions as well. For instance, both Hindi/Urdu and Shina have phrasal comparatives only and they both lack clausal comparatives. They both lack superlatives, thus the notion of superlative is expressed by "than all." It is worth investigating phrasal comparatives in Hindi/Urdu with different types of standard markers. *-se* is a well-known standard marker in Hindi/Urdu, and it is of our interest if there is any alternative expression.

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Scalar NPIs in polar questions: evidence from Balkar, Kumyk, and elsewhere

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Intro: In this paper, we examine negative polarity items (NPIs) of the following form: scalar-additive particle (e.g. English *even*) + the item denoting the low endpoint of a scale (e.g. *one*), henceforth scalar NPIs. This kind of construction is unacceptable in positive episodic sentences (1).

(1) a. *John read even ONE book.
b. John didn't read even ONE book. (Crnič 2014: p. 120)

We will focus on the cross-linguistic variation in acceptability of scalar NPIs in polar questions (PQs) exemplified in (2)–(4). English *even*, Japanese *demo* and Russian *xot'* are ok with 'one' in PQs, while Japanese *mo*[1], *sae* and Russian *daže*, although acceptable in negative sentences, are ruled out in PQs.[2]

(2) Did John read even ONE book? (Crnič 2014: p. 138)

(3) **Japanese**
a. i-tteki-{**??demo**/ **mo**/ **sae**} noma-naka-tta.
one-CL.DROP-even_{weak}/ even_{strong}/ even_{strong} drink-NEG-PST
'(I) didn't drink even one drop.' (Yoshimura 2007: pp. 142, 254)[3]
b. ichi-peeji-{**demo**/ ***mo**/ ***sae**} kai-ta no?
one-CL.PAGE-even_{weak}/ even_{strong}/ even_{strong} write-PST Q
'Did you write even one page?' (Yoshimura 2007: pp. 163, 241–242)

(4) **Russian (own data)**
a. P ne s-mog pročitat' { **daže** / **xot'** } odnu straniču.
P NEG PFCT-can.PST read.INF even_{strong} / even_{weak} one.ACC page.ACC
'P was not able to read even one page.'
b. Petja pročital { **#daže** / **xot'** } odnu straniču?
Petya read.PFCT.PST even_{strong} / even_{weak} one.ACC page.ACC
'Did Petya read even one page?'

A typology: We account for this variation by considering the patterns emerging from the distribution of the following particles: English *even*; German *sogar, auch nur*; Greek *akomi ke*, *esto*; Japanese *-demo*, *-mo*, *-sae*; Mandarin *shenzhi*; Russian *daže*, *xot'*; Slovenian *magari*, Spanish *siquiera* (see references below). We also introduce the novel data on the particle *da* / *-dA*[4] in two closely related Kipchak Turkic languages: Karachay-Balkar (Malkar variety; henceforth Balkar) and Kumyk (Terek variety; henceforth Kumyk).

We propose a typology of scalar NPIs in (5). $\textbf{even}_{\textbf{strong}}$ stands for overt, unambiguously strong scalar particles like German *sogar* and Russian *daže*, which always project a 'low-likelihood' presupposition. $\textbf{even}_{\textbf{weak}}$ stands for weak (concessive) scalar particles like German *auch nur* and Russian *xot'* with roughly the opposite presupposition. **EVEN** stands for the covert EVEN operator. Details will be specified below.

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[1]For simplicity, we regard *mo* as a scalar particle synonymous to English *even* in one of its readings ("strong *even*"). The actual distribution of *mo* is very different from *even* and it is more justified to regard it as an additive or anti-exhaustive particle (Kobuchi-Philip 2009, Szabolcsi 2015, 2017, Mitrović 2021), which can be but is not necessarily scalar. We sidestep this issue here, see Rossyaykin 2024 for a comparison of scalarity and additivity in NPIs.

[2]In these examples, we compare ONE book/page to larger numbers of books/pages.

[3]There is no this particular example with *-sae* in Yoshimura 2007: p. 142, but there is a similar example *mizu i-tteki-sae naka-tta* 'there was not even one drop of water'.

[4]Capital *A* stands for a segment which can be realized as [a]/[e] depending on vowel harmony.

(5) scalar NPIs

- non-compositional, lexicalized indefinites
  - NCIs (Agree with NEG)
    (i) negation
  - NPI indefinites (invoke EVEN)
    (i) DE contexts
    (ii) questions
- compositional SCAL.PTCL + low endpoint
  - $\text{even}_{\text{strong}}$ + low endpoint
    (i) DE contexts
  - $\text{even}_{\text{weak}}$ + low endpoint (+ covert EVEN)
    (i) DE contexts
    (ii) questions
    (iii) modal contexts

It turns out that the following parameters determine the distribution of scalar NPIs: **(I)** is the whole construction lexicalized as a negatively polar indefinite? **(II)** if yes, is it a vanilla NPI invoking covert EVEN or a negative concord item (NCI), which agrees with NEG? **(III)** if no, is the compositionally present scalar particle 'strong' or 'weak'?
As for **(III)**, weak ("concessive") scalar particles can be distinguished from the strong ones thanks to their acceptability in UE modal environments. Notably, a particle can be ambiguous between weak and strong, which is the case, we argue, with English *even*, cf. Rooth 1985, Rullmann 1997, Giannakidou 2007. As for **(I)**, language-specific data are needed in order to determine whether an NPI is lexicalized. Segmentally identical compositional and lexicalized NPIs can co-exist, which is the case with Japanese 'one'+*mo* (Yoshimura 2007: sec. 5.7).
According to (5), the distributional difference between NPI indefinites and $\text{even}_{\text{strong}}$ + 'one' items is: only the former are acceptable in PQs. The generalization in (6) follows:

(6) **Generalization: $\text{even}_{\text{strong}}$ in polar questions**
$\text{even}_{\text{strong}}$ cannot associate with a low endpoint denoting item in polar questions.

In what follows, we provide cross-linguistic evidence for (6).
<u>Novel Data:</u> Balkar and Kumyk feature morphologically similar NPIs of the form 'one' (*bir*) + restriction (XP) + a scalar-additive particle (*da* / *-dA*)[5]. Their distribution is almost the same with some differences which might seem enigmatic at first glance. Most importantly, only Kumyk NPIs are acceptable in PQs, cf. (7-b) and (8-b).

(7) a. (**bir**) **adam da** kel*(-me)-di.
one person ADD come-NEG-PST.3SG
'No one came.'

b. sen **bir zat-nɨ** (***da**) aša-ʁan-mɨ-sa?
you one thing-ACC ADD eat-PFCT-Q-2SG
'Have you eaten anything?' (Balkar)

(8) a. *(**bir**) **adam-na** gel*(-me)-di.
one person-ADD come-NEG-PST.3SG
'No one came.'

b. **bir zat-ni-da** Alim gör-di-m?
one thing-ACC-ADD Alim see-PST-Q
'Did Alim see anything?' (Kumyk)

<u>Idea:</u> Balkar NPIs are semantically decomposable into 'one' + additive, which we re-

[5] Kumyk *-dA* is an affix/clitic and is subject to nasal assimilation (and vowel harmony), cf. *adam-na*.

gard here as equivalent to $\text{even}_{\text{strong}}$.[6] On the other hand, we argue that Kumyk NPIs are lexicalized indefinites, which is typologically common for constructions with 'one' (Haspelmath 1997: pp. 157–192). This is supported by (9) where the Balkar NPI requires overt negation in fragment answers, but the Kumyk one can stand alone. Although we do not have an explanation for this, we assume that this suggests that Kumyk items were reinterpreted as non-compositional indefinites.[7] Also note that Balkar NPIs allow dropping *bir* 'one' (7-a)/(9-a), while Kumyk ones don't (8-a)/(9-b).

(9) a. kim kel-di? — [**(bir) adam da** ~~kel-di~~] ??(uʁaj).
who come-PST.3SG one person ADD come-PST.3SG NOT
'Who came? — No one.' (Balkar)

b. kim gel-di? — ***(bir) adam-na**.
who come-PST one man-ADD
'Who came? – No one.' (Kumyk)

<u>Derivation:</u> We assume that:

(10) a. Compositional NPIs involve *one* + $\text{even}_{\text{strong}}$ (Lee & Horn 1994, Lahiri 1998: a.o.);
b. Grammaticalized NPIs invoke a covert EVEN(Krifka 1995, Chierchia 2013, Crnič 2019, Jeong & Roelofsen 2023: a.o.).[8]

It follows that the difference of Balkar and Kumyk in PQs (7-b)/(8-b) comes from the difference between $\text{even}_{\text{strong}}$ and covert EVEN. In fact, the pattern observed in Balkar is not isolated. Crosslinguistically, unambiguously strong 'even'-particles cannot associate with a weak scale item in PQs, cf. German *sogar* (Guerzoni 2003: p. 170), Greek *akomi ke* (Giannakidou 2007: p. 75), Japanese *-sae* (Yoshimura 2007: p. 158), Mandarin *shenzhi* (16), Russian *daže* (4-b).[9] This motivates our **Generalization** (6), and suggests that the covert EVEN operator should be distinguished from its overt counterpart.

We explore a semantic account, without excluding the possibility for syntactic ones.

<u>A semantic account of (6):</u> We argue that Kumyk NPIs are lexicalized items (≈ *any NP*) which associate with a covert EVEN in the sense of Jeong & Roelofsen (2023), whose meaning is presented in (11) in a slightly simplified form of inquisitive semantics. The scalar presupposition is construed in terms of cumulative likelihood (13).

(11) a. $[\![\text{EVEN } \phi]\!]^c$ is defined iff no $A \in [\![\phi]\!]^c_{\text{alt}}$ is such that $[\![\phi]\!]^c >_c A$. (Scalar psp)
b. If defined, $[\![\text{EVEN } \phi]\!]^c = [\![\phi]\!]^c$.

(12) a. $[\![\text{John came}]\!] = \{\{w \mid \text{CAME}(J)(w)\}\}$
b. $[\![\text{Did John come?}]\!] =]\!] = \{\{w \mid \text{CAME}(J)(w)\}, \{w \mid \neg\text{CAME}(J)(w)\}\}$

[6] Rossyaykin (2024) argues that *da/-dA* in these languages is an anti-exhaustive particle, cf. Xiang 2020, Kirby 2024 on Mandarin *dou* and Tuvan *daa*. For the reasons of space, we do not address this option here, see Footnote 1 for a similar qualification regarding Japanese *mo*. What is important here is that these particles are not 'weak' (concessive).

[7] Turkish *kimse* indefinite has a similar distribution. It is acceptable in PQs and as a negative fragment answer without overt negation. It is arguably not inherently negative in any sense, since at least some speakers also accept it in conditional antecedents (Görgülü 2017, Gould & Alxatib 2024).

[8] Previous literature also explored different options for what this covert operator may be, including EMPH.ASSERT (Krifka 1995) and EXH (Chierchia 2013). For the purpose of this study, we use EVEN, without excluding the possibility of other options.

[9] Nicolae (2013) constructs polar questions as a DE environment, which would wrongly predict that $\text{even}_{\text{strong}}$ can associate with low scale endpoints if it scopes above the question. Her analysis does not provide a way to prevent this, and even if we do define such a constraint, it will be difficult to justify such a distinction among various DE environments.

c. $\textbf{info}(\llbracket\phi\rrbracket) := \bigcup\llbracket\phi\rrbracket$ (the informative content of ϕ, all the w's "mentioned" in $\llbracket\phi\rrbracket$)

(13) **Cumulative likelihood (Jeong & Roelofsen 2023: p. 24)**
$\llbracket\phi\rrbracket >_c A$ iff $\mathcal{P}^c(\textbf{info}(\llbracket\phi\rrbracket)) > \mathcal{P}^c(\textbf{info}(A))$,
where $\mathcal{P}^c(p) := \sum_{w\in p}\mathcal{P}^c(w)$ and $\mathcal{P}^c(w)$ is the probability that w is the actual world given the information in c.

The scalar presupposition (11-a) is always satisfied in PQs, since (ignoring other presuppositions) for a polar question ϕ and any question alternative A, $\bigcup\llbracket\phi\rrbracket = \textbf{info}(\phi) = W = \textbf{info}(A) = \bigcup(A)$. It follows that NPIs with covert EVEN are licensed in PQs.
On the other hand, following Greenberg (2018) and Chen & Greenberg (2022), a.o., we assume that overt $\text{even}_{\text{strong}}$ has more complex semantics than EVEN. Crucially, it requires ϕ to be **strictly ordered** with respect to its alternatives.[10] In (14) we present it in a simplified form, see Greenberg 2018 for elaboration.

(14) a. $\llbracket \text{even}_{\text{strong}}\phi\rrbracket^c$ is defined iff $\forall A \in \llbracket\phi\rrbracket^c_{\text{alt}} \wedge A \neq \llbracket\phi\rrbracket : A >_c \llbracket\phi\rrbracket^c$ (Scalar psp)
b. If defined, $\llbracket \text{even}_{\text{strong}}\phi\rrbracket^c = \llbracket\phi\rrbracket^c$.

It follows that the scalar presupposition (14-a) cannot be satisfied if ϕ denotes a question, since for any question alternative A, $\textbf{info}(A) = \textbf{info}(\phi) = W$, violating $A >_c \llbracket\phi\rrbracket^c$ (14-a). Therefore, overt *even*$_{\text{strong}}$ can only scope low in questions, but in this case its scalar presupposition cannot be satisfied either if it associates with a low-scale item (at least in normal contexts where low-scale items are insignificant). In other words, an overt $\text{even}_{\text{strong}}$ cannot be felicitous in PQs regardless of its scope.
Together, our analysis predicts the following LF patterns, which are consistent with crosslinguistic data (INT stands for the interrogatve operator).

(15) a. ***even**$_{\textbf{strong}}$ [INT [Did you see ONE person?]] (≈ (7-b))
(Scalar presupposition of $\text{even}_{\text{strong}}$ always fails due to the nature of questions.)
b. #INT [**even**$_{\textbf{strong}}$ [Did you see ONE person?]] (≈ (7-b))
(Scalar presupposition of $\text{even}_{\text{strong}}$ fails in normal contexts.)
c. **EVEN** [INT [Did you see ANYONE?]] (≈ (8-b))

Additional evidence: Mandarin minimizers (as emphatic 'one'-CL) cannot occur with any overt strong scalar particle (e.g. *shenzhi*).[11] The only valid interpretation of (16) would be in a weird context where the writing of just one page is considered significant, suggesting that *shenzhi* can only scope below the question operator. This straightforwardly follows from our analysis.

(16) Mali (*shenzhi) xie-wan YI-YE le ma?
Mary $\text{even}_{\text{strong}}$ write-finish one-page PFV Q
'Did Mary write ONE SINGLE PAGE?'

In general, we follow the analysis of Jeong & Roelofsen (2023) that minimizers must

[10] In other words,the prejacent of overt $\text{even}_{\text{strong}}$ must 'stand out' in the set of alternatives. Consider a context in which we are looking for someone who lives in France to be our tour guide for an upcoming trip to France, with Paris being the main destination. In this case, we have *Mary lives in France. She even lives in {Paris, #Bourdeaux, #Nantes, etc.}*, where *even* is only felicitous if its prejacent is strictly more desirable than the other alternatives. If we are indifferent about the French cities, we cannot associate *even* with *Paris*. In Greenberg (2018), this idea is represented by comparing the degree associated with a salient entity x in p-worlds (the prejacent of *even*) and in $q \wedge \neg p$-worlds (the alternatives), and requiring the degree in p-worlds to be strictly higher.

[11] Illustrated with *shenzhi* here which is clausal level because *lian...dou...* can only associate with the local phrase and not the proposition (Liao & Jheng 2025).

invoke a covert EVEN, which scopes above the interrogative operator, which is parallel to (15-c) and our $\text{even}_{\text{weak}}$ below.[12]

NPIs with $\text{even}_{\text{weak}}$: We argue that (17) is not a counterexample to (6) but involves $\text{even}_{\text{weak}}$, cf. Rooth 1985, Rullmann 1997, Giannakidou 2007. In particular, English *even one* is acceptable in imperatives and modal environments (Crnič 2011), a hallmark of $\text{even}_{\text{weak}}$, cf. German *auch nur*, Greek *esto*, Japanese *(dake-)demo* (18)[13], Russian *xot'* (19), Spanish *siquiera*, Slovenian *magari* (Giannakidou 2007, Yoshimura 2007, Crnič 2011, Alonso-Ovalle 2016).[14]

(17) Did John read even ONE book? (Crnič 2014: p. 138)

(18) I-tteki{-demo/ -*mo/ -?#sae} nomi-tai.
one-CL-$\text{even}_{\text{weak}}$/ $\text{even}_{\text{strong}}$/ $\text{even}_{\text{strong}}$ drink-want
'I want to drink even one drop.' (Yoshimura 2007: pp. 257, 295)

(19) Ja xoču vypit' { xot' / #daže } odnu kapl'u.
I want drink.INF $\text{even}_{\text{weak}}$ / $\text{even}_{\text{strong}}$ one.ACC drop.ACC
'I want to drink even one drop.' (Russian; own data)

Following Crnič 2011, Alonso-Ovalle 2016, we argue that $\text{even}_{\text{weak}}$ are narrow scope operators which invoke wide scope covert EVEN (20), parallel to (15-c).[15]

(20) EVEN [INT [Did John read $\text{even}_{\text{weak}}$ ONE book?]]

(21) $[\![\text{even}_{\text{weak}}(\phi)]\!]^c$ is defined iff $\forall A \in \text{Alt}(\phi)[A \neq \phi \rightarrow A <_c \phi]$ (ϕ is the most likely)
If defined, $[\![\text{even}_{\text{weak}}(\phi)]\!]^c = [\![\phi]\!]$

In questions, the covert EVEN must scope above the interrogative operator in order to avoid conflicting presuppositions with $\text{even}_{\text{weak}}$. In this case, the prejacent of covert EVEN is the interrogative, and its scalar presupposition is automatically satisfied since we have $\textbf{info}(A) = \textbf{info}(\phi) = W$. Therefore, (20) is predicted to be felicitous.

Negative concord: Some NPIs are not licensed in PQs despite being lexicalized, e.g. Japanese 'one'+*mo* (3-b). We argue that those items are not vanilla NPI indefinites which invoke covert EVEN, but NCIs which need to agree with negation, see Watanabe 2004 on Japanese *mo*-items.

Conclusion:

(22) a. Scalar NPIs and minimizers are acceptable in PQs iff they involve a covert EVEN in the sense of Jeong & Roelofsen (2023):
 (i) **only covert EVEN:** Kumyk NPIs (8-b), English *any*, minimizers (16);
 (ii) **covert EVEN + $\text{even}_{\text{weak}}$:** English *even one* (17), Japanese 'one' + *(dake-)demo* (3-b), Russian 'one' + *xot'* (4-b)
 b. Scalar NPIs with $\text{even}_{\text{strong}}$ (3-b)/(4-b)/(7-b)/(16) are not acceptable in questions.

[12] Jeong & Roelofsen (2023) further note that minimizers can be distinguished from regular NPIs in that they are inherently emphatic. We omit the discussion here.

[13] Yoshimura (2007) argues that *demo* is $\text{even}_{\text{weak}}$, while Nakanishi (2006) argues that *dake demo* together is $\text{even}_{\text{weak}}$, with *demo* on its own being $\text{even}_{\text{strong}}$. Nakanishi further claims that all instances of *demo* appearing as $\text{even}_{\text{weak}}$ involve a covert *dake*. We omit the discussion here for limited space.

[14] Since Kumyk NPIs cannot occur in imperatives and modal environments, we argue that they are lexicalized NPIs rather than 'one'+$\text{even}_{\text{weak}}$. We do not provide the data here for the reasons of space.

[15] Crosslinguistically, the two operators may be subject to variation giving rise to a range of meanings with slight differences. See Mizutani (2023) for a recent discussion. The licensing of these various concessive particles in PQs will be left for future research.

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Where does anti-uniqueness come from? A case study of English demonstratives

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Overview. Demonstratives in English are often said to carry an anti-uniqueness requirement, such that (1) requires there to be multiple dogs (e.g. Robinson 2005; Nowak 2019; Dayal & Jiang 2022). This study argues against this requirement and proposes that anti-uniqueness is instead derivable from focus.

(1) That$_{\rightarrow A}$ dog is pretty. ($\rightarrow$A = a deictic gesture pointing towards location A)

Anti-uniqueness as presupposition. Here I consider two types of existing analyses of anti-uniqueness. The first type of existing analyses models anti-uniqueness as a presupposition. Nowak (2019), for example, lexically encodes anti-uniqueness as a presupposition on the English demonstrative article *that*. For Nowak, *that* takes two arguments, one provided by the NP and the other by a relative clause or a pointing gesture. *That* presupposes that this second argument must properly restrict the NP argument, thus in effect requiring the NP to denote a non-singleton set. A slightly different analysis, Dayal & Jiang (2022), also lexically encodes anti-uniqueness as a presupposition on the demonstrative article, but additionally allows anti-uniqueness to be satisfied in a situation larger than the situation at which the sentence that contains the demonstrative is evaluated.

Anti-uniqueness as conversational implicature. The second type of existing analyses derives anti-uniqueness as a conversational implicature, which arises when demonstratives compete with definites (e.g. Blumberg 2020; Ahn 2025). For example, in Ahn's analysis, demonstratives take two arguments, one an NP and the other a pointing gesture, an anaphoric index, or a relative clause, while definites take just an NP argument. Ahn argues that when a demonstrative and a definite denote the same individual, the demonstrative is infelicitous because of a general economy principle: don't use a semantically more complex expression when a simpler one can do the job (à la Schlenker 2005's *Minimize Restrictors!*). If a definite and demonstrative both take the same NP argument, they denote the same individual if and only if the NP argument denotes a singleton. The felicitous use of a demonstrative thus implicates that its NP argument must not denote a singleton, giving rise to an anti-uniqueness inference.

Shortcomings. I argue that both types of existing analyses have shortcomings. First, the presupposition analyses struggle to account for (2). Contra Nowak (2019), there are felicitous uses of demonstratives where the NP is unique. (2) gives five such examples. Furthermore, contra Dayal & Jiang (2022), the NPs in (2) are unique in a variety of situations, including the immediate situation in (2a)-(2b), the situations quantified over by the conditional in (2c), the larger situation in (2d), and any situation in (2e). The presupposition analyses thus fail to predict the felicities of (2a)-(2e), no matter in what situation anti-uniqueness is checked.

(2) a. [Context: there is only one Lamborghini in the showroom.]
That$_{\rightarrow \text{A}}$ Lamborghini looks expensive. (modified from Blumberg 2020)

b. Look at that oddly-shaped disc flying in the air right now. (Ahn 2025)

c. I love cats. All cats. If there were only one cat left on Earth, I would find that cat and adopt it. (Nowak 2019)

d. Today we'll finally get to learn about that sun that we see in the sky every day.

e. Today we'll finally get to learn about that smallest prime number that Mr. Smith has been teasing us about.

Examples like those in (2) have traditionally motivated researchers to adopt the conversational implicature analyses. However, I argue below that neither the presupposition analyses nor the conversational implicature analyses accounts for (3), where anti-uniqueness is manipulated by focus. In (3), stress on the demonstrative article, but not stress on the noun, is infelicitous in a context with only one salient dog. The presupposition analyses either incorrectly predict (3b) to be infelicitous because anti-uniqueness is violated in the context (e.g. Nowak 2019), or (3a) to be felicitous because there should exist larger situations with multiple dogs where anti-uniqueness is satisfied (e.g. Dayal & Jiang 2022). On the other hand, the conversational implicature analyses also incorrectly predict (3a) and (3b) to receive the same judgments, since demonstratives are expected to compete with definites to give rise to anti-uniqueness regardless of stress.

(3) [Context: there is only one salient dog (but there are other non-dog individuals).]

a. #THAT$_{\rightarrow \text{A}}$ dog is pretty. b. That$_{\rightarrow \text{A}}$ DOG is pretty.

Proposal. I propose to derive anti-uniqueness in English demonstratives as a by-product of focus. First, I propose that the English demonstrative article *that* denotes (4) (ignoring the distal presupposition and other irrelevant details). (4) simply takes two arguments and return the unique individual that satisfies both, with no reference to anti-uniqueness in the denotation. Because (4) does not presuppose anti-uniqueness, it makes the right predictions about (2). In (2a), for example, *that* takes the NP *Lamborghini* and the deictic gesture as its two arguments, and return the unique individual that is both a Lamborghini and at location A (here I assume that $\rightarrow$A denotes a predicate true of individuals at A).

(4) $[\![\text{that}]\!] = \lambda P \lambda R. \iota x. P(x) \wedge R(x)$

Next, I propose to derive anti-uniqueness from the following two assumptions about focus, both standard assumptions in the literature:

(5) a. **Assumption 1:** focus alternatives are contextually restricted.

b. **Assumption 2:** the set of focus alternatives is non-singleton. (Rooth 1992)

(5a) is commonly assumed to be necessary, since a sentence like (6) does not entail that no individual other than Ede wants coffee whatsoever, but only that no contextually relevant people (who might want coffee) other than Ede wants coffee. (5b) is part of the presupposition that Rooth (1992) proposes for the squiggle operator $\sim$. In Rooth's Alternative Semantics, $\sim$ takes a silent pronoun C as its argument and adjoins to a syntactic constituent ϕ. $\sim$ presupposes that C is a subset of the focus semantic value of ϕ containing the ordinary semantic value of ϕ and at least one other element, in effect requiring the focus semantic value of ϕ to denote a non-singleton set of focus alternatives.

(6) Only [EDE]$_F$ wants coffee.

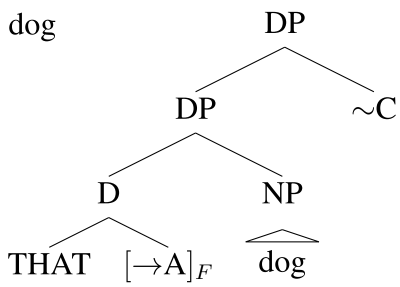
Consider now (3a) with stress on *that*. Adopting Rooth (1992)'s Alternative Semantics, I propose that the demonstrative in (3a) has the structure in (9) (see pg.2), where focus is marked on the deictic gesture and the focus domain is the entire DP. Here I assume that when focus is placed on something silent (incl. physical gestures), stress may be shifted to some adjacent linguistic material that is overtly pronounced (see Laka 1990, Ahn 2015, Saha et al. 2023 for similar proposals on the stress assignment of silent focus-marked elements). In (3a), this adjacent material is the demonstrative determiner *that*. I also assume following Ahn (2022) that $[\![\rightarrow\text{A}]\!] = \lambda x.x$ is at A at w_0. Accordingly, (9) generates the focus alternatives in (7), swapping $[\![\rightarrow\text{A}]\!]$ for other type $\langle e,t\rangle$ predicates. According to (5a), (7) is contextually restricted, so that only the contextually available alternatives remain. Thus if only one salient dog exists in the context (e.g. (3)), (7) would be restricted to a singleton. However, according to (5b), (7) must be non-singleton. Contexts with only one salient dog thus inevitably conflict with (5b). (3a) is then correctly predicted to be infelicitous in such contexts, creating an appearance of anti-uniqueness.

(7) $[\![(9)]\!]^f$ = {that dog at A, that dog at B, that dog that's white, that dog that's black…}

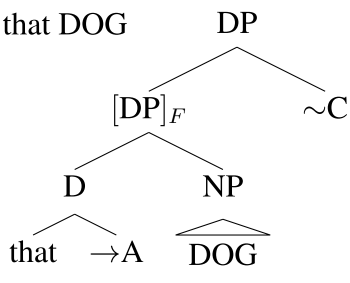
Consider next (3b) with stress on the noun. I propose that (3b) has the structure in (10), where focus is now marked on the entire DP and the focus domain remains the entire DP as well. (10) generates the focus alternatives in (8). (8) is likewise contextually restricted, so that if only one salient *individual* (e.g. a salient dog) exists in the context, (8) would become a singleton and at odds with (5b). (3b) is then correctly predicted to be infelicitous in such contexts but felicitous elsewhere, including in (3) where there is a dog and other non-dog individuals.

(8) $[\![(9)]\!]^f$ = {that dog at A, that cat at B, that rabbit that's white…}

(9) THAT dog



(10) that DOG



(3b) is ambiguous between focus placed on the entire DP and on the noun. However, the latter is infelicitous in (3b) because it inevitably conflicts with (5b). When focus is placed on the noun, (3b) generates the focus alternatives in (11). According to (5b), only alternatives that are contextually available remain. However, assuming that only one individual may occupy a location at a given time, (11) is inevitably singleton, and therefore at odds with (5b). (3b) is then infelicitous when focus is placed on the noun.

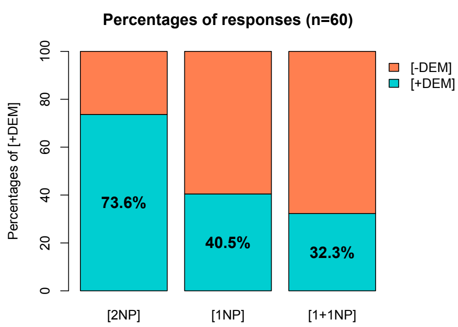
(11) $[\![[\text{that}_{\rightarrow A}\ \text{DOG}]_F]\!]^f$ = {that dog at A, that cat at A, that rabbit at A...}

There does exist examples where focus is placed on the noun that are felicitous. Consider (12) as a case in point. In (12), focus is unambiguously on the noun, yet (12) is nevertheless felicitous. The demonstrative in (12) generates the focus alternatives in (13). Given (13), (5a) and (5b) correctly predict (12) to be infelicitous in contexts with only one salient individual to the right (e.g. a salient wall to the right), but felicitous elsewhere, including in (12) where there is a wall and a table to the right.

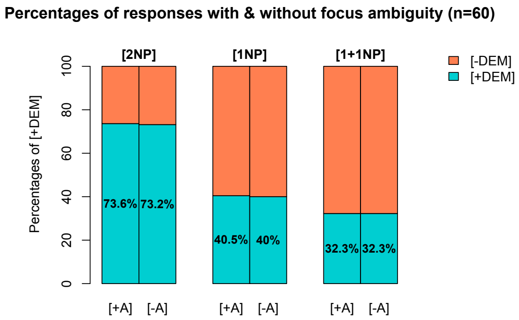
(12) [Context: I'm deciding whether to put a painting on a wall or a table to the right.]
I will put it on that WALL to the right.

(13) $[\![\text{that } [\text{WALL}]_F \text{ to the right}]\!]^f$ = {that wall to the right, that desk to the right...}

The aforementioned predictions were tested in an acceptability judgement task experiment. 60 adult native English monolinguals were recruited on Prolific Academic. Participants were presented with various contexts, each paired with two recordings, and were asked to choose the recording that sounds more natural to them in each given context. The two recordings differ only in their stress assignments: stress is either on *that* (+DEM) or elsewhere in the demonstrative, such as the noun (−DEM). The contexts came in three types: contexts that contain more than one individual satisfying the NP description of the demonstrative in the recording (2NP), contexts that contain only one individual satisfying the NP description but any number of individuals not satisfying the NP description (1+1NP), and contexts contain only one individual satisfying the NP description and no other individuals (1NP). The experiment found that going from [1+1NP] contexts to [1NP] contexts to [2NP] contexts, the likelihood of participants choosing the [+DEM] recording increases monotonically. This is depicted below.



In other words, participants were most likely to choose the recording with stress on *that* when the context contains more than one individual satisfying the NP description, and least likely to do so when the contexts contain only one individual satisfying the NP description and at least one other individual not satisfying the NP description. This is depicted in the figure below. A binary logistic regression model with ordinal predictors was used to analyze the dependence of the number of participants choosing [+DEM] recordings on the type of context. The types of context are treated as ordinal, such that $[2NP] > [1NP] > [1 + 1NP]$. The model revealed a strong positive effect of the type of context on the likelihood of participants choosing a [+DEM] recording ($\beta = 0.63$, $p < 0.001$). A binary logistic regression model with ordinal predictors was also used to analyze the dependence of the number of participants choosing [−DEM] recordings on the type of context. The model again revealed a strong positive effect ($\beta = 0.88$, $p < 0.001$). Excluding target items where focus placement is ambiguous (e.g. (3b)) did not significantly improve model fit in either models ($\beta = 0.86$, $p < 0.001$ for both). This is depicted in the figure below (+/−A: with/without focus ambiguity). The experiment therefore confirms that the predictions of the present analysis are indeed borne out.



Parallels. The analysis proposed here finds parallels in Saha et al. (2023). They propose that anaphoric demonstratives in English take an NP and an anaphoric index as arguments, and place obligatory focus on the index, which biases these demonstratives towards contexts where multiple individuals satisfy the NP description. Although similar in spirit to the present analysis, Saha et al. still face the same criticisms as the existing analyses. First, because focus on the index is obligatory, Saha et al. incorrectly predict anti-uniqueness when stress is on the noun. Second, although Saha et al. connect anti-uniqueness to focus, they nevertheless propose that *that* presupposes anti-uniqueness, making them vulnerable to the same criticisms as the existing presupposition analyses.

Conclusion and future directions. In sum, lexically encoding anti-uniqueness as a presupposition or deriving it as a conversational implicature is neither empirically adequate nor theoretically necessary, since we can derive anti-uniqueness for free by adopting standard assumptions about focus and employing standard theories of focus interpretation. Beyond English demonstratives, a variety of expressions in other languages have also been argued to encode anti-uniqueness, including strong definites in Austro-Bavarian (Simonenko 2014) and the familiarity marker *nó* in Akan (Owusu 2022). It remains to be seen whether anti-uniqueness is subject to the same criticisms cross-linguistically.

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On the use of binary relations as collective predicates in natural mathematics*

— extended abstract —

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1 Introduction This paper contributes to the linguistic and semantic study of the language of *natural mathematics*, i.e., the language that mathematicians use to express pieces of mathematics in textbooks and articles [Zinn, 2004, Ganesalingam, 2013]. This language, which consists of a mixture of natural language and mathematical formulas, has its own idiosyncrasies, and is worth studying in particular with the aim of interacting with proof assistants, such as Isabelle, Lean or Rocq, at a level closer to natural language than the formal language of mathematical logic.

More specifically, we study the conditions under which adjectives that denote binary relations can be used as collective predicates. This leads us to propose a fine-grained semantic interpretation of grammatical numbers and to introduce distributivity operators that enable a compositional semantic treatment of plurals in natural mathematics.

Our study relies on numerous examples taken from a large corpus made of mathematics papers submitted to the arXiv and some standard algebra and number theory textbooks.

2 Collectivity versus distributivity A collective predicate, as opposed to a distributive one, is a predicate that applies to a plural entity considered as a whole, rather than to each individual that comprises it (see Champollion [2020], for a comprehensive review). As an illustration, consider the following sophism:

(1) Every set of prime numbers is *a fortiori* a set of coprime numbers. Therefore, every prime number is a coprime number.

While this reasoning would be perfectly acceptable if *prime* and *coprime* were respectively replaced by *rational* and *real*, it just does not make any sense in the present case because *coprime* is a collective predicate.

Interpreting plural entities as sets of individuals (see Winter and Scha [2015]), *coprime* must be semantically interpreted as a predicate on sets, that is, in Montague semantics, as a term of type $(\mathbf{e} \rightarrow \mathbf{t}) \rightarrow \mathbf{t}$, which is indeed the case according to definition (2a). By contrast, (2b) defines *prime* as a predicate over entities, that is, as a term of type $\mathbf{e} \rightarrow \mathbf{t}$.

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(2) a. $\mathbf{coprime} \stackrel{\triangle}{=} \lambda S.\, (\forall a.\, (S\, a) \to (\mathsf{N}\, a)) \wedge$
$(\forall n.\, ((\mathsf{N}\, n) \wedge (\forall a.\, (S\, a) \to (\mathbf{div}\, n\, a))) \to (n = 1))$

b. $\mathbf{prime} \stackrel{\triangle}{=} \lambda a.\, (\mathsf{N}\, a) \wedge (a \neq 1) \wedge (\forall n.\, ((\mathsf{N}\, n) \wedge (\mathbf{div}\, n\, a)) \to ((n = 1) \vee (n = a)))$

To provide a compositional semantics for the common noun phrases *prime numbers* and *coprime numbers*, we need to distinguish between the category of singular noun phrases, N_{sg}, and the one of plural noun phrases, N_{pl}. Then the abstract syntactic structures of the two phrases essentially differ in the scope taken by the plural marker PL.

(3) a. $[\,[\text{PL}]_{N_{\text{sg}} \to N_{\text{pl}}}\, [\,[\text{PRIME}]_{N_{\text{sg}} \to N_{\text{sg}}}\, [\text{NUMBER}]_{N_{\text{sg}}}\,]_{N_{\text{sg}}}\,]_{N_{\text{pl}}}$

b. $[\,[\text{COPRIME}]_{N_{\text{pl}} \to N_{\text{pl}}}\, [\,[\text{PL}]_{N_{\text{sg}} \to N_{\text{pl}}}\, [\text{NUMBER}]_{N_{\text{sg}}}\,]_{N_{\text{pl}}}\,]_{N_{\text{pl}}}$

From a semantic perspective, the plural marker PL is an operator that transforms a predicate on entities into a predicate on sets of entities. Accordingly, we interpret is as the distributivity operator of Link [1983], the definition of which is as follows:[3]

(4) $\mathbf{distr} \stackrel{\triangle}{=} \lambda P S.\, \forall x.\, (S\, x) \to (P\, x)$

The preceding discussion illustrates some of the issues related to the treatment of plurals, and emphasizes the importance of distinguishing between distributive and collective predicates in order to avoid paradoxes. In the remainder of this paper, we focus on a specific class of collective predicates used in natural mathematics, namely, those collective predicates which are derived from adjectives denoting binary relations.

3 Symmetric predicates It has been observed that phrases that denote binary symmetric predicates, typically verbs or adjectives, may often be used as collective predicates (see, among others, Lakoff and Peters [1969] and Winter [2018]). Consider, for instance, the verb *agree* and the adjective *different*. In sentences (5a) and (5b), they are used in their binary forms, with both verb phrases *agrees* and *is quite different* taking two syntactic arguments.

(5) a. James agrees with Carol.

b. Boston is quite different from New York.

Alternatively, they can be used in a collective form, like in sentences (6a) and (6b).

(6) a. James and Carol Agree.

b. Boston and New York are quite different.

[3] For the sake of ease, we have simplified the semantic treatment of plurals. A plural entity, by definition, is a combination of at least two singular entities. Consequently, a more accurate semantic definition of the plural marker is as follows: $[\![\text{PL}]\!] = \lambda p S.\, (|S| \geq 2) \wedge (\mathbf{distr}\, p\, S)$. Interestingly enough, the formula $\forall S.\, (\mathbf{distr}\, \mathbf{prime}\, S) \to (\mathbf{coprime}\, S)$, which can be considered as a possible interpretation of the first sentence of example (1), is true for every set containing at least two elements. However, it is not true for the empty set and the singletons (with the exception of the singleton $\{1\}$).

Focusing on the case of adjectives, we can try stating the following general principle:

(7) If [ADJ] stands for an adjective that denotes a binary symmetric relation, then the sentences obtained by instantiating schemes (a) and (b), here below, are semantically equivalent.

a. $[\text{NP}_1]$ is [ADJ] [PREP] $[\text{NP}_2]$.
b. $[\text{NP}_1]$ and $[\text{NP}_2]$ are [ADJ].

In scheme (7a), $[\text{NP}_1]$ can be a singular noun phrase denoting an entity (examples 8a and 8c) or a quantified singular noun phrase (example 8b). As for $[\text{NP}_2]$, it can be a simple singular noun phrase (example 8a), a quantified singular noun phrase (example 8b), or a plural noun phrase (example 8c).

(8) a. The vector y is orthogonal to the vector x.
b. Every row of $\mathbf{H}_X$ is orthogonal to every row of $\mathbf{H}_Z$.
c. The section s is orthogonal to the first m eigenfunctions of the operator.

Applying principle (7) to (8), We obtain the following sentences.

(9) a. The vector y and the vector x are orthogonal.
b. ?Every row of $\mathbf{H}_X$ and every row of $\mathbf{H}_Z$ are orthogonal.
c. ?The section s and the first m eigenfunctions of the operator are orthogonal.

In the case of sentence (8a), the process is successful. Sentence (9a) is felicitous and is synonymous with (8a). By contrast, sentences (9b) and (9c) are questionable. According to some of our informants, they are ill-formed, bad style, or possibly ambiguous. In any case, they are not synonymous with the original sentences. We therefore draw the conclusion that principle (7) only applies to pairs of simple singular noun phrases, i.e., noun phrases that denote single entities. This leads us to distinguish between simple and quantified singular noun phrases, but also between general plural noun phrases and plural noun phrases denoting pairs of single entities. To this end, we introduce a special syntactic category, NP_{du}, to refer to pairs of entities. This category, in fact, corresponds to the dual grammatical number, which exists in several languages.We end up with four categories of noun phrase: simple singular noun phrases, NP_{sg}, quantified singular noun phrases, QNP_{sg}, dual noun phrases, NP_{du}, and plural noun phrases, NP_{pl}, with the following interpretations:

(10)
$$[\![NP_{\text{sg}}]\!] = \mathbf{e} \qquad [\![QNP_{\text{sg}}]\!] = (\mathbf{e} \to \mathbf{t}) \to \mathbf{t}$$
$$[\![NP_{\text{du}}]\!] = (\mathbf{e} \to \mathbf{e} \to \mathbf{t}) \to \mathbf{t} \qquad [\![NP_{\text{pl}}]\!] = ((\mathbf{e} \to \mathbf{t}) \to \mathbf{t}) \to \mathbf{t}$$

With this type system, we can provide an appropriate compositional treatment to sentences such as those in examples (8) and (9a). For the sake of brevity, we omit the formal details of this treatment in this abstract.

4 Binary distributivity Adjectives denoting symmetric binary relations can also be used with noun phrases which denote collections of three or more elements.

(11) The three lines L, L_-, and L_+ are parallel.

A natural way of interpreting such sentences is to use a *binary distributivity* operator, analogous to the distributivity operator (4) that is used for unary predicates. Its definition is the following:

(12) $\textbf{bdistr} \triangleq \lambda RS. \forall xy. ((S\,x) \wedge (S\,y)) \rightarrow (R\,x\,y)$

Applying this operator to an equivalence relation (i.e., a reflexive, symmetric, and transitive relation) amounts to interpreting the corresponding collective predicate as the set of subsets of equivalence classes of the relation. More generally, it amounts to interpreting the collective predicate corresponding to a symmetric binary relation as the set of cliques in the graph of the relation. In particular, $(\textbf{bdistr}\,R\,S)$ implies that $R\,x\,x$ holds for every x in the set S, which is perfectly fine for a reflexive relation. However, in the case of example (13), using operator (12) fails at giving the proper interpretation because it requires each coefficient to be distinct from itself, which is absurd.

(13) The coefficients $\lambda_0, \ldots, \lambda_n$ are all distinct.

What is needed in this case is a *strict binary distributivity operator* that adds to (12) the condition that $x \neq y$.

(14) $\textbf{sbdistr} \triangleq \lambda RS. \forall xy. ((S\,x) \wedge (S\,y) \wedge (x \neq y)) \rightarrow (R\,x\,y)$

Strict binary distributivity is often marked overtly by adverbial phrases such as *pairwise*, *mutually*, and *by pairs*, or also by reciprocals such as *each other* and *one another*, and the like.

(15) Since these generating vectors are pairwise orthogonal, they are independent.

In the case of example (13), we posit the existence of a covert strictness marker whose presence can be explained by the *Non-Vacuity Principle* of Kamp and Partee [1995] or the *Strongest Meaning Hypothesis* proposed by Dalrymple et al. [1998].

The semantic interpretation of *pairwise*, when applied to a binary relation, is given by the distributivity operator (14). The adverb *pairwise*, however, can also be applied to collective predicates that do not derive from binary relations. In this case one obtains a new predicate whose meaning is different from the original one. For a downward closed collective predicate such as *linearly independent*, the new meaning is weaker, such that being *linearly independent* always implies being *pairwise linearly independent*. Conversely, an upward closed predicate such as *coprime* is strengthened by the use of *pairwise*; that is, being *pairwise coprime* implies being *coprime*. In both cases, the meaning of *pairwise* is given by a variant of operator (14) in which the collective predicate is applied to an unordered pair:

(16) $\lambda PS. \forall xy. (x \neq y \wedge (S\,x) \wedge (S\,y)) \rightarrow (P\,(\lambda z. (z = x) \vee (z = y)))$

We conclude this extended abstract with a table that provides a qualitative account of the distribution we observed for the adverb “pairwise” .

Type of predicate	Examples	Use of *pairwise*
collective	*linearly independent*, *coprime*	changes meaning
equivalence relation	*isomorphic*, *parallel*, *equal*	rare
symmetric non-reflexive	*orthogonal*, *distinct*, *disjoint*	common
symmetric reflexive	*commuting*, *intersecting*, *comparable*	common?
matching	*antipodal*, *complex conjugate*	only with a different meaning
non-symmetric	*consecutive*	not used

Table 1. Use of *pairwise* with different kinds of predicates

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Correcting context updates

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Stakes. Interlocutors can correct their own commitments and discourse contributions, and they can correct one another's. The former has been termed self-repair or 'disfluency', for instance, with spontaneously interpolated speech signals (*sorry*, *um*, pauses; Ginzburg, Fernández & Schlangen 2014, Rudin et al. 2016). Focusing on the latter, I present here some puzzles that demonstrate how certain cases of 'corrective coordination' should be subsumed within a semantics for negotiating the form of assertions.

Some puzzles. A familiar use of *but* is via counterexpectational coordination (*John smokes, but he's in good health.*). More recent attention has been drawn to corrective coordination (1), which differs from the counterexpectational variety in at least the obligatory occurrence of negation. While this attention centers on the construction's syntax (as in Bianchi & Zamparelli 2004, Vicente 2010, Wu 2022), a corresponding picture of the semantics remains underdeveloped. Toosarvandani (2013:847–849), for instance, gives a semantics for (1) as (2), where *but* is a meet operator (conjoining quantifiers here) and *not* introduces boolean negation.

(1) Not a mathematician, but a physicist discovered the neutron.

(2) $\neg[\![\text{a mathematician}]\!](\lambda x.\textsf{discover}\,[\![\text{the neutron}]\!]\,x) \wedge [\![\text{a physicist}]\!](\lambda x.\textsf{discover}\,[\![\text{the neutron}]\!]\,x)$

However, data such as (3) become problematic for the truth-conditional predictions made by example (2). Under standard assumptions for numerals, we're left with a non-contingent denotation when the corrected material is scalar in nature (4). Even if we were to stipulate a maximality/upper-bound reading to sidestep the downward monotonicity problem (5), scalar modifiers are also licit. (Suppose $\textsf{max}_{\sqsubseteq} := \lambda Px.P\,x \wedge \neg\exists y.P\,y \wedge x \sqsubseteq y$.)

(3) Not two boys, but three boys smoked.

(4) $\neg(\exists x.{}^{*}\textsf{boy}\,x \wedge \mu\,x = 2 \wedge \textsf{smoke}\,x) \wedge \exists x.{}^{*}\textsf{boy}\,x \wedge \mu\,x = 3 \wedge \textsf{smoke}\,x$

(5) a. Not at least two boys, but at least three boys smoked. ≈ . . .

b. $\neg(\exists x.{}^{*}\textsf{boy}\,x \wedge \mu\,x \geqslant 2 \wedge \textsf{max}_{\sqsubseteq}(\lambda y.\textsf{smoke}\,y)\,x) \wedge$
$\exists x.{}^{*}\textsf{boy}\,x \wedge \mu\,x \geqslant 3 \wedge \textsf{max}_{\sqsubseteq}(\lambda y.\textsf{smoke}\,y)\,x$

A boolean-negation-plus-conjunction analysis falters at scalar correction. And while we may attribute such cases to a metalinguistic interpretation of sorts (as I'll adopt), the novel observation of scopal ambiguity in (6) differentiates corrective coordination from other kinds of side-issue material (e.g., supplements, which notoriously prefer to project). In what follows, I'll flesh out these examples and argue for a flexible judge-style analysis, where correction can communicate subjective content about the preference for one proposition over another.

(6) Either about Mary's beliefs (narrow scope), or a correction of what they are (wide)

a. Mary thinks that MIT hired not two but three semanticists.

b. Mary argued that MIT should hire not two but three semanticists.

Correction and comparison. A simply at-issue contribution of correction is evidently insufficient for such cases where contradiction would arise. Whether or not corrective coordination is clausal, phrasal, or elliptical (as is debated; see Toosarvandani 2013), we must revise our semantics to handle (3). I start by casting a background with insights from subjectivity in comparatives and negation.

Intuitively, the examples we've considered carry a metalinguistic flavor — involving either the correction of past discourse/events (7a) or of interlocutor expectations (7b). Adding some simple context helps elucidate this observation:

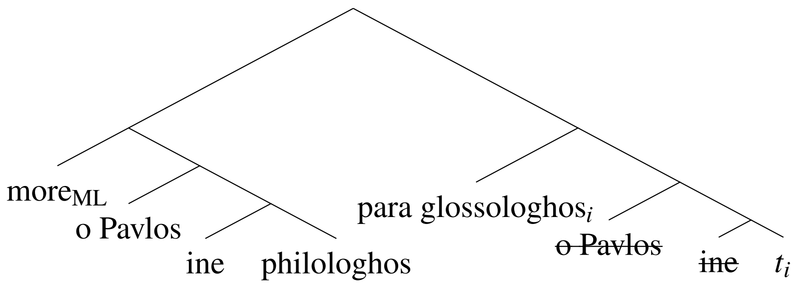
(7) a. Your report is wrong: not two boys, but three boys were caught smoking at school.
 b. You won't believe this. The race tomorrow is not 5km, but 20km!

As such, we can look to other metalinguistic phenomena for guidance. Giannakidou & Yoon (2011), for instance, argue that an analysis of Greek and Korean metalinguistic comparatives (8) is best captured as a comparison of preferential desire between two clauses. Their semantics relies on a denotation for *more* that introduces an ordering relation $>_{\mathsf{Des}\ a_c}$ relativized to a contextual 'anchor' of comparison (cf. Rudolph & Kocurek 2024). *Para* 'than' is a lexical form specific to metalinguistic comparatives; *apoti* would be used for a normal comparative. I use $\ulcorner\cdot\urcorner$ to signal the treatment of an expression as the corresponding utterance (cf. mixed quotation: Potts 2007, Shan 2010, Li 2017, Kirk-Gianni 2024). ($\cdot_{\mathrm{ML}}$ annotates metalinguistic intepretation.)

(8) 'Accuracy assessment' in Greek (adapted from Giannakidou & Yoon 2011:639–640)

 a. O Pavlos ine perissotero philologhos para glossologhos.
 the Paul is.3SG more philologist than linguist
 'Paul is more a philologist than a linguist.'

 b. $\ulcorner$Paul is a philologist$\urcorner$ $>_{\mathsf{Des}\ a_c}$ $\ulcorner$Paul is a linguist$\urcorner$
 ≈ ⟦The degree to which the speaker *a* likes the sentence 'Paul is a philologist' exceeds the degree to which *a* likes 'Paul is a linguist'.⟧^{c}



In a related manner to metalinguistic comparatives, Giannakidou (1998) and Giannakidou & Stavrou (2009) assume that Greek *oxi* is a form lexicalizing constitutent and metalinguistic negation (9). They suggest a semantics for *oxi* that encodes an attitude (Giannakidou & Stavrou simply notate it as *R*) abbreviating 'correct to say':

(9) Sinithos taksidevi oxi [me aeroplano]^{R} ala [me treno]$^{\neg R}$.
 usually travels.3SG not with airplane but with train
 'He usually travels not with the airplane but with the train.'

This draws an inviting similarity with Potts' (2007) multidimensional semantics for metalinguistic focus that stipulates a covert utter relation accessing prosodic information. Setting aside negation in (10) (example originally from Horn 2001[1989]), this relation can then serve to background the speech-level details from what factors into the at-issue composition. The latter is a calling event (10a), and the former concerns utterance (10b):

(10) He$_i$ didn't call the pólice, he$_i$ called the políce. (let *he*$_i$ ↦Charlie$_i$)
 a. call ⟦the police⟧ Charlie
 b. utter $\ulcorner$pólice$\urcorner$ speaker *versus* utter $\ulcorner$polície$\urcorner$ speaker

Negation, then, can act on one dimension or the other. Applying it to the utterance information (that is, (10b)) will only result in a new background dimension — which, in his system, would be the set $\{w \mid w \notin$ ⟦utter $\ulcorner$pólice$\urcorner$ speaker⟧$\}$.

Sketching a semantics. Given what we've said so far, it may be tempting to place the semantics of corrective coordination under the umbrella of supplemental content. Both negation and supplements may be understood as affecting (negating or writing to, respectively) some background dimension of information. For the latter, a notorious characteristic that falls out from this is projection — such that examples like (11)-(13) can only be understood with wide scope.

(11) John didn't eat the sandwich, which was poorly made. (supplement $\gg \neg$)
$\rightarrow$ The sandwich was poorly made.

(12) John might decide to visit MIT, which is a rather pretty campus. (supplement $\gg \diamond$)
$\rightarrow$ MIT is a rather pretty campus.

(13) John thinks Bill, a total buffoon, is a genius. (supplement $\gg$ *think*)
$\rightarrow$ Bill is a total buffoon.

Yet, a critical factor distinguishing correction from supplemental content is the ability to scopally interact with operators such as attitude reports, along the lines of what we might call *de re* interpretation. I provide such an observation in (14), along with descriptions:

(14) Mary thinks that MIT hired not two but three semanticists.

a. $\rightsquigarrow$ *think* $\gg$ *not-two-but-three-sem*: Mary is surprised by the number of semanticists that (she thinks) were hired, or she believes someone else is incorrect in having said MIT hired two semanticists.

b. $\rightsquigarrow$ *not-two-but-three-sem* $\gg$ *think*: What Mary is thinking is just that three semanticists were hired, and the speaker is stating it is incorrect to say she thinks two were hired.

Under the latter, wide-scope reading, the intuition matches (13). Under the narrow-scope reading, however, we end up with an assertion that solely reports on Mary's own doxastic state. A dialogue like (15) helps emphasize this.

(15) a. John: Did you hear, everyone? MIT just hired two new semanticists!

b. Mary: No, John, they hired *three* new semanticists.

c. Onlooker's thoughts: Mary thinks that MIT hired not two but three semanticists.

Based on this, I analyze corrective coordination as a bidimensional phenomenon that *can* interact under embedded attitudes. Since the syntax suggests that negation forms a separate constituent with the former proposition at the exclusion of the second (i.e., [[not p] [but q]]; see Wu 2022), actual scope-taking (QR) is untenable for explaining projection.

Instead, let metalinguistic *not* take the form an operator that relativizes a desiderative attitude to a Lasersohnian judge j (16). Revising from Giannakidou & Yoon's ordering function for comparatives, suppose $[\![\textsf{Des}\ j\ p]\!]^j = \top$ just in case judge j counts p as a desired or committable assertion (i.e., it lies on a positive interval on the scale that Giannakidou & Yoon propose is strictly ordered by $>_{\textsf{Des}\ a_c}$). What thus provides us the apparent scopal flexibility is to whom the judge is set for the subjective attitude — Mary (narrow-scope) or the speaker (wide-scope).

(16) $[\![\text{not}_{\text{ML}}]\!]^j = \lambda p.\neg\textsf{Des}\ j\ p$ $\quad$ ($\approx \lambda p.\neg\exists d > 0.$(the degree j accepts p) $= d$)

(17) $\neg\textsf{Des}\ j\ \ulcorner$MIT hired two semanticists.$\urcorner$

a. Reading one: $j \mapsto \textsf{Mary}$ (Mary: I think John is wrong)

b. Reading two: $j \mapsto \textsf{speaker}$ (Speaker: You're wrong about Mary's thoughts)

Permitting the denied propositional utterance to still evade at-issue composition, *despite* being relativizable to an attitude holder, is by packing the backgrounding (in the sense of the Potts-style multidimensionalism) into the coordinator:

(18) $[\![\text{but}_{\text{ML}}]\!]^c = \lambda pq : q \in \mathsf{alt}\ p.p \bullet q$

Let • separate foreground/at-issue and background/side-issue semantic information. To explain the expectation of contrast between the denied and accepted propositions, I add a presupposition of focus that simplifies from the Roothian-comparison-class system. It suffices to stipulate for our purposes that the two propositional utterances must minimally differ (e.g., *two* versus *three*) in such a way that semantic focus can mark.

With little to say about why *but* is required instead of *and* (perhaps due to the very expectation of contrast), the coordinator simply chains an at-issue proposition with side-issue correction about an alternative proposition. Thus, an implementation of this approach to our original examples gives us an LF as in (19). The judge maps to the speaker unless otherwise relativized.

(19) $\exists x.{}^*\mathsf{boy}\ x \wedge \mu\ x = 3 \wedge \mathsf{smoke}\ x \bullet \neg\mathsf{Des\ speaker}\ \ulcorner\text{Two boys smoked.}\urcorner$

Extensions. In the talk itself, I'll extend the current semantics (i) by unpacking what I've written off as $\ulcorner\cdot\urcorner$ into an ontology for utterances as alternatives for a given meaning (Maier 2014, Li 2017, Mankowitz 2020); and (ii) by dynamically tracking assertions and their corrections (Asher & Gillies 2003, Asher & Pogodalla 2010, Rudin et al. 2016, Hofmann 2025) to explain how the latter can occur separately from the former.

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Japanese modalities of (non)-existence

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Abstract The Japanese modal nouns *hazu*, *tsumori*, and *wake* interact with negation in a way incompatible with classification as necessity or possibility modals common in languages like English. To explain this contrast, I propose that these modal nouns encode expected outcomes based on (different types of) premises, where negation either targets the existence of said premises, or the expectation arising from them.

Overview

I focus on how the Japanese nominal modals *hazu*, *tsumori* and *wake* interact with negation, in particular existential negation, and the conclusions this allows about their meanings. Starting from *hazu*, an alleged weak epistemic necessity (henceforth WEN) modal, its interaction with negation cannot be explained by analyzing it as corresponding to English *should* on its WEN reading. To explain the observations, I propose analyzing *hazu* as an anticipative modal encoding that its prejacent can be expected given a salient premise, and assume that negation can target either the existence of the premise, or the expectation arising from it. In this way, the present proposal connects to possibility/necessity, albeit in a way that is orthogonal to its distinction in, *e.g.* English modals. This, in turn, can be expanded to *tsumori*, which functions similar to *hazu* but encodes the behavioral intentions and expected outcomes rather than contextual premises and expectations, and *wake*, which I take to be a more generalized version of *hazu* encoding expectation based on world knowledge without involving individual reasoning, and can therefore be rhetorically used to present its prejacent as indisputable fact.

Expectation-marking *hazu* and negation

The modal noun *hazu* is cross-linguistically interesting in that it unambiguously encodes a type of expectation that is central to belief formation and revision as reflected in natural language, for instance in **concessive meaning**. (1) conveys concessive meaning, *i.e.* an expectation ("they're here"), marked by *hazu*, is not born out in the observed state of affairs ("they're not"), indicated by *no-ni* 'though'. While English *should*, which corresponds to *hazu* in the translation, is ambiguous between epistemic and deontic readings, *hazu* unambiguously encodes the kind of expectation frustrated in concessives.

(1) Koko-ni iru hazu na no-ni inai.
here-LOC be *hazu* COP though be.NEG
"Although [they] should be here, [they] aren't."

Interaction with negation Two types of negation occur with *hazu*: existential negation with *nai* (the negation of *aru* 'exist','be there'), paraphraseable as "there is no *hazu* that *p*", and predicate negation with *dewanai* (the negation of the copula *da*), paraphraseable as "it's not *p* *hazu*", as shown in (2).

(2) a. Koko-ni iru hazu-ga nai.
here-LOC be *hazu*-NOM NEG

b. Koko-ni iru hazu dewanai.
here-LOC be *hazu* COP.NEG

An English translation of (2) would roughly be on the lines of "They shouldn't be here." (on a WEN reading of *should*), but the difference between the two types of negation cannot be directly reflected in English. Uegaki [3] observes that (2-a) conveys that there is no possibility that they are here ($\neg\Diamond p$), whereas (2-b) conveys that "They should be here." is not the case ($\neg\Box p$), and raises the question of whether *hazu* is a necessity modal or a possibility modal. I suggest that this question is misleading as *hazu* is not an epistemic modal[1], either of necessity or possibility.

Anticipative modality: encoding premise-based expectations

Rather, I propose that *hazu* is an **anticipative** modal, similar to a normality modal as proposed *e.g.* by Yalcin [4] in that it expresses that its prejacent is normally the case, *i.e.* will be expected to hold or anticipated given a set of assumptions about the circumstances. In contrast to English modals like weak epistemic necessity *should*, the meaning of *hazu* involves two parts: in addition to marking that **the prejacent is normally expected**, it encodes the **existence of a premise** for this expectation. In this sense, *hazu* involves grounds for anticipating the prejacent to be true.

This explains why *hazu* behaves differently from epistemic modals. First, it dovetails with concessive meaning as shown above and can therefore be used counterfactually to denote frustrated expectation, in contrast with epistemic modals (just like WEN *should*). Second, the existential quantifier contained in the meaning of *hazu* can be targeted by negation. Existential negation with *hazu* targets the existence of grounds to anticipate the prejacent rather than the expectation as such, or (weak epistemic) necessity. This creates the surface effect of negating possibility rather than necessity.

Formalization To capture this proposal, I introduce the following simplified formalism. First, there are two sets of contextually relevant propositions, the set Π of premises π, and the set Ξ of expectations ξ. These are linked by a defeasible entailment relation $\rightsquigarrow$, where $\pi \rightsquigarrow \xi$ means that π is (typically) sufficient grounds to assume ξ. However, this may not be born out, as in the (atypical) concessive case. Defining the set of expectations that arise from a premise π as in (3), I propose that the instances of *hazu* in examples (1), (2-a), and (2-b), can be captured as in (4), (5), and (6), respectively.

(3) $\Xi_\pi = \{\xi | \pi \rightsquigarrow \xi\}$

(4) "*p hazu*": $\exists \pi \in \Pi : p \in \Xi_\pi$ (no negation)

(5) "*p hazu-ga nai*": $\neg\exists \pi \in \Pi : p \in \Xi_\pi$ (existential negation)

(6) "*p hazu dewanai*": $p \notin \Xi$ (predicate negation)

The non-negated version of *hazu* (4) has it that there is a premise π based on which the prejacent p is expected. With existential negation, the existence of this premise is negated, yielding (5). Note that this also means that p is not expected as a consequence of an absence of grounds for expecting it. Predicate negation yields (6), where p also comes out as not expected, but there is no claim that there is not grounds at all to expect it. This

[1]There are distinct epistemic necessity (*nichigainai* 'must') and possibility (*kamoshirenai* 'may') modals in Japanese, as discussed below.

can for instance be due to not all relevant premises having to be taken into consideration. Other that this interpretation, predicate negation can also simply be a case of constituent negation indicating that not p, but some distinct q is expected, without making any claim about p's status, a reading not available with existential negation.

Note that the claim that there is no premise to expect p to hold ($\neg\exists\pi : p \in \Xi_\pi$) is similar to negation scoping over a possibility modal ($\neg\Diamond p$), but stems not from negation of the modalized prejacent, but from negation of existential quantification over the premise. Predicate negation, on the other hand, simply states that p is not (necessarily) expected, similar to negation scoping over a necessity modal ($\neg\Box p$), but the mechanism is different.

Epistemic modals and *hazu* How does this compare to epistemic modals? (7) and (8) respectively show the Japanese correspondents to *must* and *may*, which indicate that the speaker considers it a premise that p is either possible or necessary, without reference to expectations or grounds for them.

(7) "*p nichigainai*": $\Box p \in \Pi$ (8) "*p kamoshirenai*": $\Diamond p \in \Pi$

In this way, the question of whether negating a modal reveals that its modality is fundamentally one of possibility or of necessity (as discussed in detail by Jeretič [1]) does not apply to *hazu*. It does encode anticipative necessity, but this can be counterfactual, *i.e.* contrary to what is considered an epistemic fact. When the target of negation is the underlying premise, this appears as negation of necessity as it pulls the ground from necessary anticipation. However, when the target of negation is anticipation itself, there is room for further scrutiny of the circumstances.

Note that this also accounts for the possibility of epistemic modals scoping over *hazu*, but not the other way around — the availability of a premise that makes a prejacent expected can be subject to epistemic speculation by an agent, but epistemic speculation in itself cannot be anticipated the same agent based on premises available to them.

Hindsight is 20/20 A frequent use of predicate negation with *hazu* is one referring to past expectations[2], as in (9). Even in the absence of a concessive marker *no-ni*, this is typically interpreted as the way things turned out being not as was previously expected. In contrast to existential negation (which would be interpreted as "there was no way that…"), predicate negation in (9) is compatible with a situation where the speaker *might have* been able to foresee the actual outcome taking all facts into consideration, but did in fact not, making the present state of affairs unexpected.

(9) Sonna hazu-janakatta (no-ni)...
thus *hazu*-COP.NEG though
"It wasn't supposed to be like that."

This underscores how *hazu* encodes a type of modality involved in evidence-based belief formation and revision in natural language, making reference not only to what is compatible with an agents beliefs, but rather what is to be expected given specific premises. There are two other Japanese nominal modals (or grammaticalized nouns similar to *hazu*): *tsumori* and *wake*, which interact with negation in similar ways, suggesting that a parallel analysis is possible, but where the grounds for anticipation are qualitatively different, representing something like different modal flavors within the paradigm.

[2] I thank an anonymous reviewer for pointing this out.

Anticipating results of behavior: *tsumori*

The modal *tsumori* behaves similar to *hazu*, but is concerned with someones behavioral intentions and their outcomes, as in the following examples. First, (10) shows a concessive-like use of *tsumori*, which is rather difficult to translate to English. It could be paraphrased on the lines of "Although based on my behavioral intention should be here, it's not here", and would be uttered when one is quite sure that one had placed the item in question somewhere, but it is not there. Thus, *tsumori* conveys something about the speaker's intention, while the outcome may not conform to this.

(10) Koko-ni oita tsumori na no-ni nai.
here-LOC put.PST *tsumori* COP though be.NEG
"Although [I] intended to (have) put [it] here, it's not."

What happens to *tsumori* under negation? (11) show examples parallel to those for *hazu* in (2). While both of these example can roughly be translated as "[I] don't intend to go", the only available reading of (11) is that the speaker has absolutely no wish to go, *i.e.* there is a complete lack of volition and if the speaker went, it would be against their will. While (11-b) has a similar reading, it is softer in the sense that if the speaker ends up going, this could be a positive outcome, but it was not necessary based on their preferences. This could roughly be paraphrased as "I really don't want to go" *vs.* "I don't really want to go".

(11) a. Iku tsumori-ga nai.
go *tsumori*-NOM NEG

b. Iku tsumori dewanai.
go *tsumori* COP.NEG

This contrast is also reflected in typical uses of *tsumori* with negation: whereas existential negation is typically used to indicate a future-directed lack of volition or motivation, *i.e.* active dispreference, predicate negation is typically used to indicate an unintended outcome, often in apologies ("I didn't mean to..."), parallel to the use of *hazu* in hindsight.

Stating the obvious and the impossible: *wake*

A final grammaticalized noun (also known as formal nouns) related to *hazu* and *tsumori* is *wake*. It is not as clearly modal as the other two and often used in constructions that separate negation from the predicate, seemingly not adding much additional pragmatic meaning. It is also not as productive in concessive constructions as the other two. A typical example for its use in isolation is shown in (12), where it adds a nuance of obviousness or unavoidability. While its original nominal meaning is on the lines of "reason", here the chain of reasoning is reversed — being expensive is expected from a Michelin-starred restaurant.

(12) Michuranrestoran-wa takai wake da.
Michelin_restaurant-TOP expensive *wake* COP
"Michelin [starred] restaurants are just expensive."

When negated, the contrast with *wake* is rather pronounced in that it is used quite differently with existential negation compared to predicate negation, as the following parallel examples to (11) show. Existential negation as in (13-a) conveys that the person in question does not go to parties ever, and there is no reason to assume that they ever would. Predicate negation as in (13-b) is much more situational, typically conveying that there is some misunderstanding and the person in question will not go to a party, but does not touch on whether this is generally the case or not.

(13) a. Iku wake-ga nai.
go *wake*-NOM exist.NEG

b. Iku wake dewanai.
go *wake* COP.NEG

I propose that this can be accounted for by assuming that *wake* targets premises that constrain what can be generically expected, which differs from *hazu* in that the premises it targets are situational in the first place, *i.e.* what one assumes about the state of affairs at hand rather than what one assumes to know about the world in general, and differs from *tsumori* which is concerned with an individuals intentions and the outcomes of their behavior. This can also explain why *wake* can be used to state something as a given fact, without adding much semantic content — in this case, the conveyed meaning is something on the lines of "It is how it is", where no reason but the (supposed) previous establishedness of the prejacent is given as a basis for this claim.

Outlook

While I maintain that my proposal straightforwardly explains the case of existential negation, there are many different interpretations for predicate negation of Japanese modal nouns, including constituent negation ("It shouldn't be that *this* is the case, but that *that* is the case."), or denying an intention that has been externally ascribed to the speaker, which, as an anonymous reviewer points out, is not necessarily straightforwardly accommodate within the present proposal.

What remains to be worked out in more detail then, is what it means to indicate that there is no such expectation, or anticipated outcome, while not denying that there might be grounds for expecting or anticipating this. This will likely require more detailed examination of the reasoning behind expectations, and differentiating between cases where an agents claims to have taken all relevant premises into consideration, and such where an agent suspends judgment.

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The semantics and pragmatics of the Japanese emphatic expression *hodo-ga aru* 'there is a limit'

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1 Introduction

The Japanese expression *hodo-ga aru* literally means 'there is a limit', as in (1):

(1) Nani goto-ni-mo hodo-ga a-ru.
what thing-to-*mo* limit-NOM exist-Non.PST
'There is a limit to everything.'

However, when it co-occurs with a gradable predicate, it conveys an extreme/excessive degree, as in (2):

(2) Taro-no furumai-wa {futekisetsu / shitsurei}-ni-mo hodo-ga a-ru.
Taro-GEN behavior-TOP inappropriate / rude-to-*mo* limit-NOM exist-Non.PST
'lit. There is a limit to how {inappropriate/rude} Taro's behavior can be.'
(Actual meaning: Taro's behavior is extremely {inappropriate/rude}.)

Where does this emphatic meaning come from? Is the emphasis conveyed by *hodo-ga aru* different from that expressed by general intensifiers or excessive expressions?

In this paper, I investigate the intensified use of *hodo-ga aru* and argue that it has been conventionalized as a special degree expression. Specifically, it conveys that the relevant degree is beyond the speaker's acceptable threshold and that the speaker holds a negative attitude toward the target. I demonstrate that *hodo-ga aru* belongs to a new type of intensification construction, distinct from intensifiers, excessives, and wh-exclamatives.

2 Conventionality and distributions

Regarding the development of the intensifying use of *hodo-ga aru*, I propose that its meaning originally emerged pragmatically from the interaction between its literal sense, 'there is a limit', and contexts in which the degree in question was extremely high. In such contexts, the speaker's negative attitude arises pragmatically, given that the degree exceeds the limit. Over time, through repeated usage, this pattern of intensification became conventionalized and was incorporated into the meaning of *hodo-ga aru*. (As I will explain later, this differs from the English expression *there is a limit*, which allows for a more flexible interpretation.)

The claim that the intensifying use of *hodo-ga aru* carries a conventional negative attitudinal meaning is supported by its strong association with negative gradable expressions, such as *futekisetsu* 'inappropriate'. When it co-occurs with a positive gradable expression, such as *tekisetsu* 'appropriate', as in (3), the resulting sentence is perceived as unnatural.

(3) ?? Taro-no furumai-wa {tekisetsu / shinsetsu}-ni-mo hodo-ga a-ru.
Taro-GEN behavior-TOP appropriate / kind-to-*mo* limit-NOM exist-Non.PST
'Taro's behavior is extremely {appropriate/kind}.' (lit. There is a limit to how {appropriate/kind} Taro's behavior can be.)

However, if we assume a special context in which the speaker is amazed by Taro's behavior because it is exceptionally appropriate or kind, the expression becomes natural. Even in such cases, however, the speaker is not simply praising Taro's behavior. Rather, the utterance carries a negative nuance—perhaps mockery or a resigned smile—or it may reflect a deliberate use of the negative expression *hodo-ga aru* to convey an opposite evaluative meaning, such as intimacy.

3 Analysis

I assume that *X-ni-mo hodo-ga aru* functions as a fixed expression and exemplifies a special kind of mixed content (e.g., McCready 2010; Gutzmann 2011), in that it simultaneously involves presupposition, at-issue meaning, and conventional implicature (CI) as in (4) (The left side of ♦ indicates the at-issue component, while the right side represents the CI component. The superscript *a* stands for the at-issue type and the superscript *s* stands for a shunting type, which is used in the interpretation of CI involving resource-sensitive application (McCready 2010). The underlined part represents the presupposition.)

(4) ⟦ni-mo hodo-ga aru⟧: $\langle G^a, \langle e^a, \langle i^a, t^a \rangle\rangle\rangle \times \langle e^a, t^s \rangle =$
$\lambda G_{\langle d^a, \langle e^a, \langle i^a, t^a \rangle\rangle\rangle} \lambda x \lambda t \exists d' : \underline{\exists t' \exists d[t' < t \wedge d > \text{STAND}_G \wedge G(d)(x)(t')]}.$
$d' > max_{permissible}(\{d'' | G(d'')(x)(t)\}) \wedge G(d')(x)(t)$ ♦ $\lambda x.$Neg-attitude(j, x) given *j*'s experience in the utterance situation s^*

In prose, *ni-mo hodo-ga aru* takes a gradable predicate, an individual *x*, and a time *t* and semantically denotes that there exists a degree d' such that d' exceeds the maximum permissible degree associated with the gradable predicate *G* at time *t*. In conveying this at-issue meaning, *ni-mo hodo-ga aru* presupposes that *x* has already met the contextually determined standard of *G* at some point prior to *t*, as indicated in the underlined part. (Here, *-ni-mo hodo-ga aru* is treated as a fixed expression, but this presupposition is thought to come from the meaning of *mo*.) This presupposition is necessary because if the target is not considered to have satisfied the relevant standard, the sentence becomes infelicitous, as illustrated in (5):

(5) (Context: The speaker feels for the first time that Taro has acted very inappropriately.)
\# Taro-no furumai-wa {futekisetsu / shitsurei}-ni-mo hodo-ga a-ru.
Taro-GEN behavior-TOP inappropriate / rude-to-*mo* limit-NOM exist-Non.PST
'Taro's behavior is extremely inappropriate/rude.' (lit. There is a limit to how inappropriate/rude Taro's behavior can be.)

In the CI component, judge *j* (typically the speaker) expresses a negative attitude toward *x*. This component is, by default, speaker-oriented and independent of "what is said" (e.g., Grice 1975; Potts 2005). The independence of this component is evidenced by the fact that its expressive meaning cannot be directly targeted by denial, as shown in (6):

(6) (Context: One employee was late for a meeting again. Conversation between the president and the general manager.)
A: Mata okure-te ku-ru-nante burei-ni-mo hodo-ga a-ru.
again late-*te* come.Non.PST-COMP rude-to-*mo* limit-NOM exist-Non.PST
'It is beyond rude of him to be late again.' (CI: I have a negative attitude toward the employee.)

B: Iya, watashi-wa soo-wa omwa-nai. #Anata-wa kare-nitaishite kouteitekina
No I-TOP so-TOP think-NEG you-TOP he-toward positive
taido-o tot-tei-ru.
attitude-ACC take-PROG-Non.PST
'No, I don't think so. #You have a positive attitude toward him.'

I argue that the CI (expressive component) plays a crucial role in accounting for the distribution patterns of *hodo-ga aru*. As the following examples illustrate, *hodo-ga aru* cannot appear in negative environments, modal contexts, and embedded structures such as questions and conditionals:

(7) (Negation/modal/question)
* Taro-wa burei-ni-mo hodo-ga {nai / a-ru-kamoshiremai / a-ru-no?}
Taro-TOP rude-to-*mo* limit-NOM NEG.exist / exist-Non.PST-may / exist-Non.PST-Q
'Intended. Taro is not beyond rude./Taro may be beyond rude./Is Taro beyond rude?'

(8) (Conditional)
?* Moshi kare-no furumai-ga burei-ni-mo hodo-ga are-ba, kare-o
by.any.chance he-GEN behavior-NOM rude-to-*mo* limit-NOM exist-COND he-ACC
kubi-ni shi-masu.
loss.of.job-to do-HON
'Intended. If his conduct is beyond rude, we will fire him.'

In negative sentences, a mismatch arises between the expressive and at-issue components. In modal, interrogative, or conditional contexts, the embedded at-issue proposition is non-veridical (i.e., not entailed as true), making it pragmatically infelicitous to express a negative attitude toward the target individual in such environments. While the expressive meaning of *hodo-ga aru* projects, its at-issue content is semantically embedded, making the overall utterance sound unnatural.

4 Compositionality

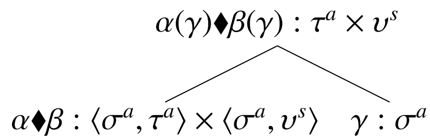
Next, let us consider the compositional system/derivation of *hodo-ga aru*, focusing on example (2) in combination with *shitsurei* 'rude'. The key point is that in *hodo-ga aru*, the input arguments in the at-issue dimension (which includes a presupposition) and those in the CI dimension are not exactly the same. As shown in the denotation in (4), *hodo-ga aru* takes the gradable predicate G only in the left-hand side of ♦. To account for this, I introduce what I call mismatch mixed application (=9), in addition to mixed application (=10), which is utilized in the analysis of mixed content (McCready 2010).

(9) Mismatch mixed application

$$\alpha(\gamma)\blacklozenge\beta : \langle\sigma^a, \tau^a\rangle \times \langle\sigma^a, \upsilon^s\rangle$$

$$\alpha\blacklozenge\beta : \langle\iota^a, \langle\sigma^a, \tau^a\rangle\rangle \times \langle\sigma^a, \upsilon^s\rangle \qquad \gamma : \iota^a$$

(10) Mixed application



(Based on McCready (2010))

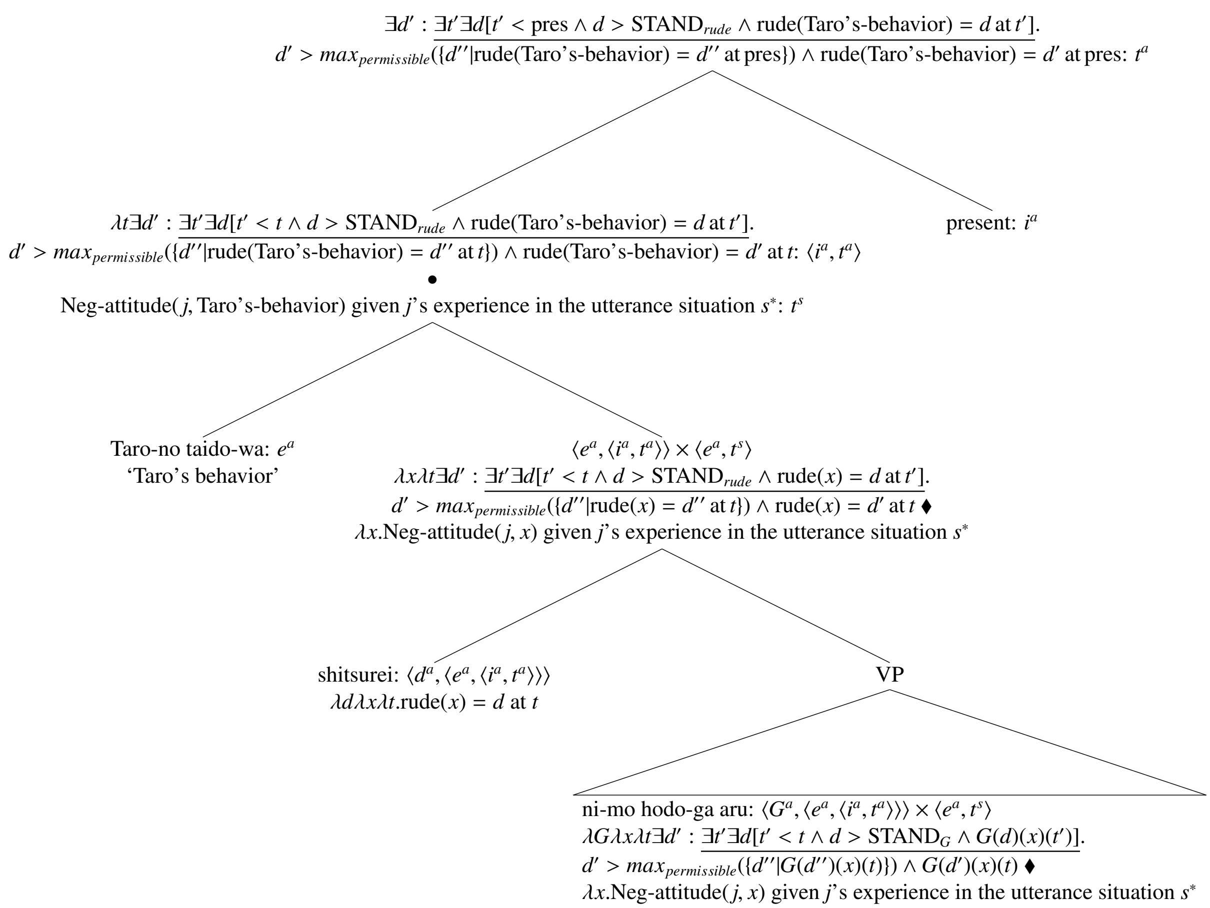
As for the meaning of gradable predicates such as *shitsurei* ‘rude’, I assume that they represent relations between individuals and degrees (e.g., Cresswell 1977; von Stechow 1984; Klein 1991; Kennedy & McNally 2005):

(11) [[shitsurei]]: $\langle d^a, \langle e^a, \langle i^a, t^a \rangle\rangle\rangle = \lambda d \lambda x \lambda t.\text{rude}(x) = d \text{ at } t$

In this system *ni-mo hodo-ga aru* first combines with *shitsurei* ‘rude’ via mismatch mixed application and subsequently combines with the individual via mixed application. When the derivation of the CI component of the mixed content is complete, ♦ is replaced with • (McCready 2010).

The following figure illustrates the logical structure of example (2) with *shitsurei* ‘rude’:

(12)



At the final stage of the derivation, applying parsetree interpretation (Potts 2005; McCready 2010) yields the following interpretation:

(13) $\exists d' : \underline{\exists t' \exists d[t' < \text{pres} \wedge d > \text{STAND}_{rude} \wedge \text{rude(Taro's-behavior)} = d \text{ at } t'].}$
$d' > \underline{max_{permissible}\{d''|\text{rude(Taro's-behavior)} = d'' \text{ at pres}\} \wedge \text{rude(Taro's-b}}\text{ehavior)} = d' \text{ at pres} :$
$t^a \bullet \text{Neg-attitude}(j, \text{Taro's-behavior}) \text{ given } j\text{'s experience in the utterance situation } s^* : t^s$

5 Comparison with the English expression

There is a similar expression, *there is a limit*, in English. However, unlike Japanese *hodo-ga aru*, it can convey both an intensification reading and a non-intensification reading:

(14) a. (Intensification reading)(Context: A person is extremely irresponsible. The speaker is annoyed with him and says)
There is a limit to how irresponsible one can be, and you've definitely hit it.

b. (Non-intensification reading)(Context: A person is irresponsible but not extremely irresponsible.)
There's a limit to how irresponsible one can be, so don't stress too much about him.

I therefore argue that the intensification meaning has not been conventionalized in *there is a limit*; rather, both readings are derived pragmatically. Note that there is a modal *can* in both pairs, but there is a difference in terms of flavor between the intensification reading and the non-intensification reading. In (14a), *can* has a deontic flavor, such that the implicature is that someone has surpassed a limit imposed by social norms. In contrast, in (14b), *can* has a purely circumstantial flavor, referring to a theoretical upper limit on how irresponsible or rude someone has the ability to be, irrespective of social norms.

In *hodo-ga aru*, the only modal flavor present is deontic, as the degree in question exceeds a permissible maximum, and only the intensification reading is available. In this respect, Japanese *hodo-ga aru* resembles English *there is a limit* in how modal flavor interacts with intensification.

6 Conclusion and discussion

This paper contributes to the typology of intensification. Compared with other excessive markers, such as English *too* (von Stechow 1984; Heim 2000), *hodo-ga aru* stands out because it necessarily encodes a negative judgment, whereas *too* does not, as in (15). （Furthermore, it does not have a norm-related presupposition.)

(15) The food is too good to throw (it) away. (Meier 2003)

Similarly, while *hodo-ga aru* shares with wh-exclamatives the ability to convey emotional intensification in factual contexts (e.g., Zanuttini & Portner 2003; Rett 2011; Castroviejo 2021), it differs in its obligatory expression of negative emotion. As illustrated in (16), wh-exclamatives can convey a positive evaluative meaning:

(16) What delicious desserts John bakes! (Rett 2011)

Furthermore, wh-exclamatives lack a norm-related presupposition. This paper demonstrates a new type of excessive expression in natural language: an excessive emotive expression.

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Lemons to vitamin C: Mapping between amounts with Japanese *bun* ‘amount’

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Introduction This paper investigates the semantics of Japanese measure constructions including the element *bun* ‘amount’, as in (1), (2). We demonstrate that *bun* introduces a relation between two ad hoc scales of amounts, construed as the entity correlates of quantity-uniform properties (Scontras (2017), Mendia and Solt (2025)).

(1) [remon san-ko]-bun-no bitamin C
lemon 3-CL-amount-GEN vitamin C
‘three lemons’ worth of vitamin C.’

(2) [ichi-nen]-bun-no ame
1-year-amount-GEN rain
‘A year’s worth of rain’

Data *Bun* takes a measure phrase that consists of either a simple classifier phrase (3a)/(3b) or a more complex expression (4a)/(4b); the host noun may be mass (3a)/(4a) and count (3b)/(4b). We observe the following four semantic contributions made by *bun*.

(I) Meaning shift: *Bun* forces denotation of *amount*: (3a) without *bun* refers to food for a specific set of three people, but with *bun*, it refers to the *amount* of food that could feed three people. Similarly, (4a) without *bun* refers to water contained in three (possibly distinct) cups, whereas with *bun*, it denotes the *amount* of water that, if measured using cups, would equal three cups; that is, the water might be contained e.g. in a bowl rather than cups (cf. the individuating vs. measurement distinction of Rothstein (2017)).

(3) a. [san-nin]-(bun)-no shokuryoo
3-CL-amount-GEN food
w.o. *bun*: ‘3 people’s food’
with *bun*: ‘3 people’s worth of food’

b. [san-nin]-(bun)-no taoru
3-CL-amount-GEN towel
w.o. *bun*: ‘3 people’s towels’
with *bun*: ‘3 people’s worth of towels’

(4) a. [koppu san-bai]-(bun)-no mizu
cup 3-CL-amount-GEN water
w.o. *bun*: ‘3 portions of water in cups’
with *bun*: ‘3 cups’ worth of water’

b. [dabooru san-hako]-(bun)-no hon
box 3-CL-(amount)-GEN book
w.o. *bun*: ‘3 sets of books in boxes’
with *bun*: ‘3 boxes’ worth of books’

(II) Non-standard measures: While *bun* in the above examples is optional (with a meaning difference), *bun* also facilitates the combination of a host noun with a numeral + classifier construction that it otherwise could not compose with; e.g. (2) without *bun* would be ill-formed. Intuitively, amounts of rain aren't typically measured in years, but *bun* may establish a link between them. In fact, non-standard measures are not just compatible with, but *required* by *bun*. For instance, *bun* is odd when water is measured via volume (5), but acceptable when measured via cups (4a).

(5) [30 rittoru]-(#bun)-no mizu
30 liter-amount-GEN water
'three liter water'

(6) [20 do]-(*bun)-no mizu
20 degrees-amount-GEN water
w.o. *bun*: '20°C water'
with *bun* (intended): '20°C worth of wtr'

(III) Monotonicity: *Bun* requires that the dimension encoded by the measure phrase be monotonic wrt. the host noun, similarly to English measure phrases in (pseudo-)partitives **20 degrees of water* (Schwarzschild (2002)). For instance, absent *bun*, (6) receives a simple attributive reading; it becomes odd with *bun*, because temperature does not track the part-whole structure of water, i.e. it does not hold that for any x and y such that x is a proper subpart of y, $Temp(x) < Temp(y)$. Contrast this with (4a), where the dimension is volume (measured in cups); here, monotonicity is satisfied, since for any x and y such that x is a proper subpart of y, $Vol(x) < Vol(y)$. One might wonder whether monotonicity is needed as a separate constraint—i.e. perhaps *bun* in (6) is odd simply because temperature is a standard way to measure water, just like volume (recall (5), cf. Watanabe (2006)). However, unlike (5), which can be rescued by switching to a non-standard volume measurement (4a), (6) remains odd when '20 degree' is replaced with a non-standard temperature measurement, such as *sitsuon* 'room temperature' (e.g. *sitsuon-(*bun)-no bataa* 'room temperature butter').

(IV) Measurement asymmetry: We have seen in (1) that *bun*-phrases can express volume measurement through cardinality. Conversely, using *bun* to express cardinality measurement through volume is odd, as in (7). We thus take *bun* to reflect a form of measurement asymmetry: while the quantity of lemon juice can be indicated easily by specifying the number of lemons (cf. (1)), the number of lemons cannot be determined solely based on the quantity of lemon juice (cf. (7)).

(7)#[vitamin C 100 mg]-bun-no remon
vitamin C 100 mg-amount-GEN lemon
(intended) 'the number of lemons corresponding to 100 mg of vitamin'

Analysis To capture the patterns discussed above, we propose that *bun* introduces a relation between two ***amounts***, where amounts can be understood as the entity correlates of quantity-uniform properties. However, before spelling out the analysis, we discuss why a simpler analysis that does not complicate the standard semantic ontology with the addition of amounts would not work.

First, we might propose that *bun* encodes a measure function mapping entities to degrees:

(8) $[\![\text{bun}]\!] = \lambda d \lambda P \lambda x. P(x) \wedge MEAS(x) = d$ (to be rejected)

E.g., with this semantics, (4a) with *bun* would be analyzed as denoting a property that holds of water whose volume as measured by $MEAS$ is equivalent to the degree denoted by *san-bai* '3 cups'. However, such an analysis faces problems: i) while some of the 'measure' expressions that occur in the first position of *bun* constructions can readily be analyzed as degree-denoting (e.g. *koppu san-bai* '3 cups', *ichi-nen* '1 year'), others cannot (e.g. *remon san-ko* '3 lemons'); ii) measure functions typically track properties of individuals themselves, whereas *bun* appears to encode a more complex relation between the 'measure' expression and the substance being measured (e.g. in *san-nin-bun-no shokuryoo* '3 people bun of food', we have the relation 'x is an amount that could feed y').

Basic set-up: Instead, we argue that the measure expressions occurring in the first position of *bun* constructions refer to degrees on an ad hoc scale of amounts, formed on the basis of a partition of a mereologically structured domain of entities of some sort. More specifically, *bun* encodes a homomorphism between two such ad hoc scales: e.g. in *san-nin-bun-no shokuryoo* '3 people bun of food', between quantities of people and amounts of food; in *remon 3-ko-bun-no bitamin C* '3 lemons bun of vitamin C', between quantities of lemons and amounts of vitamin C. For concreteness, we take the degrees on such scales to be nominalizations of quantity-uniform properties (Scontras 2017) and refer to them as *amounts* (type a); but nothing in our analysis would be affected if they were instead treated as equivalence classes or properties.

We formalize the notion of an ad hoc amount scale $\langle D, < \rangle$, as follows: We begin with a property P whose denotation is mereologically structured (a complete join semi-lattice). $\Pi_P = \{\pi_1, \pi_2, \pi_3, \ldots\}$ is a partition on P into quantized subsets, where π is quantized iff no proper part of an element of π is also in π. From Π_P, the corresponding set of amounts D_P can be derived as follows. Quantized properties and amounts are related via the operators $^{\Cap}$ and $^{\Cup}$, parallel to the $^{\cap}$ and $^{\cup}$ operators of Chierchia (1998) that relate kinds to their corresponding properties: $^{\Cap}\pi$ is the amount correlate of π, whereas $^{\Cup}a$ is the set of entities realizing a. The set D_P of amounts on P is then defined as in (9), and the relation $<$ on D_P defined so that it satisfies the constraints in (10), which ensure that it tracks the original part-whole relation $\sqsubset$ on P. For illustration, see the left part of Figure 1, where an ad hoc amount scale $\langle \{^{\Cap}\pi_{lemon}, ^{\Cap}\pi'_{lemon}, ^{\Cap}\pi''_{lemon}\}, < \rangle$ is formulated based on a property whose atomic entities consist of LEMON_1, LEMON_2 and LEMON_3.

(9) $D_P = \{a : \exists \pi \in \Pi_P [a = ^{\Cap}\pi]\}$

(10) $<$ is a strict total order on D_P such that:
(i) $\forall x, y \in P, \forall a, a' \in D_P : [x \in {}^{\Cup}a \land y \in {}^{\Cup}a' \land y \sqsubset x] \rightarrow a' < a$
(ii) $\forall a, a' \in D_P : a' < a \rightarrow [\forall x \in {}^{\Cup}a \exists y \in {}^{\Cup}a' [y \sqsubset x]]$

Given two ad hoc amount scales, we can define an order-preserving mapping between them, as in (11). See also Figure 1 for a visualization of a mapping between ad hoc scales of lemon quantities and vitamin amounts. (For ease of illustration, the figure depicts the domain *vitamin* as containing atomic elements. This is not crucial for the analysis; what is important is that the function H ensures that for each lemon quantity (being of e.g. cardinality 1, 2 and 3), there is a unique amount (being of e.g. 10 mg, 20mg and 30mg) that is realized by a subset of the entities in the denotation of *vitamin*).

(11) For any two ad hoc amount scales $\langle D, < \rangle$ and $\langle D', <' \rangle$,
$H : D \rightarrow D'$ is a total function such that for any $a, a' \in D$, $a < a'$ iff $H(a) <' H(a')$.

Semantics of *bun*: With these definitions in place, the denotation of *bun* can be stated in terms of a mapping of the form in (11), per (12); this entry can be viewed as a generalized version of (8). The semantics of (1) is given in (13). We assume that *bun* takes a covert pronoun H whose value as assigned by g is a function H from quantities of lemons to amounts of vitamin (e.g. the function 'amount of vitamin contained in'); (13) is true of an entity x iff x is a portion of vitamin that instantiates the amount that is the result of applying H to '3 lemons'. Note that (13) does not require that x is actually contained in lemons; it is completely sensible to say *This candy contains three lemons **bun** of vitamin C*.

(12) $[\![$ bun H $]\!]^g = \lambda a_a.\lambda P_{\langle e,t\rangle}.\lambda x_e.P(x) \wedge \exists a'[{}^{\cup}a'(x) \wedge g(\text{H})(a) = a']$

(13) $[\![$ [[[lemon 3-CL] bun H] vitamin] $]\!]^g = \lambda x_e.\text{VITAMIN}(x) \wedge \exists a'[{}^{\cup}a'(x) \wedge g(\text{H})({}^{\cap}\lambda y.\text{LEMON}(y) \wedge |y| = 3) = a']$

As a final note, the reason that we have adopted a pronominal implementation of H is that the measurement mapping expressed by *bun* can be bound, as shown by the continuation of (14):

(14) boku-wa maisyuu [30 doru-bun-no gasorin]-o ire-teiru ga, . . .
I-TOP every.week 30 dollar-amount-NO gasoline-ACC add-PROG but
'Every week I buy $30 worth of gasoline, but . . .' ✓I get less and less gasoline as time goes on.

Explaining the data: With this analysis, we are able to account for the data discussed above. *Bun* can take a wide variety of measure expressions, as long as they can be construed as *amounts* (entity correlates of quantized subsets of a mereologically structured domain); this includes numeral+classifier constructions ('3-CL'), container noun phrases ('3 boxes of'), numerically quantified NPs ('3-CL lemons') and temporal expressions ('1 year'). The analysis explains the meaning shifts induced by *bun* (**I**). For example, the interpretation of (4a) without *bun* involves counting discrete portions of water in cups; this reading is unavailable with *bun*, which necessarily introduces *amounts* of water (i.e. the amount corresponding to 3 cups).

Furthermore, *bun* facilitates composition of a host noun with an otherwise incompatible measure phrase **(II)**, as in 'one year *(bun) of rain' (2): with *bun*, it is not necessary to measure rain in years, but simply to establish a mapping from temporal extents to amounts of rain. As for the incompatibility between *bun* and standard measures (5), we assume that such examples are ruled out by a violation of Grice's maxim of manner, since a less complex form (e.g. the one without *bun*) is available to express the same meaning.

The analysis also correctly rules out measure expressions corresponding to non-monotonic dimensions such as '20 degrees' **(III)**: '20 degrees' does not have an amount interpretation, because the corresponding set is not quantized (a portion of 20°C water has subparts with temperature 20°C).

Finally, the asymmetry **(IV)** in (1) vs. (7) can be explained by the requirement that H be a total function: any amount (quantity) of lemons can be mapped to an amount of vitamin C, but there are some amounts of vitamin C that cannot be mapped to a whole-number quantity of lemons. This also correctly predicts that (7) becomes acceptable if *remon* 'lemon' is interpreted as a mass noun (denoting the property of being e.g. a lemon chunk), since without being restricted to whole lemons, each amount of vitamin C can be mapped to some amount of lemon chunks.

Outlook In the main talk, we demonstrate that the analysis can also be extended to the occurrence of *bun* in other constructions that make reference to amounts (e.g. amount relatives, (15)), and compare *bun* with expressions in other languages that bear similar functions (e.g. English *worth*).

(15) kinoo kobosita-#(bun-no) shanpan-o nomu-niwa 10-nen kakaru daroo.
yesterday spilled-amount-GEN champagne-ACC drink-to 10-year take MODAL
'It will take 10 years to drink the champagne they spilled yesterday.'

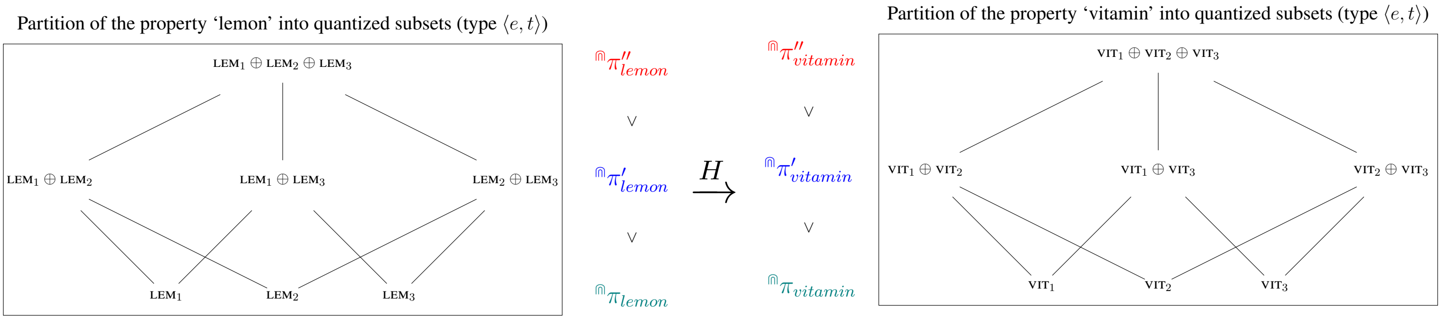

Figure 1: Mapping between ad hoc scales, where $H : \langle \{^{\Cap}\pi_{lemon}, ^{\Cap}\pi'_{lemon}, ^{\Cap}\pi''_{lemon}\}, < \rangle \rightarrow \langle \{^{\Cap}\pi_{vitamin}, ^{\Cap}\pi'_{vitamin}, ^{\Cap}\pi''_{vitamin}\}, < \rangle$

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Fake nouns: Reconsidering the the role of presupposition in reference

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Phi-features of pronouns and nouns in certain environments have been observed to have 'fake' meaning, where their content is ignored (Kratzer 1998; von Heusinger 2007; Heim 2008, a.o.). For example, when pronouns like *she* appear bound inside exhaustive operators leading to a covaried reading as in (1), the gender inference is not required in the alternatives, leading to the inference that everyone else, regardless of their identification, did not finish their song.

(1) Only Jin_F finished her song.
(No one else, female or not, finished their song)

This 'fake' behavior has led to many analyses of phi-features not projecting to focus alternatives (Sauerland 2013, a.o.) or not being part of the meaning altogether (Kratzer 1998, a.o.).

In this talk, I present data showing that in languages where nominals are used relatively freely in place of (2nd or 3rd person) pronouns in bound uses, nominals can appear in contexts like (1) and show the same 'fake' behavior where the meaning of the noun is ignored in the alternatives. This is shown in Tagalog in (2), where the noun-containing description *si/ni guro* appears in a bound reading in place of a 2nd person pronoun and the property of being a teacher does not apply to the focus alternatives. With enough contextual support, the same can be shown with English as in (3).

(2) *Si guro lang ang nagreklamo na masyadong maliit ang kuwarto ni guro.*
SI teacher only ANG complain.PRF C too small ANG room NI teacher.
'Teacher is the only one who complained that teacher's room is too small.'
(No one else, teacher or not, complained about their room.)

(3) (Organizing a conference) Only one student complained that the poster dimension provided by the conference didn't fit the student's printer.
(No one else, student or not, complained about their printer)

Analyses of definite descriptions as involving an *iota*-operator carrying indices do not result in the desired meaning for the alternatives. To account for this, I propose that 'fakeness' is not a property special to features or pronouns, but instead to the mechanism of reference in general. Specifically, I argue that the contribution of the referential expressions is not in the identification of the relevant antecedent through requirements of ϕ or uniqueness but in speaker-addressee coordination through labeling. The semantics of referential expressions only carry variables with indices, while the speaker, when expressing a sentence containing these variables, choose a relevant label to maximize coordination. In discussing the new proposal, I return to the general assumptions on pronouns and definite descriptions and reevaluate the role of presupposition in referential expressions.

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