Internal reading and the comparative meaning[1]

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Abstract. In this paper, I argue that the existing compositional accounts on the internal reading of *same/different* can't directly extend to scalar comparatives. I also develop a new theory that explains away this empirical challenge and extends to the many uses of comparatives beyond the internal reading. The implementation crucially requires characterizing sentence meanings as relations between pairs of *parallel* information states.

Keywords: comparatives, internal reading, dynamic semantics

1. Introduction

When comparative adjectives are used without an overt *than*-phrase/clause, the context provides a relevant comparison standard. In (1) for example, the comparative *bigger* is naturally interpreted as a comparison between John's boat and Nick's boat.

(1) Nick's boat is small. John's is bigger.

Sometimes, the context is within the clause containing the comparative adjective. Sentences like (2) have a reading where the interpretation of the comparative is not dependent on any clause-external standard: under this reading (2) is true when John buys a boat each year and the boat he buys is increasingly bigger. This has been called the *internal reading* of the comparative (Carlson 1987), in contrast to the *external reading* in (1).

(2) Every year John buys a bigger boat.

The internal reading was first discovered on identity comparatives *same/different*, in sentences like (3) (Carlson 1987), and was later observed on scalar comparatives like *bigger* as well (Beck 2000). It has also been observed that the internal reading of scalar comparatives has exactly the same distribution as singular *different* (i.e. *different inside a singular noun phrase*) (Brasoveanu 2011, Bumford 2015): both are only possible when the comparative/*different* is in the nuclear scope of a lexicalized universal like *each/every*. However, fruitful investigations in recent years notwithstanding, none of the existing theories on *every*-licensed internal readings – which still overwhelmingly focus on *same/different* – can directly extend to scalar comparatives.

(3) Every year John buys a different boat.

I begin with an empirical problem in section 2: a simple-minded extension of these accounts would predict that the internal reading in (2) requires that the boat John bought in the first year is still bigger than something; it doesn't. I give a sketch of the proposal in section 3, and the formal implementation in section 4. Section 5 proceeds to show that the proposal can provide a unified meaning for comparatives, in the internal reading, the external reading, and the explicit comparative construction. The implementation of the proposal is couched in a dynamic framework where sentence meanings are relations between pairs of *parallel* info states; section 6 explains why this built-in parallelism is important to building a unified comparative meaning.

[1]I am grateful for the helpful comments from Simon Charlow, Yimei Xiang, Dorothy Ahn, Lydia Newkirk, Augustina Owusu, the three anonymous reviewers, and the audience at SuB 26. All errors are mine.

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2. The empirical challenge for previous theories

The first kind of existing theories lets a lexicalized universal distribute over every pair of distinct entities in its domain (Brasoveanu 2011, Bumford and Barker 2013). For example, the meaning of *every boy recited a poem* can be paraphrased as in (4): every pair of distinct boys both read a poem. The meaning of a comparative relates and compares the two entities in each pair. The internal reading thus derived is truth-conditionally equivalent to (5).

(4) $\forall x, x' \in \mathsf{boy}, x \neq x', \exists y, y' \in \mathsf{poem} : \langle x, y \rangle, \langle x', y' \rangle \in \mathsf{recited}$

(5) *Every boy recited a different poem* $\rightsquigarrow$
$\forall x, x' \in \mathsf{boy}, x \neq x', \exists y, y' \in \mathsf{poem} : \langle x, y \rangle, \langle x', y' \rangle \in \mathsf{recited} \wedge y \neq y'$

The second approach analyzes lexicalized universal quantification as iterated dynamic conjunctions (Bumford 2015). The derived meaning of *every boy recited a different poem* can be paraphrased as (6); this becomes the internal reading when the standard in each comparison is provided by the immediately preceding conjunct:

(6) *Every boy recited a different poem.* $\rightsquigarrow$
John recited a different poem from some previously mentioned poems AND
Nick recited a different poem from some previously mentioned poems AND
Fred recited a different poem from some previously mentioned poems AND ...

In the last kind of analysis, comparatives like *same* and *different* restrict the output of a (skolemized) choice function (Barker 2007, Lahm 2016)[2]. The results are listed below (details greatly simplified): the internal *different* restricts the poem read by each boy to be a poem that could be any but one recited by any other boy.

(7) *Every boy recited a different poem* $\rightsquigarrow$
$\forall x \in \mathsf{boy} : \exists y : \ \mathsf{poem}\, y \wedge \mathsf{recited}(y, x) \wedge \neg \exists z \in \mathsf{boy} : z \neq x \wedge \mathsf{recited}(y, z)$ Lahm (2016)

The truth conditions of the internal reading of a scalar comparative, e.g. (2), is different from these meanings in two respects.

The first is that the internal reading of a scalar comparative is interpreted relative to a given ordering on the distributive domain. In (2), this is the inherent ordering of times. In (8), this is an inferred ordering based on common knowledge: typically the jobs of one person are ordered in time. In fact, it seems impossible to get the internal reading of a scalar comparative when no ordering can be inferred from the context. For instance, getting an internal reading of (9) in an out-of-blue context is very hard, if not impossible, plausibly because a set of boys do not usually come with an ordering. In contrast, an ordering never seems to play a role in licensing the internal reading of *same* or *different*.

(8) Each job makes me more frightening to others and more passionate.
Brasoveanu (2011): ex. (204)

(9) Every boy recited a longer poem.

[2]Choice functions are functions from a set to an element of the set. However, for technical reasons, the function in both Barker (2007) and Lahm (2016) are defined to be a function from a set to a singleton set.

The second difference is that, while in all of these existing theories every entity in the distributive domain is a comparison target, this clearly cannot be true in the internal reading of scalar comparatives. We can test this by constructing sentences where the domain of the universal quantification is fixed by an overt adverbial phrase, e.g. (10). This sentence does not entail that I was more stressed in my first year than any later year in grad school. Neither does it entail that the first year is more stressful than any year outside of grad school. The judgment becomes even sharper in (11), which contains a predicate of personal taste *beautiful* (Egan 2010, a.o.). Predicates of personal taste like *beautiful* give rise to what Ninan (2014) calls the *Acquaintance Inference* (see also Pearson 2013, Kennedy and Willer 2016, Anand and Korotkova 2018): in using these predicates, the speaker is committed to having a relevant firsthand perceptual experience. In other words, it is infelicitous to use *beautiful* to describe someone without seeing them. Therefore, in this sentence, comparing the first time of my seeing John to any times I don't see him should not even be an option. Since comparing this time to the later times is impossible either, it is compelling to say that the first time is simply not a comparison target in the internal reading of (11).

(10) When I was in grad school, I was more stressed every year.

(11) John is more beautiful every time I see him.

In view of these observations, it is fair to say that there is not yet a comprehensive compositional semantic analysis of the *every*-licensed internal reading that extends to scalar comparatives.

3. Preview of the account of the internal reading

3.1. The interpretation of the internal reading

In spite of the apparent discrepancies discussed above, it *is* possible to paraphrase the *every*-licensed internal reading with *same/different* or the scalar comparatives uniformly.

Suppose that the lexicalized universal quantification is always interpreted relative to an ordering of evaluation on the distributive domain. And suppose, once that ordering is fixed, the quantification of *each/every* amounts to assimilating every entity that comes later in the evaluation to the previous ones, in terms of the nuclear scope property. In short, *every boy recited a poem* is interpreted as the following series of *as*-statements:

(12) Boy 2 recited a poem as boy 1 did, boy 2 recited a poem as boy 1 & 2 did, ...

Piggybacking on this (more on the compositional implementation later), the *every*-licensed internal reading can be interpreted as a series of incrementally construed comparisons between every later entity in the domain and *all* its predecessors. In prose, *every boy recited a different poem* is interpreted as (13) and, completely analogously, *every year John buys a bigger boat* as (14). The only difference is the specific ordering relation imposed by the comparative.

(13) Boy 2 recited a poem different from boy 1, boy 3 recited a poem different from boy 1 and 2, ...

(14) Year 2 John bought a boat bigger than in year 1, year 3 John bought a boat bigger than in year 1 and 2, ...

All the seeming differences we have discussed above could stem from one thing: the ordering relation imposed by *same/different* is symmetric, whereas the ordering of scalar comparatives is asymmetric. That is, if A is the same as/different from B, B is the same as/different from A as well; however, if A is bigger than B, it is impossible for B to be bigger than A at the same time. The truth conditions in (13) can be re-stated as if the first entity is a comparison target precisely because of the symmetric ordering of *different*.

The symmetric ordering also explains why the internal reading of *different* does not appear to require any ordering of the distributive domain – because it makes the truth of (13) ignorant to the specific domain ordering we choose. The truth conditions in (13) will invariantly be equivalent to requiring each boy to be different from the other boys, no matter how the boys are ordered. On the other hand, for (14), if we change the ordering of the years, say, from the temporal precedence relation to its reverse, the truth value of this statement will change accordingly. I argue that the same contrast is present in (15) and (16). While every quantifier is interpreted relative to a certain domain, and so the truth of (15) might be dependent on, e.g., whether the domain is the editorial board or not, evaluating (16) requires no identified domain. This is because (16) is guaranteed to be true by the subset relation between ⟦semanticist⟧ and ⟦linguist⟧, regardless of the domain we choose.

(15) If every linguist agrees, we will publish the paper.

(16) If every linguist agrees to publish this paper, then we know that every semanticist agrees to publish it.

In sum, we can come up with a unified interpretation of the internal reading licensed by *every*, i.e. a series of comparisons between each later entity in the distributive domain to all its predecessors. The seeming differences between scalar comparatives and identity comparatives can be reduced to a side effect of the (a)symmetry of the ordering relation the comparative imposes.

3.2. Implementation using pairs

With a little revision to the basic idea developed in Brasoveanu (2011) and Bumford and Barker (2013), we can compositionally implement the targeted reading I have just sketched.

The idea on the conceptual level is that lexicalized distributive quantification is similar to focus interpretation in that it also introduces a non-ordinary semantic value managed in an additional information channel. Just like the focus value is accessible to focus-sensitive operators, the non-ordinary semantic values introduced by a lexicalized universal like *each/every* will be accessible to comparatives. The technical execution is couched in a specialized dynamic framework where sentence meanings are relations between *pairs* of information states. The additional channel that only *every* and comparatives make crucial use of is the secondary info state, i.e. the second member of a pair.

More concretely, to compositionally derive the internal comparisons I have sketched above, I will borrow the proposal in Brasoveanu (2011) that a lexicalized universal quantification contains a distributive update that distributes over pairs of entities in its domain – but change the pairs it distributes over. While Brasoveanu pairs up every two distinct entities in the distributive domain, I will let *every* distribute over pairs that are incrementally built, following the given ordering. Take *every year John buys a boat* for example, given the temporal ordering on *every*'s domain, the incrementally built pairs it distributes over are $\langle\{\text{year 2}\}, \{\text{year 1}\}\rangle$, $\langle\{\text{year 3}\}, \{\text{year 2, year 1}\}\rangle$, etc., and the distributive update checks if each of these pairs satisfies the nuclear scope of quantification, i.e. being a year where John buys a boat. The result is as shown in Figure 1: after the nuclear scope update, each state in a pair stores John and the boat he bought in the year stored in that state.

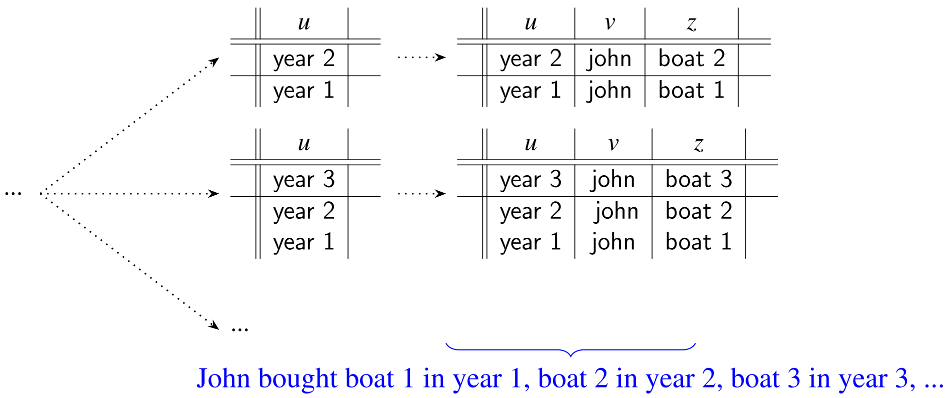

Figure 1: Sketch of pair-based distributive updates in *every year John buys a boat*

The comparative marker *er* introduces pairs of maximal degrees that satisfy its scope degree property, then imposes an ordering relation between them, which are now the values of the same degree dref in an info state pair. The internal reading arises when *er* is in the nuclear scope of *every*, above the variable it binds. For instance, with the LF in (17), *er* will introduce pairs of bigness degrees of the boats John bought in *u*; since the value of *u* in each pair are passed on from *every*'s distributive update, these will be the bigness degrees of the boats John bought in year 1 and year 2, or the bigness degree of the boat he bought in year 3 and in year 1, 2, etc.. This is shown in Figure 2: as *every* passes along the incrementally built pairs of years, the ordering relation imposed by *er* requires the boat stored in the primary state to be bigger

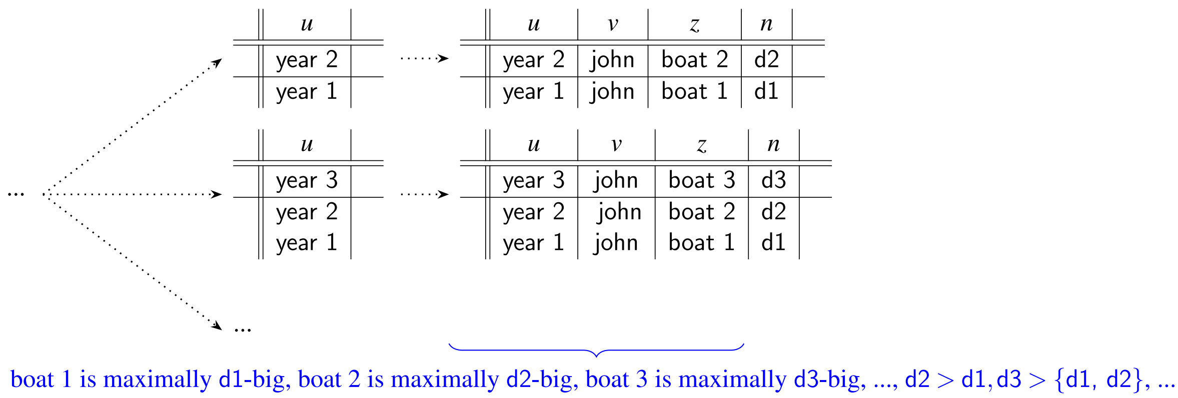

Figure 2: Sketch of the internal reading in *every year John buys a bigger boat*

than any of the boats stored in the secondary state. With a proper interpretation of plural degree predication, this can be exactly the incremental comparisons I have sketched above.

(17) $[\text{every}^u \text{ year } \lambda u [\text{er } \lambda n [\text{a}^z \ n\text{-big boat } \lambda z [u \text{ John}^v \text{ buys}]]]]$

4. Formalizing the account

4.1. The baseline plural dynamic system

The baseline dynamic system is essentially that of Plural Compositional Discourse Representation Theory (PCDRT)[3] (Brasoveanu 2007, Brasoveanu 2008, I take some liberty in presentations throughout this paper[4]). On top of the basic static types (t for truth values, e for individuals, d for degrees), we add one more basic type, $\mathscr{V}$, as the type of variables. With this, we can construct (partial) assignment functions as functions from variables to (any type of) objects, which have the type $\mathsf{g} ::= \mathscr{V} \to \mathsf{a}$. A plural information state is a set of assignment functions, type $\mathsf{G} ::= \mathsf{g} \to \mathsf{t}$. $\mathscr{T} ::= \mathsf{G} \to \mathsf{G} \to \mathsf{t}$ is thus the type of a CCP. Sentence meanings are context change potentials (CCP), which are (normally) relations between plural info states.

In addition, a dummy individual $\star$ is incorporated into the range of our assignment functions. $\star$ is a universal falsifier for any lexical relations; that is, any lexical relation with $\star$ as one of its arguments is false. It is useful in a number of ways, e.g. we can model information growth as a process of replacing the dummy individuals with real referents. What's relevant to us is it will also be needed in the definition of *every*.

A plural discourse referent (dref) is the set of all the objects stored at the same variable position in a state, excluding the dummy individual (18). Lexical relations are interpreted distributively within a plural info state (19). Existential quantification in non-plural systems like DPL (Groenendijk and Stokhof 1991) or CDRT (Muskens 1996) extends the input assignment function with nondeterministic assignments of a certain variable (20). Existential quantification with plural info states is defined as the cumulative-quantification style generalization of this dref introduction (21).

(18) $S_u := \bigsqcup \{s_u \mid s \in S \wedge s_u \neq \star\}$ $\qquad \mathsf{a} \to \mathsf{t}$

(19) $[\text{walks}] := \lambda u.\mathbf{walks}\ u$ where $\mathbf{walks}\ u := \lambda S.\{S \mid \forall s \in S : s_u \in \mathsf{walks}\}$ $\qquad \mathscr{T}$

(20) $s[\exists u] := \{s^{u \to x} \mid x \in D\}$

(21) $S[\exists u] := \{I \mid \forall s \in S : \exists i \in I : i \in \{s^{u \to x} \mid x \in D\}, \forall i' \in I : \exists s' \in S : i \in \{s'^{u \to x} \mid x \in D\}\}$

For instance, G in Figure (3a) is a plural info state. In this state, G_u refers to the plural individual stored in the u column $\{\mathsf{a}, \mathsf{b}, \mathsf{c}, \mathsf{a} \oplus \mathsf{b}\}$. $\mathbf{met}(u,v)$ denotes a lexical relation test, G can pass this test (i.e. $G[\mathbf{met}(u,v)] \neq \emptyset$) so long as in *all* rows of G the relation met holds between the assignment of u and the assignment of v, i.e. $\langle \mathsf{a},\mathsf{x}\rangle, \langle \mathsf{b},\mathsf{y}\rangle, \langle \mathsf{c},\mathsf{y} \oplus \mathsf{z}\rangle, \langle \mathsf{a} \oplus \mathsf{b},\mathsf{z}\rangle \in \mathsf{met}$. Introducing a plural dref u' proceeds in the way depicted in Figure (3b): all the assignments in the

[3] It is possible to formalize the analysis using van den Berg's Dynamic Plural Logic as well, I'm only choosing PCDRT here because it makes the composition a little easier.

[4] The main difference from Brasoveanu's original formulation of PCDRT is that he makes the type of assignments, as opposed to variables, to be primitive.

output state has a predecessor in the input; in any output state, and all the assignments in the input state has a successor that has a value associated with u'.

G	u	v
g_0	a	x
g_1	b	y
g_2	c	y ⊕ z
g_3	a ⊕ b	z

(a) A plural info state

$G[\exists u']$ → …

J	u	v	u'
J_0	a	x	e
J_1	b	y	e
J_2	c	y ⊕ z	e ⊕ f
J_3	a ⊕ b	f	f

(b) Introducing a new plural dref

Figure 3

Finally, a feature of plural info states that we will take advantage of to define distributivity is the possibility to define substates, i.e. subsets of an info state in which the assignment of u is a particular value. This is given in (22). For G in Figure (3a), $G|_{u=\{\mathsf{a}\}}$ is the subset where the value of u is a member of $\{\mathsf{a}\}$, i.e., the first row $\{g_0\}$; $G|_{u=\{\mathsf{a},\ \mathsf{c}\}}$ is $\{g_0, g_2\}$.

(22) $S|_{u=X} := \{s \in S \mid s_u \in X\}$ $\qquad$ G

4.2. Upgrading to pairs

Let's add a product type $\mathsf{G} \times \mathsf{G}$ as the type of pairs of (plural) info states into the system. Sentence meanings (CCPs) are now relations between pairs of info states, type $\mathbb{T} ::= \mathsf{G} \times \mathsf{G} \to \mathsf{G} \times \mathsf{G} \to \mathsf{t}$. The definition of dynamic conjunction is also upgraded to apply to pairs:

(23) $; := \lambda L \lambda R \lambda \langle S, S' \rangle . \{\langle I, I' \rangle \in R \langle K, K' \rangle \mid \langle K, K' \rangle \in L \langle S, S' \rangle\}$ $\qquad$ $\mathbb{T} \to \mathbb{T} \to \mathbb{T}$

The secondary state of a pair is mostly a mirror image of the primary state (cf. Bumford and Barker 2013). Ordinary predicates are relations from variables to tests on the input context, and now their tests are imposed on the two states of a pair simultaneously; e.g. **recited** (u, v) tests if u and v in both the primary and the secondary states satisfy the recited relation (24). (Dynamic) names are also a direct pair-generalization of their PCDRT meaning, as shown in (25): **john**^{u} introduces john to the u position in both states of a pair (25).

(24) $\textbf{recited} := \lambda u \lambda v \lambda \langle S, S' \rangle . \left\{ \langle S, S' \rangle \mid \begin{array}{c} \forall s \in S : (s_u, s_v) \in \mathsf{recited} \\ \forall s \in S' : (s_u, s_v) \in \mathsf{recited} \end{array} \right\}$ $\qquad$ $\mathscr{V} \to \mathscr{V} \to \mathbb{T}$

(25) $\textbf{john}^u := \lambda P. {}^{\top}u \to \mathsf{j}, {}^{\perp}u \to \mathsf{j}; Pu$ $\qquad$ $(\mathscr{V} \to \mathbb{T}) \to \mathbb{T}$
where ${}^{\top}u \to \mathsf{j}, {}^{\perp}u \to \mathsf{j} := \lambda \langle S, S' \rangle . \{\langle S^{u \to \mathsf{john}}, S'^{u \to \mathsf{john}} \rangle\}$

Indefinites introduce indeterminacy into the input context. With pairs, they introduce a dref that is indeterminate within a pair, i.e. a dref associated with two possibly different values.

(26) $\textbf{a}^u := \lambda P \lambda Q. \exists u; Pu; Qu$ $\qquad$ $(\mathscr{V} \to \mathbb{T}) \to (\mathscr{V} \to \mathbb{T}) \to \mathbb{T}$
where $\exists u := \lambda \langle S, S' \rangle . \{\langle I, I' \rangle \mid I \in S[\exists u], I' \in S'[\exists u]\}$

We can also define a pair-based maximization operator $\mathbb{max}^u$ (27), which maximizes the u-value distributively in a pair, i.e. it lets the context update with its scope CCP and keeps only the info state pairs where neither the u-value of the primary state or the u-value of the secondary state is less than other states in the output.

(27) $$\mathbb{max}^u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \in \langle S, S' \rangle [\exists u; M] \mid \begin{array}{l} \neg\exists \langle K, K' \rangle \in \langle S, S' \rangle [\exists u; M] : \\ K_u > I_u \text{ or } K'_u > I'_u \end{array} \right\}$$

4.3. Lexicalized distributivity with pairs

The meaning of a lexicalized universal is re-defined as (28):

(28) $$\textbf{every}^u := \lambda P \lambda Q . \exists u; \mathbb{max}^u(Pu); \mathbb{D}_u(Qu) \text{ where } \mathbb{D}_u :=$$
$$\lambda M \lambda \langle S, S' \rangle \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \exists \overrightarrow{x} \text{ on } S_u : \forall n : 0 < n < |S_u| \to \\ \langle S|_{u=\{x_n\}}, S|_{u=\{x_0, \ldots x_{n-1}\}} \rangle [M] \langle I|_{u=\{x_n\}}, I|_{u=\{x_0, \ldots x_{n-1}\}} \rangle \end{array} \right\}$$

Now suppose the nuclear scope property P is **year**. The PCDRT-style universal quantification will first store the maximal set of years as the restrictor set update. The restrictor set update of $\textbf{every}^u$ defined in (28) is merely the pair-generalization of this update: it will store the maximal set of years in both the primary state u-position and the secondary state u-position.

The crucial difference between PCDRT-style universal quantification and the pair-based universal quantification is in the nuclear scope update. $\textbf{every}^u$ defined in (28) directly distributes the nuclear scope property over the restrictor set using a distinct distributivity operator $\mathbb{D}_u$.

Let's unpack the meaning of $\mathbb{D}_u$. It associates an input and output pair of plural states with the same bookkeeping on the value of u ($S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}$), so the u-column in the primary state is unchanged from the input to the output. The clause $I = I'$ is there to ensure that the two states in the output are identical to each other – this will become useful in section 5. The rest is about how to distribute over the u-column of the input primary state using pairs, following a contextually given ordering $\overrightarrow{x}$: $\mathbb{D}$ checks that each pair of the input-substate containing the $n+1$th entity ($S|_{u=\{x_n\}}$) and the input-substate containing all the prior u-values ($S|_{u=\{x_0, \ldots x_{n-1}\}}$) passes the nuclear scope update and arrives at the corresponding pair of substates in the output. In other words, with the given ordering, every pair of a later entity and its predecessors is required to have the nuclear scope property.

Using the LF in (29), we derive the meaning of *every year John buys a boat* in (30). These updates are visualized in Figure 4. After the restrictor set update, we have a pair of states, each of them stores the maximal set of relevant years in the u position (i.e. $\langle I, I' \rangle$ in Figure 4). $\mathbb{D}$ checks that the nuclear scope holds for each pair of a later year and the years before. If they do, we get a set of output states like $\langle J, J' \rangle$: two identical copies of a plural state, which stores the years and the quantificational dependencies between years and the boat bought in those years.

(29) $[\text{every}^u \, \text{year} \, \lambda u \, [\text{a}^z \, \text{boat} \, \lambda z \, [\text{John}^v \, \text{buys} \, z]]]$

(30) $\mathbb{max}^u(\textbf{year}\, u); \mathbb{D}_u(\exists z; \textbf{boat}\ z; v \to \text{j}; \textbf{buys}(z, v, u))$

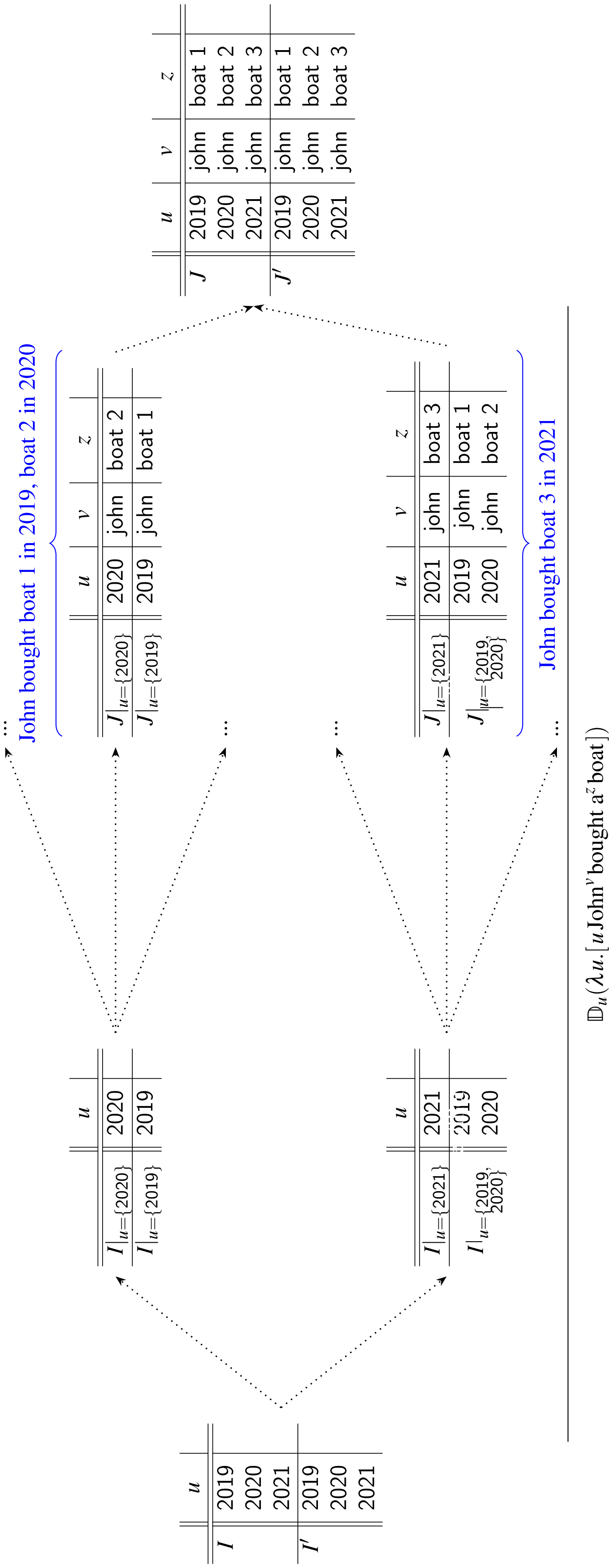

Figure 4: Pair-based distributivity

4.4. Internal comparisons on pairs

Below is a simple definition of *er* that exploits pair-based distributivity:

(31) $\textbf{er}^n_u := \lambda f.\mathbb{max}^n(fn); >_n$ where $>_n := \lambda \langle S,S' \rangle . \{\langle S,S' \rangle \mid S_n > S'_n\}$ $(\mathscr{V}_\mathsf{d} \to \mathbb{T}) \to \mathbb{T}$

This $\textbf{er}^n_u$ compares alternative values of the same degree dref in a pair. In order for the comparison to be possible, the variable u in the scope of *er* must be a dref that the degree dref is dependent on and gets assigned (possibly) different values in a pair. This variable can easily be the variable bound by *every* when *er* is in its nuclear scope, in which case we derive a comparison between the pair-values assigned by $\mathbb{D}$.

Using the LF in (32), the meaning of *every year John buys a bigger boat* comes out as (33).

(32) $[\text{every}^u\ \text{year}\ \lambda u\ [\text{a}^z\ \text{boat}\ \lambda z\ [\text{John}^v\ \text{buys}\ z]]]$

(33) $\mathbb{max}^u(\textbf{year}\ u); \mathbb{D}_u(\mathbb{max}^n((\exists z; \textbf{big}(n,z); \textbf{boat}\ z; v \to \mathsf{j}; \textbf{buys}(z,v,u))); >_n)$

Comparing (33) to (30), we can see the comparative contributes to the scope of $\mathbb{D}_u$ two more context updates:

(i) Introducing the maximal bigness degrees of the boat(s) that John buys in the primary and the secondary state, respectively[5];

(ii) Testing if the degree in the primary state is larger than the secondary state.

Figure 5 on the next page illustrates more vividly how the modified pair-distributivity looks like. Let the boats John buys in 2019 be maximally d'-big, the boats bought in 2020 be d-big, and the boats in 2021 d''-big. The distributive updates return true if $\{\mathsf{d}\} > \{\mathsf{d'}\}$ and $\{\mathsf{d''}\} > \{\mathsf{d}, \mathsf{d'}\}$. I assume, following Dotlačil and Nouwen's (2016) framework on degree pluralities, that both are only defined under a cumulative interpretation, so they are equivalent to $\mathsf{d} > \mathsf{d'}$ and $\mathsf{d''} > \mathsf{d}$, $\mathsf{d''} > \mathsf{d'}$, respectively. Eventually, the sentence is true if in 2021 John bought a boat bigger than the biggest boats he bought in 2020 *and* in 2019, in 2020 he bought a boat bigger than the biggest boat he bought in 2019. This is exactly the internal reading we are after.

[5]Since the degree maximization scopes over the existential introduction of the boats, we get the maximal degree of the biggest boats.

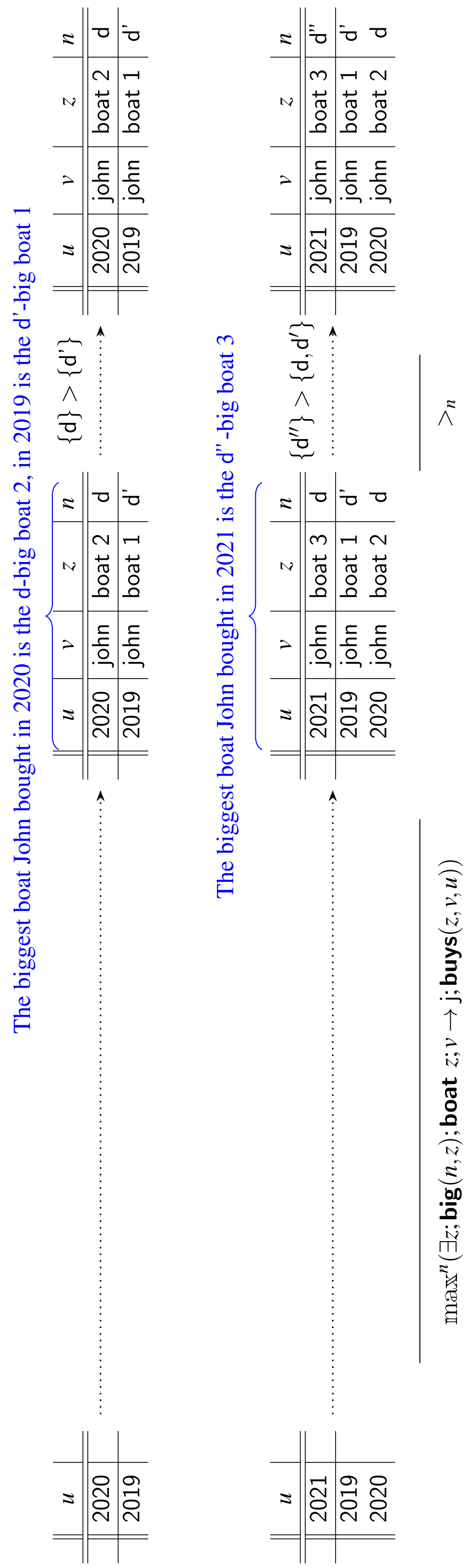

Figure 5: Comparisons in the internal reading

4.5. Varieties of internal readings

Brasoveanu (2011) shows that his system can generate internal readings licensed by things other than lexicalized universals, which are attested for *same* and *different*. I'll show that we can also generate these readings – essentially the same analyses can be re-phrased in the current system.

I will give *same/different* a meaning parallel to scalar comparatives, de-composing them into a predicate of identity and a scope-taking comparative marker (Sun 2022):

(34) $\text{IDENT} := \lambda z \lambda v.v = z$

(35) different $\rightsquigarrow$ DIFF - IDENT
where $\text{DIFF}^z_u := \lambda f.\mathbb{max}^z(fz); \neq_z$ where $\neq_z := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid S_u \not\subseteq S'_u\}$

(36) different $\rightsquigarrow$ SAME - IDENT
where $\text{SAME}^z_u := \lambda f.\mathbb{max}^z(fz); =_z$ where $=_z := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid S_u = S'_u\}$

The *every*-licensed internal readings are derived in the same way as scalar comparatives, when the comparative marker co-indexed with the universal quantifier. With the dynamic definition of the definite determiners given in (37), readers are welcomed to check that the interpretations we thus derived in (38) and (39) say that as $\mathbb{D}$ looks through the domain of *every*, the next boy it encounters always recited a poem that is different or the same as all the previous boys.

(37) $[\text{the}^v] := \lambda P \lambda Q.\mathbb{1}_v(\exists v; Pv; Qv)$ $\quad (\mathscr{V} \to \mathbb{T}) \to (\mathscr{V} \to \mathbb{T}) \to \mathbb{T}$
where $\mathbb{1}_v := \lambda M \lambda \langle S, S' \rangle . \begin{cases} I \in \langle S, S' \rangle [M] \text{ iff } |\{K_v \mid K \in \langle I, I' \rangle \in \langle S, S' \rangle [M]\}| = 1 \\ \text{undefined otherwise} \end{cases}$

(38) $[\text{Every}^u \text{ boy } \lambda u[\text{DIFF}^z_u \lambda z[\text{a}^v\, z\text{-IDENT poem } \lambda v[u \text{ recited } v]]] \rightsquigarrow$
$\mathbb{max}^u(\textbf{boy}\, u); \mathbb{D}_u(\mathbb{max}^z(\exists v; v = z; \textbf{poem}\ v; \textbf{recited}(v,u)); \neq_z)$

(39) $[\text{Every}^u \text{ boy } \lambda u[\text{SAME}^z_u \lambda z[\text{the}^v\, z\text{-IDENT poem } \lambda v[u \text{ recited } v]]] \rightsquigarrow$
$\mathbb{max}^u(\textbf{boy}\, u); \mathbb{D}_u(\mathbb{max}^z(\mathbb{1}_v(\exists v; v = z; \textbf{poem}\, v; \textbf{recited}(v,u))); =_z)$

same and *different* also receive internal readings licensed by expressions other than lexicalized universals. A plural noun phrase is a possible licensor for *same* and plural *different* (i.e. *different* contained in a plural noun phrase), in sentences like *three boys recited different poems/the same poem*. I take the spirit of Brasoveanu's analysis of this reading to be essentially right – they are licensed by a covert $\mathbb{D}$ (or Brasoveanu's **dist**) distributing over the set denoted by the noun phrase containing *same/different*. The LFs deriving these readings are given in (41) and (42), the determiner takes scope and the comparative marker takes scope inside the noun phrase (EC^v is the silent existential determiner I assume for bare NPs), under the covert $\mathbb{D}$, with which it is co-indexed:

(40) $[\text{three}^v] := \lambda P \lambda Q.\exists v; 3_v; Pv; Qv$ $\quad (\mathscr{V} \to \mathbb{T}) \to (\mathscr{V} \to \mathbb{T}) \to \mathbb{T}$
where $3_v := \lambda M \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid |S_v| = 3, |S'_v| = 3\}$

(41) $[\text{Three}^u \text{ boys } \lambda u[\text{EC}^v \lambda v[\mathbb{D}_v[\text{DIFF}^z_v \lambda z[v[z\text{-IDENT poem }]]]\lambda v[u \text{ recited } v]]]$
$\rightsquigarrow \exists u; 3_u; \textbf{boys}\, u; \exists v; \mathbb{D}_v(\mathbb{max}^z(v = z; \textbf{poem}\, v); \neq_z); \textbf{recited}\,(v,u)$

(42) $[\text{Three}^u \text{ boys } \lambda u[\text{the}^v \lambda v[\mathbb{D}_v[\text{SAME}^z_v \lambda z[v[z\text{-IDENT poem }]]]\lambda v[u \text{ recited } v]]]$
$\rightsquigarrow \exists u; 3_u; \textbf{boys}\, u; \mathbb{1}_v(\exists v; \mathbb{D}_v(\mathbb{max}^z(v = z; \textbf{poem}\, v); =_z); \textbf{recited}\,(v,u))$

The parts of the meanings in (41) - (42) relevant to the internal comparisons in blue. What we have derived here are comparisons inside the values assigned by the noun phrases, i.e. (41) says the poems are non-identical ones and (42) says they are the same one. What gives rise to the flavor of an internal reading is the default cumulative interpretation of plural predication, i.e. recited({poem 1, poem 2, poem 3, poem 4}, {boy 1, boy 2, boy 3}) is true in a scenario where the poem recited by each boy is different from those recited by others, as long as the total of these three boys recited the total of those four poems. Similarly for *same* – that all the boys stand in the reciting relation with one poem is equivalent to saying that the poem recited by each of them is identical to the poem recited by others. We can also explain why this kind of internal reading is not possible with the singular *different*, it's because it isn't possible to satisfy the ordering relation of *different* in the distribution of a singleton set, i.e. nothing can be different from itself.

Beck (2000) notes that the singular and the plural *different* are two morphologically distinct items in German. This is consistent with this account: it is possible that an optional lexical incorporation of the covert distributivity operator happens in some (but not all) languages. In other words, we can say that the German plural *different* (*verschieden*) is exactly like English *different* (or German *anders*) except that its comparative marker is DIFF'^z_v :

(43) $\text{DIFF'}^z_v := \lambda f.\mathbb{D}_v(\mathbb{max}^z(fz)); \neq_z)$

The last kind of internal reading is one licensed by expressions like *both/all* and aspectual modifiers like *for*-adverbials. According to Brasoveanu (2011), these licensors can only license the internal reading of *same*:

(44) Both/all boys recited the same poem.

(45) John recited the same poem for five days.

Also following Brasoveanu's solution here, these internal readings in (44) - (45) can be explained if these licensors distribute over pairs of each entity in their domain and the entire set ((46)). For example, with *both* defined in (47) and the LF in (48), we derive a reading that says each of the two boys recited a poem that is the same as the poem recited by both of them.

(46) $$\mathbb{D}'_u := \lambda M \lambda \langle S, S' \rangle \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \forall x \in S_u : \langle S|_{u=\{x\}}, S \rangle [M] \langle I|_{u=\{x\}}, I \rangle \end{array} \right\} \qquad \mathbb{T} \rightarrow \mathbb{T}$$

(47) $[\text{both}^u] := \lambda P \lambda Q.\exists u; 2_u; Pu; \mathbb{D}'_u(Qu)$

(48) $[\text{Both}^u \text{ boys } \lambda u[\text{SAME}^z \lambda z[\delta_u[\text{the}^v z\text{-IDENT poem } \lambda v[u \text{ recited } v]]]]] \rightsquigarrow$
$\exists u; 2_u; \textbf{boys}\, u; \mathbb{D}'_u(\mathbb{max}^z(1_v(\exists v; v = z; \textbf{poem}\, v; \textbf{recited}(v,u))); =_z)$

The reason that this reading is only possible with *same* is because whole-set distributivity (as defined in (46)) is impossible to combine with the comparison of *different* or scalar comparatives. It is impossible that each of the two boys recited a poem that is disjoint from the poems recited by both, or is longer/more interesting than the poems recited by both boys.

Interim conclusion. In this section, I have shown that we can give fully compositional treatments to the variety of internal readings of comparatives, using distributivity operators and comparative markers that operate on pairs of information states. The main advantage is that we extend the empirical coverage to scalar comparatives, and for (I believe) the first time explain the subtle differences between scalar comparatives and identity comparatives.

5. A unified comparative meaning

5.1. Unifying the external and the internal reading

The question now is whether the analysis can be extended to the external reading. A unified meaning is possible, if we think the external reading also expresses a comparison between two correlates on the same measurement function, e.g. John's and Nick's boat in (1) on the function of their size – instead of a deictic reading pointing to only a degree.

This idea has been pursued in Li (2022), where I argue that if an externally anaphoric comparative is only anaphoric to a degree, (49b) should have a felicitous *more than ten* reading, because (49a) shows that *ten* in (49) is an accessible degree antecedent. (49b) doesn't have this reading.

(49) Mary didn't read ten^d books. ...
  a. I have never seen that$_d$ many books on her shelf.
  b. # John read more$_d$ (books).

The meaning proposed in Li (2022) for an externally anaphoric *er* is (50): it takes parasitic scope above the would-be scope of another operator *Q* in the sentence to compare between the variable bound by *Q* and an alternative variable of the same type (the underline indicates a definedness condition). For *John read more (books)*, we derive the meaning in (52) using the LF in (51): it is only defined if the antecedent degree is the amount of books that Mary read. The *more* in (49b) can't be anaphoric to *ten* because ten can't be the maximal degree of any potential correlate, thanks to the negation; the definedness condition of *er* is unsatisfiable.

(50) $[\![\text{er}_{d',y}]\!] := \lambda f \lambda x.\underline{\mathsf{max}\{d \mid fdy\}}.\mathsf{max}\{d \mid fdx\} > d'$ $\qquad (\mathsf{d} \to \mathsf{e} \to \mathsf{t}) \to \mathsf{e} \to \mathsf{t}$

(51) $[\text{John}\,[\text{er}_{d',y}\,\lambda x \lambda d\,[x[\text{is}\,[\text{read } d\text{-many books }]]]]$

(52) $\underline{d' = \mathsf{max}\{d \mid y \text{ read } d\text{-many books}\}}.\mathsf{max}\{d \mid \text{John read } d\text{-many books}\} > d'$

I propose (53) as a unified comparative meaning that encompasses (31) and (50). The superscript $\underline{{}^{\perp}u = u', {}^{\perp}n = n'}$ indicates that this anaphoric resolution is a *postsupposition*, i.e. a dynamic test that can be passed on and discharged in a later context (Brasoveanu 2012, see also Farkas 2002, Lauer 2009, Charlow 2016, Glass 2022, Kuhn 2022).

(53) $\mathbf{er}^{\perp u,n}_{u',n'} := \lambda f.\exists^{\perp}u; \mathbb{max}^{n}(fn); >_n;^{\underline{\perp u=u', \perp n=n'}}$ $\qquad (\mathscr{V}_{\mathsf{d}} \to \mathbb{T}) \to \mathbb{T}$
  where $\exists^{\perp}u := \lambda \langle S, S' \rangle . \{\langle I, I' \rangle \mid I = S, I' \in S'[\exists u]\}$
  $\underline{{}^{\perp}u = u', {}^{\perp}n = n'} := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle\}$ iff $S'_u = S_{u'}, S'_n = S_{n'}$, else undefined.

In the external reading in (1), *er* takes scope under the subject *John's boat* (54). This derives the meaning in (55); the postsupposition can be discharged immediately, which results in (56).

(54) $[\text{John's boat } \lambda u[\text{er}^{\perp u,n}_{u',n'}\ \lambda n[u \text{ is } n\text{-big}]]]$

(55) $u \to \text{j's boat}; \exists^{\perp}u; \mathbb{max}^n(u\ \textbf{is}\ n\textbf{-big}); >_n; \underline{^{\perp}u{=}u', ^{\perp}n{=}n'}$

(56) $u \to \text{j's boat}; \exists^{\perp}u; \mathbb{max}^n(u\ \textbf{is}\ n\textbf{-big}); >_n; \underline{^{\perp}u = u', ^{\perp}n = n'}$

These updates are illustrated in Figure 6 on the next page. Up until after the subject assigns u to John's boat ($u \to$ j's boat), we have in the context pairs of info states that are identical to each other. Next, $\textbf{er}^{\perp u,n}_{u',n'}$ re-writes the value of u in the secondary state to some indefinite object ($\exists^{\perp}u$)[6], so we have in the output a set of pairs assigning the secondary value of u to possibly different things, a, b, etc.. Then we introduce the maximal bigness degrees of u to the n position; now because both the normal lexical relations and the maximization $\mathbb{max}$ are checked distributively in a pair, the output of this update stores the maximal bigness degrees of John's boat – the primary u-value – in the primary n position, and the maximal bigness degrees of the secondary u-value – the indefinite object introduced by $\textbf{er}^{\perp u,n}_{u',n'}$ – in the secondary n-position. After this we check if the primary n-value exceeds the secondary n-value; pairs where the secondary u-assignment is a thing that John's boat isn't bigger than (e.g. b), are filtered out. Finally, the postsuppositional test is applied, and we have in the context only those pairs where the secondary u-value is identical to Nick's boat and the secondary n-value is identical to Nick's boat's maximal bigness degree. This makes it clear that the comparison is between John's boat and Nick's boat, true if John's boat is the bigger one between the two.

In comparison to (31), (53) reformulates correlate comparison using pairs; in addition, it decomposes the anaphoric definedness condition in (31) into two steps: introducing an indefinite dref in the secondary context, followed by a postsuppositional anaphoric resolution of this dref.

This de-composition is crucial to deriving the internal reading. The meaning we arrive at using the same LF in (32) and the new *er* is (57); let the postsuppositional test be discharged in the output context of the distributive update, this is then equivalent to (58). The parts that were not included in the internal reading we have derived in section 4.4 are marked in blue.

(57) $\mathbb{max}^u(\textbf{year}\ u);$
$\mathbb{D}_u(\exists^{\perp}u; \mathbb{max}^n(\Delta_u(\exists z; \textbf{big}(n,z); \textbf{boat}\ z; v \to \text{j}; \textbf{buys}(z,v,u))); >_n; \underline{^{\perp}u{=}u', ^{\perp}n{=}n'})$

(58) $\mathbb{max}^u(\textbf{year}\ u);$
$\mathbb{D}_u(\exists^{\perp}u; \mathbb{max}^n(\Delta_u(\exists z; \textbf{big}(n,z); \textbf{boat}\ z; v \to \text{j}; \textbf{buys}(z,v,u))); >_n); \underline{^{\perp}u = u', ^{\perp}n = n'}$

Now let's consider the contribution of the two added components in this formula. First, the correlate introduction $\exists^{\perp}u$ is effectively vacuous. Recall that $\mathbb{D}$ distributes over an ordered domain $\overrightarrow{x}$ by requiring the nuclear scope of quantification, M, to associate $\langle S|_{u=\{x_n\}}, S|_{u=\{x_0,\ldots x_{n-1}\}}\rangle$ and $\langle I|_{u=\{x_n\}}, I|_{u=\{x_0,\ldots x_{n-1}\}}\rangle$, for any n between 0 and $|\overrightarrow{x}|$ (see (28)). In other words, the definition of $\mathbb{D}_u$ guarantees that the nuclear scope associates two pairs of states with identical u-values. Thus, even though *er* can re-introduce the secondary u-value, because it is in the scope of $\mathbb{D}$, this re-introduction is pre-conditioned to be vacuous, i.e. it cannot change the secondary u-value or the updates will return false.

[6]This is a kind of *destructive update*. Some researchers have argued that allowing for destructive updates can have worrisome consequences (Vermeulen 1993, Groenendijk et al. 1995); see Charlow (2019) for a response.

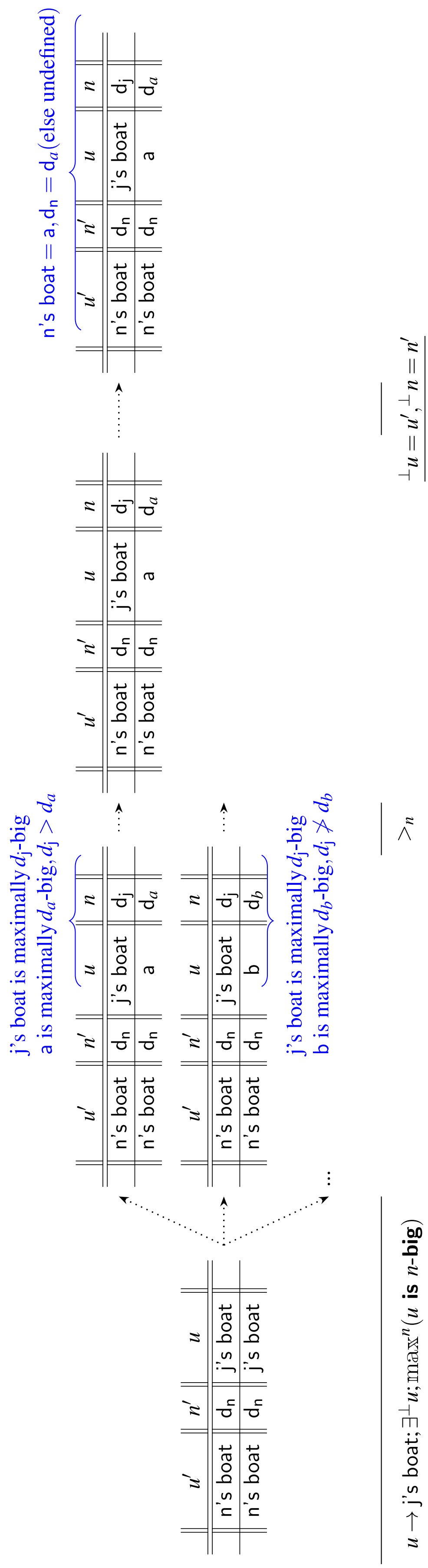

Figure 6: Comparative updates in the external reading, using pairs

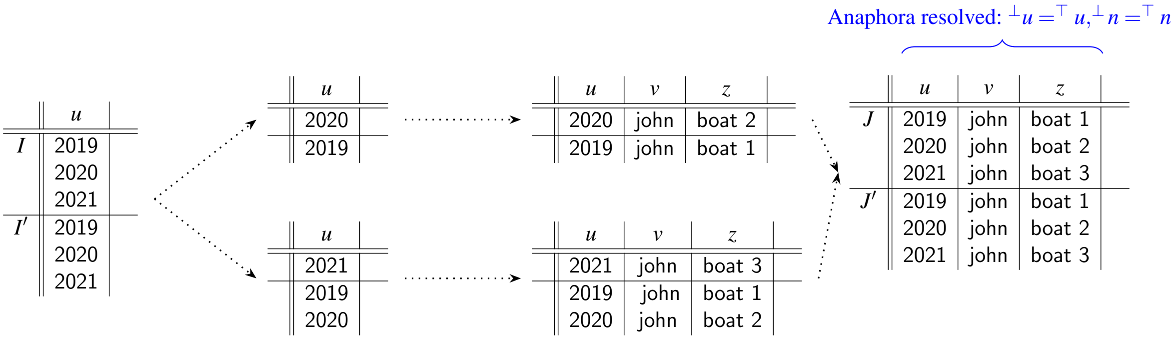

Figure 7: Anaphoric test in the internal reading of *every year John buys a bigger boat*

Second, the anaphoric test $\underline{^{\perp}u = u', ^{\perp}n = n'}$ can always be satisfied in the local context. Again, recall the definition (28): the distributivity operator $\mathbb{D}$ outputs a set of pairs $\langle I, I' \rangle$ where $I = I'$. This means when the postsuppositional anaphoric test is discharged at the output context of the distributive quantification, the test is effectively applied to pairs of identical info states. For instance, in the internal reading of *every year John buys a bigger boat*, the anaphoric test will take the pair $\langle J, J' \rangle$ in Figure 7 as its input.

Can we find drefs that have the same value as $^{\perp}u$ and $^{\perp}n$ in this pair? Yes – their counterparts in the primary state. So simply by giving the comparative marker the appropriate indices, i.e. $\textbf{er}^{\perp u, n}_{\top u, \top n}$, the anaphoric condition is always satisfied in the output of the distributive update; no clause-external antecedent is needed.

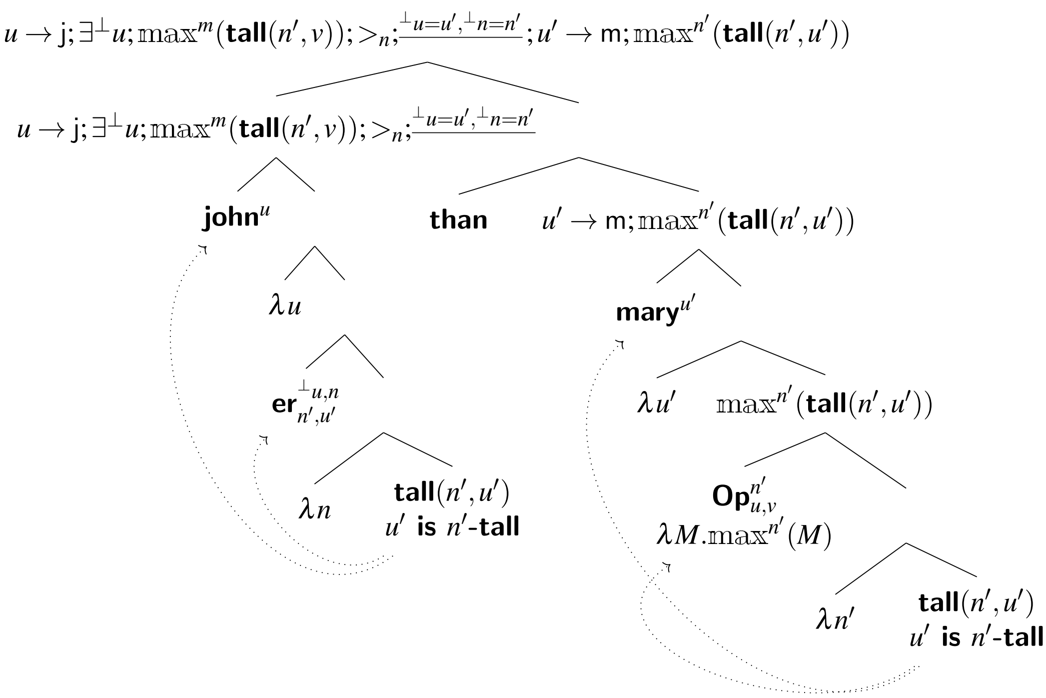

Figure 8: Composing an explicit comparative

5.2. The explicit comparatives

It is also possible to extend the lexical entry in (53) to explicit comparative constructions like *John is taller than Mary*. Since the anaphoric test is a postsupposition, it can be delayed till after the evaluation of the *than*-P, which allows the comparative marker to be bound by semantic objects introduced in the complement of *than*.

I give a complete derivation of *John is taller than Mary is* in Figure 8 on the previous page. The *than*-clause is conjoined with the "matrix" comparative clause. The argument position of the gradable adjective inside the *than*-clause is filled by a covert degree operator Op (Chomsky 1977), which takes scope under the subject *Mary* and introduces her maximal height. The implicit correlate *er* introduces is bound by the explicit correlate *Mary*, and the implicit degree standard is bound by the maximal degree that Op introduces. I assume *than* is semantically null.

The updates we get at the top node are repeated in (59); after the anaphoric postsupposition is delayed and discharged at the output context of the *than*-clause, the final result is (60). These updates are visualized in Figure 9 on the next page: the comparative clause first introduces a set of pairs where the secondary state stores an indefinite individual shorter than John, then the *than*-clause introduces Mary and her height, and finally the anaphora is resolved, the updates return true if *that* indefinite individual in the secondary state is Mary.

(59) $u \to \mathsf{j}; \exists^{\perp} u; \mathbb{max}^{m}(\textbf{tall}(n', v)); >_n; \underline{{}^{\perp}u{=}u', {}^{\perp}n{=}n'}; u' \to \mathsf{m}; \mathbb{max}^{n'}(\textbf{tall}(n', u'))$

(60) $u \to \mathsf{j}; \exists^{\perp} u; \mathbb{max}^{m}(\textbf{tall}(n', v)); >_n; u' \to \mathsf{m}; \mathbb{max}^{n'}(\textbf{tall}(n', u')); \underline{{}^{\perp}u{=}u', {}^{\perp}n{=}n'}$

6. Parallelism in a pair

Our implementation in section 4 is not the only way to introduce pairs into a semantic system. In Brasoveanu's (2011) system, semantic composition mostly cares only the primary state and leaves the secondary state untouched, with *every* and comparatives being the exceptions that actually make use of the secondary state. For instance, an ordinary predicate only checks if the drefs in the primary states satisfy the lexical relation and ignores the secondary state (61).

(61) $\textbf{recited}(u, v) := \lambda \langle S, S' \rangle . \{\langle S, S' \rangle \mid \mathsf{recited}(S_u, S_v)\}$

Unlike in my implementation (and in Bumford and Barker 2013), in this approach the two states are not always parallel to each other: because information in the secondary state is simply ignored by ordinary predicates, there is no guarantee that all the relations and properties that hold in the primary state also hold in the secondary state. However, for the pair-based distributivity to work as intended in the internal reading, parallelism between a pair is necessary at least in the scope of a universal quantification. Brasoveanu (2011) gets to ensure this parallelism indirectly, by giving *every* the definition in (62). The crucial part is the definition of the distributivity operator $\textbf{dist}_u$: for any two distinct individuals x and x' in the restrictor set of *every*, $\textbf{dist}_u$ ensures that: (i) the nuclear scope M associates the substate in the input primary state $S|_{u=\{x\}}$ and the substate in the output primary state $I|_{u=\{x\}}$; (ii) in the meantime the other substate in the output *primary* state $I|_{u=\{x'\}}$ is available as the secondary member of both the

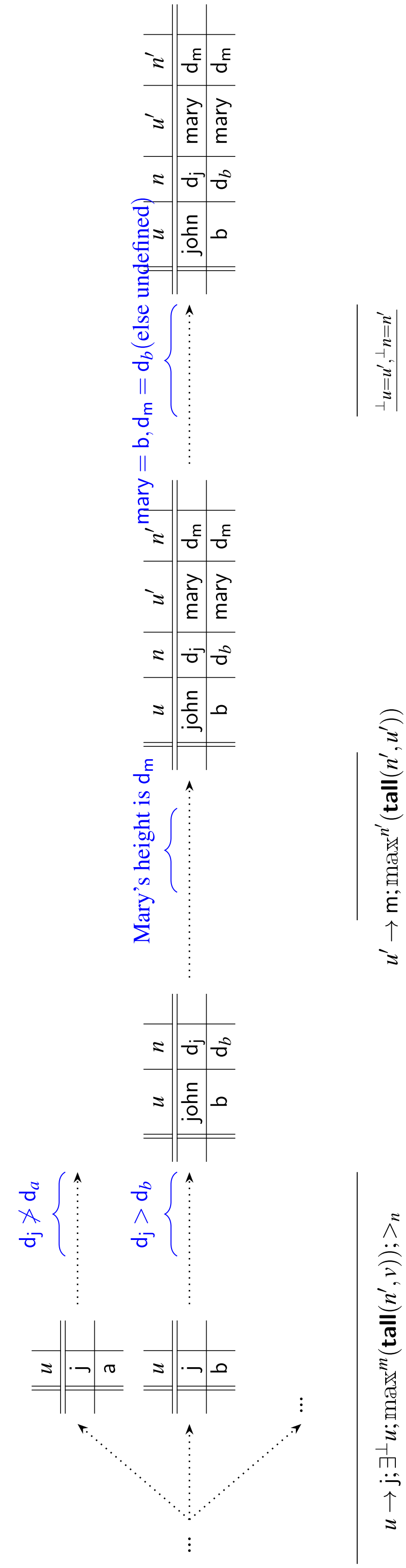

Figure 9: Updates of *John is taller than Mary is* with pairs

input and the output pair of M. Because $x \neq x'$ entails $x' \neq x$ for any x, x', this definition guarantees that M will associate $S|_{u=\{x\}}$ and its corresponding substate in the output primary state for any individual x in the domain of *every*. It is this that ensures the input pairs of the CCP in the scope of $\mathbf{dist}_u$ are parallel to each other – because the secondary state in those pairs are manually taken from the primary state in the output primary state.

(62) $\mathbf{every}^u := \lambda P \lambda Q.\mathbf{max}^u(Pu); \mathbf{dist}_u(Qu)$
where $\mathbf{max}^u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} \langle I, I' \rangle \in \langle S, S' \rangle [M] \\ \neg\exists : \langle K, K' \rangle \in \langle S, S' \rangle [M] : K_u \subseteq S'_u \end{array} \right\}$
$\mathbf{dist}_u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, S' = I' \\ \forall x, x' \in S_u : x \neq x' \to \\ \langle S|_{u=\{x\}}, I|_{u=\{x'\}} \rangle [M] \langle I|_{u=\{x\}}, I|_{u=\{x'\}} \rangle \end{array} \right\}$

However, I have explained in section 3 that this particular kind of pair distributions can't extend to scalar comparatives, due to the asymmetric ordering relations they impose: if x exceeds x' on a certain scale, it is impossible to have x' exceed x on the same scale. Moreover, the first year in *every year John buys a bigger boat* is not required to be a year where John buys a boat bigger than the boats he bought in any other years. My analysis explains these observations by having the pair-distributions follow a fixed ordering. Is it possible to make similar changes to (62)? (63) is an attempt, where we change condition $x \neq x'$ to $x' \prec x$ (on the given ordering). However, with this change, the first entity in the domain of *every* is no longer in the primary state of any pair, thus for this entity x, there is no guarantee that the scope of $\mathbf{dist}_u$ associates the sub-state in the input $S|_{u=\{x\}}$ to the corresponding sub-state in the output. In other words, with the definition in (63), in the output of *every year John buys a boat*, there is no guarantee that the John bought a boat in the first year. This is obviously not a desired result.

(63) $\mathbf{dist}_u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, S|_{u=\{\star\}} = I|_{u=\{\star\}}, S' = I' \\ \forall x, x' \in S_u : x' \prec x \to \\ \langle S|_{u=\{x\}}, I|_{u=\{x'\}} \rangle [M] \langle I|_{u=\{x\}}, I|_{u=\{x'\}} \rangle \end{array} \right\}$

A possible way out here is to still let the first entity be in the primary state of a pair while making sure that no comparison occurs in that pair. For example, we can give $\mathbf{dist}_u$ the definition in (64) and the comparative marker the definition in (65). This $\mathbf{dist}_u$ places *every*'s first entity in the primary state of the pair with the dummy individual, thus the nuclear scope of *every* gets to apply to the first entity. In the meantime, the comparison of the $\mathbf{er}^{\perp u,n}_{n',u'}$ in (65) is conditional on the u-value of the secondary state being not empty; in the pair of the first entity and $\star$, the secondary state $I|_{u=\{\star\}}$ necessarily has an empty u-value as its u-column contains only the dummy individual, so no ordering relation is imposed – the first entity still doesn't compare to anything. The truth conditions should come out exactly as we want.

(64) $\mathbf{dist}_u := \lambda M \lambda \langle S, S' \rangle . \left\{ \langle I, I' \rangle \mid \begin{array}{l} S_u = I_u, I|_{u=\{\star\}} = I|_{u=\{\star\}}, I = I' \\ \exists \overrightarrow{x} \text{ on } S_u : \langle S|_{u=\{x_1\}}, I|_{u=\{\star\}} \rangle [M] \langle I|_{u=\{x_1\}}, I|_{u=\{\star\}} \rangle \\ \forall n : 1 < n < |S_u| \to \\ \langle S|_{u=\{x_n\}}, I|_{u=\{x_0, \ldots x_{n-1}\}} \rangle [M] \langle I|_{u=\{x_n\}}, I|_{u=\{x_0, \ldots x_{n-1}\}} \rangle \end{array} \right\}$

(65) $\mathbf{er}^{\perp u,n}_{n',u'} := \lambda f.\exists^{\perp} u; \mathbf{max}^n(fn), >_n; \overline{^{\perp}u = u', ^{\perp}n = n'}$
where $>_n := \lambda \langle S, S' \rangle . \{ \langle S, S' \rangle \mid S'_u \neq \emptyset \to S_n > S'_n \}$

Nevertheless, it's hard to see how this approach can be extended to other uses of the comparative. The problem is that even with the fix in (64) - (65), parallelism between a pair is only guaranteed by *every*'s distributivity operator, but we still need the parallelism to get the intended meaning in those other uses. For instance, in the external reading of *Mary read five books, John read more*, we wish to compare John and Mary on the same measurement relation, i.e. the amount of books they read; yet even if we assign Mary to be the secondary alternative to John, there is no guarantee that the secondary degree is related to her via the same measurement relation that holds in the primary state – or that there is a secondary degree at all – because ordinary semantic relations simply ignore the secondary state. Having a (covert) $\mathbf{dist}_u$ is not going to help these cases, since $\mathbf{dist}_u$ only pairs up individuals in the primary u value in its input pair and thus will always lead to an internal reading.

In Brasoveanu (2011), parallelism is not a concern in the external reading, because the external reading he aims to capture only amounts to anaphora to an individual/degree. Take (66) for example, for Brasoveanu the external reading of *same* here is only anaphoric to the book *War and Peace* in the first sentence. As was first pointed out in Hardt et al. (2012), this characterization fails to predict *same*'s sensitivity to a larger context than the individual alone, e.g. it fails to predict that (67) can't license a subsequent external reading of *same* in (67b), even though the book name is still accessible and can be picked up by the individual pronoun in (67a).

(66) Mary read *War and Peace*^{x}. ... John read the same$_x$ book.

(67) Mary didn't read *War and Peace*^{x}. ...
  a. It$_x$ is a boring book.
  b. # John read the same$_x$ book.

References

Anand, P. and N. Korotkova (2018). Acquaintance content and obviation. In U. Sauerland and S. Solt (Eds.), *Proceedings of Sinn und Bedeutung 22*, Volume 1, pp. 55–72.

Barker, C. (2007). Parasitic scope. *Linguistics and Philosophy 30*(4), 407–444.

Beck, S. (2000). The semantics of *different*: Comparison operator and relational adjective. *Linguistics and Philosophy 23*(2), 101–139.

Brasoveanu, A. (2007). *Structured nominal and modal reference*. Ph. D. thesis, Rutgers University New Brunswick, NJ.

Brasoveanu, A. (2008). Donkey pluralities: plural information states versus non-atomic individuals. *Linguistics and Philosophy 31*(2), 129–209.

Brasoveanu, A. (2011). Sentence-internal *different* as quantifier-internal anaphora. *Linguistics and Philosophy 34*(2), 93–168.

Brasoveanu, A. (2012). Modified numerals as post-suppositions. *Journal of Semantics 30*(2), 155–209.

Bumford, D. (2015). Incremental quantification and the dynamics of pair-list phenomena. *Semantics and Pragmatics 8*, 9–1.

Bumford, D. and C. Barker (2013). Association with distributivity and the problem of multiple antecedents for singular *different*. *Linguistics and Philosophy 36*(5), 355–369.

Carlson, G. N. (1987). *Same* and *different*: Some consequences for syntax and semantics.

Linguistics and Philosophy 10(4), 531–565.
Charlow, S. (2016). Post-suppositions and semantic theory. To appear in *Journal of Semantics*.
Charlow, S. (2019). Where is the destructive update problem? *Semantics and Pragmatics 12*, 10.
Chomsky, N. (1977). On wh-movement. In P. Culicover, T. Wasow, and A. Akmajian (Eds.), *Formal syntax*, pp. 71–132. New York: Academic Press.
Dotlačil, J. and R. Nouwen (2016). The comparative and degree pluralities. *Natural Language Semantics 24*(1), 45–78.
Egan, A. (2010). Disputing about taste. In R. Feldman and T. A. Warfield (Eds.), *Disagreement*, pp. 247–286. Oxford: Oxford University Press.
Farkas, D. F. (2002). Varieties of indefinites. In B. Jackson (Ed.), *Proceedings of SALT 12*, pp. 59–83.
Glass, L. (2022). The negatively biased mandarin belief verb *yi wei*. *Studia Linguistica*.
Groenendijk, J. and M. Stokhof (1991). Dynamic predicate logic. *Linguistics and Philosophy*, 39–100.
Groenendijk, J., M. Stokhof, and F. Veltman (1995). Coreference and modality. In S. Lappin (Ed.), *The Handbook of Contemporary Semantic Theory*, pp. 179–216. Oxford: Blackwell.
Hardt, D., L. Mikkelsen, and B. Ørsnes (2012). Sameness, ellipsis and anaphora. In *Logic, Language and Meaning*, pp. 341–350. Springer.
Kennedy, C. and M. Willer (2016). Subjective attitudes and counterstance contingency. In M. Moroney, C.-R. Little, J. Collard, and D. Burgdorf (Eds.), *Proceedings of SALT 26*, pp. 913–933.
Kuhn, J. (2022). The dynamics of negative concord. *Linguistics and Philosophy 45*(1), 153–198.
Lahm, D. (2016). “Different” as a restriction on Skolem functions. In M. Moroney, C.-R. Little, J. Collard, and D. Burgdorf (Eds.), *Proceedings of SALT 26*, pp. 546–565.
Lauer, S. (2009). Free relatives with *ever*: Meaning and use. Ms., Stanford University.
Li, A. (2022). Comparative anaphora: Comparing alternatives. In N. Dreier, C. Kwon, T. Darnell, and J. Starr (Eds.), *Proceedings of SALT 31*, pp. 484–505.
Muskens, R. (1996). Combining Montague semantics and discourse representation. *Linguistics and Philosophy 19*(2), 143–186.
Ninan, D. (2014). Taste predicates and the acquaintance inference. In *Semantics and Linguistic Theory*, Volume 24, pp. 290–309.
Pearson, H. (2013). A judge-free semantics for predicates of personal taste. *Journal of Semantics 30*(1), 103–154.
Sun, Y. (2022). Decomposing *same*. *Natural Language & Linguistic Theory 40*, 911–931.
van den Berg, M. (1996). *Some aspects of the internal structure of discourse*. PhD Diss,. Universiteit van Amsterdam.
Vermeulen, C. F. M. (1993). Sequence semantics for dynamic predicate logic. *Journal of Logic, Language and Information 2*(3), 217–254.